San Joaquin River Exchange Contractors GSA

City of Newman GSA
City of Gustine GSA
City of Los Banos GSA
City of Dos Palos GSA
City of Firebaugh GSA
City of Mendota GSA
Turner Island Water District-2 GSA
County of Madera-3 GSA
Portion of Merced County – Delta-Mendota GSA
Portion of Fresno County – Management Area B GSA

Groundwater Sustainability Plan

for the

San Joaquin River Exchange Contractors GSP Group

in the

Delta-Mendota Subbasin (5-022.07)

December 2019

DELTA-MENDOTA SUBBASIN (5-022.07)

Groundwater Sustainability Plan for:

San Joaquin River
Exchange Contractors
GSP Group

December 2019

Pursuant to the Professional Engineers Act, and California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2, I, Jarrett Martin, affix my professional seal to the following Sections of the enclosed Groundwater Sustainability Plan: Sections 2.2.3, 2.2.5, 7.2, 8.2, 9.2, 10.2, 11.2, 12.2, 13.2, 14.2, 15.2, and 16.2. In accordance with applicable regulations, those portions of the Plan bearing my seal have been prepared in accordance with engineering professional standards of practice.

REGISTERED PROFESSIONAL ENGINEER
Jarrett Wade Martin
No. C 82048
Expires: 3/31/2020
CIVIL
STATE OF CALIFORNIA

Jarrett Wade Martin
California Professional
Civil Engineer No. 82048

EXECUTIVE SUMMARY

The Executive Summary provides a brief history of the San Joaquin River Exchange Contractors Groundwater Sustainability Agency (SJREC GSA) and the San Joaquin River Exchange Contractors Water Authority (SJRECWA or Exchange Contractors) and its member entities; Central California Irrigation District (CCID), San Luis Canal Company (SLCC), Firebaugh Canal Water District (FCWD) and Columbia Canal Company (CCC). The historical groundwater conditions are described along with historic groundwater management. The SJREC have managed groundwater sustainability which will be further described in the executive summary coupled with Sustainable Management Criteria (SMC). The GSA's partnering to develop this plan include: San Joaquin River Exchange Contractors GSA, City of Newman GSA, City of Gustine GSA, City of Los Banos GSA, City of Dos Palos GSA, City of Firebaugh GSA, City of Mendota GSA, Turner Island Water District – 2 GSA, County of Madera – 3 GSA, a Portion of the Fresno County Management Area B GSA and a portion of the Merced County – Delta-Mendota GSA. This GSP used the GSP Annotated Outline prepared by DWR as the genesis for the organization of content. Section 1 – Section 2.2.2 and Section 6 covers the SJREC GSP Group in its entirety with a major focus on the SJREC GSA covering almost 90% of the plan area. Section 2.2.3 – Section 5 is specific to the SJREC GSA. Each GSA will have its own discrete section for Water Budgets, SMC and Projects and Management Actions; Section 7 – Section 16. The final Section of this plan is the Appendices which are used to provide supporting documentation. Appendix B describes the Common Chapter for each GSP in the Delta-Mendota Subbasin which provides details on how each GSP in the Delta-Mendota Subbasin has coordinated to provide an overall sustainable plan for the subbasin. The Table of Contents can be used as a guide to organization of this GSP.

ES1 INTRODUCTION

In the 1860's, John Bensley had a vision of digging the "Great Canal" from Mendota Pool north with aspirations of developing a barge traffic system from Tulare Lake to the Sacramento-San Joaquin Delta. The first 40 miles of the canal was constructed from Mendota to the confluence of the Los Banos Creek. During this time America was struggling with the post Civil War era and there was a financial panic which caused the cash flow to complete the barge traffic system to be discontinued. However, there was another man with a more practical vision for the area. By 1871, Henry Miller owned a large tract of land near the San Joaquin River and was fulling developing all of the Riparian and Appropriative water rights on the San Joaquin River. Henry Miller purchased the Great Canal and expanded the facilities another 40 miles north. The Great Canal is still in use today and is the CCID Main Canal. This was at the genesis of development of water rights in California.

Fast forward to the post World War 1 America and the Federal Government had a vision of developing water supply to the eastside of the Central Valley. The vision was to construct a dam and reservoir on the San Joaquin River and divert flows into new facilities for delivery from Madera County south to Kern County. The major concern was Henry Miller had fully developed the water rights on the San Joaquin River. Ultimately, in 1939 Henry Miller sold the high flow water rights to the federal government under the "Purchase Contract". The low flow water rights were retained by Henry Miller but through an agreement known as the "Exchange Contract", the water right would not be exercised so long as the federal government delivered a substitute water supply. This exchange allowed for the development of surface water on the eastside of the valley.

Ultimately, the Miller and Lux holdings were formed into four entities that maintained the historic water rights. The CCID was formed in 1951 and is the successor to the San Joaquin and Kings River Canal & Irrigation Company. The SLCC was formed in 1913. The CCC was formed in 1926. The Panoche Canal Company was incorporated in 1914 and was succeeded by the Firebaugh Canal Company in 1921. The Firebaugh Canal Company was succeeded by FCWD in 1988 and the district has remained the FCWD to date.

The groundwater around the City of Dos Palos, a Severely Disadvantaged Community (SDAC), was of poor quality. In 1936, the predecessor to CCID agreed to deliver surface water to the City of Dos Palos. In the late 1980's and early 1990's, CCID partnered with the local communities to jointly study and manage groundwater to ensure reliability for the communities that are completely dependent on groundwater. Those communities include: Newman (a DAC), Gustine (a DAC), Los Banos (a DAC), Firebaugh (a SDAC) and Mendota (a SDAC). The cities looked to CCID and the Exchange Contractors for a partnership to develop groundwater management strategies to promote long-term drinking water supply for these DAC's. Each City met with the SJREC to discuss a collaborative effort to implement the requirements set forth in the SGMA. Each City determined that it was their independent best interest to form their own GSA. The SJREC GSA agreed to take the lead developing a joint GSP. Historically, CCID shared the costs to develop the groundwater studies around the City. Consistent with historical practice, the SJREC GSA agreed to offset the cost for the City section in the SJREC GSP through a 50% cost share and further reduce costs to the cities by offsetting expenses with the SGWP grant received by the SJREC GSA.

The SJREC also have a great partnership with Grassland Water District (GWD) and the state and federal refuge complex in the Delta-Mendota Subbasin. Most of the water provided to the habitat in GWD and the refuges is delivered through the SJREC facilities. From 2009-2018, the SJRECWA wheeled about 200,000 acre-feet per year on average to the grassland area. The SJREC value the ecological importance of the Great Grassland Area and its significance to the Pacific Flyway for migratory waterfowl and the habitat it provides for endangered species. The Exchange Contractors are partnering with GWD on several local water resource projects to efficiently put more water to beneficial use in the area and help the United States Bureau of Reclamation (USBR) meet the water supply requirements prescribed in the Central Valley Improvement Project (CVPIA).

The SJREC have been working on water resource management projects with the four counties in the service area; Stanislaus County, Merced County, Madera County and Fresno County. This long partnership working jointly on water resource management with the Cities, Counties and refuges have afforded this SJREC GSA a great relationship to cooperate and solve regional problems. The SJREC have a proven track record of consulting with these parties and developing a strategic vision that benefits the area holistically.

The Sustainability Goal is defined as the existence and implementation of one or more GSP's that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin (or plan) is operated within its sustainable yield. Sustainable Yield is defined as managing groundwater that culminates in the absence of undesirable results by 2040. The SJREC GSP Group will manage the sustainability goal consistent with the Sustainable Management Criteria described in Section 3 of this plan.

ES2 BASIN SETTING

The genesis of drafting the Basin Setting for the SJREC GSP Group started in the 1990's when the San Joaquin River Exchange Contractors Water Authority (SJRECWA) worked with Kenneth D. Schmidt and Associates (KDSA) on to develop reports on groundwater conditions in and around the Exchange Contractors service area. The groundwater conditions were further studied with KDSA in collaboration with the cities within the Exchange Contractors service area. These reports are referenced in Section 6 of this plan.

The Cities (Newman, Gustine, Los Banos, Dos Palos, Firebaugh, Mendota) and Counties (Merced, Madera, Fresno) have land use planning authority and are each respectively members of this GSP. This plan, consistent with the SGMA, reaffirms the land use planning authority maintains with the appropriate City and County and is a continuation of historical collaboration to manage water resources. The monitoring and management actions proposed in this plan have mostly been in place for years with coordination of the local agencies.

The Delta-Mendota Subbasin is part of the Central Valley Basin and extends from the town of Tranquility in the south up to the near the City of Tracy in the north and covers about 750,000 acres. The subbasin has two principal aquifers throughout the majority of the area separated by an aquitard termed the Corcoran Clay. The Upper Aquifer is typically the unconfined area above the Corcoran Clay. The Lower Aquifer is the confined area below the Corcoran Clay. The depth to the Corcoran Clay in this GSP ranges from a depth of 100 feet to 450 feet below ground surface. The Corcoran Clay is deepest to the south and pinches out near the western boundary of the plan area. The definable bottom of the basin is consistent with the 1973 United States Geologic Survey report defined as an electrical conductivity of 3,000 micromhos per centimeter at 25°C to delineate the regional base of the fresh groundwater in the San Joaquin Valley. The depth below ground to the definable bottom of the basin ranges from 300 feet to 800 feet deep.

The primary beneficial users of groundwater are for agriculture and municipal water supply. Additional users of groundwater include domestic water supply, industry use and Groundwater Dependent Ecosystems (GDE). The lateral flow of groundwater in the upper aquifer generally flows to the east. In dry years there is a hydraulic divide in Stanislaus County and in Fresno County south of Dos Palos where water from the SJREC GSP Group flows to the west from the western boundary and flows east from the eastern boundary (refer to Appendix I for further details). In the lower aquifer groundwater typically flows east from the northern portion of the plan area. The southern portion of the plan area has lateral groundwater outflow from the lower aquifer to the south along the southwestern border and to the northeast from the eastern border. The lateral outflow of groundwater from the SJREC GSP area is indicative of sustainable pumping within the plan area. This is due to the significant recharge provided the SJREC GSA. The primary sources of recharge include deep percolation of irrigation water and seepage from the unlined canals/ditches in the area. Additionally, some recharge is provided by precipitation and also recharge and recovery projects.

The SJREC hold senior water rights on the San Joaquin River. In 1939, the predecessors to the Central California Irrigation District, San Luis Canal Company, Firebaugh Canal Water District and Columbia Canal Company, collectively referred to as the San Joaquin River Exchange Contractors (SJREC), entered into an agreement with the federal government to not exercise their water rights on the San Joaquin River in exchange for a substitute water supply currently delivered via the Delta-Mendota Canal. The contract is commonly referred to as the “Exchange Contract”. The primary water supply for this GSP is the surface water supply of the SJREC. The historic water budget for the Delta-Mendota Subbasin was defined as Water Years 2003-2012. This time period represented a near normal 10-year hydrologic cycle. The most accurate method to estimate changes in groundwater storage is to evaluate water level trends and specific yields for the upper aquifer. The SJREC GSP reviewed the results of the water budget analysis and compared to the measured changes in groundwater levels to double check the results of the computational water budget. The change in groundwater storage for the historic water budget averaged -13,000 acre-feet/year for the upper aquifer. The current water budget year was defined as Water Year 2013 and an overdraft of 37,000 acre-feet was observed. After the current water, California entered into a record drought that had devastating impacts across the state. Even after going through the worst drought on record, the water levels in the SJREC service area had fully recovered by 2019 indicating full recovery of groundwater storage in the upper aquifer. The projected water budget followed sequentially after the current year and represents Water Years 2014-2070. Actual data was used in the projected water budget for years 2014-2017. To represent a long hydrologic cycle, historic data from Water years 1965-2017 were used as a baseline for conditions. Once the baseline was established, impacts from Climate Change and population growth were used to refine the projected modeled water budget. Additionally, existing projects and projects under development were analyzed. The net result of the projected water budget shows no change in groundwater storage for the upper aquifer through the planning and implementation horizon (2070). The lower aquifer water budget has significantly fewer parameters than the upper aquifer. Primarily the water budget consists of: 1) extractions from the lower aquifer, 2) flow through the Corcoran Clay between the upper and lower aquifers, 3) lateral groundwater inflow and 4) lateral groundwater outflow. It should be noted that a confined aquifer cannot simply add these four parameters together to determine the change in storage. The most accurate method to determine the change in groundwater storage of the lower aquifer is to determine how much subsidence has occurred below the Corcoran Clay which reduces the total volume of groundwater that can be stored. Inelastic land subsidence causes a permanent reduction in groundwater storage in the lower aquifer. As described in further detail later in this plan, the SJREC GSP have very minimal groundwater extractions that are well below the established sustainable yield for the subbasin. The change in groundwater storage for the historic, current, and projected water budgets are respectively -10,000 acre-feet/year, -24,000 acre-feet, and -5,000 acre-feet/year. Land subsidence outside the Delta-Mendota subbasin is causing impacts in the Delta-Mendota Subbasin. The SJREC are working on several projects to mitigate land subsidence and further details are discussed in the plan. The key assumption in the projected water budget is that areas causing significant land subsidence outside the SJREC GSP area, will begin to ramp down their pumping from the lower aquifer to the point where subsidence has been mitigated between the 2030 and 2035 GSP updates.

Establishment of groundwater management areas for the SJRECWA was recommended by KDSA in the 1997 AB 3030 Groundwater Management Plan. That recommendation has carried through from the AB 3030 Groundwater Management Plan to the SGMA required Groundwater Sustainability Plan.

ES3 SUSTAINABLE MANAGEMENT CRITERIA

The indication of sustainable groundwater management is defined as the absence of Undesirable Results. The path to sustainability starts with good data. The SJREC started collecting groundwater data in the 1960’s. With each passing decade, the SJREC sharpened their knowledge of the local groundwater conditions to the point where the area was operated under a groundwater management plan accompanied by annual groundwater assessments reports. With a broadening understanding of the groundwater conditions, the SJREC were monitoring the data and were able to implement groundwater management that was protective of the aquifers. Experience successfully managing groundwater leads to an understanding of the sustainability goal and how to maintain sustainable management criteria to less than significant and unreasonable.

The next step in the process is to define what constitutes significant and unreasonable. With good data and an understanding of the sustainability goal for the plan, the SJREC developed minimum thresholds to meet the goals set forth. The next step was to establish measurable objectives to provide operational flexibility to the beneficial users of groundwater, accounting for annual fluctuations of hydrology. With a good understanding of the operational bookends, the SJREC expanded their historic groundwater management strategies to comply with the SGMA.

Chronic lowering of groundwater is best managed through establishing water levels that trigger a management action to mitigate the risk of water levels declining to the minimum threshold. For the SJREC GSP, a trigger water level has been suggested to limit groundwater extractions leaving the management areas when water levels have declined below the trigger level. This management was in place in the impacted areas during the drought of 2013-2016 and was successful in limiting aquifer impacts. By 2019, the water levels had fully recovered without any significant or unreasonable impacts.

The SJREC have managed and will continue to manage a reduction in groundwater storage consistent with the triggers established to keep water levels from chronically lowering. Furthermore, the SJREC recharge more surface water than they extract and have a positive impact on groundwater storage. The impacts of climate change have been included in this plan and will be monitored to maintain sustainability.

The Delta-Mendota Subbasin is unlikely to experience seawater intrusion and therefore sustainable management criteria have not been established for this sustainability indicator.

Degraded water quality is managed to mitigate the impacts of the migration of poor quality water from lands outside of this GSP. The Camp 13 area of CCID and FCWD have been actively mitigating the impacts of drainage water entering the service area. These projects principally either blend the poor quality water with surface, dispose of the drainage water to the San Joaquin River Improvement Project (SJRIP) or through groundwater elevation control of tile drainage lines to keep the root zone from being inundated by the drainage water.

In the Delta-Mendota Subbasin, inelastic land subsidence is caused by groundwater extractions from the lower aquifer. The SJREC are pumping well below the sustainable yield of the lower aquifer established for the subbasin. The SJREC have been impacted by groundwater pumping from outside its service area.

The SJREC have not proposed to develop measurable objectives and interim milestones to address interconnected surface water and groundwater. Rather than developing a plan to mitigate a problem after the problem has presented itself, the SJREC GSP group has proposed to work with the counties to develop well construction standards to fully mitigate the potential for wells installed near the San Joaquin River to have an impact to the surface water flows.

ES4 PROJECTS AND MANAGEMENT ACTIONS

The SJREC has been actively managing groundwater conditions and independently have sustainable resource as described in Sections ES2 and ES3 above. The projects described in this plan are part of the SJRECWA Water Resources Plan. In 2012, the SJREC modeled the reliability to receive their surface water and decided that it was in their best interest, and the communities and habitat included in this GSP, to develop a water resource plan with the goal of having 50,000 acre-feet of local dispatchable storage. The goal would offset reductions in water supply during critical years under the Exchange Contract.

The Los Banos Creek Diversion Facility is a joint project with San Luis Water District (CVP contractor), Grasslands Water District (Refuge supply) and the SJREC. This project has an average annual yield of about 7,000 acre-feet and provides benefits to the Riparian corridor along the Los Banos Creek, improves wetland habitat, flood protection to the City of Los Banos, and water supply for the Riparian water users.

The Los Banos Creek Recharge and Recovery Project provides 7,000 acre-feet of water supply to the SJREC during a Critical year under the Exchange Contract. This project also benefits the riparian corridor in portions of the Los Banos Creek and provides a water quality benefit to the City of Los Banos (DAC). In 2017, the SJREC recharged a significant amount of water as part of this project. One of the City of Los Banos supply wells is located near the creek and experienced a reduction in hexavalent chromium due to the recharge of better quality water from the project. Furthermore, the domestic well users in the area reached out to the SJREC and were pleased to see the water level in their wells become shallower which reduces the cost to pump the water for their use. These projects will recharge more water than will be extracted, contributing to an improved overall water budget.

The Los Banos Creek Storage Project is another joint project with San Luis Water District, Grasslands Water District and the SJREC. This project will increase the beneficial use of the Los Banos Creek Detention Reservoir by making releases during the flood control season and provide that water to the Riparian landowners. These releases will also increase the flood protection. The project will provide 8,000 acre-feet of water supply to the SJREC during a Critical year under the Exchange Contract. In all other years, the SJREC will make the 8,000 acre-feet stored in the reservoir available to Grasslands Water District and San Luis Water District.

The Orestimba Creek Recharge and Recovery Project is a joint project with Del Puerto Water District and provides about 7,500 acre-feet of water supply to the SJREC during a Critical Year under the Exchange Contract. This project also provides a flood protection benefit to the City of Newman (DAC). These projects will recharge more water than will be extracted, contributing to an improved overall water budget.

The BB Limited and Farmers Water District Recharge Projects both have the ability to capture and recharge flood flows which will help reduce the potential flooding impact to the City of Firebaugh (SDAC) during high flow events from either the San Joaquin River or Kings River through the Fresno Slough. These projects will provide the SJREC about 8,000 acre-feet of water supply during a Critical year under the Exchange Contract. These projects will recharge more water than will be extracted, contributing to an improved overall water budget.

These projects combine to provide the SJREC will about 30,000 acre-feet of water supply during a Critical year under the Exchange Contract. This supply would have historically used groundwater to meet demand. The implementation of these projects will offset groundwater impacts during critically dry years by using stored water from these projects. The overall groundwater conditions are expected to improve as a result of these projects since some water will be left behind as a contribution to the local aquifers.

Another project the SJREC are participating in is the Red Top Area Subsidence Mitigation project. This project is helping to solve a regional problem that has impacted the SJREC due to groundwater extractions outside the SJREC service area and also outside of the Delta-Mendota Subbasin. The project includes the installation of recharge basins, facilities to capture and use flood flows and a pipeline under the San Joaquin River to deliver surface water to the Red Top area on the eastside of the river. Much of the area has recently used extractions from the lower aquifer to meet irrigation demands. This pumping has caused significant subsidence. The SJREC reached out to the landowners in the Red Top to area assess the problem and develop a vision to mitigate subsidence. The general concept is to capture flood flows and either recharge the upper aquifer or directly apply the water to meet crop demand (in-lieu recharge). The recharged water will create underground storage that can be used in later years. The subsidence reduction is achieved by abandoning wells in the lower aquifer and drilling shallower wells to use the recharged water in the upper aquifer. In 2017, almost 50,000 acre-feet was recharged directly and in-lieu of pumping groundwater. In 2018, an additional 10,000 acre-feet of surface water was put to beneficial use on the ranch. The current project is about 50% complete and the subsidence rate at Sack Dam (SLCC headworks) has reduced from 0.5'/year to 0.15'/year. Once the project is complete, the subsidence is expected to reduce to background levels.

The SJREC also have several management actions that were in place prior to the SGMA. One valuable management is the Annual Groundwater Assessment Report that reviews groundwater conditions for the SJREC management areas. Each year the report is updated to track and compare the current year conditions with historical observations. The report includes water level trends, water quality trends, well pumping volumes, and well pump tests. Kenneth D Schmidt and Associates (KDSA) prepares an analysis of the groundwater conditions for the current year and makes recommendations on specific groundwater management strategies to be implemented to maintain a healthy aquifer. Three areas have historically been impacted during drought years; Management Area A, Management Area G and the Los Banos Creek Sub-area of Management Area C. Water levels and groundwater impacts from these areas were below the established triggers in the recent drought, and it was recommended to limit extractions in these areas. As a result, the water levels fully recovered by 2019 without any significant impacts to the beneficial users of groundwater.

The SJREC allow private well owners to pump into district facilities for credit. Groundwater pumped into district facilities must meet water quality standards and have overall limits on how much groundwater can be pumped while monitoring and mitigating damage to other beneficial users. Since 2000, about 70% of the total pumping within the SJREC area has been subject to these policies and the recommendations based on the annual groundwater report. Additionally, during 2014 and 2015 about 90% of the total pumping was subject to these policies which are the years of highest stress on the local aquifers. This management has afforded the SJREC the ability to monitor and manage groundwater conditions each year, allowing KDSA to review potential problems and provide monitoring and management strategies to mitigate the potential problem.

The SJREC have periodically updated joint groundwater condition reports with the cities adjacent to the SJREC service area. These updates allow collaboration on impacts to groundwater as the cities demand on water increases to support impacts from climate change and population growth.

The SJREC have been managing groundwater quality impacts from drainage from the San Luis Unit of the Central Valley Project. The areas primarily impacted are the Firebaugh Canal Water District (FCWD) and the Camp 13 area within the Central California Irrigation District (CCID). The SGMA requires that a GSP shall not affect the ability of another GSP to achieve sustainability. In order to mitigate the water quality impacts from lands upslope, the SJREC have an active mitigation plan for the migration of shallow saline groundwater. Such projects include 1) point source control through installation of high efficiency irrigation systems and canal lining projects, 2) groundwater management including blending some poor quality groundwater, 3) installation of tile drainage systems along with a pipeline to dispose of the drain water on a reuse area and 4) potential groundwater treatment options. This management has been vital to maintain water levels below the effective root zone. Due to this poor quality groundwater migrating through the area, the cities of Firebaugh and Mendota (both are SDAC's) have worked with the SJREC do develop urban water supply wells on the opposite side of the San Joaquin River so they can supply safe and affordable drinking water to their residents.

Most of these projects and management actions have been in place prior to the enactment of SGMA. The SJREC are committed to continue their partnership with local agencies to better manage water resources through collaborative and inclusive projects and management actions that can benefit the whole community. Groundwater recharged by the SJREC is used to offset overdraft from the GSA's partnering in this plan

ES5 PLAN IMPLEMENTATION

The development of the SJREC GSP is estimated to cost $700,000. The SJREC GSA participated in grant funding on behalf of all of the GSA's in the SJREC GSP and have been awarded about $335,000 in Category 2 funding and also received Category 1 funding to offset costs to the Severely Disadvantaged Communities. The SJREC have been sustainably managing groundwater for decades and will continue to implement projects and management actions that will enhance the sustainability of the local aquifers and help neighboring GSA's and GSP Groups achieve and maintain sustainability.

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1.0 INTRODUCTION:

This section describes the purpose of this GSP and how each GSA will work together to meet the sustainability goal of this plan and the Delta-Mendota Subbasin. Some background information for each GSA is provided detailing the organization and management structure along with the legal and financial authority to implement this plan. DWR provided a checklist for GSP submittal which is included at the end of this section for reference.

1.1 Purpose of the Groundwater Sustainability Plan (GSP or Plan)

In 1914, the California Water Commission Act was enacted to create a state water commission for control of appropriation and use of surface water. California recognizes a dual doctrine system that allows both Riparian and Appropriative water rights. Appropriated water rights have seniority based on "first in time, first in right". One-hundred years after enacting the Water Commission Act, Governor Edmund G. Brown Jr., signed a group of three bills collectively known as the Sustainable Groundwater Management Act (SGMA) into law in September 2014. SGMA established a framework for local agencies to develop a Groundwater Sustainability Agency (GSA) to sustainably manage groundwater through implementation of a Groundwater Sustainability Plan (GSP). All high and medium priority basins, as defined in the Department of Water Resources Bulletin 118, must have complete GSA coverage by June 30, 2017. Failure to have full GSA coverage by the deadline allows the State Water Resources Control Board (State Board) to deem that basin "probationary" and assess non-compliance fees to fund the review of annual groundwater extractions and the development of an interim plan for the basin. Critically overdrafted high and medium priority basins must be managed under a GSP by January 31, 2020. If a basin is not managed under a GSP or the GSP is inadequate to achieve sustainability, the State Board may designate that basin as probationary and assume the management responsibility. The goal of SGMA is to have sustainably managed groundwater within 20 years of the initial GSP submittal and maintain sustainability for a 50-year planning and implementation horizon. Each basin must submit annual progress reports to DWR for analysis. An updated GSP must be submitted to DWR starting in 2025 and every year thereafter that ends in a (0) or a (5).

DWR is responsible for developing regulations to modify groundwater basin boundaries. California's existing groundwater basins and subbasins are described in DWR's Bulletin 118 and have been revised based on the best available information during each update. The Basin Boundary Modification (BBM) process builds off historical knowledge of the basin and provides a mechanism to modify boundaries based on new scientific information and local groundwater management knowledge to improve coordination and promote statewide sustainable groundwater management. The legislative intent and fundamental goal of SGMA is for groundwater to be managed locally. Successful groundwater management may, at times, require a BBM based on scientific and/or jurisdictional justification. A scientific modification is based on the geologic or hydrologic conditions that define that basin. A jurisdictional modification is based on coordination of local agencies t implement strategies towards sustainable groundwater management.

Local groundwater management is best achieved with involvement of stakeholders. Outreach is critical for successful implementation of the SGMA. Each GSP shall include a summary of information relating to notification and communication by the GSA to other stakeholders. Some stakeholders include:

- State, Federal and Tribal Governments: Governor's Administration, Legislature and key State and federal agencies, tribes
- Regional and local governments and agencies: Water and groundwater management agencies and districts; land use entities such as counties and cities
- Other stakeholders: Non-governmental organizations representing water, groundwater, environmental, environmental justice, and agriculture interests as well as universities
- The public

SGMA requires that each basin prepare a GSP(s) consistent with the goals of the legislation. All of the GSA's in a basin must coordinate implementation efforts to comply with the GSP regulations. As of 2018, DWR published the first six Best Management Practices (BMP's) to provide guidance to help GSA's develop essential elements of a GSP. BMP refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science. A GSA may use BMP's established by DWR or develop their own BMP's. BMP's will provide a consistent framework on data collection and management for the basin. The following is a list of currently available DWR published BMP's.

- BMP 1 – Monitoring Protocols Standards and Sites
- BMP 2 – Monitoring Networks and Identification of Data Gaps
- BMP 3 – Hydrogeologic Conceptual Model
- BMP 4 – Water Budget
- BMP 5 – Modeling
- BMP 6 – Sustainable Management Criteria (DRAFT)

The SGMA established six Undesirable Results that, if applicable, must be sustainably managed. Triggers and thresholds may be established to prevent the occurrence of Undesirable Results in the basin. Those Undesirable Results include:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion.
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Depletions of interconnected surface water that has significant and unreasonable adverse impacts on beneficial uses of the surface water.

1.1.1 Key Definitions

- Refer to California Code of Regulations, Title 23. Waters, Division 2. Department of Water Resources, Chapter 1.5 Groundwater Management, Subchapter 2. Groundwater Sustainability Plans, Article 2. Definitions, § 351. Definitions.
- **GSP Group** – Collection of GSA's working together to prepare a Groundwater Sustainability Plan

- **San Joaquin River Exchange Contractors GSP Group** – The following group of GSA's working together to develop a GSP in the Delta-Mendota Subbasin: SJREC GSA, City of Newman GSA, City of Gustine GSA, City of Los Banos GSA, City of Dos Palos GSA, City of Firebaugh GSA, City of Mendota GSA, TIWD GSA, Madera County – 3 GSA, Portion of Merced County – Delta-Mendota GSA, and Portion of Fresno County Management Area B GSA
- **Shallow Zone/Aquifer** – locally termed aquifer above the A-Clay
- **Deep Zone/Aquifer** – locally termed aquifer between the A-Clay and Corcoran Clay

1.1.2 Acronyms

- **AB 3030 – 1992 California Assembly Bill 3030**
- **AWMP – Agriculture Water Management Plan**
- **BMP – Best Management Practices**
- **CASGEM – California Statewide Groundwater Elevation Monitoring**
- **CCC – Columbia Canal Company**
- **CCF – Climate Change Factors**
- **CCID – Central California Irrigation District**
- **CDFW – California Department of Fish and Wildlife**
- **CFS – Cubic Feet per Second**
- **CVP – Central Valley Project**
- **CVRWQCB – Central Valley Regional Water Quality Control Board**
- **DAC – Disadvantaged Community**
- **DMC – Delta-Mendota Canal**
- **DPDD – Dos Palos Drainage District**
- **DPWD – Del Puerto Water District**
- **DWR – California Department of Water Resources**
- **ET – Evapotranspiration**
- **ET_c – Total Crop Evapotranspiration**
- **ET_{iw} – Crop Evapotranspiration of Irrigation Water**
- **ET_{misc} – Miscellaneous Evapotranspiration including; canal evaporation, consumptive use of phreatophytes, etc.**
- **ET_{precip} – Evapotranspiration from precipitation**
- **FCWD – Firebaugh Canal Water District**
- **FNF – Full Natural Flow**
- **GDD – Gustine Drainage District**
- **GDE – Groundwater Dependent Ecosystem**
- **GPM – Gallons Per Minute**
- **GRCD – Grassland Resource Conservation District**
- **GSA – Groundwater Sustainability Agency**
- **GSP – Groundwater Sustainability Plan**
- **GWD – Grassland Water District**
- **GWMP – Groundwater Management Plan**
- **HCM – Hydrogeologic Conceptual Model**
- **HMRD – Henry Miller Reclamation District**

- **ILRP – Irrigated Lands Regulatory Program**
- **IRWMP – Integrated Regional Water Management Plan**
- **JPA – Joint Powers Authority**
- **KDSA – Kenneth D. Schmidt & Associates**
- **LSCE – Luhdorff and Scalmanini Consulting Engineers**
- **MAF – Million Acre-Feet**
- **KDSA – Kenneth D. Schmidt and Associates**
- **NASA JPL – National Aeronautics and Space Administration Jet Propulsions Laboratory**
- **P&P – Provost and Pritchard Consulting Group**
- **SAGBI – Soil Agriculture Groundwater Banking Index**
- **SB 372 – 2017 California Senate Bill 372**
- **SGMA – Sustainable Groundwater Management Act**
- **SGWP – Sustainable Groundwater Planning**
- **SJREC – San Joaquin River Exchange Contractors**
- **SJREC GSA – San Joaquin River Exchange Contractors Groundwater Sustainability Agency**
- **SJRECWA – San Joaquin River Exchange Contractors Water Authority or Exchange Contractors**
- **SJRIP – San Joaquin River Improvement Project**
- **SJRRP – San Joaquin River Restoration Program**
- **SLCC – San Luis Canal Company**
- **SLDMWA – San Luis and Delta-Mendota Water Authority**
- **SLWD – San Luis Water District**
- **SMC – Sustainable Management Criteria**
- **SWP – State Water Project**
- **SWRCB – State Water Resources Control Board**
- **TAF – Thousand Acre-Feet**
- **TIWD – Turner Island Water District**
- **TNC – The Nature Conservancy**
- **USACE – United States Army Corp of Engineers**
- **USBR – United States Bureau of Reclamation**
- **USF&WS – United State Fish and Wildlife Service**
- **USGS – United States Geological Survey**
- **UWMP – Urban Water Management Plan**
- **WSIP – Water Storage Investment Program**
- **WWD – Westlands Water District**
- **WWTF – Waste Water Treatment Facility**

1.2 Sustainability Goal

Each Agency shall establish in its Plan a sustainability goal for the basin the 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.

For a more in depth analysis of the sustainability goal of this plan refer to Section 3.1. The SJREC GSP Group has developed this plan to achieve independent plan sustainability while also working with the other GSP's in the Delta-Mendota Subbasin to coordinate the plans together to achieve sustainability for the subbasin. The Delta-Mendota Subbasin Sustainability Goal is further described in the Delta-Mendota Subbasin Common Chapter; Appendix B.

1.3 Agency Information

1.3.1 SJREC GSA Information

The San Joaquin River Exchange Contractors Water Authority (SJRECWA or Exchange Contractors) was established as a Joint Powers Authority in May 1993 and consists of four water agencies, Central California Irrigation District, San Luis Canal Company, Firebaugh Canal Water District and Columbia Canal Company (member entities) serving approximately 240,000 acres of prime agricultural land east of 1-5 and west of the San Joaquin River with about 16,000 acres situated east of the San Joaquin River. These lands span four counties: Fresno, Madera, Merced and Stanislaus, from the town of Mendota in the south to Patterson in the north. The Exchange Contractors hold some of the oldest water rights in the state which date back to the late 1800's. The rights were established by Henry Miller of the legendary Miller and Lux cattle empire. Today several of the original Miller and Lux canals continue to be operated by the Exchange Contractors entities. The Exchange Contractors mission is to monitor environmental, legislative and legal issues which may impact any of the four entities.

The Exchange Contractors' water rights are based on the riparian and pre-1914 diversions made by Henry Miller. When construction of Friant Dam of the Central Valley Project was under consideration, feasibility studies showed that no extensive development could occur on the east side of the San Joaquin Valley between Chowchilla and Bakersfield unless water could be diverted from the San Joaquin River to those areas. In the 1930's, the Exchange Contractors were asked by the United States to quantify their water rights and "exchange" their right to divert San Joaquin and Kings River water for guaranteed deliveries of "substitute" water from the Sacramento River by means of the Delta-Mendota Canal; hence the name, "San Joaquin River Exchange Contractors." In 1939, the United States Government signed two contracts with Miller and Lux and the four entities, to exchange where they exchanged use of their pre-1914 Appropriative and Riparian water from the San Joaquin and Kings Rivers for substitute water delivered from the Delta-Mendota Canal (DMC). This agreement is commonly referred to as the "Exchange Contract" and was accompanied by what is known as the "Purchase Contract". The Exchange Contractors are currently operating under the "Second Amended Contract for Exchange of Waters" executed in 1968. The Exchange Contractors did not abandon their San Joaquin River water rights. Instead, they agreed not to exercise those water rights as long as guaranteed deliveries continued to be made to them by the U.S. Bureau of Reclamation (Bureau) through the Delta-Mendota Canal or from other Bureau sources. In the event that the Bureau is unable to make its contracted deliveries of substitute water to the Exchange Contractors, the Exchange Contractors have reserved the right to return to the San Joaquin River to satisfy their historic water rights. In non-critical years under the Exchange Contract, the United States Bureau of Reclamation (USBR) will deliver of 100% of the contractual water allotment (840,000 acre-feet) and will deliver 77% (650,000 acre-feet) during critical years. This water is delivered through the DMC when available and down the San Joaquin River during those times when conveyance down the DMC cannot meet the obligations set forth in the "Exchange and Purchase Contracts".

The California Department of Water Resources (DWR) deemed the Exchange Contractors as the Exclusive GSA for the service area on March 28, 2016. The SJREC GSA, through SB 372, is the successor to the SJRECWA GSA as the exclusive GSA for the Exchange Contractor member's service area. The Exchange Contractors service area delivers water to approximately 240,000 acres. Figure 2 shows the SJREC GSP area. The SJREC members have proactively monitored groundwater pumping since the 1960's. A stable surface water supply coupled with active groundwater management has enabled sustainable groundwater management over that period.

1.3.1.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

Contact Information:

Website: http://sjrecwa.net/groundwater.html

SJREC GSA Board of Directors
James O'Banion (Chair), Kimberly Brown (Vice-Chair), James Nickel, and Mike Stearns

San Joaquin River Exchange Contractors Water Authority & SJREC GSA
Chris White, Executive Director: cwhite@sjrecwa.net
541 H Street
Los Banos, CA 93635
(209) 827-8616

Central California Irrigation District
Jarrett Martin, Deputy General Manager: jmartin@ccidwater.org
1335 West I Street
Los Banos, CA 93635
(209) 826-1421

San Luis Canal Company
John Wiersma, General Manager: jwiersma@hmrd.net
11704 W. Henry Miller Road
Dos Palos, CA 93620
(209) 826-5112

Columbia Canal Company
Randy Houk, General Manager: rghccc@sbcglobal.net
6770 Avenue 7-1/2
Firebaugh, CA 93622
(559) 659-2426

Firebaugh Canal Water District
Jeff Bryant, General Manager: bryant_jeff@sbcglobal.net

2412 Dos Palos Road
Mendota, CA 93640
(559) 655-4761

Included herein is the contact information for the other partnering GSA's within the SJREC GSP Group

City of Newman GSA
Michael Holland, City Manager mholland@cityofnewman.com
938 Fresno Street
Newman, CA 95360
(209) 862-3725

City of Gustine GSA
Doug Dunford, City Manager ddunford@cityofgustine.com
352 Fifth Street
Gustine, CA 95322
(209) 854-9403

City of Los Banos GSA
Mark Fachin, Public Works Director mark.fachin@losbanos.org
520 J Street
Los Banos, CA 93635
(209) 827-7056

City of Dos Palos GSA
Darrell Fonseca, City Manager cityofdp@cityofdp.com
2174 Blossom Street
Dos Palos, CA 93620
(209) 392-2174

City of Firebaugh GSA
Ben Gallegos, City Manager BGallegos@ci.firebaugh.ca.us
1133 P Street
Firebaugh, CA 93622
(559) 659-2043

City of Mendota GSA
Cristian Gonzalez, City Manager cristian@cityofmendota.com
643 Quince Street
Mendota, CA 93640
(559) 655-4298

Turner Island Water District – 2 GSA
Scott Skinner, TIWD-GSA-2@wolfseninc.com
1269 West I Street
Los Banos, CA 93635

County of Merced Delta-Mendota GSA
Lacey Kiriakou, Water Resources Coordinator LKiriakou@co.merced.ca.us
2222 M Street
Merced, CA 95340
(209) 385-7654
County of Madera – 3 GSA
Stephanie Anagnoson, Director of Water and Natural Resources
stephanie.anagnoson@maderacounty.com
200 W. Fourth Street
Madera, CA 93637
(559) 675-7703

County of Fresno Management Area B GSA
Augustine Ramirez, Senior Engineer auramirez@fresnocountyca.gov
2220 Tulare Street
Fresno, CA 93721
(559) 600-4022

1.3.1.2 Legal Authority of the GSA
The SJREC GSA received Special Act Legislation (SB 372) with an update Water Code Section 10723 to include the SJREC GSA as an agency created by statute to manage groundwater and is deemed the exclusive local agency within its respective statutory boundary. Refer to Appendix A for SB 372.

1.3.1.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs
The Exchange Contractors are currently funding much of the obligations of the SGMA through current programs. Funding for implementing the GSP is part of the standard operating budget for the agency and will continue to be funded through those existing mechanisms. The estimated cost to develop and implement the GSP for the SJREC GSA is $505,000. Refer to Section 5.1 of this GSP for a more detailed explanation.

1.3.1.4 Contact Information of Plan Manager
The collective GSP Groups in the Delta-Mendota Subbasin, through the Coordination Agreement (Appendix B), have authorized Andrew Garcia of the SLDMWA to be the Plan Manager for the Subbasin. The contact information for Andrew Garcia is below:

- Andrew Garcia, Plan Manager: andrew.garcia@sldmwa.org
  San Luis & Delta-Mendota Water Authority
  842 6th Street
  Los Banos, CA 93635
  (209) 832-6200 / Fax (209) 833-1034
  andrew.garcia@sldmwa.org

1.3.2 City of Newman GSA Information
The City of Newman was incorporated on June 10, 1908. Currently, the only source of potable water for the residents of Newman is treated groundwater. With a vested interest in sustainable groundwater management, the City Council approved filing as the local GSA for the City limits.

1.3.2.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

The City of Newman GSA uses the same organization and management structure for both GSA and City operations. The three main departments engaged in development of this GSP include: Administration, Public Works and Planning.

1.3.2.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The City of Newman, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the City limits on December 13, 2016. DWR deemed the GSA exclusive on March 13, 2017.

1.3.2.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the City of Newman is $20,000. The CCID has a long-standing history jointly developing groundwater assessment reports and equally splitting the associated costs for the area in and around the City. Both the SJREC GSA and the City GSA intend to build off this successful partnership and develop a sustainable groundwater management plan. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the City in this Plan, will receive a portion of the SGWP grant funds. The remaining costs will be equally split between the SJREC GSA and the City GSA. The City plans to cover their share of the costs as part of their annual budget. These costs will be updated consistent with current laws and practices utilizing a rate adjustment to cover City costs.

1.3.3 City of Gustine GSA Information

The City of Gustine was incorporated on November 11, 1915. Currently, the only source of potable water for the residents of Gustine is treated groundwater. With a vested interest in sustainable groundwater management, the City Council approved filing as the local GSA for the City limits.

1.3.3.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

The City of Gustine GSA uses the same organization and management structure for both GSA and City operations. The three main departments engaged in development of this GSP include: Administration, Public Works and Planning.

1.3.3.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The City of Gustine, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the City limits on June 23, 2017. DWR deemed the GSA exclusive on September 21, 2017.

1.3.3.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the City of Gustine is $15,000. The CCID has a long-standing history jointly developing groundwater assessment reports and equally splitting the associated costs for the area in and around the City. Both the SJREC GSA and the City GSA intend to build off this successful partnership and develop a sustainable groundwater management plan. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the City in this Plan, will receive a portion of the SGWP grant funds. The remaining costs will be equally split between the SJREC GSA and the City GSA. The City plans to cover their share of the costs as part of their annual budget. These costs will be updated consistent with current laws and practices utilizing a rate adjustment to cover City costs.

1.3.4 City of Los Banos GSA Information

The City of Los Banos received its first post office in 1873. Currently, the only source of potable water for the residents of Los Banos is treated groundwater. With a vested interest in sustainable groundwater management, the City Council approved filing as the local GSA for the City limits.

1.3.4.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

The City of Los Banos GSA uses the same organization and management structure for both GSA and City operations. The three main departments engaged in development of this GSP include: Administration, Public Works and Planning.

1.3.4.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The City of Los Banos, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the City limits on February 9, 2017. DWR deemed the GSA exclusive on May 10, 2017.

1.3.4.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the City of Los Banos is $75,000. The CCID has a long-standing history jointly developing groundwater assessment reports and equally splitting the associated costs for the area in and around the City. The local CVP contractors have engaged the City of Los Banos for local water resource projects. As a result, the SJREC GSA, GWD GSA and SLWD are working with the City to develop sustainable groundwater management within the greater Los Banos area. More details on this joint effort is described in Section 9.0. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the City in this Plan, will receive a portion of the SGWP grant funds. The remaining costs will be equally split between the SJREC GSA, GWD GSA, SLWD and the City GSA. The City plans to cover their share of the costs as part of their annual budget. These costs will be updated consistent with current laws and practices utilizing a rate adjustment to cover City costs.

1.3.5 City of Dos Palos GSA Information

The City of Dos Palos was incorporated on May 24, 1935. Currently, the City provides treated surface water for residents. In the event of a catastrophic failure to the delivery system, the City is planning to use groundwater as an emergency supply. With a vested interest in sustainable groundwater management, the City Council approved filing as the local GSA for the City limits.

1.3.5.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

The City of Dos Palos GSA uses the same organization and management structure for both GSA and City operations. The three main departments engaged in development of this GSP include: Administration, Public Works and Planning.

1.3.5.2 Legal Authority of the GSA
Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The City of Dos Palos, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the City limits on June 29, 2017. DWR deemed the GSA exclusive on September 27, 2017.

1.3.5.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs
The estimated cost to develop and implement the GSP for the City of Dos Palos is $5,000. The CCID has a long standing history jointly developing groundwater assessment reports and equally splitting the associated costs for the area in and around the City. Both the SJREC GSA and the City GSA intend to build off this successful partnership and develop a sustainable groundwater management plan. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the City in this Plan, will receive a portion of the SGWP grant funds. The remaining costs will be equally split between the SJREC GSA and the City GSA. The City plans to cover their share of the costs as part of their annual budget. These costs will be updated consistent with current laws and practices utilizing a rate adjustment to cover City costs.

1.3.6 City of Firebaugh GSA Information
The City of Firebaugh received its first post office in 1865. Currently, the only source of potable water for the residents of Firebaugh is treated groundwater. With a vested interest in sustainable groundwater management, the City Council approved filing as the local GSA for the City limits.

1.3.6.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)
The City of Firebaugh GSA uses the same organization and management structure for both GSA and City operations. The three main departments engaged in development of this GSP include: Administration, Public Works and Planning.

1.3.6.2 Legal Authority of the GSA
Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The City of Firebaugh, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the City limits on May 18, 2017. DWR deemed the GSA exclusive on August 16, 2017.

1.3.6.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs
The estimated cost to develop and implement the GSP for the City of Firebaugh is $15,000. The CCID has a long-standing history jointly developing groundwater assessment reports and equally splitting the associated costs for the area in and around the City. Both the SJREC GSA and the City GSA intend to build off this successful partnership and develop a sustainable groundwater management plan. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the City in this Plan, will receive a portion of the SGWP grant funds. The remaining costs will be equally split between the SJREC GSA and the City GSA. The City plans to cover their share of the costs as part of their annual budget. These costs will be updated consistent with current laws and practices utilizing a rate adjustment to cover City costs.

1.3.7 City of Mendota GSA Information

The City of Mendota received its first post office in 1892. Currently, the only source of potable water for the residents of Mendota is treated groundwater. With a vested interest in sustainable groundwater management, the City Council approved filing as the local GSA for the City limits.

1.3.7.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

The City of Mendota GSA uses the same organization and management structure for both GSA and City operations. The three main departments engaged in development of this GSP include: Administration, Public Works and Planning.

1.3.7.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The City of Mendota, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the City limits on February 3, 2017. DWR deemed the GSA exclusive on May 4, 2017.

1.3.7.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the City of Mendota is $15,000. The CCID has a long-standing history jointly developing groundwater assessment reports and equally splitting the associated costs for the area in and around the City. Both the SJREC GSA and the City GSA intend to build off this successful partnership and develop a sustainable groundwater management plan. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the City in this Plan, will receive a portion of the SGWP grant funds. The remaining costs will be equally split between the SJREC GSA and the City GSA. The City plans to cover their share of the costs as part of their annual budget. These costs will be updated consistent with current laws and practices utilizing a rate adjustment to cover City costs.

1.3.8 Turner Island Water District-2 GSA Information

Turner Island Water District is a conjunctive use district that facilitates the delivery of water to the landowners. TIWD lies within both the Merced Subbasin (05-022.04) and the Delta-Mendota Subbasin (05-022.07). TIWD-2 GSA is the portion of the district within this GSP and the Delta-Mendota Subbasin. However, TIWD intends to maintain flexibility to deliver water to the landowners in each Subbasin. A more detailed analysis on sustainable groundwater management for TIWD is described in Section 13.0.

1.3.8.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

The TIWD-2 GSA uses the same organization and management structure for both the GSA and Water District.

1.3.8.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The TIWD, a public agency, notified the DWR of its intent to be the Exclusive GSA for the district lands in the Delta-Mendota Subbasin on March 27, 2017. DWR deemed the GSA exclusive on June 25, 2017.

1.3.8.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the TIWD-2 GSA is $15,000. The SLCC and TIWD have a long-standing relationship managing surface water and groundwater. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering TIWD in this Plan will receive a portion of the SGWP grant funds. The remaining costs will be covered by TIWD. These costs will be updated consistent with current laws and practices. The TIWD implemented a landowner agreement in lieu of a Prop 218 election.

1.3.9 County of Madera-3 GSA Information

Madera County was founded in 1893. With a vested interest in sustainable groundwater management, the County Board of Supervisors approved filing as the local GSA for white areas in the Delta-Mendota Subbasin.

1.3.9.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

The County of Madera - 3 GSA uses the same organization and management structure for both GSA and County operations. The three main departments engaged in development of this GSP include: Administration, Water & Natural Resources, and Planning.

1.3.9.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The County of Madera, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the white areas in the County on February 9, 2017. DWR deemed the GSA exclusive on May 10, 2017.

1.3.9.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the County of Madera-3 GSA is $5,000. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the County of Madera-3 in this Plan will receive a portion of the SGWP grant funds. The remaining costs will be covered by the County. These costs will be updated consistent with current laws and practices.

1.3.10 Portion of Merced County – Delta-Mendota GSA Information

Merced County was founded in 1855. With a vested interest in sustainable groundwater management, the County Board of Supervisors approved filing as the local GSA for white areas in the Delta-Mendota Subbasin. A portion of the GSA is covered by this Plan.

1.3.10.1Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

Merced County – Delta-Mendota GSA uses the same organization and management structure for both GSA and County operations. The three main departments engaged in development of this GSP include: Administration, Community & Economic Development, and Planning.

1.3.10.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The County of Merced, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the white areas in the County on March 28, 2017. DWR deemed the GSA exclusive on June 26, 2017.

1.3.10.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the Portion of Merced County – Delta-Mendota GSA is $25,000. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the Portion of Merced County – Delta-Mendota GSA in this Plan will receive a portion of the SGWP grant funds. The remaining costs will be covered by the County. These costs will be updated consistent with current laws and practices.

1.3.11 Portion of Fresno County – Management Area B GSA Information

Fresno County was founded in 1856. With a vested interest in sustainable groundwater management, the County Board of Supervisors approved filing as the local GSA for white areas in the Delta-Mendota Subbasin.

1.3.11.1 Organization and Management Structure of the Groundwater Sustainability Agency (GSA or Agency)

Fresno County – Management Area B GSA uses the same organization and management structure for both GSA and County operations. The Department of Public Works and Planning was engaged in the development of this GSP.

1.3.11.2 Legal Authority of the GSA

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. The County of Fresno, a political subdivision of the State of California, notified the DWR of its intent to be the Exclusive GSA for the white areas in the County on May 30, 2017. DWR deemed the GSA exclusive on August 28, 2017.

1.3.11.3 Estimated Cost of Implementing the GSP and the GSA's Approach to Meet Costs

The estimated cost to develop and implement the GSP for the Portion of Fresno County – Management Area B GSA is $5,000. The SJREC GSA has participated in the SGWP Grant in the Delta-Mendota Subbasin on behalf of the SJREC GSP Group. The costs associated with covering the Portion of Fresno County – Management Area B GSA in this Plan will receive a portion of the SGWP grant funds. The remaining costs will be covered by the County on a pro-rata share with the SJREC GSA costs to develop and implement the GSP. It is anticipated that the County will impose extractions fees for non-minimum pumpers, through Proposition 218, to recover expenses.

1.4 GSP Organization

1.4.1 Description of how the GSP is organized

The Delta-Mendota Subbasin (5-022.07) has twenty-three GSA's working to coordinate six GSP's. Figure 1 gives a graphical representation of the governance structure for the GSA's and GSP's in the Delta-Mendota Subbasin. The GSA's held a meeting to discuss GSP coordination consistent with the requirements defined in the SGMA. The group collectively decided to form a Coordination Committee with the initial task of developing a Coordination Agreement and accompanying Cost Sharing Agreement; Appendices B and C respectively. In addition, the Coordination Committee approves recommendations of the other committees and also authorizes coordinated expenditures. The

Coordination Committee recommended the formation of a Technical Subcommittee tasked with coordinating GSP development and implementation. One recommendation from the Technical Subcommittee was for all six GSP's to have a Common Chapter for the subbasin wide coordinated elements; refer to Appendix B of this GSP. For more details about the Coordination Committee refer to Appendix B.

The GSA's in the SJREC GSP Group have elected a representative from the SJREC GSA to represent the entire group on the various committees and sub-committees established for coordinating development and implementation of the six GSP's in the Delta-Mendota Subbasin. The SJREC GSA representative is tasked with keeping the group informed of pertinent information and will ask for each GSA to weigh in on decisions that may affect that respective GSA. The SJREC GSA has an MOU directly with each other GSA that is party to the SJREC GSP Group. The MOU describes how development and implementation of the GSP occurs and each party's respective role and responsibility.

This GSP used the GSP Annotated Outline prepared by DWR as the genesis for the organization of content. Section 1 – Section 2.2.2 and Section 6 covers the SJREC GSP Group in its entirety with a major focus on the SJREC GSA covering almost 90% of the plan area. Section 2.2.3 – Section 5 is specific to the SJREC GSA. Each GSA will have its own discrete section for Water Budgets, SMC and Projects and Management Actions; Section 7 – Section 16. Section 17 describes the Common Chapter for each GSP in the Delta-Mendota Subbasin. The final Section of this plan is the Appendices which are used to provide supporting documentation. The Table of Contents can be used as a guide to organization of this GSP.

FIGURE 1 - DELTA-MENDOTA SUBBASIN GOVERNANCE

1.4.2 Preparation Checklist for GSP Submittal

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 3. Technical Reporting Standards				
352.2		Monitoring Protocols	Monitoring protocols adopted by the GSA for data collection and management	3.5.2
			Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin	3.5.2
Article 5. Plan Contents, Subarticle 1. Administrative Information				
354.4		General Information	Executive Summary	Executive Summary
			List of references and technical studies	6
354.6		Agency Information	GSA Mailing List	1.3.1
			Organization and management structure	1.3.1
			Contact information of Plan Manager	1.3.2.4
			Legal authority of GSA	1.3.2
			Estimate of implementation costs	1.3.3 & 5.1
354.(a)	10727(a)(4)	Map(s)	Area covered by GSP	2.1.1
			Adjudicated areas, other agencies within the basin, and areas covered by an Alternative	N/A
			Jurisdictional boundaries of Federal or State land	2.1.1
			Existing land use designations	2.1.3
			Density of wells per square mile	2.1.1
354.8(b)		Description of the Plan Area	Summary of jurisdictional areas and other features	2.1.1
354.8(c) 354.8(d) 354.8(e)	10727.2(g)	Water Resource Monitoring and Management Programs	Description of water resources monitoring and management programs	2.1.2 (see GSA specific Section 7.0 - Section 16.0)
			Description of how the monitoring networks of those plans will be incorporated into the GSP	
			Description of how those plans may limit operational flexibility in the basin	
			Description of conjunctive use programs	

354.8(f)	10727.2(g)	Land Use Elements or Topic Categories of Applicable General Plans	Summary of general plans and other land use plans	2.1.3
			Description of how implementation of the GSP may change water demands or affect achievement of sustainability and how the GSP addresses those effects	
			Description of how implementation of the GSP may affect the water supply assumptions of relevant land use plans	
			Summary of the process for permitting new or replacement wells in the basin	
			Information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management	
354.8(g)	102727.4	Additional GSP Contents	**Description of Actions Related To:**	
			Control of saline water intrusion	2.1.4
			Wellhead protection	
			Migration of contaminated groundwater	
			Well abandonment and well destruction program	
			Replenishment of groundwater extractions	
			Conjunctive use and underground storage	
			Well construction policies	
			Addressing groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects	
			Efficient water management practices	
			Relationships with State and Federal regulatory agencies	
			Review of land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity	2.1.3
			Impacts on groundwater dependent ecosystems	2.1.4
354.10		Notice and Communication	Description of beneficial uses and users	2.1.5
			List of public meetings	
			GSP comments and responses	
			Decision-making process	
			Public engagement	
			Encouraging active involvement	

			Informing the public on GSP implementation progress	
Article 5. Plan Contents, Subarticle 2. Basin Setting				
354.14		Hydrogeologic Conceptual Model	Description of the Hydrogeologic Conceptual Model	2.2.1
			Two scale cross-sections	
			Map(s) of physical characteristics: topographic information, surficial geology, soil characteristics, surface water bodies, source and point of delivery for imported water supplies	
354.14(c)(4)	10727(a)(5)	Map of Recharge Areas	Map delineating existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas	2.2.1
	10727.2(d)(4)	Recharge Areas	Description of how recharge areas identified in the plan substantially contribute to the replenishment of the basin	2.2.1
354.16	10727.2(a)(1) 10727.2(a)(2)	Current and Historical Groundwater Conditions	Groundwater elevation data	2.2.2
			Estimate of groundwater storage	
			Seawater intrusion conditions	
			Groundwater quality issues	
			Land subsidence conditions	
			Identification of interconnected surface water systems	
			Identification of groundwater-dependent ecosystems	2.1.4
354.18	10727.2(a)(3)	Water Budget Information	Description of inflows, outflows, and change in storage	2.2.3
			Quantification of overdraft	
			Estimate of sustainable yield	
			Quantification of current, historical, and projected water budgets	
	10727.2(d)(5)	Surface Water Supply	Description of surface water supply used or available for use for groundwater recharge or in-lieu use	1.3 and 2.2.3
354.20		Management Areas	Reason for creation of each management area	2.2.4 and 3
			Minimum thresholds and measurable objectives for each management area	
			Level of monitoring and analysis	
			Explanation of how management of management areas will not cause undesirable results outside the management area	

			Description of management areas	
Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria				
354.24		Sustainability Goal	Description of the sustainability goal	3.1
354.26		Undesirable Results	Description of undesirable results	3.4
			Cause of groundwater conditions that would lead to undesirable results	3.4
			Criteria used to define undesirable results for each sustainability indicator	3.4
			Potential effects of undesirable results on beneficial uses and users of groundwater	3.4
354.28	10727.2(d)(1) 10727.2(d)(2)	Minimum Thresholds	Description of each minimum threshold and how they were established for each sustainability indicator	3.3
			Relationship for each sustainability indicator	3.3
			Description of how selection of the minimum threshold may affect beneficial uses and users of groundwater	3.3
			Standards related to sustainability indicators	3.3
			How each minimum threshold will be quantitatively measured	3.3
354.30	10727.2(b)(1) 10727.2(b)(2) 10727.2(d)(1) 10727.2(d)(2)	Measurable Objectives	Description of establishment of the measurable objectives for each sustainability indicator	3.2
			Description of how a reasonable margin of safety was established for each measurable objective	3.2
			Description of a reasonable path to achieve and maintain the sustainability goal, including a description of interim milestones	3.2
Article 5. Plan Contents, Subarticle 4. Monitoring Networks				
354.34	10727.2(d)(1) 10727.2(d)(2) 10727.2(e) 10727.2(f)	Monitoring Networks	Description of monitoring network	3.5.1
			Description of monitoring network objectives	3.5.1
			Description of how the monitoring network is designed to: demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features; estimate the change in annual groundwater in storage; monitor seawater intrusion; determine groundwater quality trends; identify the rate and extent of land subsidence; and calculate depletions of surface water caused by groundwater extractions	3.5.1

			Description of how the monitoring network provides adequate coverage of Sustainability Indicators	3.5.1
			Density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends	3.5.1
			Scientific rational (or reason) for site selection	3.5.3
			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	3.5.1
			Description of technical standards, data collection methods, and other procedures or protocols to ensure comparable data and methodologies	3.5.2
354.36		Representative Monitoring	Description of representative sites	3.5.3
			Demonstration of adequacy of using groundwater elevations as proxy for other sustainability indicators	3.5.3
			Adequate evidence demonstrating site reflects general conditions in the area	3.5.3
354.38		Assessment and Improvement of Monitoring Network	Review and evaluation of the monitoring network	3.5.4
			Identification and description of data gaps	3.5.4
			Description of steps to fill data gaps	3.5.4
			Description of monitoring frequency and density of sites	3.5.4
Article 5. Plan Contents, Subarticle 5. Projects and Management Actions				
354.44		Projects and Management Actions	Description of projects and management actions that will help achieve the basin's sustainability goal	4
			Measurable objective that is expected to benefit from each project and management action	
			Circumstances for implementation	
			Public noticing	
			Permitting and regulatory process	
			Time-table for initiation and completion, and the accrual of expected benefits	
			Expected benefits and how they will be evaluated	

			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	
			Legal authority required	
			Estimated costs and plans to meet those costs	
			Management of groundwater extractions and recharge	
354.44(b)(2)	10727.2(d)(3)		Overdraft mitigation projects and management actions	
Article 8. Interagency Agreements				
357.4	10727.6	Coordination Agreements - Shall be submitted to the Department together with the GSP's for the basin and, if approved, shall become part of the GSP for each participating Agency.	**Coordination Agreements shall describe the following:**	
			A point of contact	Appendix B
			Responsibilities of each Agency	
			Procedures for the timely exchange of information between Agencies	
			Procedures for resolving conflicts between Agencies	
			How the Agencies have used the same data and methodologies to coordinate GSP's	
			How the GSP's implemented together satisfy the requirements of SGMA	
			Process for submitting all Plans, Plan Amendments, supporting information, all monitoring data and other pertinent information, along with annual reports and periodic evaluations	
			A coordinated data management system for the basin	
			Coordination agreements shall identify adjudicated areas within the basin, and any local agencies that have adopted an Alternative that has been accepted by the Department	

Table 1 – Preparation Checklist for GSP Submittal

2.0 PLAN AREA AND BASIN SETTING

This section describes the SJREC GSP Group plan area and Basin Setting. More specifically, this section describes the location of the geographic areas covered in this GSP and the following categories, that when coordinated, provide a robust plan for sustainability for the area. The plan area includes some State and Federal Jurisdictional Areas. This section will discuss coordination with state and local agencies to coordinate sustainable management criteria with existing and planned land use designations, land use zoning, well permitting, well construction standards, well destruction standards and wellhead protection. Additionally, this plan will have coordinated goals with existing water management plans including Agriculture Water Management Plans (AWMP), Urban Water Management Plans (UWMP), Groundwater Management Plans (GWMP), California Statewide Groundwater Elevation Monitoring (CASGEM), Irrigated Lands Regulatory Program (ILRP) and Integrated Regional Water Management Plan (IRWMP). A description of each GSA's water source and water use will be discussed and how the information provided in the Hydrogeologic Conceptual Model (HCM), Groundwater Conditions, Water Budgets and Management Areas, will further the goal of sustainability and efficient water use. Notice and communication with the public and beneficial users of groundwater is discussed below.

2.1 Description of the Plan Area

2.1.1 Description of Jurisdictional Areas and Other Features

The Delta-Mendota Subbasin (5-022.07) lies within the greater San Joaquin Valley Basin (5-022). Effective groundwater management requires coordination with areas adjacent to the Delta-Mendota Subbasin to ensure groundwater management of one subbasin does not negatively impact the groundwater management of another subbasin. As a result, the GSA's in the Delta-Mendota Subbasin have engaged the GSA's in the following subbasins of the San Joaquin Valley Basin that are adjacent to the Delta-Mendota Subbasin: Tracy Subbasin (05-022.15), Eastern San Joaquin Subbasin (05-022.01), Modesto Subbasin (05-022.02), Turlock Subbasin (05-022.03), Merced Subbasin (05-022.04), Chowchilla Subbasin (05-022.05), Madera Subbasin (05-022.06), Kings Subbasin (05-022.08), and Westside Subbasin (05-022.09).

SUBBASIN	GSA
Chowchilla Subbasin (5-022.05)	Triangle T Water District GSA
	County of Merced - Chowchilla Subbasin GSA
	County of Madera - 1
	Chowchilla Water District
Eastern San Joaquin Subbasin (5-022.01)	Eastside San Joaquin GSA
	South San Joaquin GSA
	Oakdale Irrigation District GSA
	Central San Joaquin Water Conservation District
	South Delta Water Agency
	Central Delta Water Agency
	City of Lathrop
	Woodbridge Irrigation District
	City of Manteca
	Linden County Water District
	North San Joaquin Water Conservation District
	City of Lodi
	San Joaquin County - ESJ
	San Joaquin County No. 2
	City of Stockton
	Lockeford Community Service District
	Stockton East Water District
Kings Subbasin (5-022.08)	Tulare County GSA
	South Kings GSA
	McMullin Area GSA
	Central Kings GSA
	North Fork Kings GSA
	North Kings GSA
	Kings River East GSA
	James Irrigation District

SUBBASIN	GSA
Madera Subbasin (5-022.06)	County of Madera - 2
	New Stone Water District
	City of Madera
	Madera Water District
	Root Creek Water District
	Gravelly Ford Water District
	Madera Irrigation District
Merced Subbasin (5-022.04)	Merced Irrigation - Urban GSA
	Merced Subbasin GSA
	Turner Island Water District - 1
Modesto Subbasin (5-022.02)	Tuolumne GSA
	Stanislaus and Tuolumne Rivers Groundwater Basin Association
Tracy Subbasin (5-022.15)	Stewart Tract GSA
	Byron-Bethany Irrigation District
	City of Antioch
	Diablo Water District
	East Contra Costa Irrigation District
	Contra Costa County
	Discovery Bay Community Services District
	County of Sacramento
	City of Brentwood
	West Side Irrigation District
	City of Tracy
	Banta-Carbona Irrigation District
	San Joaquin County - Tracy
Turlock Subbasin (5-022.03)	East Turlock Subbasin GSA
	West Turlock Subbasin GSA
Westside Subbasin (5-022.09)	Fresno County - Westside Subbasin
	Westlands Water District

Table 2 - GSA's in Subbasins Adjacent to the Delta-Mendota Subbasin

The Delta-Mendota Subbasin has twenty-three GSA's coordinating the development of six GSP's. The SJREC are working with the other GSA's in the subbasin to develop and implement a coordinated effort for the development of a sustainable plan for the subbasin. The table below is color coordinated into each of the GSP's in the Delta-Mendota Subbasin. Fresno County Management Area B has a portion of the GSA in the SJREC GSP and the remaining portion in the Fresno County GSP. The Merced County – Delta Mendota has a portion of the GSA in the SJREC GSP and the remaining portion in the Grassland GSP.

City of Dos Palos		Central Delta-Mendota Region Multi-Agency GSA
City of Firebaugh		City of Patterson
City of Gustine		DM-II (Del Puerto WD)
City of Los Banos		Northwestern Delta-Mendota GSA
City of Mendota		Ora Loma Water District
City of Newman		Patterson Irrigation District
County of Madera - 3		West Stanislaus Irrigation District
San Joaquin River Exchange Contractors		Widren Water District GSA
Turner Island Water District - 2		Aliso Water District
Fresno County -	Management Area B	Fresno County - Management Area A
Merced County -	Delta Mendota	Farmers Water District
Grasslands GSA		

Table 3 - GSA's in the Delta-Mendota Subbasin by GSP Group

Description of the Plan Area: The San Joaquin River Exchange Contractors (SJREC) GSP contains eleven GSA's within the Delta-Mendota Subbasin. Nine of the GSA's are wholly contained within the limits of the SJREC GSP and are respectively; SJREC GSA, City of Newman GSA, City of Gustine GSA, City of Los Banos GSA, City of Dos Palos GSA, City of Firebaugh GSA, City of Mendota GSA, Turner Island Water District – 2 GSA, and County of Madera – 3 GSA. Two of the GSA's, Merced County – Delta-Mendota GSA and Fresno County – Management Area 'B' GSA, are only partially included in the SJREC GSP. The remaining area in the Merced County – Delta-Mendota GSA will be included in the GSP prepared by the Grassland GSA. The remaining area in the Fresno County - Management Area 'B' GSA will be included jointly in the GSP prepared with the Fresno County – Management Area A GSA.

Each of the City GSA's in the SJREC GSP Group (Newman, Gustine, Los Banos, Dos Palos, Firebaugh, and Mendota) geographically covers the City limits. The TIWD GSA covers all of the land in the district that is in the Delta-Mendota Subbasin. The Madera County GSA covers all white areas in the Delta-Mendota Subbasin. The portion of Fresno County Management Area B in the SJREC GSP Group is generally defined as the County white area in the Delta-Mendota Subbasin and north of the City of Mendota GSA; refer to Figure 2 for the geographic locations depicted on a map. The portion of Merced County – Delta-Mendota GSA in the SJREC GSP Group is generally defined as the County white area in the Delta-Mendota Subbasin, primarily consisting of farmland, east of the SJREC GSA western boundary; refer to Figure 2 for the geographic locations depicted on a map.

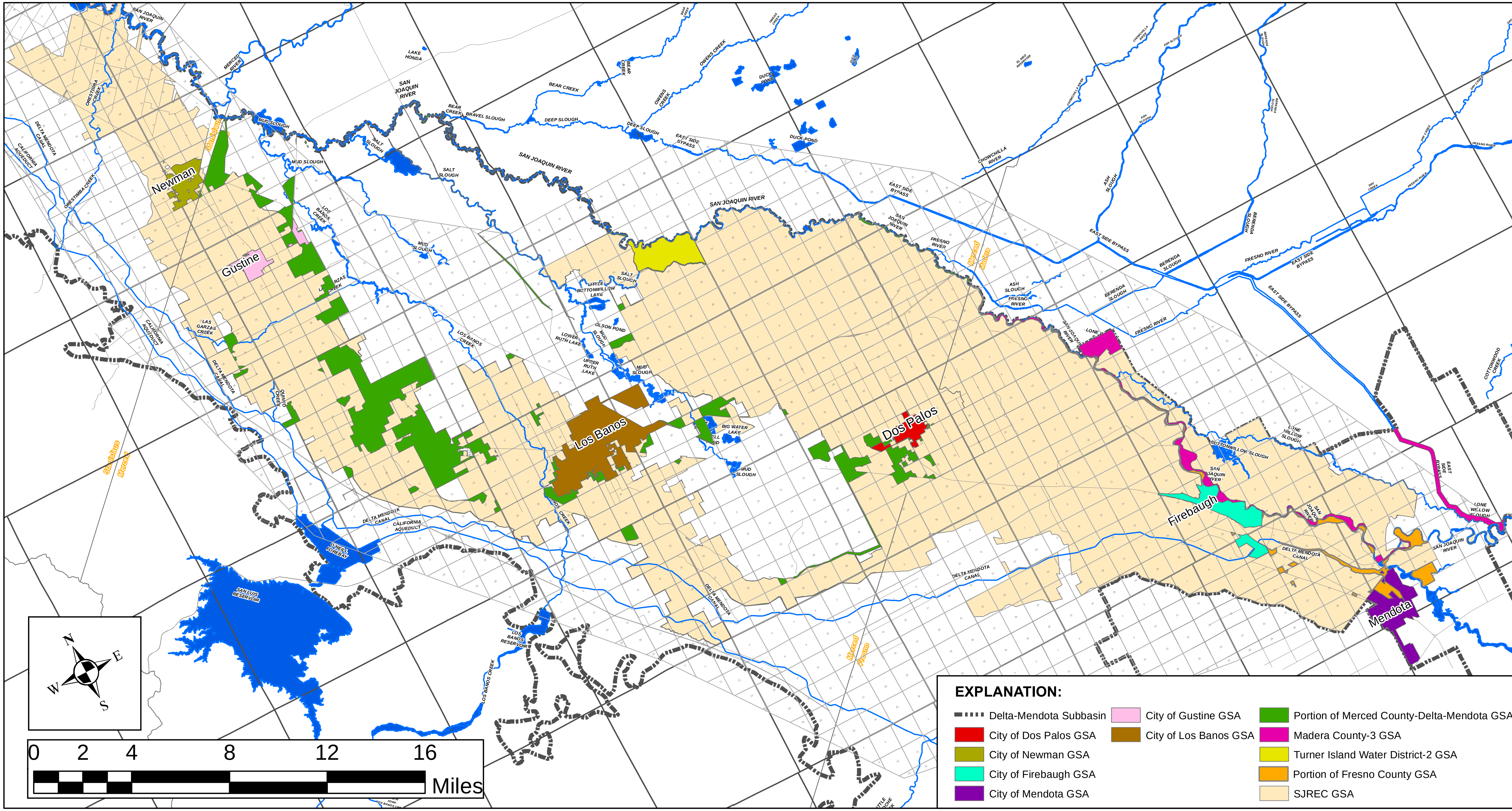

FIGURE 2 - MAP OF GSA'S IN THE SJREC GSP GROUP

The Delta-Mendota Subbasin does not have any areas managed through an Adjudication of Groundwater Rights.

There are several State and Federal jurisdictional areas within the SJREC GSP. Those areas are depicted on Figure 3. The United States Bureau of Reclamation manages the Central Valley Project and owns certain facilities in the SJREC GSP including the Delta-Mendota Canal (DMC), shared ownership with DWR on the California Aqueduct (San Luis Canal), San Luis Drain, Newman Spillway, Volta Spillway and the Firebaugh Spillway. The United States Fish & Wildlife Service owns land east of the City of Los Banos. There are several parcels of land that have a California Conservation Easement. The California Department of Fish and Wildlife own and operate lands included California Protected Areas and Wildlife Areas.

The SJREC have a great partnership with Grassland Water District (GWD) and the state & federal refuge complex. Most of the water provided to the habitat in GWD and the refuges is delivered through the SJREC facilities. In March 1989, the Report on Refuge Water Supply Investigations was published by USBR. The report presented information on water needs and potential water sources and conveyance systems for providing a firm water supply of good quality to ten National Wildlife Refuges, four Wildlife Management Areas and one privately managed wetland area (GRCD). In December 1989, USBR, USF&WS and California Department of Fish and Game (currently CDFW) released the Action Plan Report which identified wetland enhancement. In October 1992, the Central Valley Project Improvement Act (CVPIA) was enacted into law, which requires the Secretary of the Interior to provide firm water supplies in accordance with the 1989 Investigation Report. Several subsequent reports were published consistent with public engagement to review conveyance alternatives based on environmental, technical and economic factors. The SJREC member entities own and operate various canals which have historically been used to make deliveries to Grassland. In 1998, the USBR and CCID entered into a contract to deliver refuge water supplies consistent with CVPIA. Much of the infrastructure was in place and some improvements were necessary to deliver adequate supplies to meet wetland management needs. Currently, water deliveries are made under the "Contract Between the United States and Central California Irrigation District for the Conveyance of Refuge Water Supplies to the China Island and Salt Slough Units of the North Grasslands Wildlife Area, Los Banos Wildlife Area, Freitas and Kesterson Units of the San Luis National Wildlife Refuge and Grassland Resource Conservation District. The current contract is in effect until February 28, 2042. From 2009-2018, the SJRECWA wheeled about 200,000 acre-feet per year on average to GWD and the refuges. The SJREC value the ecological importance of the Grassland area and its significance to the Pacific Flyway for migratory waterfowl. The SJREC are working on joint projects with GWD to efficiently put more water to beneficial use in the area. Some of these projects are referenced in Section 4 of this plan. GWD and the SJRECWA have peak water demands during different times of the year. A natural partnership with GWD enhances our ability to efficiently use our local water resources throughout the year while maintaining flexibility to meet demand.

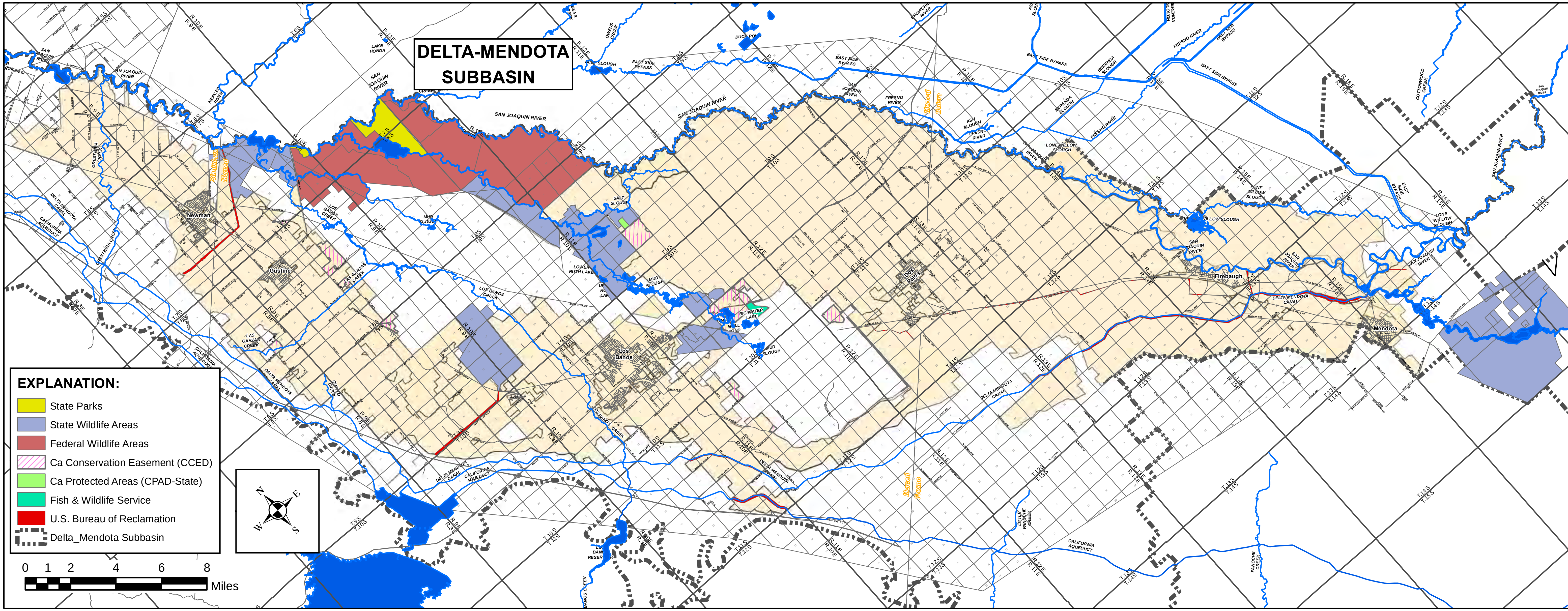

FIGURE 3 - JURISDICTIONAL BOUNDARIES OF STATE AND FEDERAL LANDS

A majority of the area in the SJREC GSP is agriculture. Refer to Figure 4 for a map of the current Land Use Designations. This information was collected from the CADWR Land Use Viewer for 2014: https://gis.water.ca.gov/app/CADWRLandUseViewer/. The data is this map is used for consistency in the Basin and it should be noted that the actual Land Use for this area has not been vetted by the SJREC GSA for accuracy. It should further be noted that land use may change from year to year and the data from this should be used as a point in time and may not be representative as a surrogate for past or future land use. Each GSA in the SJREC GSP has differing Water Source Types and Water Use Sectors. Following is a general explanation. A more detailed understanding of water source type and water use sector for each GSA is described in their respective water budget section.

The primary source of water for the SJREC GSP group is from the Central Valley Project. The major facilities are included below.

C. W. "Bill" Jones Pumping Plant (Jones Pumping Plant): The Jones Pumping Plant lifts water from the Sacramento-San Joaquin Delta into the Delta-Mendota Canal. Most of the water supplied to the Jones Pumping Plant comes from CVP reservoirs located in northern California. Water is released from these reservoirs and routed across the Sacramento-San Joaquin Delta, from the Sacramento and San Joaquin Rivers, to the intakes of the pumps. The Plant has six pumps that lift the water about 200 feet from the intake to the headworks of the DMC at a maximum flow rate of 5,200 cfs.

Delta-Mendota Canal (DMC): The headworks of the DMC is at the Jones Pumping Plant. The DMC carries water from Jones Pumping Plant and terminates at the Mendota Pool. The DMC was completed in 1951 with a capacity of 4,600 cfs at the head that gradually decreases to 3,200 cfs after the 116 mile journey to the Mendota Pool.

O'Neill Pumping-Generating Plant: Located about twelve miles west of the City of Los Banos on the DMC, the O'Neill Pumping Plant connects the DMC to the O'Neill Forebay and ultimately the San Luis Reservoir. This plant was completed in 1968 and is capable of pumping about 3,900 cfs into the O'Neill Forebay and is ultimately pumping into the San Luis Reservoir. The O'Neill Plant is also capable of generating power when water is released from the San Luis Reservoir into the O'Neill Forebay and then released into the DMC. This facility was constructed along with the State Water Project to allow for storage of water south of the Delta.

San Luis Reservoir and O'Neill Forebay: The State Water Project (SWP) received authorization of the Legislature in 1951 to begin construction of a water storage and supply system. One of the projects was a joint venture between the USBR and DWR to construct the California Aqueduct (San Luis Canal), O'Neill Forebay and the San Luis Reservoir to provide additional surface water to agriculture and urban areas south of the Delta. The San Luis Reservoir can store over 2.0 MAF shared between the SWP contractors and the CVP contractors.

Mendota Pool: The Mendota Pool is located near the City of Mendota at the confluence of the San Joaquin River and Fresno Slough (Kings River). The Mendota Pool is also the terminus of the DMC. CCID, FCWD and CCC receive their water from Mendota Pool.

Sack Dam: Sack Dam is located on the San Joaquin River downstream of the Mendota Pool and is the headworks where SLCC takes delivery of surface water.

- SJREC GSA – The water source type is conjunctive use of San Joaquin River water, Central Valley Project water, groundwater, local supplies and precipitation. The Water Use Sector is agriculture, managed wetlands, managed recharge and native vegetation. The SJRECWA's member entities submitted 2016 AWMP's. Documented in the 2016 AWMP's are water conservation and efficiency measures implemented by each agency. One major water conservation effort is installation of canal lining and high efficiency irrigation systems to reduce the amount of water lost to shallow saline groundwater in the southwestern area of the GSA. The SJREC actively manage their surface water, groundwater and conserved water resources conjunctively, and manage water application within their service are to minimize drainage discharges from their service area in accordance with existing laws and regulations. Additionally, the SJRECWA adopted an updated AB 3030 Groundwater Management Plan in 2014. A valuable management tool employed by each entity is installing conservation projects that increase water use efficiency. While the SJREC primarily use surface water to meet consumptive use, groundwater extractions are vital to meet demand during drought years. Groundwater pumping in the SJREC area is also necessary to control the water levels from rising too high and saturating the effective rooting depths.
- City of Newman GSA – The water source type is groundwater, local supplies and precipitation. The Water Use Sector is urban and industrial. The City of Newman is developing a strategy to capture runoff to offset groundwater extractions.
- City of Gustine GSA – The water source type is groundwater, local supplies and precipitation. The Water Use Sector is urban and industrial. The City of Gustine is developing a strategy to capture runoff to offset groundwater extractions.
- City of Los Banos GSA – The water source type is groundwater, local supplies and precipitation. The Water Use Sector is urban and industrial. The City of Los Banos is developing a strategy to capture runoff to offset groundwater extractions.
- City of Dos Palos GSA – The water source type is Central Valley Project, local supplies and precipitation. The Water Use Sector is urban and industrial.
- City of Firebaugh GSA – The water source type is groundwater, local supplies and precipitation. The Water Use Sector is urban and industrial.
- City of Mendota GSA – The water source type is groundwater, local supplies and precipitation. The Water Use Sector is urban and industrial.
- Turner Island Water District – 2 GSA - The water source type is groundwater, surface water supplies, local supplies and precipitation. The Water Use Sector is agriculture.
- Madera County – 3 GSA - The water source type is groundwater, local supplies and precipitation. The Water Use Sector is agriculture.
- Merced County Delta-Mendota GSA - The water source type is groundwater, local supplies and precipitation. The Water Use Sector is agriculture and industrial.
- Fresno County Management Area 'B' GSA - The water source type is groundwater, local supplies and precipitation. The Water Use Sector is agriculture.

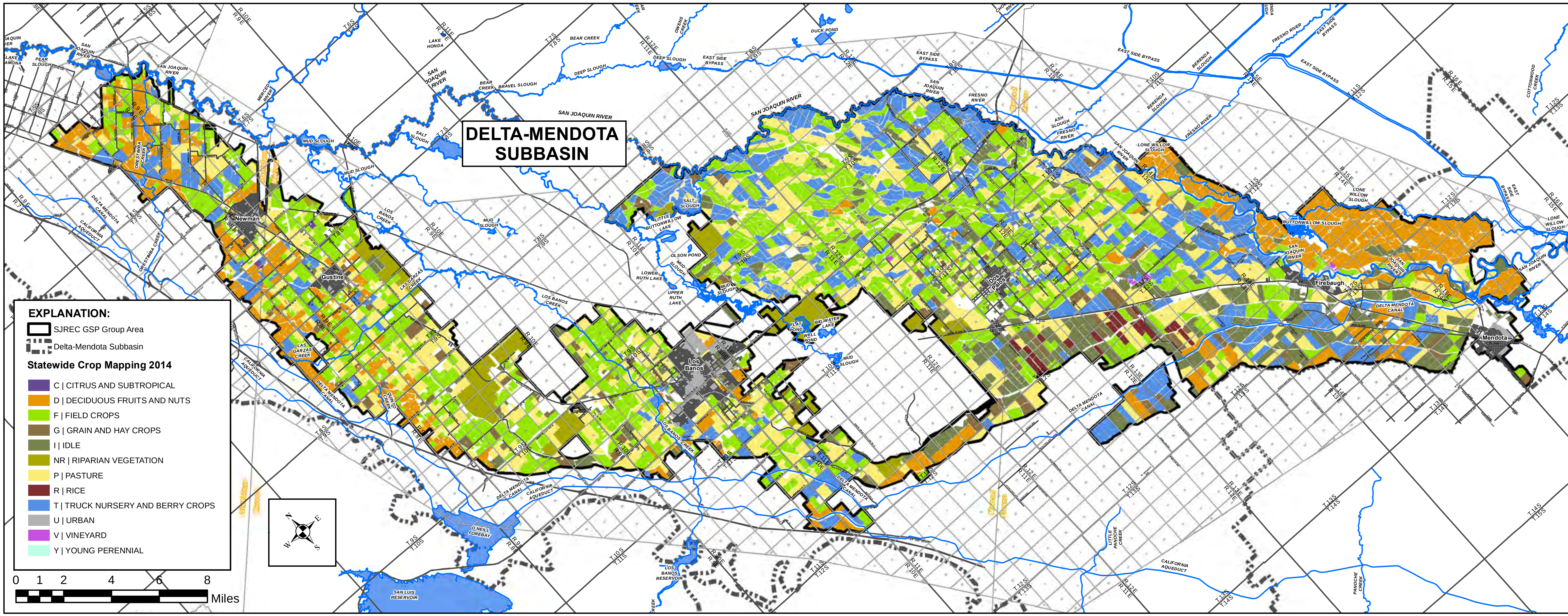

FIGURE 4 - 2014 LAND USE FROM CADWR

Figure 5 shows the density of domestic wells per square mile within the SJREC GSP. Data for Figure 5 used the information provided on the DWR Well Completion Report Map Application (https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37). These wells are typically referred to as "de minimis" extraction wells. Figure 6 shows the density of production (agriculture, City, industry, etc.) wells per square mile within the SJREC GSP. Data for Figure 6 was provided from historic field surveys of active wells in the area. Field surveys provide the most reliable data to map active wells in an area. Primarily, all communities are dependent upon groundwater or plan to use groundwater as an emergency water supply.

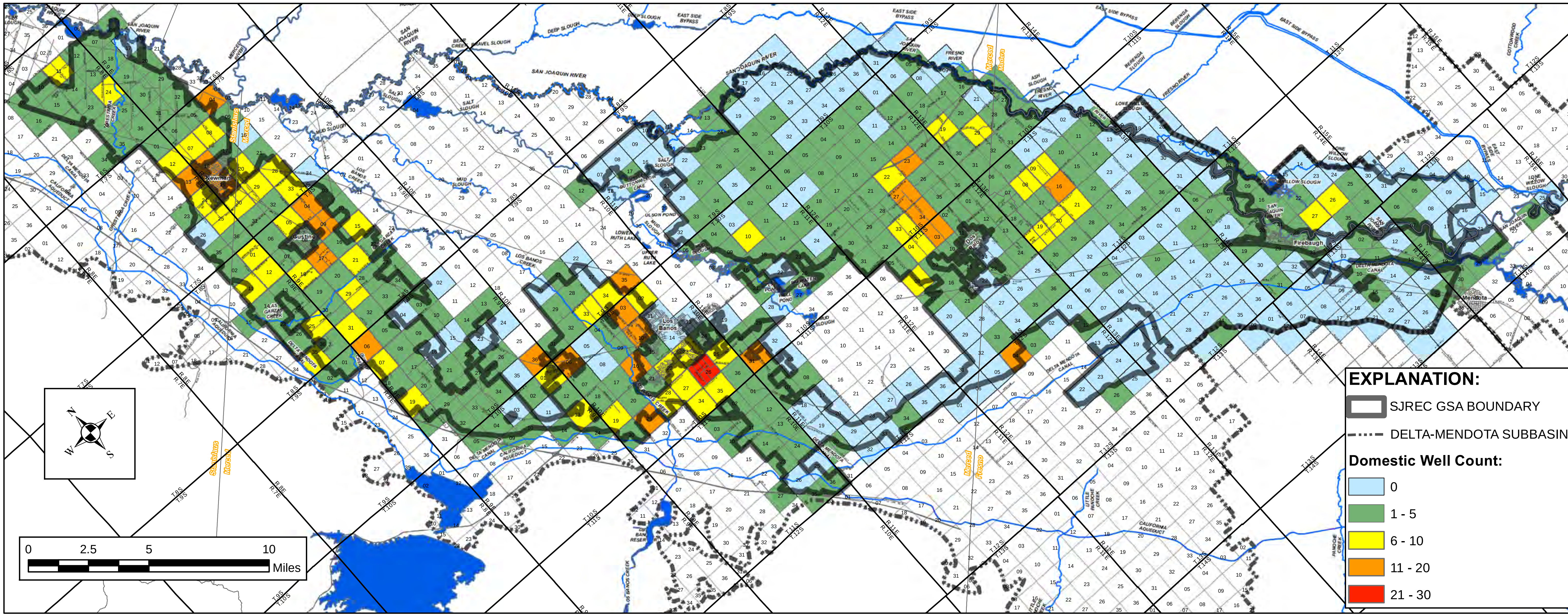

FIGURE 5 - WELL DENSITY MAP FOR DOMESTIC WELLS

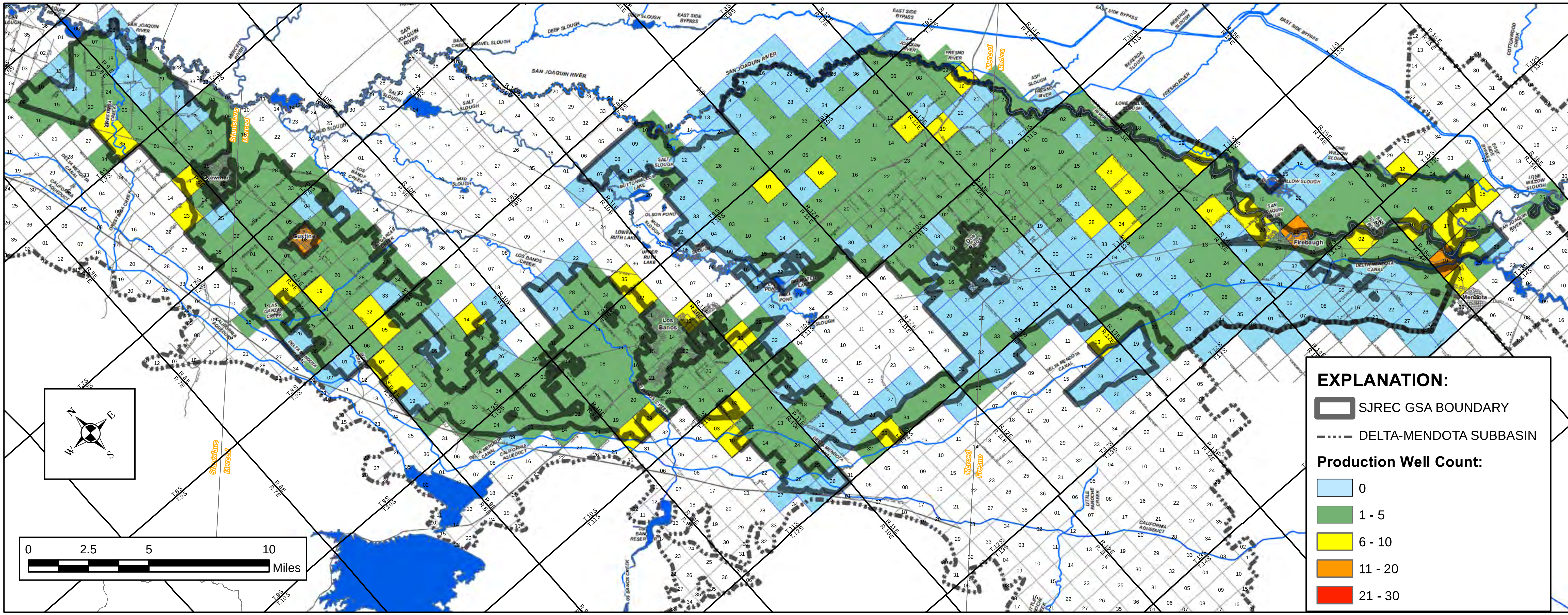

FIGURE 6 - WELL DENSITY MAP FOR PRODUCTION WELLS

2.1.2 Water Resources Monitoring and Management Programs

Agricultural Water Management Plans (AWMP's) are required through the state enacted Water Conservation Act of 2009 (Senate Bill X7-7). The SJRECWA has adopted the 2016 AWMP on behalf of its member agencies. Data reported in the AWMP's will be used to supplement other data sets to successfully manage groundwater through the SGMA.

The Urban Water Management Planning Act was enacted through the California Legislature in 1983. Every urban water supplier that provides over 3,000 acre-feet of water annually or serves more than 3,000 urban connections is required to submit an Urban Water Management Plan (UWMP). UWMP's are prepared by urban water suppliers every five years. The primary purpose of the UWMP is to provide urban water suppliers with a long-term plan to ensure that adequate water supplies are available to meet existing and future water needs. The City of Newman GSA and the City of Los Banos GSA have adopted an UWMP. Water Resource planning requires flexibility to changing water supply and demand. A more detailed analysis on urban water management can be found in the respective City GSA Section in this GSP.

The Groundwater Management Act (AB 3030) was enacted through the California Legislature in 1992. Groundwater Management Plans (GWMP's) provided a planned and coordinated monitoring, operation, and administration of groundwater basins with the long-term goal of groundwater resource sustainability. The GSP's required through the SGMA, once adopted, will replace GWMP's. The SJRECWA is currently managing groundwater through their AB 3030 GWMP adopted in 2014. The SJRECWA AB 3030 plan is the foundation for the successful management of groundwater within the SJRECWA service area. One of the key elements of the plan is establishing management areas based on hydrogeological characteristics.

The California Statewide Groundwater Elevation Monitoring (CASGEM) Program was enacted through the California Legislature in 2009 (Senate Bill X7-6). CASGEM was established to systematically monitor and manage groundwater in California. Data reported in CASGEM will be used to supplement other data sets to successfully manage groundwater through the SGMA. The Groundwater Monitoring Program in the Delta-Mendota Subbasin is managed by the SLDMWA and characterizes the groundwater basin and outlines monitoring procedures.

The Irrigated Lands Regulatory Program (ILRP) was initiated in 2003 to prevent agricultural runoff from impairing surface waters, and in 2012, groundwater regulations were added to the program. ILRP in the Delta-Mendota Subbasin is managed by the CVRWQCB. All irrigated lands used commercially, require an ILRP discharge permit. All irrigated agriculture in the SJREC GSA has coverage through the Westside San Joaquin River Watershed Coalition. Data reported in ILRP will be used to supplement groundwater quality data sets to successfully manage groundwater through the SGMA.

The Regional Water Management Planning Act (Senate Bill 1672) was passed by the California Legislature in 2002. Integrated Regional Water Management (IRWM) is a collaborative effort to identify and implement water management solutions on a regional scale that increase regional self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives. The SJREC GSP group participates in the Westside San Joaquin Integrated Water Resources Plan. This integrated regional plan has promoted collaborative water resource management. This process is a continuation of regional collaboration to implement local water resource projects that provide resiliency to surface water and groundwater supply. It is anticipated that projects listed in the IRWM grant will be part of regional Projects to maintain and/or achieve sustainability in the Delta-Mendota Subbasin. The SLDMWA is acting as the Regional Water Management Group for the region and let the effort in the Delta-Mendota Subbasin for the 2018 Westside-San Joaquin IRWM Plan.

Since 1996, the CCID has prepared an annual Deep Well Study Summary of Central California Irrigation District Wells and Private Wells. Each year the results of the study were provided to KDSA for review. The annual deep well study works in conjunction with the SJRECWA AB 3030 GWMP. Water levels in each management area are reviewed to determine the status of the aquifer. In a few management areas, where the aquifer is stressed during times of drought, trigger levels have been established for transferring groundwater out of the area. In the drought of 2014-2016, the water level in Management Areas A and C were below the established trigger and therefore KDSA recommended restricting the transfer of groundwater from parts those areas. By 2017, the water levels in those areas had fully recovered and KDSA recommended allowing groundwater transfers from the area consistent with the CCID Rules Governing Pumping of Private Wells for Water Credits in Other Districts. This study and the resulting analysis have proven invaluable to the success of the groundwater management within the SJREC GSA.

The member agencies of the SJRECWA have taken an active role managing groundwater dating back to the 1950's. There is a deep understanding of the aquifer as a result of over 60 years of actively monitoring and managing groundwater through local independent assessments, to voluntary state legislative programs, to the landmark SGMA. The SJRECWA has proven success to sustainably manage groundwater and successful implementation of SGMA, in coordination with other monitoring and management programs, will continue through the SJREC GSA. The existing monitoring programs in place will be reviewed by a Hydrogeologist/Engineer and implemented into the SJREC GSP where applicable in analyzing potential impacts to the six Undesirable Results outlined in the SGMA.

The primary water supply to CCID, SLCC, FCWD and CCC (member agencies of the SJREC GSA) is surface water delivered as part of the CVP. However, the use of groundwater has proven an effective water management planning tool. The member agencies of the SJREC GSA and their landowners, own and operate a series of groundwater extraction wells. Typically, groundwater is used to meet peak demand, provide flexibility to operational delivery and provide additional supply during critical years. Pumping groundwater is also an effective tool to help control the migration of poor water quality in certain areas and can also relieve a perched water table. Groundwater recharge is vitally important to the sustainability within the SJREC GSA. The SJREC will continue to maintain groundwater management sustainability through a positive contribution to groundwater storage. The SJREC GSA, through the SJRECWA, is actively pursuing Projects to increase groundwater recharge. A more in depth analysis on Projects can be found in Section 4.0.

2.1.3 Land Use Elements or Topic Categories of Applicable General Plans

California state law requires each City and County to develop and adopt a general plan. The General Plan, amended from time to time, consists of the respective community's vision for the future. Some mandatory elements that are addressed in the plan include: land use planning, transportation, housing, conservation, open space, noise and safety. Of these, the most important elements that are directly relevant in SGMA are land use planning and population predictions. The SJREC GSA includes six City General Plans and four County General Plans. The SJREC GSA in coordination with other GSA's as part of the SJREC GSP group are working together to coordinate GSP development consistent with approved General Plans. Following is a table of current General Plans that are covered within this GSP.

Entity	Year Adopted or Last Amended	Planning Area
City of Newman	2016	City and unincorporated land north of W Stuhr Road to Lundy Road, Draper Road to Eastin Road, and south of Newman to the Newman Wasteway
City of Gustine	2017	City and 1/4 to 1/2 mile north of North Avenue, 1/4 mile east of East Avenue, Gun Club Road to the south, and Jensen Road to the west
City of Los Banos	2016	City and agricultural land and residential, commercial and industrial developments as well as public facilities, including parks, schools, and the Waste Water Treatment Plant
City of Dos Palos	2003	City and SOI north to Carmelia Road
City of Firebaugh	2016	City and approximately 3,410 acres outside City limits
City of Mendota	2016	City and approximately 2,500 acres outside City limits
County of Stanislaus	2016	County, including unincorporated land
County of Merced	2016	County, including unincorporated land
County of Madera	2015	County, including unincorporated land
County of Fresno	2016	County, including unincorporated land

Table 4 – Existing General Plans within the SJREC GSP Boundary

The existing land use designations are shown on Figure 7. The following categories, depicted on Figure 7, represent the zoning codes for land use descriptions.

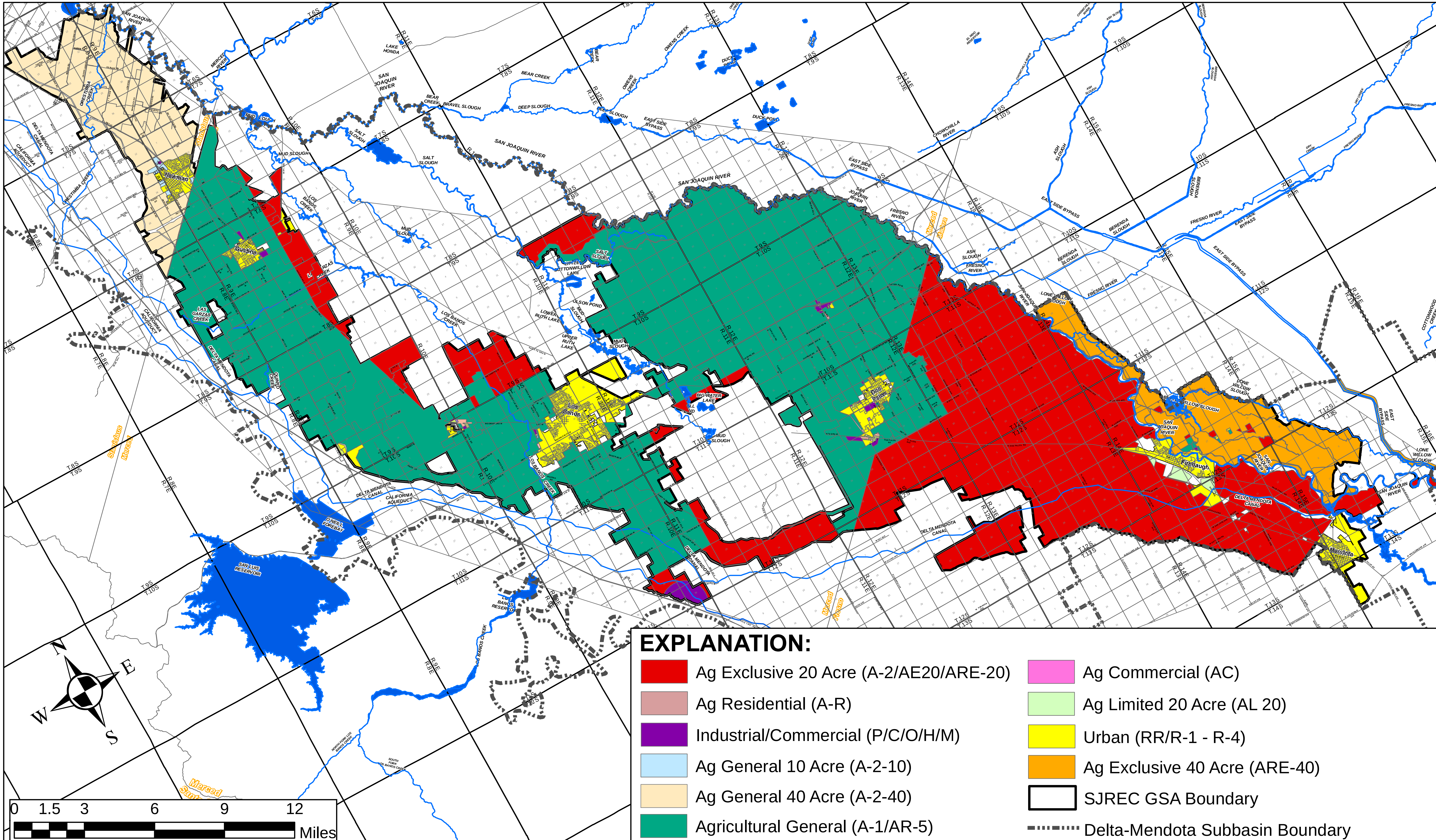

FIGURE 7 - 2018 LAND USE ZONING CODES

- **Ag Residential (A-R):** The purpose of the agricultural-residential zone is to provide areas for rural residential development, hobby farming and limited animal raising operations with less than a full range of urban services. It is intended that this zone typically serve as a transitional area between more dense urban communities and agricultural uses with the option of allowing either one unit or three units per acre.
- **Urban/Residential (R-#, RR):** The purpose of the Residential Zone is to provide a full range of urban services and reserve appropriately located areas for family living at a range of low, medium (up to 15 dwellings per acre), and high (up to 33 dwellings per acre) population densities consistent with sound standards of public health, welfare, and safety. It is the intent of this zone to protect the residential characteristics of an area.
- **Ag Exclusive 20 Acre (A-2, AE20, ARE-20):** The purpose of the exclusive agricultural zone (A-2) is to allow for considerably expanded agricultural enterprises, due mainly to the requirement of larger size land parcels which are more economically suitable to support farming activities occurring in the area. The district shall be accompanied by an acreage designation which establishes the minimum size lot that may be created within the District. Acreage designations of 640, 320, 160, 80, 40, 20, 5 are provided for this purpose.
- **Industrial/Commercial (P, C, O, H, M):** The purpose of the commercial-professional office zone (C, P) is to provide areas for development and operation of professional and administrative offices and personal services rather than retail trade. Typical uses in this zone include medical/dental offices, insurance/travel agencies, government offices, and banks and savings and loans offices. This zone is intended for smaller scale developments that are compatible with residential zoning. The purpose of the highway interchange center zone (H) is to provide areas for commercial uses adjacent to highway interchanges oriented almost exclusively to serve the needs of travelers. The purpose of the general manufacturing zone (M) is to provide for all types of manufacturing, distribution and storage uses.
- **Ag General 40 Acre (A-2-40):** The purpose of the general agricultural zone is to provide areas where the forty (40) acre minimum parcel size of the zone allows for the widest variety of farming operations including agricultural commercial/industrial uses which are dependent on medium to higher quality soils, water availability and larger parcel sizes away from urban areas.
- **Ag General 10 Acre (A-2-10):** The purpose of the general agricultural zone is to provide areas where the ten (10) acre minimum parcel size of the zone allows for the widest variety of farming operations including agricultural commercial/industrial uses which are dependent on medium to higher quality soils, water availability and larger parcel sizes away from urban areas.
- **Agricultural General (A-1/AR-5):** The purpose of the general agricultural zone is to provide areas where an assigned parcel size of the zone allows for the widest variety of farming operations including agricultural commercial/industrial uses which are dependent on medium to higher quality soils, water availability and larger parcel sizes away from urban areas.
- **Ag Commercial (AC):** This district is intended to provide for the location of commercial centers within agricultural areas for the purpose of providing food and services to the surrounding farm community.
- **Ag Limited 20 Acre (AL 20):** It is intended to protect the general welfare of the agricultural community by limiting intensive uses in agricultural areas with a twenty (20) acre minimum parcel size where such uses may be incompatible with, or injurious to, other less intensive agricultural operations. The District is also intended to reserve and hold certain lands for future

urban use by permitting limited agriculture and by regulating those more intensive agricultural uses.

The SJREC GSP, consistent with local/state laws and regulations, will not preempt the City or County land use planning authorities. The SJREC GSA in coordination with the other GSA's as part of the SJREC GSP Group are establishing a plan to achieve and maintain groundwater sustainability. Implementation of this plan will be managed directly with the six cities and four counties in and around the SJREC GSP area. The City and County respective General Plans will require updates from time to time. As those General Plans are updated, close coordination with the SJREC GSP group will prove beneficial for the long-term sustainability of groundwater management in the area. Management actions and Projects are being analyzed to achieve/maintain sustainability for each GSA. As the demand for water changes in each respective GSA, the SJREC GSA will help lead a technical effort to analyze new management actions and/or projects to maintain sustainability. A more detailed description of water demands for projected water budgets for each GSA can be found in the respective Section in this GSP.

The GSA's in the Delta-Mendota Subbasin have been engaging with the neighboring subbasins to coordinate GSP assumptions and implementation of SMC. A successful plan to sustainably manage groundwater in the Delta-Mendota Subbasin requires public outreach to beneficial users of groundwater in those subbasins that are adjacent. The SJREC GSP Group is already successfully managing groundwater, within the boundaries of the plan, in a sustainable fashion. In addition, the SJRECWA has been actively involved to reduce and mitigate subsidence in the Chowchilla Subbasin. A more detailed description of the subsidence mitigation project can be found in Section 4.1.7 under the Red Top Subsidence Mitigation Project. It is anticipated that management actions in adjacent subbasins is unlikely to affect the ability of the SJREC GSP Group to maintain sustainability. Rather, the SJREC will continue efforts to work with the neighboring subbasins to help the region achieve sustainability through projects and management actions.

2.1.4 Additional GSP Elements

Well Permitting: California State requirements for the well permitting process must follow Article 3 of Division 7 of the California Water Code. This states that No person shall undertake to dig, bore, or drill a water well, cathodic protection well, groundwater monitoring well, or geothermal heat exchange well, to deepen or re-perforate such a well, or to abandon or destroy such a well, unless the person responsible for that construction, alteration, destruction, or abandonment possesses a C-57 Water Well Contractor's License. Every person who digs, bores, or drills a water well, cathodic protection well, groundwater monitoring well, or geothermal heat exchange well, abandons or destroys such a well, or deepens or re-perforates such a well, needs to file with the department a report of completion of that well within 60 days from the date its construction, alteration, abandonment, or destruction is completed. These reports must contain information regarding: 1) A description of the well site sufficiently exact to permit location and identification of the well. 2) A detailed log of the well. 3) A description of the type of construction. 4) The details of perforation. 5) The methods used for sealing off surface or contaminated waters. 6) The methods used for preventing contaminated waters of one aquifer from mixing with the waters of another aquifer. 7) The signature of the well driller. All of the information on these reports will be made available for the public and for governmental agencies. Merced, Fresno, Madera, and Stanislaus Counties all follow the requirements put in place by Article 3 of Division 7 of the California Water Code. Certain counties have more specific permitting details such as minimum requirements for well depth as well as timetables for that County, however all counties require action within 180 days of receiving a permit. For a full description refer to State and County Standards.

Well Construction: Chapter 2 of California Well Standards Bulletin 74-81/90 define that any well that is to be constructed must follow guidelines with respect to; 1) well location around pollutants and contaminants, 2) sealing the upper annular space, 3) surface construction features, and 4) well casing.

1) Well location: All water wells shall be located an adequate horizontal distance from known or potential sources of pollution and contamination. Such sources include; sewers, septic tanks, waste ponds, barnyard and stable areas, feedlots, solid waste disposal sites, above and below ground petroleum tanks, and storage of pesticides and fertilizers. For required distances from potential sources of contaminants for Merced, Fresno, Stanislaus, and Madera counties refer to Table 5. Where possible a well shall be located up the groundwater gradient from potential sources of pollution or contamination. Locating wells up gradient from pollutant and contaminant sources can provide an extra measure of protection for a well. If possible, a well should be located outside areas of flooding. The top of the well casing shall terminate above grade and above known levels of flooding caused by drainage or runoff from surrounding land. All wells shall be located an adequate distance from buildings and other structures to allow access for well modification, maintenance, repair, and destruction, unless otherwise approved by the enforcing agency.

	Merced County		**Madera County**			**Fresno County**	**Stanislaus County**
Potential Pollution Source	**Water Well**	**Public Well**	**Ag Well**	**Domestic Well**	**Public Well**	**General Wells**	**General Wells**
Agricultural	300	300	-	300	300	-	-
Areas of intense animal confinement	100	150	100	100	100	100	100
Leach line or disposal field	100	150	150	100	150	100	100
Seepage pit or cesspool	150	200	150	150	150	150	150
Septic tank	50	100	150	100	150	100	100
Sewer line	-	-	50	50	50	50	50
Unlined canals, drainage water pond	100	100	-	-	-	-	-
Swimming pool	10	10	-	-	-	-	-

Table 5 - Well Setback Requirements from Potential Contamination Sources

2) Sealing upper Annular Space: The space between the well casing and the wall of the drilled hole, often referred to as the annular space, shall be effectively sealed to prevent it from being a preferential pathway for movement of poor-quality water, pollutants, or contaminants. The most common sealing material is cement, which consists of several types; neat cement, sand cement, concrete, or mixing cement. To see adequate annular seal depths and corresponding well types for Merced, Fresno, Stanislaus, and Madera counties refer to Table 6.

Minimum Depth of Annular Seal Below Ground Surface (in feet)				
Type of Well	**Fresno County**	**Merced County**	**Madera County**	**Stanislaus County**
Community Water Supply	50	50	50	50
Industrial	50	50	50	50
Individual Domestic	20	50	20	20
Agricultural	20	50	20	20
Air-Conditioning	20	-	20	20
Dairy	20	50	100	20
Drainage	20	-	20	20
Cathodic Projection	20	20	20	20
Observation/ monitoring	20	20	20	20

Table 6 - Well Annular Seal Depths

3) Surface Construction Features: Openings into the top of the well which are designed to provide access to the well, i.e., for measuring, chlorinating, adding gravel, etc., shall be protected against entrance of surface waters or foreign matter by installation of watertight caps or plugs. Access openings designed to permit the entrance or egress of air or gas (air or casing vents) shall terminate above the ground and above known flood levels and shall be protected against the entrance of foreign material by installation of down-turned and screened "U" bends. All other openings (holes, crevices, cracks, etc.) shall be sealed. A "sounding tube", tap hole with plug, or similar access for the introduction of water level measuring devices shall be affixed to the casing of all wells.

A concrete base or pad will be constructed at ground surface around the top of the well casing and contact the annular seal, unless the top of the casing is below the ground surface; see Table 7 for concrete surface seal standards. The use of well pits, vaults, or equivalent features to house the top of a well casing below ground surface shall be avoided, if possible, because of their susceptibility to the entrance of poor-quality water, contaminants and pollutants. Well pits or vaults can only be used if approval is obtained from the enforcing agency. Pump blow offs, air vents, and backflow prevention devices will be constructed on wells to help minimalize the possibility of contamination from flooding events or changes in atmospheric pressure within well piping.

	Merced County	**Fresno County**	**Madera County**	**Stanislaus County**
Minimum thickness	6 in.	4 in.	4 in.	4 in.
Minimum depth below surface	2 in.	-	1 in.	-
Radial distance (all directions)	2 ft.	2 ft.	2 ft.	2 ft.
Seal gradient distance	1 ft.	-	1 ft.	-

Table 7 - Surface Seal Standards

4) Well Casing: Well casing shall be strong and tough enough to resist the force imposed on it during installation and those forces which can normally be expected after installation. Several types of well casing include; steel, plastic, and concrete. Steel is the material most frequently used for well casing, especially in drilled wells. Two basic types of plastic are commonly used for

plastic well casing: thermoplastics and thermosets. The most common thermoplastic used for well casing is PVC within the state of California. Thermoset plastics are commonly used for well casing fiberglass, due to it holding its shape after being heated.

Well Destruction: In accordance with California Well Standards Bulletins 74-81 and 74-90, a well may be destroyed if it is considered 'abandoned'. A well is considered 'abandoned' or permanently inactive if it has not been used for one year, unless the owner demonstrates intention to use the well again. In accordance with Section 24400 of the California Health and Safety Code, the well owner shall properly maintain an inactive well as evidence of intention for future use in such a way that the following requirements are met: 1) The well shall not allow impairment of the quality of water within the well and ground water encountered by the well. 2) The top of the well or well casing shall be provided with a cover, that is secured by a lock or by other means to prevent its removal without the use of equipment or tools, to prevent unauthorized access, to prevent a safety hazard to humans and animals, and to prevent illegal disposal of wastes in the well. The cover shall be watertight if the well is inactive for more than five consecutive years. 3) The well shall be marked so as to be easily visible and located, and labeled so as to be easily identified as a well. 4) The area surrounding the well shall be kept clear of brush, debris, and waste materials. A monitoring well shall be investigated before it is destroyed to determine its condition and details of its construction. The well shall be sounded immediately before it is destroyed to make sure no obstructions exist that will interfere with filling and sealing. The well shall be cleaned before destruction as needed so that all undesirable materials, including obstructions to filling and sealing, debris, oil from oil-lubricated pumps, or pollutants and contaminants that could interfere with well destruction, are removed for disposal. The enforcing agency shall be notified as soon as possible if pollutants or contaminants are known or suspected to be present in a well to be destroyed. A monitoring well shall be destroyed by removing all material within the original borehole, including the well casing, filter pack, and annular seal; and the created hole completely filled with appropriate sealing material. For a full description of well destruction practices refer to State and County Standards.

Saline Water Intrusion: The Counties of Stanislaus, Merced, Madera and Fresno recognize the significance of saline groundwater intrusion. However, the proximal distance from the Pacific Ocean is great enough to negate the possibility of seawater intrusion to the underlying aquifers. In the event that saline water intrusion becomes a problem, an amendment to the General Plan will be prepared to address the concern. Although the counties have not adopted protocols in their respective General Plans to control saline water intrusion, the SJRECWA has been engaged in mitigating the migration of shallow saline water from upslope areas (south and west of the SJREC GSA boundary) primarily in Fresno County. The migration of poor quality water is further detailed in Section 3 in the discussion about drainage from upslope lands.

Migration of Contaminated Groundwater: The SJREC GSA has historically been engaged with analyzing the potential migration of contaminated groundwater. A more detailed description establishing SMC to control the migration of contaminated groundwater can be found in Section 3 addressing the Degraded Water Quality Undesirable Result.

The SJREC GSA manages a sustainable interaction of surface water supplies and groundwater extraction. While surface water is the primary source of water supply, groundwater is conjunctively used to meet peak demand, provide operational flexibility and provide additional supply during dry years. The underground storage has been sustainably managed primarily though replenishment of groundwater extractions. Groundwater recharge is generally recharged through seepage from earthen lined canals and deep percolation from irrigation. In addition, the SJRECWA has an active Water Resource Management Plan to construct recharge ponds and directly recharge the groundwater and recover the water at a later date consistent with implementation of management actions in the SJREC GSP. Recharge of the aquifer is further analyzed in the Water Budget Section of this Plan.

Wellhead protection: The California Well Standards Bulletin 74, published by DWR, addresses several vulnerabilities for potential groundwater contamination due to improper design of the wellhead. The four primary concerns are: 1) the well is located too close to a known source of pollution, 2) the annular space is not sealed adequately, 3) intrusion through the pump head into the well and 4) direct connection to the well casing. The Counties of Stanislaus, Merced, Madera and Fresno have adopted the standards set forth in Bulletin 74 or provided more restrictive guidelines for well head protection. These standards provide a required setback distance from a specific potential contaminated source. The standards also provide what type of seal and what depth of seal is required for adequate sealing of the well annular space. To prevent intrusion into the pump, a watertight seal is placed between the pump head and the wellhead support. A concrete slab should be constructed around the top of the well casing to provide a weatherproof and watertight seal between the pump head and the top of the well casing to prevent contaminants entering the well. Table 8 summarizes setback distances regarding the state and County standards for wellhead protection.

Potential Contamination	DWR Bulletin 74	Stanislaus County	Fresno County	Merced County	Madera County
Subsurface sewage leaching field	100 feet	100 feet	100 feet	100 feet (Ag) 150 feet (public)	100 feet (domestic) 150 feet (Ag & public)
Cesspool or seepage pit	150 feet	150 feet	150 feet	150 feet (Ag) 200 feet (public)	150 feet
Animal or fowl enclosure	100 feet	100 feet	100 feet	100 feet (Ag) 150 feet (public)	100 feet
Septic tank	50 feet	50 feet	50 feet	50 feet (Ag) 100 feet (public)	100 feet (domestic) 150 feet (Ag & public)
Sewer line	50 feet	50 feet	50 feet	50 feet (Ag) 100 feet (public)	50 feet
Unlined canals, surface body or course or drainage	-	-	-	100 feet	-
Swimming pool	-	-	-	10 feet	-
Agricultural wells	-	-	-	300 feet	300 feet

Table 8 – Summary of setback distances for wellhead protection

The member agencies of the SJREC GSA invests in local conservation projects for district facilities and also on farm projects. Some types of districtwide conservation projects include automated water control structures, spill reduction, recapture pumps and canal lining. On farm conservation projects include district funded grants and also a low interest loan program to increase water use efficiency through installing highly efficient irrigation systems and lining irrigation channels. While lining irrigation channels increases the instantaneous water use efficiency, the SJREC GSA is actively analyzing the need to keep some channels earth lined to maintain a sustainable aquifer through channel seepage. Since this area is primarily conjunctive use, the best way to conserve water is to reduce spills leaving the area. The SJREC GSA members have primarily accomplished this through construction of in-line regulating reservoirs and canal automation using Supervisory Control And Data Acquisition (SCADA) to better manage flows in the canals.

The SJREC GSA members have worked with state and federal regulating agencies through compliance with California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) for implementation of Projects. Oftentimes, construction of Projects requires compliance with certain permitting requirements. Following is a list of agencies and the associated permits necessary for certain construction projects: CVRWQCB Section 401 Permit, CDFW Section 1600 Permit, California State Lands Commission Lease, Central Valley Flood Protection Board Encroachment Permit, and USACE Section 404

Permit. The SJREC GSA has also worked directly with CDFW and USFWS for ESA compliance. The SJREC GSA has a strong working relationship with the USBR for administration of CVP water supply.

A description of the beneficial users of groundwater can be found in Section 2.1.5. One such type of user of groundwater are Groundwater Dependent Ecosystems (GDE's). The SGMA requires each GSP to identify and consider impacts to GDE's as the SMC is being developed. The Nature Conservancy reviewed and compiled historical datasets to be used by GSA's to aid in identifying potential GDE's. Figures 8 and 9 show some potential GDE's. The potential GDE's on the map have not been field surveyed to ensure that the GDE exists and actual vegetation matches with the type of vegetation described. The SJREC GSA has been sustainably managing groundwater for decades and is highly unlikely to have any impacts to GDE's through implementation of the SJREC GSP. In the event the SJREC GSA notices impacts to GDE's, an in-depth review to mitigate those impacts will be initiated. The Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset Viewer was reviewed for the potential of GDE's in the SJREC GSP Group area. The SJREC GSP Group has several vegetation types that have the potential to have dependency on groundwater none of which are listed under CESA as threatened or Endangered: Allenrolfea Occidentalis (Iodine Bush), Artemisia Douglasiana (Douglas' Wormwood), Arundo Donax (Giant Reed), Atriplex Lentiformis (Quailbush), Elymus (leymus) Triticoides (Creeping Wildrye), Juglans Hindsii and Hybrids (Northern California Black Walnut), Populus Fremontii (Fremont Cottonwood), Quercus Lobata (Valley Oak), Rubus Armeniacus (Himalayan Blackberry), Salix Exigua (Narrowleaf Willow), Salix Gooddingii (Gooding's Willow), Salix Laevigata (Red Willow), Salix Lasiolepis (Arroyo Willow), Schoenoplectus (acutus, californicus) (Hardstem Bulrush), Suaeda Monquinii (Shrubby Seepweed), and Typha (Angustifolia, domengensis, Latifolia) (Narrowleaf Cattail). The state and federally listed endangered, threatened and rare plants of California updated from the State of California DFW California Natural Diversity Database (CNDDB) as updated on August 6, 2018.

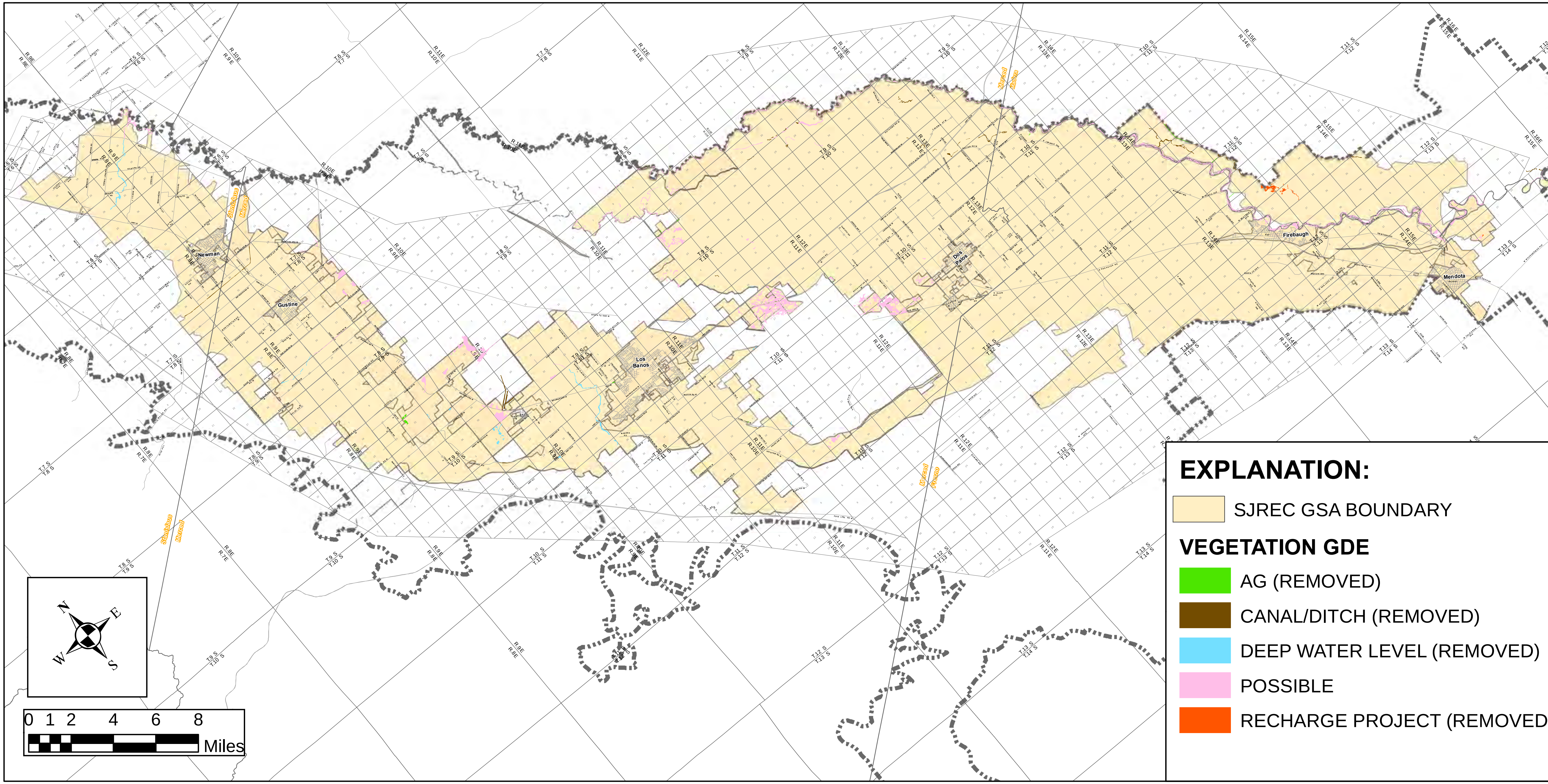

FIGURE 8 - VEGETATION GROUNDWATER DEPENDENT ECOSYSTEMS

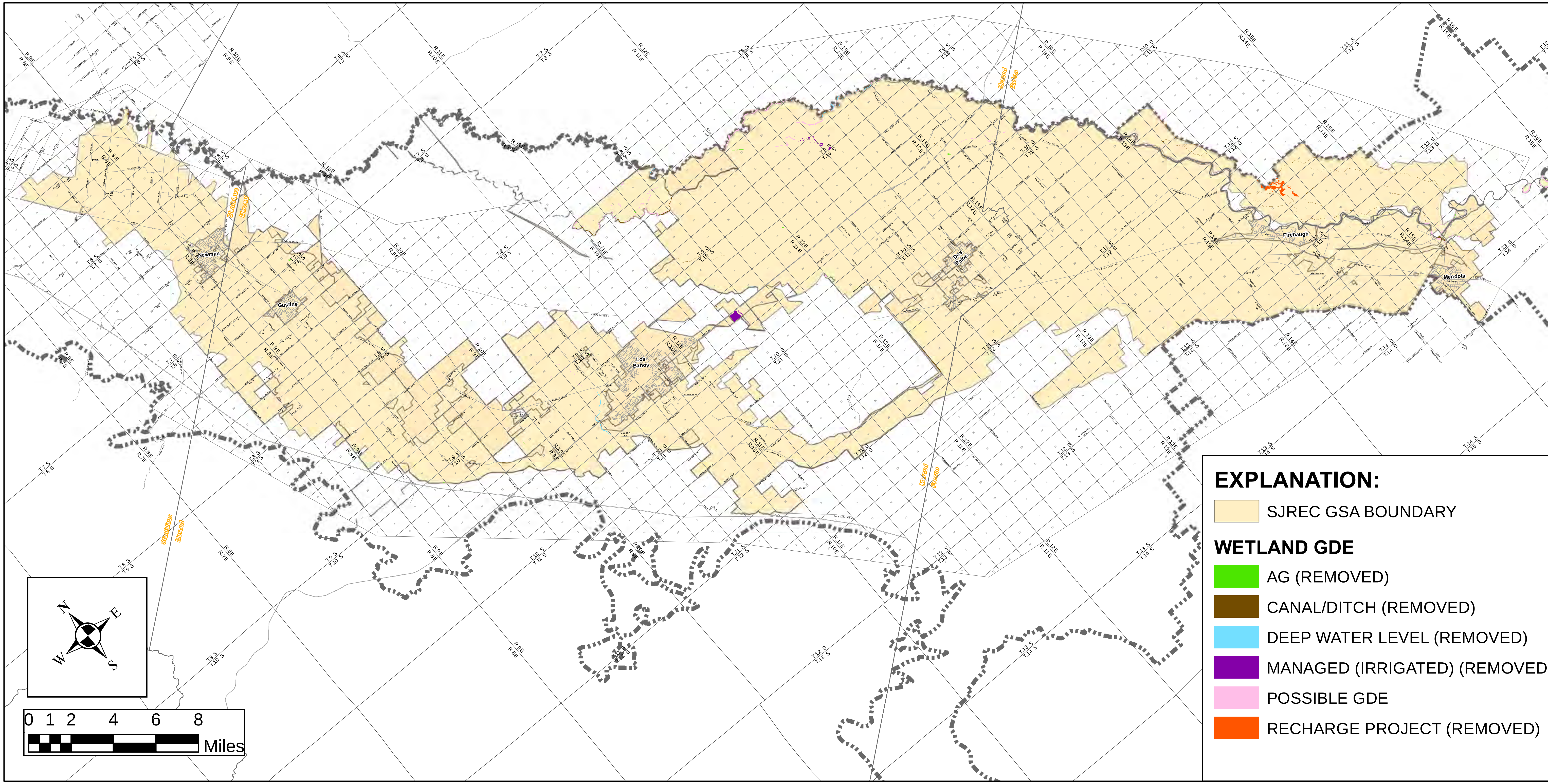

FIGURE 9 - WETLAND GROUNDWATER DEPENDENT ECOSYSTEMS

2.1.5 Notice and Communication

There are several types of beneficial uses and users of groundwater including: agriculture, domestic wells, municipal wells, public water systems, environment, surface water users where there is a connection to groundwater, federal interests, DAC and Industrial wells. Of these various types of uses, over 95% (88% is in the SJREC GSA) of the SJREC GSP area is designated as holders of overlying groundwater rights for agriculture and domestic groundwater use. There are six GSA's in the SJREC GSP that cover municipal water supply. Currently the City of Dos Palos relies on treated surface water for municipal supply. The other five City GSA's in this plan rely solely on groundwater for municipal supply. Newman, Gustine and Los Banos are primarily DAC's, whereas Firebaugh and Mendota are Severely DAC's. These communities, including the City of Dos Palos GSA comprise about 4% of the plan area. These communities are actively involved in development and implementation of this GSP. The remaining less than 1% consists mostly of Industrial and Environmental uses. The following processing plants are a majority of the Industrial uses of groundwater: Leprino Foods Company, Saputo Cheese USA, Hill View Packing Company, Ingomar Packing Company, Liberty Packing, Morning Star Packing, Kagome USA, and Tomatek. The Environmental uses are primarily through managed duck clubs or GDE's.

The Board of Directors for the SJREC GSA are the decision-making body for the GSA. Each Director was appointed from the home Board of Directors from their respective member agencies (CCID, SLCC, FCWD and CCC). Each Board member is elected by the landowners to a four-year term. While the Board of Directors were elected to be the decision makers, the organizational hierarchy is as follows starting at the top of the chart: Landowners, Board of Directors, General Manager, staff and consultants. The Board of Directors acts as the voice for the people they represent and strive to serve those interests to the best of their ability. All decisions are weighed based on supporting data from staff, consultants and the public. Ultimately these decisions require a majority (3/4) vote to approve. The SJREC have a long standing partnership with the other GSA's in the SJREC GSP. Most of the basin setting and groundwater management of this plan were in place prior to the SGMA. Numerous reports on groundwater conditions in and around the cities and the SJREC service area were completed in the 1990's. Additionally, most of the management actions and projects described in Sections 3 and 4 of this GSP were in place or under development prior to the SGMA. These reports, projects and management actions were adopted through public involvement to ensure a broad range of ideas and strategies to successfully manage groundwater. Much of this plan is merely an extension of historical practices that have been in place with public involvement and groundwater management has been successfully operating under these conditions. Each City and County has been involved in the development of this plan and has relied heavily on the trust developed over years of a great partnership with the SJREC to lead the effort developing this GSP.

The best decisions are made through public engagement as groundwater management strategies are under development and during implementation. All of the SJREC GSA meetings are posted consistent with the Brown Act. Interested parties may participate in the planning and development of the GSP by attending the SJREC GSA monthly board meetings held on the first Friday of the month beginning at 8:30 am. The meetings are held at the SJRECWA office located at 541 H Street, Los Banos, CA 93635. In addition, any interested party may refer to the contact information in Section 1.3.1 of this Plan.

The majority of beneficial users of groundwater in the area covered by the SJREC GSP lie within the SJREC GSA. Each member of the SJREC GSA holds annual shareholder meetings and discuss the SGMA and the development of the GSP. At these meetings, the shareholders (beneficial users) are encouraged to participate in the development of the GSP and are also given an opportunity to ask questions. This process is vital to ensure that the shareholders' interests are included in the development of the plan. These same shareholders, in addition to other interested parties, are encouraged to attend Subbasin meetings where coordination of methodologies for the various plans in the Delta-Mendota Subbasin is discussed. There are three primary committees that meet monthly and post notification of the meetings consistent with Brown Act requirements. These committees are the Coordination, Technical and Communication committees and respectively meet the 2nd Monday, 3rd Tuesday and 4th Tuesday of the month; located at 842 6th Street, Los Banos, California. More information on regional coordination in the Delta-Mendota Subbasin can be found at www.deltamendota.org. Each month, the Communications Committee prepares a newsletter that is shared on the SJRECWA website. One of the first committee tasks was to prepare a Communications Plan for the Delta-Mendota Subbasin; refer to Appendix G for this report. Consistent with the public outreach requirements in SGMA, the Communication Committee for the Delta-Mendota Subbasin has hosted several public workshops geared toward outreaching to DAC's. These meetings are included in the list of public meetings in Appendix E. Anyone who has reached out to the SJREC GSA as an interested party is added to the public outreach contact list in Appendix F. In addition, the SJREC GSA submitted a formal letter to DWR, Appendix D, regarding the Notice of Intent to Develop a GSP and how interested parties may participate in the planning and development of the GSP.

In addition to holding public committee meetings for the Delta-Mendota Subbasin development of GSP's, the Communications Subcommittee hosted a series of public workshops. Each set of workshops were held in various locations across the subbasin to reduce travel time for interested parties. Flyers for the workshops were prepared in English and Spanish and also in a standard letter size and a 1/3 sheet mailer for ease of transmittal. There was a total of four sets of workshops to introduce the public to the SGMA requirements and GSP development in the Delta-Mendota Subbasin. All of the public meetings encouraged public engagement in the planning and development process. The presentations were presented in English with a Spanish translation through headsets. There is a large population of Spanish speakers and having a translator at the public workshops offered SGMA updates to a greater number of beneficial users.

The Delta-Mendota Subbasin worked with CDFW, The Nature Conservancy and the Audubon Society at a public workshop on August 24, 2018 to discuss managing GDE's as a beneficial user of groundwater. The SJREC also gave a presentation at the 57th Annual California Irrigation Institute Conference, the 2018 Merced County Farm Bureau Water Symposium and the 2019 Merced County Farm Bureau Water Symposium respectfully on: February 5, 2019, March 1, 2018 and February 21, 2019. The SJREC also participated in the Fresno County School Outreach hosted by Self-Help Enterprises on September 29, 2018. Furthermore, the SJREC participated in an interview with a student from the University of Massachusetts who is studying SGMA and the effects of plan development with a particular interest in public involvement.

In addition to the meetings directly with each GSA in this GSP, the SJREC GSP participated in several other outreach events. The SJREC participated in several Central Valley Basin meetings hosted by the

Delta-Mendota Subbasin on the dates as follows: October 20, 2017, January 29, 2018, April 2, 2018 and June 8, 2018. The primary function of these Central Valley Basin meetings was to establish a contact for each GSP within each subbasin so further coordination discussions could materialize. The SJREC participated in a meeting with Westland Water District (WWD) representing the Westside Subbasin on April 4, 2019 to discuss plan development. The SJREC also participated in a meeting with the Turlock Subbasin on June 19, 2019 to discuss plan development. The Turlock Subbasin is particularly interested in the development of the GSP's in the Delta-Mendota Subbasin since the Turlock Subbasin is not in critical overdraft and has until 2022 to submit their plan. The SJREC and the Delta-Mendota Subbasin have been reached out to the Chowchilla and Madera Subbasin in an attempt to setup a meeting to discuss plan development.

The development of the SJREC GSP was a collaborative process where discussions of the GSP planning process encouraged an iterative procedure to determine appropriate groundwater management. Most of the groundwater monitoring and management in the SJREC area was in place prior to the signing of the SGMA in 2014. Additional coordination meetings with neighboring subbasins is anticipated after the public hearing to adopt this plan and the SJREC are hopeful these meetings will continue through the planning and implementation horizon.

2.1.5.1 Adoption of Plan Following a Public Hearing

The California Water Code, Section § 10728.4 states: A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a City or County within the area of the proposed plan or amendment. The groundwater sustainability agency shall review and consider comments from any City or County that receives notice pursuant to this section and shall consult with a City or County that requests consultation within 30 days of receipt of the notice.

The SJREC GSP Group will notify the following cities and counties of the proposed public hearing to adopt the SJREC GSP at least 90 days prior to the public hearing: City of Newman, City of Gustine, City of Los Banos, City of Dos Palos, City of Firebaugh, City of Mendota, County of Stanislaus, County of Merced, County of Fresno and County of Madera. Any comments and response to comments will be included as in Appendix H of this plan.

2.2 Basin Setting

Refer to the Hydrogeologic Conceptual Model and Groundwater Conditions Report for an in-depth description of the Basin in and around the SJREC GSP Group. The DWR has provided a more general description of the basin settings in the state through periodic updates to Bulletin 118. Bulletin 118 is California's official publication on the occurrence and nature of groundwater statewide. Bulletin 118 defines the boundaries and describes the hydrologic characteristics of California's groundwater basins and provides information on groundwater management and recommendations for the future. Bulletin 118 provides the following information for the San Joaquin Valley Groundwater Basin – Delta-Mendota Subbasin 5-22.07:

<u>Basin Boundaries and Hydrology:</u>

The San Joaquin Valley is surrounded on the west by the Coast Ranges, on the south by the San Emigdio and Tehachapi Mountains, on the east by the Sierra Nevada and on the north by the Sacramento-San Joaquin Delta and Sacramento Valley. The northern portion of the San Joaquin Valley drains toward the Delta by the San Joaquin River and its tributaries, the Fresno, Merced, Tuolumne, and Stanislaus Rivers. The southern portion of the valley is internally drained by the Kings, Kaweah, Tule, and Kern Rivers that flow into the Tulare drainage basin including the beds of the former Tulare, Buena Vista, and Kern Lakes.

The Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley, and includes portions of San Joaquin, Stanislaus, Merced, Fresno, and Madera Counties. The Delta-Mendota subbasin is bounded on the west by the Tertiary and older marine sediments of the Coast Ranges. The northern boundary begins just south of Tracy in San Joaquin County. The eastern boundary generally follows the San Joaquin River and Fresno Slough; except it follows the Columbia Canal Company and Aliso Water District Boundaries on the east side of the San Joaquin River. The southern boundary is near the small town of San Joaquin. Average annual precipitation is nine to 11 inches, increasing northwards.

<u>Hydrogeologic Information:</u>

The San Joaquin Valley represents the southern portion of the Great Central Valley of California. The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding mountains, respectively. Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is below to slightly west of the series of rivers, lakes, sloughs, and marshes, which mark the current and historic axis of surface drainage in the San Joaquin Valley.

<u>Water Bearing Formations:</u>

The geologic units that comprise the ground water reservoir in the Delta-Mendota subbasin consist of the Tulare Formation, terrace deposits, alluvium, and flood-basin deposits. The Tulare Formation is composed of beds, lenses, and tongues of clay, sand, and gravel that have been alternately deposited in oxidizing and reducing environments (Hotchkiss 1971). The Corcoran Clay Member of the formation underlies the basin at depths ranging about 100 to 500 feet and acts as a confining bed (DWR 1981).

Terrace deposits of Pleistocene age lie up to several feet higher than present streambeds. They are composed of yellow, tan, and light-to-dark brown silt, sand, and gravel with a matrix that varies from sand to clay (Hotchkiss 1971). The water table generally lies below the bottom of the terrace deposits. However, the relatively large grain size of the terrace deposits suggests their value as possible recharge sites.

Alluvium is composed of interbedded, poorly to well-sorted clay, silt, sand, and gravel and is divided based on its degree of dissection and soil formation. The flood-basin deposits are generally composed of light-to-dark brown and gray clay, silt, sand, and organic materials with locally high concentrations of salts and alkali. Stream channel deposits of coarse sand and gravel are also included.

Groundwater in the Delta-Mendota subbasin occurs in three water-bearing zones. These include the lower zone, which contains confined fresh water in the lower section of the Tulare Formation, an upper zone which contains confined, semi-confined, and unconfined water in the upper section of the Tulare Formation and younger deposits, and a shallow zone which contains unconfined water within about 25 feet of the land surface (Davis 1959).

The estimated specific yield of this subbasin is 11.8 percent (based on DWR San Joaquin District internal data and Davis 1959). Land subsidence up to about 16 feet has occurred in the southern portion of the basin due to artesian head decline (Ireland 1964).

2.2.1 Hydrogeologic Conceptual Model

The Hydrogeologic Conceptual Model (HCM) is a description of the SJREC GSP Group Area based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems. The SJREC GSP Group used the HCM BMP provided by DWR and updated to meet the needs of the GSA's in this plan. Refer to Appendix J for the BMP on the HCM. The HCM, Groundwater Conditions and Water Budget Report was prepared by KDSA in coordination with the SJREC GSP Group; refer to Appendix I for this report.

2.2.2 Current and Historical Groundwater Conditions

A description of the historical and current groundwater conditions is included in Appendix I. In general, this report will discuss groundwater conditions related to Undesirable Results.

2.2.3 Water Budget Information

The SJREC GSA's member agencies hold senior water rights on the San Joaquin River. Through an Agreement with the Federal Government, the predecessors of the SJRECWA exchanged the point of diversion to receive their water. In non-critical Shasta years, the SJRECWA receives up to 840,000 acre-feet. In critical Shasta years, the SJRECWA receives a 77% allocation or 650,000 acre-feet. This water is delivered through the DMC when available and down the San Joaquin River during those times when conveyance down the DMC cannot meet the obligations set forth in the "Exchange and Purchase Contracts". Another major surface water supply for the region is precipitation that can be used to meet evapotranspiration or can be captured and diverted into conveyance channels to be used to meet demand. In addition, there are ephemeral streams and the San Joaquin River that carry flood flows to and through the area. These flood flows provide recharge to the aquifer and can also be captured in the conveyance channels and diverted to beneficial use in the area. All of these surface water supplies are collectively used to maintain a healthy and sustainable aquifer through direct, in-direct and in-lieu recharge.

The member agencies of the SJREC are conjunctive use districts and rely on groundwater to provide operational flexibility and to meet peak demand. CCC has lined a majority of their canals to reduce seepage on sandy soils and have subsequently reduced groundwater extractions by keeping a majority of their water in the system. FCWD, due to the upslope drainage problem, overlies groundwater classified as a salt sink. FCWD has lined a majority of their canals to prevent the loss of surface water to the salt sink, thereby increasing how much water is put to beneficial use. Both CCID and SLCC primarily have unlined major canals. The major canals in CCID and SLCC contribute to about 100 TAF of recharge per year to the upper aquifer. This canal seepage has help maintain a healthy aquifer in and around the SJREC service area.

The Historical, Current and Projected Water Budgets were prepared primarily by the SJREC GSA Staff and KDSA in close coordination with the other GSP groups in the Delta-Mendota Subbasin to ensure that each GSP uses the same data and methodologies. Coordinating GSP elements across the subbasin was the primary task of the Delta-Mendota Technical Subcommittee. The Technical Subcommittee recommended the Historic Water Budget be from 2003-2012 and the Current Water Budget for 2013. Refer to Appendix I for groundwater conditions pertaining to Water Budgets. The SJREC GSP Group used the Water Budget BMP and Modeling BMP provided by DWR and updated to meet the needs of the GSA's in this plan. Refer to Appendices K and L for the BMP on the Water Budget and Modelling, respectively.

DWR has provided a monthly climate summary for the San Joaquin Region. The table below shows the mean temperature data for each month for water years 2007-2017. All values below are reported as average temperature for the month in degrees Fahrenheit.

MONTH	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
October	54.1	54.1	58.3	53.6	53.6	53.4	55	51.1	57.1	56.8	51.7
November	46.6	48.7	49.8	46.9	40.3	40.2	44.7	44.6	45.7	38.5	44.4
December	46.6	37.2	38.6	38	37.4	37.2	35.5	38.2	39.3	32.9	37.3
January	36.7	37.4	42.8	26.4	38.1	40.9	36.9	36.9	43.1	36.9	33.9
February	42.1	41.6	42.6	29.3	35.3	37.9	37.6	41.2	45.8	45.4	37.7
March	49.9	47	46.6	45.1	38.8	40.1	45.2	44.5	49	43.4	44.5
April	52.6	51.2	50.5	46.4	43.7	46.4	49.6	49.1	48.3	49.3	45.6
May	59.6	58.3	63.5	52.8	47.2	55.5	55.7	55.9	51.8	53.9	54.8
June	66.5	67.2	63.9	65.7	57.3	61.2	64.5	65	67.6	65.9	64.5
July	71.9	72.8	74.3	72.7	65.9	67.7	71.5	71.8	68.2	70.4	72
August	71.2	72.9	70.6	68.8	67.2	71.9	67.2	67.8	69.7	69.7	71.3
September	62	68.2	69.1	66.3	64.7	68.1	61.1	64.4	65.5	63	61.1
DWR Water Year Avg.	**55.0**	**54.7**	**55.9**	**51.0**	**49.1**	**51.7**	**52.0**	**52.5**	**54.3**	**52.2**	**51.6**

Table 9 - WY 2007-2017 Mean Monthly Temperatures (°F)

2.2.3.1 Historic Water Budget for SJREC GSA

The following data was used to analyze the Historic Water Budget for the SJREC GSA:

Water Year Type:

The local water year type was based on the DWR San Joaquin Valley Index; 1) Wet, 2) Above Normal, 3) Below Normal, 4) Dry, 5) Critically Dry. The surface water allocation for the SJREC is dependent on the Full Natural Flow (FNF) on the Sacramento River at Shasta, as defined in the Exchange Contract. The Water Year Type listed in the water budget is based on the San Joaquin Valley Index with the exception of a critical year under the Exchange Contract (Shasta Critical). A Shasta Critical year typically coincides with a critically dry year type in the San Joaquin Valley but has added surface water delivery restrictions to the SJRECWA and also to other CVP contractors in the Delta-Mendota Subbasin. As a result, an additional Water Year Type is needed to reflect changes in the water budget parameters during Shasta Critical years under the Exchange Contract; 6) Shasta Critical.

A Shasta Critical Year under the Exchange Contract is defined as 1) if the forecasted full natural inflow to Shasta Lake for the current water year is less than 3.2 MAF or 2) the total accumulated actual deficiencies (full natural inflow to Shasta) below 4.0 MAF in the immediately prior water year or series of successive prior water years, each of which had inflows of less than 4.0 MAF, together with the forecasted deficiency for the current water year exceeds 0.8 MAF.

YEAR	WATER YEAR TYPE (SJV)		YEAR	WATER YEAR TYPE (SJV)		YEAR	WATER YEAR TYPE (SJV)
1901	Wet		1940	Above Normal		1979	Above Normal
1902	Above Normal		1941	Wet		1980	Wet
1903	Above Normal		1942	Wet		1981	Dry
1904	Wet		1943	Wet		1982	Wet
1905	Above Normal		1944	Below Normal		1983	Wet
1906	Wet		1945	Above Normal		1984	Above Normal
1907	Wet		1946	Above Normal		1985	Dry
1908	Dry		1947	Dry		1986	Wet
1909	Wet		1948	Below Normal		1987	Critically Dry
1910	Above Normal		1949	Below Normal		1988	Critically Dry
1911	Wet		1950	Below Normal		1989	Critically Dry
1912	Below Normal		1951	Above Normal		1990	Critically Dry
1913	Critically Dry		1952	Wet		1991	Critically Dry (Shasta Critical)
1914	Wet		1953	Below Normal		1992	Critically Dry (Shasta Critical)
1915	Wet		1954	Below Normal		1993	Wet
1916	Wet		1955	Dry		1994	Critically Dry (Shasta Critical)
1917	Wet		1956	Wet		1995	Wet
1918	Below Normal		1957	Below Normal		1996	Wet
1919	Below Normal		1958	Wet		1997	Wet
1920	Below Normal		1959	Dry		1998	Wet
1921	Above Normal		1960	Critically Dry		1999	Above Normal
1922	Wet		1961	Critically Dry		2000	Above Normal
1923	Above Normal		1962	Below Normal		2001	Dry
1924	Critically Dry		1963	Above Normal		2002	Dry
1925	Below Normal		1964	Dry		2003	Below Normal
1926	Dry		1965	Wet		2004	Dry
1927	Above Normal		1966	Below Normal		2005	Wet
1928	Below Normal		1967	Wet		2006	Wet
1929	Critically Dry		1968	Dry		2007	Critically Dry
1930	Critically Dry		1969	Wet		2008	Critically Dry
1931	Critically Dry		1970	Above Normal		2009	Below Normal
1932	Above Normal		1971	Below Normal		2010	Above Normal
1933	Dry		1972	Dry		2011	Wet
1934	Critically Dry		1973	Above Normal		2012	Dry
1935	Above Normal		1974	Wet		2013	Critically Dry
1936	Above Normal		1975	Wet		2014	Critically Dry (Shasta Critical)
1937	Wet		1976	Critically Dry		2015	Critically Dry (Shasta Critical)
1938	Wet		1977	Critically Dry (Shasta Critical)		2016	Dry
1939	Dry		1978	Wet		2017	Wet

Table 10 - San Joaquin Valley Water Year Type Index

Surface Water Allocation and Surface Water Delivery:

The Surface water allocation is determined based on the FNF at Shasta per the Exchange Contract. All historic water years from 1939 – 2018 were non-critical (100% allocation) with the exception of 1977, 1991, 1992, 1994, 2014, and 2015. Actual surface water deliveries are measured consistent with industry standards and requirements. Surface Water Deliveries are reported in total acre-feet.

WATER YEAR	SHASTA WATER YEAR DESIGNATION	SURFACE WATER ALLOCATION	SURFACE WATER DELIVERY (AF)
2003	Non-Critical	100%	788,000
2004	Non-Critical	100%	776,000
2005	Non-Critical	100%	731,000
2006	Non-Critical	100%	761,000
2007	Non-Critical	100%	804,000
2008	Non-Critical	100%	753,000
2009	Non-Critical	100%	756,000
2010	Non-Critical	100%	743,000
2011	Non-Critical	100%	753,000
2012	Non-Critical	100%	795,000
Avg.		***100%***	***766,000***

Table 11 – Historic Surface Water Allocation and Delivery

Groundwater Extractions:
Each year the Exchange Contractors prepare a report on well pumping inside the entities and includes pumping from the surrounding area. The total groundwater pumping came from those reports. Groundwater extractions from the Lower Aquifer are estimated at 10% of the total pumping. The cost to drill and pump a well in the upper aquifer is significantly cheaper when compared to a well pumping from the lower aquifer. In most areas of the SJREC GSA, the upper aquifer provides good quality and quantity of groundwater which has limited the number of wells drilled to extract from the lower aquifer. This assumption is consistent with the known data from the SJREC member entity owned wells. The change in groundwater storage was calculated as the physical loss in groundwater storage in the lower aquifer caused by inelastic land subsidence. Based on these results, the following table summarizes groundwater extractions from the upper aquifer and the lower aquifer. Groundwater pumping is reported in total acre-feet.

WATER YEAR	UPPER AQUIFER GROUNDWATER EXTRACTION (AF)	LOWER AQUIFER GROUNDWATER EXTRACTION (AF)	TOTAL GROUNDWATER EXTRACTION (AF)
2003	104,000	12,000	116,000
2004	127,000	14,000	141,000
2005	61,000	7,000	68,000
2006	50,000	6,000	56,000
2007	164,000	18,000	182,000
2008	146,000	16,000	162,000
2009	148,000	16,000	164,000
2010	68,000	8,000	76,000
2011	73,000	8,000	81,000
2012	129,000	14,000	143,000
Avg.	***107,000***	***12,000***	***119,000***

Table 12 – Historic Groundwater Extractions

Precipitation:
The National Weather Service Station in Los Banos, located at the CCID office, was used to represent average precipitation for the area. The total precipitation that infiltrates was calculated using the DWR method for the relationships for calculation of effective rainfall on a monthly basis in San Joaquin Valley. The equation described in Table 3-6 of the following report was used: MacGillivray, N.A. and M.D. Jones, 1989, "Effective Precipitation", California Department of Water Resources to determine the gross rainfall that infiltrates. This value contributes to meet evapotranspiration of precipitation water (ET_{Precip}). Precipitation was collected from the Los Banos NWS station in inches/day and was converted to total acre-feet for the water budget.

WATER YEAR	PRECIPITATION (inches)	TOTAL PRECIPITATION (AF)	EFFECTIVE PRECIPITATION (ET_{precip})	NON-EFFECTIVE PRECIPITATION
2003	8.5	182,000	81,000	101,000
2004	8.5	182,000	109,000	73,000
2005	15	319,000	163,000	156,000
2006	10.8	230,000	106,000	124,000
2007	4.5	96,000	15,000	81,000
2008	6.2	131,000	76,000	55,000
2009	6	129,000	72,000	57,000
2010	11.2	238,000	129,000	109,000
2011	12.6	269,000	151,000	118,000
2012	5.1	108,000	20,000	88,000
Avg.	***8.9***	***188,000***	***92,000***	***96,000***

Table 13 – Historic Precipitation

Streamflow Recharge:

San Joaquin River Losses: The Mendota Pool has been historically wet year-round. The total seepage in Mendota Pool equates to about 80 acre-feet per day. The SJREC GSA has about a 3-mile boundary around the Mendota Pool which has a total boundary of about 17-miles. Accordingly, the SJREC has 3/17 of the total recharge per day or about 5 TAF per year. The CDEC Stations in the San Joaquin River at Mendota Dam (MEN) and South Dos Palos (SDP) were used to determine river losses through this stretch of the river after accounting for diversions to SLCC at Sack Dam. There is about 25 cfs loss per day in Reach 3 (MEN to SDP) under normal conditions which equates to about 18 TAF per year of recharge that leaves the SJREC area towards the east side of the river. In wet years, there are additional flows in the river that contribute to additional recharge in this stretch at approximately 100 cfs (75 cfs additional) loss per day for a total of 100 days or about 15 TAF in wet years. The recharge benefit to the SJREC from the San Joaquin River is limited by the direction of groundwater flow and only water recharging in the Mendota Pool is recharging the SJREC area. Recharge from the San Joaquin River is reported in acre-feet.

Ephemeral Streams: The following ephemeral streams flow through the SJREC GSA area: Orestimba Creek, Garzas Creek, Quinto Creek, Romero Creek, Los Banos Creek and Panoche Creek. The Los Banos Creek provides the greatest contribution of aquifer recharge. During a flood release from the Los Banos Detention Reservoir, CCID measured the flow rate in the creek at various locations. This study indicated that there are 25 CFS losses in the Los Banos Creek within the SJREC GSA. This recharge rate was used and compared to actual releases from the Los Banos Creek Detention Reservoir to determine the total volume of recharge in Los Banos Creek. The USACE Water Control Data System was used to determine Los Banos Creek Detention Reservoir releases. The Orestimba Creek also provides aquifer recharge at an assumed rate of about 5 CFS during creek flows. The CDEC station Orestimba Creek near Newman (ORE) was used to determine when there was runoff from the watershed resulting in creek flows. The recharge rate from the other creeks is assumed to be comparably low and was neglected in this water budget resulting in a more conservative estimate of net recharge from local streams. Recharge from ephemeral streams is reported in acre-feet.

WATER YEAR	WATER YEAR TYPE	SAN JOAQUIN RIVER RECHARGE (AF)	LOS BANOS AND ORESTIMBA CREEKS RECHARGE (AF)	TOTAL STREAM RECHARGE (AF)
2003	Below Normal	5,000	1,000	6,000
2004	Dry	5,000	0	5,000
2005	Wet	5,000	2,000	7,000
2006	Wet	5,000	1,000	6,000
2007	Critically Dry	5,000	0	5,000
2008	Critically Dry	5,000	1,000	6,000
2009	Below Normal	5,000	0	5,000
2010	Above Normal	5,000	1,000	6,000
2011	Wet	5,000	2,000	7,000
2012	Dry	5,000	0	5,000
Avg.	***Drier than avg.***	***5,000***	***1,000***	***6,000***

Table 14 – Historic Stream Recharge

Recharge Projects:

The SJREC GSA is working on several recharge projects that are further described in Section 4.0 of this plan. None of the projects mentioned in Section 4.0 were operational during the Historic and Current Water Budget timeframes. These projects will be included in the Projected Water Budget and reported in acre-feet.

Surface Water and Groundwater Outflow:
The SJREC GSA has measured and estimated how much surface water spills from the area. These spills include outflow from tile drained fields, canal spills, field runoff and precipitation runoff. The amount of surface water outflow is reported in acre-feet.

WATER YEAR	PRECIPITATION OUTFLOW (AF)	TILE DRAIN OUTFLOW (AF)	OUTFLOW AND SPILLS (AF)	TOTAL OUTFLOW (AF)
2003	101,000	3,000	138,000	242,000
2004	73,000	3,000	133,000	209,000
2005	156,000	3,000	121,000	280,000
2006	124,000	2,000	117,000	243,000
2007	81,000	3,000	123,000	207,000
2008	55,000	2,000	108,000	165,000
2009	57,000	2,000	104,000	163,000
2010	109,000	2,000	117,000	228,000
2011	118,000	2,000	127,000	247,000
2012	88,000	2,000	103,000	193,000
Avg.	***96,000***	***2,000***	**119,000**	***217,000***

Table 15 – Historic Total Surface Water Outflow

Evapotranspiration:
The largest outflow for the water budget is the evapotranspiration (consumptive use) of crops. The SJRECWA worked with ITRC to conduct a study to determine the crop coefficients within their service area in 2008. The method followed the revised FAO-24 procedure outlined in *Crop Evapotranspiration; Guidelines for Computing Crop Water Requirements* – FAO-56. This approach is based on the dual crop coefficient procedure detailed in the FAO-56 publications with some modifications made by the ITRC that are outlined in the Evaporation from Irrigated Agricultural Land in California Study (Burt et. al., 2002). The revised FAO-24 procedure calculated the crop coefficient (K_c) on a daily basis. The basal crop coefficient (K_{cb}) is adjusted depending on climatic conditions (wind speed, relative humidity, etc.) and crop stress (K_s). The procedure also adjusts for evaporation from the upper soil profile after irrigation and rainfall events (K_e). The calculations for K_c, K_e, K_s, K_{cb}, and ET_c were done using the Modified ITRC/FAO-56 Model. The program automatically calculated each crop coefficient component on a daily basis. These established crop coefficients were used to determine ET during the historic water budget timeframe of 2003-2008, based on the 2008 study.

The SJREC GSA worked with the Irrigation Training and Research Center (ITRC) at California Polytechnic State University, San Luis Obispo to determine the actual ET of the crops for the years 2009-2016. For ET data from 2009-2016, ITRC used a modified Mapping of Evapotranspiration with Internal Calibration (METRIC) procedure to compute actual ET using LandSAT Thematic Mapper data. For more details on the ITRC-METRIC process refer to: http://www.itrc.org/papers/pdf/METRICgroundwater.pdf. The ITRC-METRIC data included evaporation form canal surfaces and also ET from phreatophytes. These values have been included in the water budget under ET_{misc}. It should be noted that some agriculture fields were included in the ITRC-METRIC as non-agriculture fields. For this reason, the miscellaneous ET from 2009-2016 was higher since it also included some agriculture fields but doesn't have an impact on the water budget since both ET_c, ETi_w, and ET_{misc} are net outflows. All ET values are reported in acre-feet.

WATER YEAR	ET_C (AF)	ET_{iw} (AF)	ET_{misc} (AF)	Total ET (AF)
2003	719,000	638,000	20,000	740,000
2004	740,000	631,000	20,000	761,000
2005	707,000	544,000	20,000	726,000
2006	704,000	598,000	20,000	723,000
2007	709,000	694,000	20,000	731,000
2008	713,000	637,000	21,000	735,000
2009	665,000	593,000	67,000	732,000
2010	575,000	446,000	56,000	631,000
2011	628,000	477,000	66,000	694,000
2012	618,000	598,000	62,000	680,000
Avg.	***678,000***	***586,000***	***37,000***	***715,000***

Table 16 – Historic Evapotranspiration (Consumptive Use)

Lateral Inflow and Outflow of Groundwater:

The lateral inflow and outflow of groundwater in the SJREC area was determined using measured aquifer characteristics. Transmissivity values were determined from aquifer tests and localized deep well pumping tests. Water level maps for wet, normal and dry water year types were prepared to determine the elevation and direction of groundwater flow for both the Upper and Lower Aquifers. KDSA reviewed the water elevation maps and determined the transects and gradient of groundwater flow. Darcy's Law was used to determine groundwater flows where the total flow equals the product of the transmissivity, gradient and transect. These maps were used to determine the volume of groundwater inflow and outflow from the SJREC under those respective water year types. The data generated for normal conditions was used as a surrogate for Water Year Types designated as Above Normal and Below Normal. The data generated for dry conditions was used as a surrogate for Water Year Types designated as Dry and Critically Dry. This is a common method to determine actual groundwater flows and is a consistent method used in the various GSP's in the Delta-Mendota Subbasin. All values are reported in acre-feet.

WATER YEAR	GROUNDWATER INFLOW (Upper Aquifer)	GROUNDWATER OUTFLOW (Upper Aquifer)	GROUNDWATER INFLOW (Lower Aquifer)	GROUNDWATER OUTFLOW (Lower Aquifer)	GROUNDWATER SEEPAGE THROUGH CORCORAN CLAY
2003	71,000	53,000	18,000	47,000	45,000
2004	44,000	69,000	14,000	73,000	45,000
2005	73,000	40,000	18,000	24,000	45,000
2006	73,000	40,000	18,000	24,000	45,000
2007	44,000	69,000	14,000	73,000	45,000
2008	44,000	69,000	14,000	73,000	45,000
2009	71,000	53,000	18,000	47,000	45,000
2010	71,000	53,000	18,000	47,000	45,000
2011	73,000	40,000	18,000	24,000	45,000
2012	44,000	69,000	14,000	73,000	45,000
Avg.	***61,000***	***56,000***	***16,000***	***51,000***	***45,000***

Table 17 – Historic Lateral Groundwater Flows

Historic Water Budget Change in Groundwater Storage:

The Historic Water Budget defined from 2003-2012 was drier than the historical average and is likely to result with a change in groundwater storage that reflects the drier condition. The HCM defines two distinct aquifers, upper and lower, as separated by the Corcoran Clay. It should be noted that groundwater extraction from outside the SJREC area has an impact on lateral groundwater flow and stream recharge. For this reason, the SJREC have prepared a Free-Body Diagram to determine if our groundwater management efforts have a net positive impact on the aquifer (more surface water delivery than demand) which is indicative of sustainable groundwater management for aquifer storage.

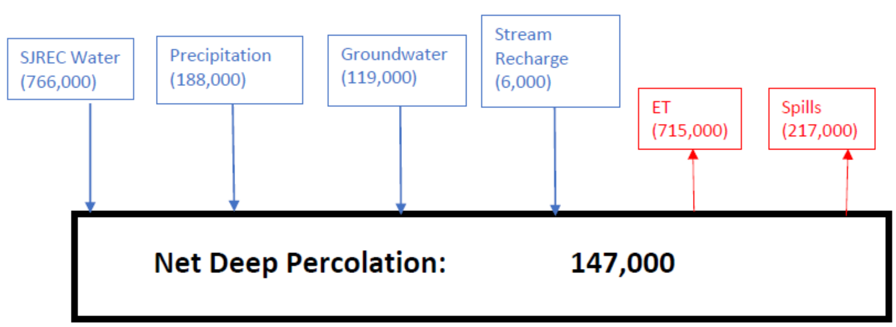

Figure 10 – Historic Free-Body Diagram for Surface Water Interaction

The result of the net deep percolation shows an average annual recharge from direct, in-direct and in-lieu recharge of 147 TAF/year. The recharge includes but is not limited to; deep percolation from irrigation, deep percolation of precipitation, stream seepage and canal seepage.

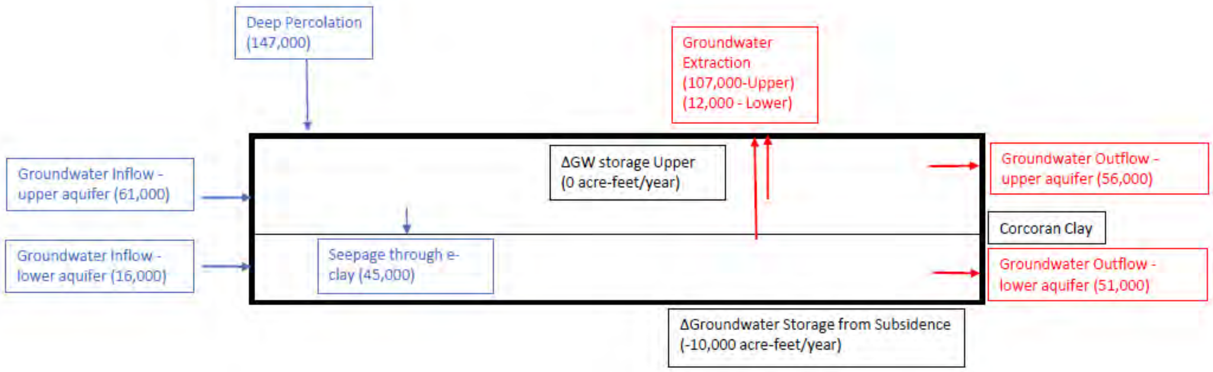

Figure 11 – Historic Free-Body Diagram for Groundwater Interaction

The results of the groundwater interaction show no change in the overall annual average change in storage in the upper aquifer. For the purpose of this analysis the upper aquifer is assumed to be in balance even through this slightly drier than average timeframe. The lower aquifer shows an average annual loss of 10 TAF in groundwater storage. The SJREC are extracting an average annual volume of 12 TAF from the lower aquifer which equates to an annual extraction of 0.05 AF/acre. It is reasonable to assert that any reduction in groundwater storage, is not principally caused by the extraction occurring with the SJREC GSA area. The primary cause of the reduction in groundwater storage in the lower aquifer is large lateral groundwater outflow particularly in dry and critically dry water years. The large groundwater outflow is indicative of over-drafting occurring outside the GSA boundary which has caused inelastic land subsidence.

The actual change in groundwater storage in the lower aquifer in primarily due to compaction caused by inelastic land subsidence resulting from groundwater extractions and subsurface groundwater flow. The negative effects of over extraction from the lower aquifer can have residual effects of land subsidence. In other words, land subsidence can continue to occur even after groundwater pumping has stopped. It is for this reason, that the following table and charts are using the approximate change in groundwater storage from the lower aquifer caused in that year and it is further assumed, for illustration purposes, that there was not any land subsidence in wet years.

YEAR	UPPER AQUIFER CHANGE IN STORAGE (AF)	LOWER AQUIFER CHANGE IN STORAGE (AF)
2003	-20,000	-2,000
2004	-62,000	-24,000
2005	45,000	0
2006	23,000	0
2007	-83,000	-24,000
2008	-63,000	-24,000
2009	-15,000	-2,000
2010	109,000	-2,000
2011	84,000	0
2012	-20,000	-24,000
Avg.	***0***	***-10,000***

Table 18 – Change in Groundwater Storage for the Historical Water Budget

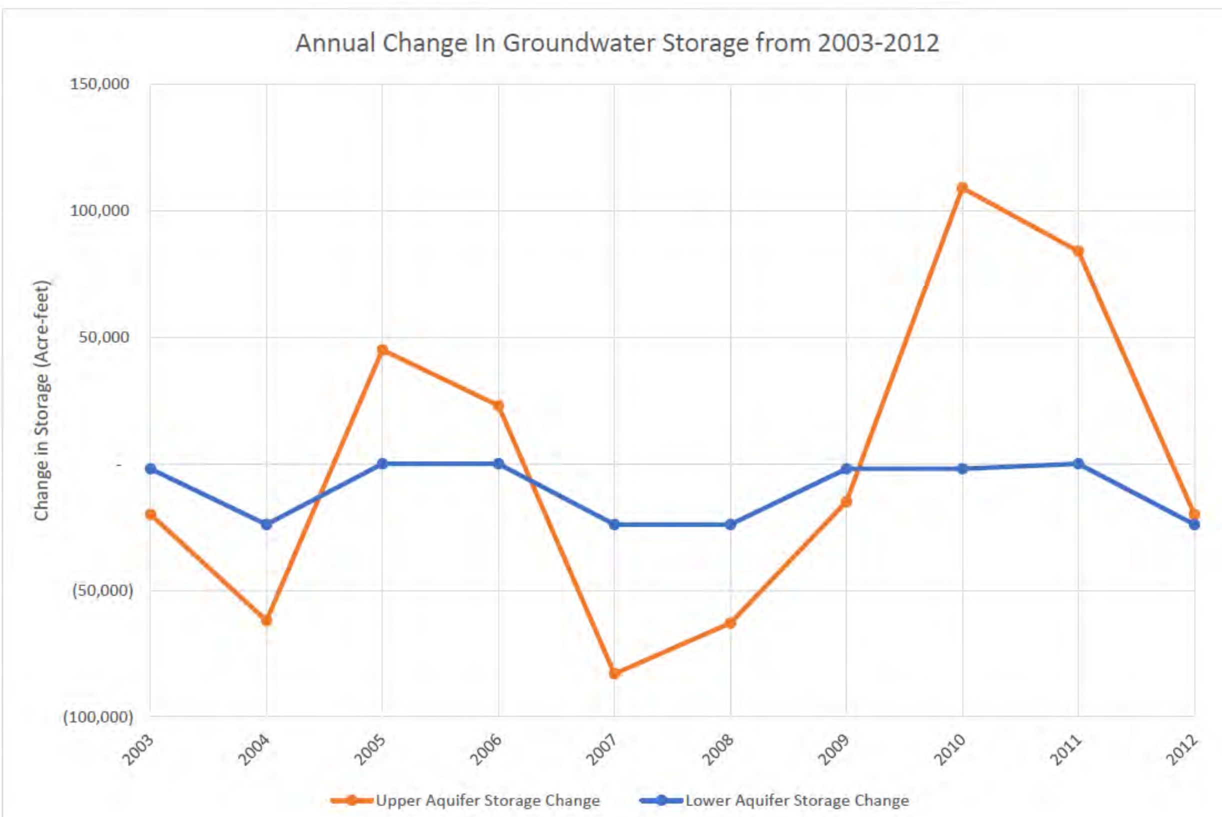

Figure 12 – Annual Historic Change in Groundwater Storage Graph

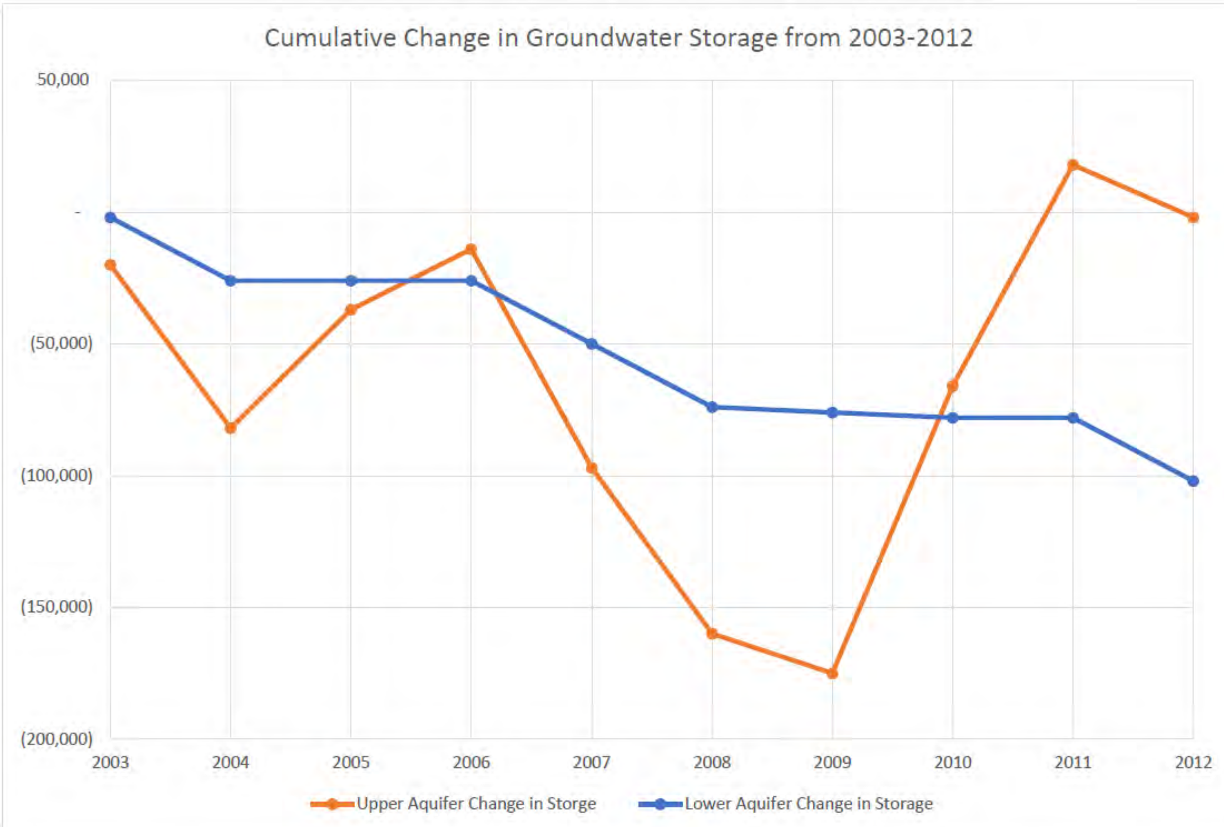

Figure 13 - Cumulative Historic Change in Groundwater Storage Graph

2.2.3.2 Current Water Budget for SJREC GSA

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

Surface Water Allocation and Surface Water Delivery:

WATER YEAR	SHASTA WATER YEAR DESIGNATION	SURFACE WATER ALLOCATION	SURFACE WATER DELIVERY (AF)
2013	Non-Critical	100%	748,000

Table 19 - Current Surface Water Allocation and Delivery

Groundwater Extractions:

WATER YEAR	UPPER AQUIFER GROUNDWATER EXTRACTION (AF)	LOWER AQUIFER GROUNDWATER EXTRACTION (AF)	TOTAL GROUNDWATER EXTRACTION (AF)
2013	161,000	18,000	179,000

Table 20 - Current Groundwater Extractions

Precipitation:

WATER YEAR	PRECIPITATION (inches)	TOTAL PRECIPITATION (AF)	EFFECTIVE PRECIPITATION (ET_{precip})	NON-EFFECTIVE PRECIPITATION
2013	5.4	115,000	52,000	63,000

Table 21 - Current Precipitation

Streamflow Recharge:

WATER YEAR	WATER YEAR TYPE	SAN JOAQUIN RIVER RECHARGE (AF)	LOS BANOS AND ORESTIMBA CREEKS RECHARGE (AF)	TOTAL STREAM RECHARGE (AF)
2013	Critically Dry	5,000	1,000	6,000

Table 22 - Current Stream Recharge

Surface Water and Groundwater Outflow:

WATER YEAR	PRECIPITATION OUTFLOW (AF)	TILE DRAIN OUTFLOW (AF)	OUTFLOW AND SPILLS (AF)	TOTAL SWATER OUTFLOW (AF)
2013	63,000	2,000	108,000	173,000

Table 23 - Current Total Surface Water Outflow

Evapotranspiration:

WATER YEAR	ET_C (AF)	ET_{iw} (AF)	ET_{misc} (AF)	Total ET (AF)
2013	608,000	556,000	57,000	665,000

Table 24 - Current Evapotranspiration (Consumptive Use)

Lateral Inflow and Outflow of Groundwater:

WATER YEAR	GROUNDWATER INFLOW (Upper Aquifer)	GROUNDWATER OUTFLOW (Upper Aquifer)	GROUNDWATER INFLOW (Lower Aquifer)	GROUNDWATER OUTFLOW (Lower Aquifer)	GROUNDWATER SEEPAGE THROUGH CORCORAN CLAY
2013	44,000	69,000	14,000	73,000	45,000

Table 25 - Current Lateral Groundwater Flows

Current Water Budget Change in Groundwater Storage:

The change in groundwater storage for the upper aquifer is representative of a snapshot in time during a critically dry year. The upper aquifer fully recovered after the back-to-back critically dry years during the Historic Water Budget. While this shows a one-year reduction in groundwater storage, it is not indicative of average conditions and serves as a one-year representative of recent conditions. In fact, we have seen the upper aquifer recover even after going through the extended drought of 2013-2016. The change in groundwater storage in the Upper Aquifer, represents an average water level decline of less than 1 foot across the SJREC GSA area. The SJREC extracted 18 TAF from the lower aquifer which equates to an extraction of 0.07 AF/acre. The change in groundwater storage from the lower aquifer can be described similarly to the Historic Water Budget analysis.

YEAR	UPPER AQUIFER CHANGE IN STORAGE (AF)	LOWER AQUIFER CHANGE IN STORAGE (AF)
2013	-23,000	-24,000

Table 26 - Change in Groundwater Storage for the Current Water Budget

2.2.3.3 Projected Water Budget for SJREC GSA

Climate Change:

The SJREC GSP Group used the climate change data provided by DWR and based on the California Water Commission's Water Storage Investment Program (WSIP) climate change analysis results. Climate Change impacts need to be evaluated to determine the effects on precipitation, ET and streamflow. The gridded data provided monthly Climate Change factors on an approximately fifteen square mile grid for 2030 (representing years 2016-2045) and 2070 (representing years 2046-2085) for precipitation and ET. That data was gathered for each management area in the SJREC GSA. A weighted average based on acreage was then applied to provide an overall representative climate change factor across the SJREC GSA area for each month. The representative climate change factor for each month was used to determine the annual climate change factor. The 2030 annual climate change factors were used in the projected water budgets from 2018-2045 for precipitation and ET. The 2070 annual climate change factors were used in the projected water budgets from 2046-2070 for precipitation and ET. The Climate Change model also determined the effects on streamflow with factors for 2030 and 2070. Similarly to the Climate Change factors for precipitation and ET, the projected water budget used the 2030 streamflow factors for years 2018-2045 and the 2070 streamflow factor for years 2046-2070. The three main rivers that were reviewed for potential impacts to the Delta-Mendota Subbasin were the Sacramento, San Joaquin and Kings rivers. The Sacramento River Full Natural Flow was reviewed to determine which years would be classified as Shasta Critical under the Exchange Contract. The San Joaquin and Kings rivers were reviewed to determine the impacts to stream recharge and flood flows. The impacts of climate change are reported as dimensionless factors in the projected water budget.

For more details on the climate change modeling refer to the WSIP and the guidance document provided by DWR: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Climate-Change-Guidance_Final.pdf

Projected Water Year Type:

The GSA's in the Delta-Mendota Subbasin, through the Technical Subcommittee and approved by the Coordination Committee, agreed on the following approach for Projected Water Budgets and received confirmation from DWR on this approach. The Projected Water Budget has been determined to represent water years 2014-2070. It was decided at the Subbasin level to use actual data from water years 2014-2017. Furthermore, it was decided to replay the hydrology of 1965-2017 with the caveat that 1979 would represent the fifth year of the projection and following sequentially the historic water year 1965 would represent the forty-fourth year of the projection. Essentially, the subbasin is using a sequential fifty-three year hydrologic cycle but started in the middle of the cycle to more nearly mimic the most recent drought. The actual projected values would begin starting in 2018. A replay of historic hydrology was used where the hydrology from 1979 is representative of the water budget year 2018, or the fifth year in the projected water budget. The following year, 2019 or the sixth year, of the Projected Water Budget is a replay of the 1980 water year and so on for all subsequent years and having the water year 2057 represented by the historic hydrology from the year 1965. The historic and current water budgets are used as a baseline condition for the water budget entries based on the Water Year type. For example; Water Year 2010 was classified as Above Normal and the water budget values from 2010 will be used as a baseline for all Above Normal years in the projected water budget. This process has now established a baseline condition.

Actual Water Year	Historical Reference Used for Hydrology	Historical Reference for Water Delivery/Demand (surrogate year)	Shasta Water Year Designation	Water Year Type (SJ Valley)
2014	2014	2014	Critical	Shasta Critical
2015	2015	2015	Critical	Shasta Critical
2016	2016	2016	Non-Critical	Dry
2017	2017	2017	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2017	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2017	Non-Critical	Wet
2022	1983	2017	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2017	Non-Critical	Wet
2026	1987	2008	Non-Critical	Critically Dry
2027	1988	2008	Non-Critical	Critically Dry
2028	1989	2008	Non-Critical	Critically Dry
2029	1990	2008	Non-Critical	Critically Dry
2030	1991	Avg. 2014 & 2015	Critical	Shasta Critical
2031	1992	Avg. 2014 & 2015	Critical	Shasta Critical
2032	1993	2017	Non-Critical	Wet
2033	1994	2008	Non-Critical	Critically Dry
2034	1995	2017	Non-Critical	Wet
2035	1996	2017	Non-Critical	Wet
2036	1997	2017	Non-Critical	Wet
2037	1998	2017	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2012	2012	Non-Critical	Dry
2052	2013	2013	Non-Critical	Critically Dry
2053	2014	2014	Critical	Shasta Critical
2054	2015	2015	Critical	Shasta Critical
2055	2016	2016	Non-Critical	Dry
2056	2017	2017	Non-Critical	Wet
2057	1965	2017	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2017	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2017	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2017	Non-Critical	Wet
2067	1975	2017	Non-Critical	Wet
2068	1976	Avg. 2014 & 2015	Critical	Shasta Critical
2069	1977	Avg. 2014 & 2015	Critical	Shasta Critical
2070	1978	2017	Non-Critical	Wet

Table 27 - Surrogate Water Years

Surface Water Allocation and Surface Water Delivery:

The surface water allocation to the SJREC is determined based on the FNF at Shasta per the Exchange Contract. The result of the WSIP program was used to determine what the projected FNF into Shasta would be after accounting for climate change. As shown above, historic water deliveries based on water year type were used as surrogates to project future water supply allocations and deliveries. As an example, the historic watery year '1984' was classified as an above normal water year for the San Joaquin Valley. Similarly 2010, in our historic water budget, was an above normal water year, and surface water deliveries in the projected water budget will mimic what was delivered in 2010 in all water years designated as above normal. This process was used to determine surface water deliveries for all water year types. The climate change model provided projected inflows using 2030 and 2070 factors for Water Years 1922-2003. In order to simulate climate change impacts to stream flow from 2004-2017, the following years were respectively used as surrogates: 2002, 2002, 1998, 1992, 1992, 2002, 2003, 1997, 1992, 1992, 1976, 1977, 2002, 1998. This method was discussed and approved by both the Delta-Mendota Coordination Committee and DWR. Table 27 describes which historic years are used when determining projected deliveries, with the exception of the streamflow from 2004-2017 as listed above. Projected surface water deliveries are assumed to follow historic patterns resulting in projecting surface water deliveries based on established data from 2003-2017. Projected surface water deliveries are reported in total acre-feet.

WATER YEAR	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)	SURFACE WATER ALLOCATION	SURFACE WATER DELIVERY (AF)
2014	Critical	Shasta Critical	77%	493,000
2015	Critical	Shasta Critical	77%	439,000
2016	Non-Critical	Dry	100%	638,000
2017	Non-Critical	Wet	100%	748,000
2018	Non-Critical	Above Normal	100%	743,000
2019	Non-Critical	Wet	100%	748,000
2020	Non-Critical	Dry	100%	795,000
2021	Non-Critical	Wet	100%	748,000
2022	Non-Critical	Wet	100%	748,000
2023	Non-Critical	Above Normal	100%	743,000
2024	Non-Critical	Dry	100%	795,000
2025	Non-Critical	Wet	100%	748,000
2026	Non-Critical	Critically Dry	100%	753,000
2027	Non-Critical	Critically Dry	100%	753,000
2028	Non-Critical	Critically Dry	100%	753,000
2029	Non-Critical	Critically Dry	100%	753,000
2030	Critical	Shasta Critical	77%	590,000
2031	Critical	Shasta Critical	77%	590,000
2032	Non-Critical	Wet	100%	748,000
2033	Non-Critical	Critically Dry	100%	753,000
2034	Non-Critical	Wet	100%	748,000
2035	Non-Critical	Wet	100%	748,000
2036	Non-Critical	Wet	100%	748,000
2037	Non-Critical	Wet	100%	748,000
2038	Non-Critical	Above Normal	100%	743,000
2039	Non-Critical	Above Normal	100%	743,000
2040	Non-Critical	Dry	100%	795,000
2041	Non-Critical	Dry	100%	795,000
2042	Non-Critical	Below Normal	100%	788,000
2043	Non-Critical	Dry	100%	776,000
2044	Non-Critical	Wet	100%	731,000
2045	Non-Critical	Wet	100%	761,000
2046	Non-Critical	Critically Dry	100%	804,000
2047	Non-Critical	Critically Dry	100%	753,000
2048	Non-Critical	Below Normal	100%	756,000
2049	Non-Critical	Above Normal	100%	743,000
2050	Non-Critical	Wet	100%	753,000
2051	Non-Critical	Dry	100%	795,000
2052	Non-Critical	Critically Dry	100%	748,000
2053	Critical	Shasta Critical	77%	590,000
2054	Critical	Shasta Critical	77%	590,000
2055	Non-Critical	Dry	100%	638,000
2056	Non-Critical	Wet	100%	748,000
2057	Non-Critical	Wet	100%	748,000
2058	Non-Critical	Below Normal	100%	756,000
2059	Non-Critical	Wet	100%	748,000
2060	Non-Critical	Dry	100%	795,000
2061	Non-Critical	Wet	100%	748,000
2062	Non-Critical	Above Normal	100%	743,000
2063	Non-Critical	Below Normal	100%	756,000
2064	Non-Critical	Dry	100%	795,000
2065	Non-Critical	Above Normal	100%	743,000
2066	Non-Critical	Wet	100%	748,000
2067	Non-Critical	Wet	100%	748,000
2068	Critical	Shasta Critical	77%	590,000
2069	Critical	Shasta Critical	77%	590,000
2070	Non-Critical	Wet	100%	748,000
Avg:				**726,000**

Table 28 - Projected Surface Water Delivery

Projected Groundwater Extractions:

The SJREC GSA has been sustainably managing groundwater extractions and plans to continue the groundwater extractions, based on water year type, in the same quantities to meet demand. Projected groundwater extractions are assumed to follow historic patterns resulting in projecting groundwater extractions based on established data from 2003-2017. Projecting the amount of groundwater extractions uses the same method as projecting surface water deliveries as described above; use historic surrogate years based on water year type to project how much groundwater will be pumped. All groundwater extractions are reported in acre-feet.

WATER YEAR	UPPER AQUIFER GROUNDWATER EXTRACTIONS (AF)	LOWER AQUIFER GROUNDWATER EXTRACTIONS (AF)	TOTAL GROUNDWATER EXTRACTION (AF)
2014	169,000	19,000	188,000
2015	228,000	25,000	253,000
2016	59,000	6,000	65,000
2017	22,000	2,000	24,000
2018	68,000	8,000	76,000
2019	22,000	2,000	24,000
2020	59,000	6,000	65,000
2021	22,000	2,000	24,000
2022	22,000	2,000	24,000
2023	68,000	8,000	76,000
2024	59,000	6,000	65,000
2025	22,000	2,000	24,000
2026	146,000	16,000	162,000
2027	146,000	16,000	162,000
2028	146,000	16,000	162,000
2029	146,000	16,000	162,000
2030	166,000	18,000	184,000
2031	163,000	18,000	181,000
2032	22,000	2,000	24,000
2033	146,000	16,000	162,000
2034	22,000	2,000	24,000
2035	22,000	2,000	24,000
2036	22,000	2,000	24,000
2037	22,000	2,000	24,000
2038	68,000	8,000	76,000
2039	68,000	8,000	76,000
2040	59,000	6,000	65,000
2041	59,000	6,000	65,000
2042	104,000	12,000	116,000
2043	59,000	6,000	65,000
2044	22,000	2,000	24,000
2045	22,000	2,000	24,000
2046	161,000	18,000	179,000
2047	161,000	18,000	179,000
2048	148,000	16,000	164,000
2049	68,000	8,000	76,000
2050	22,000	2,000	24,000
2051	59,000	6,000	65,000
2052	161,000	18,000	179,000
2053	166,000	18,000	184,000
2054	163,000	18,000	181,000
2055	59,000	6,000	65,000
2056	22,000	2,000	24,000
2057	22,000	2,000	24,000
2058	148,000	16,000	164,000
2059	22,000	2,000	24,000
2060	59,000	6,000	65,000
2061	22,000	2,000	24,000
2062	68,000	8,000	76,000
2063	148,000	16,000	164,000
2064	59,000	6,000	65,000
2065	68,000	8,000	76,000
2066	22,000	2,000	24,000
2067	22,000	2,000	24,000
2068	166,000	18,000	184,000
2069	163,000	18,000	181,000
2070	22,000	2,000	24,000
Average:	**81,000**	**9,000**	**90,000**

Table 29- Projected Groundwater Extractions

Projected Precipitation:

Historical data from the National Weather Service Station in Los Banos, located at the CCID office, was used to establish a baseline for projecting future annual precipitation. Data was collected from this station from 1961-2017 as a baseline for over 50 years of historical precipitation. Refer to Table 27 for a historical reference for water year based on hydrology. Data from this historical record was used as a baseline prior to adding climate change factors (CCF). The CCF's for precipitation were provided in a gridded format, by DWR, for approximately each 15 square miles. The value of each grid cell that overlaid the SJREC GSP Group was averaged to determine the overall factor for this area. The CCF for precipitation for each year was applied to baseline condition for each year to estimate the projected precipitation to be expected at the Los Banos weather station. As described previously, actual data was used for water years 2014-2017 in the projected water budget. The 2030 CCF's were used for water years 2018-2045 and the 2070 CCF's were used for water years 2046-2070. The climate change model provided projected precipitation using 2030 and 2070 factors for Water Years 1915-2011. In order to simulate climate change impacts to precipitation from 2011-2017, the following years were respectively used as surrogates: 2001, 1992, 1976, 1977, 2002, and 2011. This method was discussed and approved by both the Delta-Mendota Coordination Committee and DWR. The results of the climate change modeling shows minor fluctuations above and below historic average conditions. The long-term average change shows a reduction in precipitation of less than one percent for this area.

WATER YEAR	PRECIPITATION (inches)	TOTAL PRECIPITATION (AF)	CLIMATE CHANGE FACTOR	EFFECTIVE PRECIPITATION (ET_{precip})	NON-EFFECTIVE PRECIPITATION
2014	6.86	93,000	1.000	23,000	70,000
2015	10.18	142,000	1.000	81,000	61,000
2016	10.39	281,000	1.000	140,000	141,000
2017	5.04	286,000	1.000	166,000	120,000
2018	10.75	200,000	0.996	108,000	92,000
2019	8.75	209,000	0.992	108,000	101,000
2020	11.31	130,000	0.965	57,000	73,000
2021	5.90	277,000	1.007	135,000	142,000
2022	15.53	332,000	1.037	169,000	163,000
2023	7.71	141,000	1.003	83,000	58,000
2024	7.82	148,000	0.989	67,000	81,000
2025	3.54	259,000	0.997	147,000	112,000
2026	14.47	166,000	1.022	88,000	78,000
2027	9.25	191,000	0.992	86,000	105,000
2028	9.41	139,000	1.026	31,000	108,000
2029	6.77	143,000	1.032	43,000	100,000
2030	5.11	151,000	1.008	55,000	96,000
2031	16.66	188,000	1.024	93,000	95,000
2032	9.40	281,000	0.992	181,000	100,000
2033	9.89	155,000	1.027	68,000	87,000
2034	6.34	289,000	0.976	163,000	126,000
2035	12.92	229,000	0.981	123,000	106,000
2036	15.05	263,000	1.027	187,000	76,000
2037	6.61	494,000	0.963	287,000	207,000
2038	7.00	147,000	0.983	49,000	98,000
2039	12.22	174,000	0.961	84,000	90,000
2040	7.65	192,000	1.016	86,000	106,000
2041	9.04	124,000	1.000	51,000	73,000
2042	6.36	189,000	1.055	86,000	103,000
2043	6.54	178,000	1.056	107,000	71,000
2044	7.07	336,000	1.011	179,000	157,000
2045	8.63	223,000	0.991	101,000	122,000
2046	13.31	90,000	0.955	16,000	74,000
2047	7.11	134,000	1.017	78,000	56,000
2048	13.89	118,000	0.931	55,000	63,000
2049	10.94	240,000	0.985	131,000	109,000
2050	12.06	256,000	0.957	144,000	112,000
2051	24.08	103,000	1.009	18,000	85,000
2052	7.03	114,000	0.988	52,000	62,000
2053	8.51	91,000	0.973	23,000	68,000
2054	8.88	137,000	0.970	78,000	59,000
2055	5.83	266,000	0.951	133,000	133,000
2056	8.44	273,000	0.957	159,000	114,000
2057	7.91	226,000	0.987	105,000	121,000
2058	15.59	180,000	0.969	108,000	72,000
2059	10.55	232,000	0.961	125,000	107,000
2060	4.42	116,000	0.925	39,000	77,000
2061	6.22	334,000	1.011	209,000	125,000
2062	5.96	156,000	0.948	69,000	87,000
2063	11.43	164,000	0.981	65,000	99,000
2064	12.60	70,000	0.929	23,000	47,000
2065	4.80	314,000	1.021	215,000	99,000
2066	5.38	195,000	0.989	87,000	108,000
2067	4.39	209,000	1.045	98,000	111,000
2068	6.65	140,000	0.973	22,000	118,000
2069	13.15	105,000	0.970	19,000	86,000
2070	13.40	354,000	0.998	225,000	129,000
Average:	**9.35**	**199,000**	**0.992**	**100,000**	**99,000**

Table 30 - Projected Precipitation

Projected Streamflow Recharge:

San Joaquin River Losses: The climate change model was used to project the FNF into Millerton Reservoir on the San Joaquin River. The average change during the projected water budget has a reduction of FNF into Millerton of about four percent. Under most year types, there was not any water in the SJREC area in the San Joaquin River that was released from Millerton during the Historic and Current Water Budget timeframes. Rather, the water that is in the San Joaquin River adjacent to the Exchange Contractors has typically been delivered via the DMC. There are a few exceptions when water is released from Millerton and is in the river adjacent to the Exchange Contractors. The first such year type is when the USBR is unable to meet the delivery obligations to the SJREC via the DMC. The operation does not result in an increase in recharge from the San Joaquin River for the stretch of river adjacent to the Exchange Contractors. The second type is during flood releases from Millerton which typically occurs during a Wet water year type. These releases increase recharge in the river and have been included in our Historic and Current Water Budget. The climate change model shows a reduction of FNF into Millerton during wet years by about seven percent. The climate change model provided projected inflows using 2030 and 2070 factors for Water Years 1922-2003. In order to simulate climate change impacts to stream flow from 2004-2017, the following years were respectively used as surrogates: 2002, 2002, 1998, 1992, 1992, 2002, 2003, 1997, 1992, 1992, 1976, 1977, 2002, 1998. This method was discussed and approved by both the Delta-Mendota Coordination Committee and DWR.

Another component that may increase the overall seepage occurring in the San Joaquin River is a resultant of the San Joaquin River Restoration Program (SJRRP) implemented by the USBR. The SJRRP is the direct result of the San Joaquin River Restoration Settlement. Under historic conditions, the San Joaquin River was dry downstream of Gravelly Ford except during flood releases. The San Joaquin River was wet, from deliveries to the Exchange Contractors via the DMC, from San Mateo Avenue down to Sack Dam. For more information about the SJRRP refer to: http://www.restoresjr.net/

There are two main factors mentioned that will have an impact on the potential recharge in the San Joaquin River; 1) Climate Change and 2) SJRRP. The results of the climate change model shows a slight reduction in the FNF of the river. The SJRRP, when implemented, will no doubt show an increase in seepage in the river primarily in the historically dry reaches of the river but may also increase the seepage in historically wet reaches of the river due to increased flow through those areas. With this and other potential uncertainties in mind, the SJREC GSP Group has elected to use a conservative approach by assuming the recharge in the San Joaquin River will mimic historical conditions and did not include additional recharge that may occur due to the SJRRP.

Ephemeral Streams: The flood water from ephemeral streams in the SJREC area is due to local precipitation. The CCF's for precipitation indicates a reduction of less than one percent. Additionally, the climate change modeling shows that there is a reduction of less than one percent precipitation in wet years which is typically when the flood flows on the streams occurs. The projected recharge from Ephemeral Streams is assumed to mimic historical conditions.

Recharge Projects:

The SJREC are developing several recharge projects that are further described in Section 4.0 of this plan. Actual data is used for water years 2014-2017. For water years 2018-2070, the average annual benefit of the projects is assumed. No water is recharged during Shasta Critical water years.

The SJREC has several projects that are discussed in Section 4.0 that will contribute additional recharge. The operations of these recharge projects will be different for GSA's in the Delta-Mendota Subbasin. For many of the other GSA's, intentional recharge projects will be used to offset groundwater extractions as a means to achieve sustainability. The SJREC GSA is already sustainable and these recharge projects are intended to help meet peak demand and provide an additional water supply during Shasta Critical years.

WATER YEAR	WATER YEAR TYPE (SJ VALLEY)	SAN JOAQUIN RIVER RECHARGE (AF)	LOS BANOS AND ORESTIMBA CREEKS RECHARGE (AF)	RECHARGE PROJECTS (AF)	TOTAL STREAM RECHARGE (AF)
2014	Shasta Critical	5,000	0	-	**5,000**
2015	Shasta Critical	5,000	1,000	-	**6,000**
2016	Dry	5,000	2,000	-	**7,000**
2017	Wet	5,000	3,000	6,000	**14,000**
2018	Above Normal	5,000	1,000	6,000	**12,000**
2019	Wet	6,000	2,000	6,000	**14,000**
2020	Dry	5,000	0	6,000	**11,000**
2021	Wet	6,000	2,000	6,000	**14,000**
2022	Wet	6,000	2,000	6,000	**14,000**
2023	Above Normal	5,000	1,000	6,000	**12,000**
2024	Dry	5,000	0	6,000	**11,000**
2025	Wet	6,000	2,000	6,000	**14,000**
2026	Critically Dry	5,000	1,000	6,000	**12,000**
2027	Critically Dry	5,000	1,000	6,000	**12,000**
2028	Critically Dry	5,000	1,000	6,000	**12,000**
2029	Critically Dry	5,000	1,000	6,000	**12,000**
2030	Shasta Critical	5,000	1,000	-	**6,000**
2031	Shasta Critical	5,000	1,000	-	**6,000**
2032	Wet	6,000	2,000	6,000	**14,000**
2033	Critically Dry	5,000	1,000	6,000	**12,000**
2034	Wet	6,000	2,000	6,000	**14,000**
2035	Wet	6,000	2,000	6,000	**14,000**
2036	Wet	6,000	2,000	6,000	**14,000**
2037	Wet	6,000	2,000	6,000	**14,000**
2038	Above Normal	5,000	1,000	6,000	**12,000**
2039	Above Normal	5,000	1,000	6,000	**12,000**
2040	Dry	5,000	0	6,000	**11,000**
2041	Dry	5,000	0	6,000	**11,000**
2042	Below Normal	5,000	1,000	6,000	**12,000**
2043	Dry	5,000	0	6,000	**11,000**
2044	Wet	5,000	2,000	6,000	**13,000**
2045	Wet	5,000	1,000	6,000	**12,000**
2046	Critically Dry	5,000	0	6,000	**11,000**
2047	Critically Dry	5,000	1,000	6,000	**12,000**
2048	Below Normal	5,000	0	6,000	**11,000**
2049	Above Normal	5,000	1,000	6,000	**12,000**
2050	Wet	5,000	2,000	6,000	**13,000**
2051	Dry	5,000	0	6,000	**11,000**
2052	Critically Dry	5,000	1,000	6,000	**12,000**
2053	Shasta Critical	5,000	0	-	**5,000**
2054	Shasta Critical	5,000	1,000	-	**6,000**
2055	Dry	5,000	2,000	6,000	**13,000**
2056	Wet	5,000	3,000	6,000	**14,000**
2057	Wet	6,000	2,000	6,000	**14,000**
2058	Below Normal	4,000	1,000	6,000	**11,000**
2059	Wet	6,000	2,000	6,000	**14,000**
2060	Dry	5,000	0	6,000	**11,000**
2061	Wet	6,000	2,000	6,000	**14,000**
2062	Above Normal	5,000	1,000	6,000	**12,000**
2063	Below Normal	4,000	1,000	6,000	**11,000**
2064	Dry	5,000	0	6,000	**11,000**
2065	Above Normal	5,000	1,000	6,000	**12,000**
2066	Wet	6,000	2,000	6,000	**14,000**
2067	Wet	6,000	2,000	6,000	**14,000**
2068	Shasta Critical	5,000	1,000	-	**6,000**
2069	Shasta Critical	5,000	1,000	-	**6,000**
2070	Wet	6,000	2,000	6,000	**14,000**
Average:		**5,000**	**1,000**	**5,000**	**11,000**

Table 31 - Projected Stream and Intentional Recharge

Surface Water and Groundwater Outflow:

The SJREC member entities have each worked on conservation projects to reduce losses and maintain great service to the growers. One way to reduce losses from the system is to construct regulating reservoirs to capture potential spills. Regulating reservoirs provide the operators flexibility to meet the fluctuations of demand. The entities have and continue to construct regulating reservoirs primarily to reduce spills while maintaining operational flexibility for our growers. Another type of conservation project the SJREC have implemented is a recapture facility to capture runoff and recirculate the water back into the system. These systems have also been effective in reducing losses for the districts. A reduction factor for surface outflow has been applied to the projected water budget. The districts have seen a drastic decrease in surface outflows leaving the area. It is unclear at the moment when the next conservation project will be constructed and the factors indicated are assumed to be a conservative estimate on the reductions.

Another source of surface water outflow is through the tile drainage systems. These tile drains are operated to mitigate shallow saline groundwater and are expected to mimic historic conditions.

WATER YEAR	TILE DRAIN OUTFLOW (AF)	SURFACE SPILL REDUCTION FACTOR	SURFACE WATER OUTFLOW AND SPILLS (AF)	TOTAL SURFACE WATER OUTFLOW (AF)
2014	2,000	1.00	48,000	**50,000**
2015	1,000	1.00	41,000	**42,000**
2016	2,000	1.00	60,000	**62,000**
2017	2,000	1.00	93,000	**95,000**
2018	2,000	1.00	112,000	**114,000**
2019	2,000	1.00	93,000	**95,000**
2020	3,000	1.00	94,000	**96,000**
2021	2,000	1.00	93,000	**95,000**
2022	2,000	1.00	93,000	**95,000**
2023	2,000	1.00	112,000	**114,000**
2024	3,000	1.00	94,000	**96,000**
2025	2,000	1.00	93,000	**95,000**
2026	3,000	0.85	81,000	**83,000**
2027	3,000	0.85	81,000	**83,000**
2028	3,000	0.85	81,000	**83,000**
2029	3,000	0.85	81,000	**83,000**
2030	2,000	0.85	38,000	**40,000**
2031	2,000	0.85	38,000	**40,000**
2032	2,000	0.85	79,000	**81,000**
2033	3,000	0.85	81,000	**83,000**
2034	2,000	0.85	79,000	**81,000**
2035	2,000	0.85	79,000	**81,000**
2036	2,000	0.85	79,000	**81,000**
2037	2,000	0.85	79,000	**81,000**
2038	2,000	0.85	95,000	**97,000**
2039	2,000	0.85	95,000	**97,000**
2040	3,000	0.85	80,000	**82,000**
2041	3,000	0.75	71,000	**73,000**
2042	3,000	0.75	95,000	**98,000**
2043	3,000	0.75	92,000	**95,000**
2044	3,000	0.75	84,000	**87,000**
2045	2,000	0.75	79,000	**81,000**
2046	3,000	0.75	82,000	**85,000**
2047	2,000	0.75	71,000	**73,000**
2048	2,000	0.75	71,000	**73,000**
2049	2,000	0.75	84,000	**86,000**
2050	2,000	0.75	92,000	**94,000**
2051	2,000	0.75	71,000	**73,000**
2052	2,000	0.75	74,000	**76,000**
2053	2,000	0.75	36,000	**38,000**
2054	1,000	0.75	31,000	**32,000**
2055	2,000	0.75	45,000	**47,000**
2056	2,000	0.60	56,000	**58,000**
2057	2,000	0.60	56,000	**58,000**
2058	3,000	0.60	56,000	**58,000**
2059	2,000	0.60	56,000	**58,000**
2060	3,000	0.60	56,000	**58,000**
2061	2,000	0.60	56,000	**58,000**
2062	2,000	0.60	67,000	**69,000**
2063	3,000	0.60	56,000	**58,000**
2064	3,000	0.60	56,000	**58,000**
2065	2,000	0.60	67,000	**69,000**
2066	2,000	0.60	56,000	**58,000**
2067	2,000	0.60	56,000	**58,000**
2068	2,000	0.60	27,000	**29,000**
2069	2,000	0.60	27,000	**29,000**
2070	2,000	0.60	56,000	**58,000**
Average:	**2,000**	**0.8**	**71,000**	**73,000**

Table 32 - Projected Total Surface Outflow

Projected Evapotranspiration:

The SJREC GSA area is sustainable and does not anticipate any significant deviation from historical conditions. The area of the SJREC GSA is highly unlikely to expand and may even reduce the footprint as cities around CCID annex land into the City limits. Refer to Table 27 for a historical reference for water year based on hydrology. Data from this historical record was used as a baseline prior to adding climate change factors (CCF). The CCF's for ET were provided in a gridded format, by DWR, for approximately each 15 square miles. The value of each grid cell that overlaid the SJREC GSP Group was averaged to determine the overall factor for this area. The CCF for ET for each year was applied to baseline condition for each year to estimate the projected ET to be expected at the Los Banos weather station. As described previously, actual data was used for water years 2014-2017 in the projected water budget. The 2030 CCF's were used for water years 2018-2045 and the 2070 CCF's were used for water years 2046-2070. The climate change model provided projected ET using 2030 and 2070 factors for Water Years 1915-2011. In order to simulate climate change impacts to ET from 2011-2017, the following years were respectively used as surrogates: 2001, 1992, 1976, 1977, 2002, and 2011. This method was discussed and approved by both the Delta-Mendota Coordination Committee and DWR. The result of the climate change modeling shows an increase in crop consumptive use. The 2030 CCF indicates an increase of three percent and the 2070 CCF indicates an increase of eight percent with an overall average increase of about five percent. These factors were applied and the results are shown below.

WATER YEAR	PROJECTED ET_C	PROJECTED ET_{IW}	PROJECTED ET_{MISC}	CCF	PROJECTED ET_C W/ CLIMATE CHANGE	PROJECTED ET_{IW} W/ CLIMATE CHANGE	PROJECTED ET_{MISC} W/ CLIMATE CHANGE	TOTAL ET W/ CLIMATE CHANGE
2014	*560,000*	*537,000*	*56,000*	1.000	560,000	537,000	56,000	616,000
2015	*562,000*	*481,000*	*56,000*	1.000	562,000	481,000	56,000	618,000
2016	*584,000*	*444,000*	*59,000*	1.000	584,000	444,000	59,000	643,000
2017	*628,000*	*477,000*	*66,000*	1.000	628,000	462,000	66,000	694,000
2018	*575,000*	*446,000*	*56,000*	1.035	595,000	487,000	58,000	653,000
2019	*628,000*	*477,000*	*66,000*	1.035	650,000	542,000	68,000	719,000
2020	*618,000*	*598,000*	*62,000*	1.035	640,000	583,000	64,000	704,000
2021	*628,000*	*477,000*	*66,000*	1.033	649,000	514,000	68,000	717,000
2022	*628,000*	*477,000*	*66,000*	1.038	652,000	483,000	68,000	720,000
2023	*575,000*	*446,000*	*56,000*	1.030	592,000	509,000	58,000	650,000
2024	*618,000*	*598,000*	*62,000*	1.036	640,000	573,000	64,000	705,000
2025	*628,000*	*477,000*	*66,000*	1.040	653,000	506,000	69,000	722,000
2026	*713,000*	*637,000*	*21,000*	1.033	737,000	649,000	22,000	759,000
2027	*713,000*	*637,000*	*21,000*	1.034	737,000	651,000	22,000	759,000
2028	*713,000*	*637,000*	*21,000*	1.034	737,000	706,000	22,000	759,000
2029	*713,000*	*637,000*	*21,000*	1.028	733,000	690,000	22,000	754,000
2030	*561,000*	*509,000*	*56,000*	1.030	578,000	523,000	58,000	636,000
2031	*561,000*	*509,000*	*56,000*	1.033	579,000	486,000	58,000	637,000
2032	*628,000*	*477,000*	*66,000*	1.033	649,000	468,000	68,000	717,000
2033	*713,000*	*637,000*	*21,000*	1.033	737,000	669,000	22,000	758,000
2034	*628,000*	*477,000*	*66,000*	1.038	652,000	489,000	69,000	721,000
2035	*628,000*	*477,000*	*66,000*	1.031	648,000	525,000	68,000	716,000
2036	*628,000*	*477,000*	*66,000*	1.031	647,000	460,000	68,000	715,000
2037	*628,000*	*477,000*	*66,000*	1.035	650,000	363,000	68,000	718,000
2038	*575,000*	*446,000*	*56,000*	1.035	595,000	546,000	58,000	653,000
2039	*575,000*	*446,000*	*56,000*	1.035	595,000	511,000	58,000	653,000
2040	*618,000*	*598,000*	*62,000*	1.030	637,000	551,000	64,000	701,000
2041	*618,000*	*598,000*	*62,000*	1.032	638,000	587,000	64,000	702,000
2042	*719,000*	*638,000*	*20,000*	1.032	742,000	656,000	21,000	763,000
2043	*740,000*	*631,000*	*20,000*	1.030	762,000	655,000	21,000	783,000
2044	*707,000*	*544,000*	*20,000*	1.036	732,000	553,000	21,000	753,000
2045	*704,000*	*598,000*	*20,000*	1.035	728,000	627,000	21,000	749,000
2046	*709,000*	*694,000*	*20,000*	1.079	765,000	749,000	22,000	787,000
2047	*713,000*	*637,000*	*21,000*	1.080	770,000	692,000	23,000	792,000
2048	*665,000*	*593,000*	*67,000*	1.085	721,000	666,000	73,000	794,000
2049	*575,000*	*446,000*	*56,000*	1.086	625,000	494,000	61,000	685,000
2050	*628,000*	*477,000*	*66,000*	1.086	682,000	538,000	72,000	754,000
2051	*618,000*	*598,000*	*62,000*	1.075	664,000	646,000	67,000	731,000
2052	*608,000*	*556,000*	*57,000*	1.088	661,000	609,000	62,000	723,000
2053	*560,000*	*537,000*	*56,000*	1.086	608,000	585,000	61,000	669,000
2054	*562,000*	*481,000*	*56,000*	1.083	609,000	531,000	61,000	669,000
2055	*584,000*	*444,000*	*59,000*	1.082	632,000	499,000	64,000	696,000
2056	*628,000*	*477,000*	*66,000*	1.086	682,000	523,000	72,000	754,000
2057	*628,000*	*477,000*	*66,000*	1.086	682,000	577,000	72,000	753,000
2058	*665,000*	*593,000*	*67,000*	1.088	723,000	615,000	73,000	796,000
2059	*628,000*	*477,000*	*66,000*	1.087	682,000	557,000	72,000	754,000
2060	*618,000*	*598,000*	*62,000*	1.085	671,000	632,000	67,000	738,000
2061	*628,000*	*477,000*	*66,000*	1.087	683,000	474,000	72,000	754,000
2062	*575,000*	*446,000*	*56,000*	1.080	621,000	552,000	60,000	682,000
2063	*665,000*	*593,000*	*67,000*	1.091	726,000	661,000	73,000	799,000
2064	*618,000*	*598,000*	*62,000*	1.085	671,000	648,000	67,000	738,000
2065	*575,000*	*446,000*	*56,000*	1.083	622,000	407,000	61,000	683,000
2066	*628,000*	*477,000*	*66,000*	1.088	683,000	596,000	72,000	755,000
2067	*628,000*	*477,000*	*66,000*	1.088	683,000	585,000	72,000	755,000
2068	*561,000*	*509,000*	*56,000*	1.086	609,000	587,000	61,000	670,000
2069	*561,000*	*509,000*	*56,000*	1.083	608,000	589,000	61,000	668,000
2070	*628,000*	*477,000*	*66,000*	1.074	674,000	449,000	71,000	745,000
Average:	***628,000***	***528,000***	***54,000***	***1.053***	***661,000***	***560,000***	***57,000***	***718,000***

Table 33 - Projected Evapotranspiration

Projected Lateral Inflow and Outflow of Groundwater:

The SJREC have a net positive change in groundwater storage in the upper aquifer in the historic water budget. The SJREC GSA has worked with the GSA's in the Delta-Mendota Subbasin to determine projected lateral groundwater flows. Ken Schmidt prepared a report in 2015 (KDSA, 2015) analyzing the Groundwater Overdraft in the Delta-Mendota Subbasin and concluded that the subbasin was in balance for the Upper Aquifer for most of the subbasin with a few minor localized declining water levels. Additionally, the historic water budget for the Delta-Mendota Subbasin indicates an average annual overdraft of about 50 TAF which is equivalent to less than 0.07 AF/acre/year. The overdraft represents a drier than average cycle during our Historic Water Budget from 2003-2012. Given the minimal overdraft in the upper aquifer, the SJREC GSA has assumed that projected lateral groundwater flows in the upper aquifer will mimic historic conditions.

One Undesirable Result that is occurring in the Delta-Mendota Subbasin and is primarily caused from neighboring subbasins is Land Subsidence. The SJREC GSA is reducing lateral outflow from the lower aquifer as a means to mitigate subsidence originating from outside the SJREC GSP area. The lateral outflow in the Lower Aquifer in dry, critically dry and Shasta critical years needs to be reduced to near normal levels to mitigate land subsidence. A step-down reduction was assumed so as to not have a significant or unreasonable impact on the SJREC GSA area while allowing enough time for the neighboring GSP's to solve any subsidence problems occurring within their GSP area and account for subsidence lag time. Later groundwater inflow in the lower aquifer is significantly lower than the lateral outflow and is therefore assumed to mimic historic conditions. The lateral downward flow through the Corcoran Clay is assumed to reduce slightly over time as less pumping from the lower aquifer occurs and reduces the hydraulic gradient between the upper and lower aquifers.

WATER YEAR	GROUNDWATER INFLOW (Upper Aquifer)	GROUNDWATER OUTFLOW (Upper Aquifer)	GROUNDWATER INFLOW (Lower Aquifer)	ASSUMED REDUCTION IN LOWER AQUIFER OUTFLOW	GROUNDWATER OUTFLOW (Lower Aquifer)	SEEPAGE THROUGH CORCORAN CLAY
2014	44,000	69,000	14,000	0.00	115,000	45,000
2015	44,000	69,000	14,000	0.00	115,000	45,000
2016	44,000	69,000	14,000	0.00	73,000	45,000
2017	73,000	40,000	18,000	0.00	24,000	45,000
2018	71,000	53,000	18,000	0.00	47,000	45,000
2019	73,000	40,000	18,000	0.00	24,000	45,000
2020	44,000	69,000	14,000	0.00	73,000	45,000
2021	73,000	40,000	18,000	0.00	24,000	45,000
2022	73,000	40,000	18,000	0.00	24,000	45,000
2023	71,000	53,000	18,000	0.00	47,000	45,000
2024	44,000	69,000	14,000	0.20	73,000	45,000
2025	73,000	40,000	18,000	0.00	24,000	45,000
2026	44,000	69,000	14,000	0.25	73,000	45,000
2027	44,000	69,000	14,000	0.25	73,000	45,000
2028	44,000	69,000	14,000	0.25	73,000	45,000
2029	44,000	69,000	14,000	0.25	73,000	45,000
2030	44,000	69,000	14,000	0.38	72,000	40,000
2031	44,000	69,000	14,000	0.45	63,000	40,000
2032	73,000	40,000	18,000	0.00	24,000	40,000
2033	44,000	69,000	14,000	0.30	73,000	40,000
2034	73,000	40,000	18,000	0.00	24,000	40,000
2035	73,000	40,000	18,000	0.00	24,000	40,000
2036	73,000	40,000	18,000	0.00	24,000	40,000
2037	73,000	40,000	18,000	0.00	24,000	40,000
2038	71,000	53,000	18,000	0.05	45,000	40,000
2039	71,000	53,000	18,000	0.05	45,000	40,000
2040	44,000	69,000	14,000	0.33	73,000	40,000
2041	44,000	69,000	14,000	0.33	73,000	40,000
2042	71,000	53,000	18,000	0.05	45,000	40,000
2043	44,000	69,000	14,000	0.33	49,000	40,000
2044	67,000	48,000	18,000	0.00	24,000	40,000
2045	73,000	40,000	18,000	0.00	24,000	40,000
2046	44,000	69,000	14,000	0.33	49,000	40,000
2047	44,000	69,000	14,000	0.33	49,000	40,000
2048	71,000	53,000	18,000	0.05	45,000	40,000
2049	71,000	53,000	18,000	0.05	45,000	40,000
2050	73,000	40,000	18,000	0.00	24,000	40,000
2051	44,000	69,000	14,000	0.33	73,000	40,000
2052	44,000	69,000	14,000	0.33	49,000	40,000
2053	44,000	69,000	14,000	0.58	49,000	40,000
2054	44,000	69,000	14,000	0.58	49,000	40,000
2055	44,000	69,000	14,000	0.33	49,000	40,000
2056	73,000	40,000	18,000	0.00	24,000	40,000
2057	73,000	40,000	18,000	0.00	24,000	40,000
2058	71,000	53,000	18,000	0.05	47,000	40,000
2059	73,000	40,000	18,000	0.00	24,000	40,000
2060	44,000	69,000	14,000	0.33	73,000	40,000
2061	73,000	40,000	18,000	0.00	24,000	40,000
2062	71,000	53,000	18,000	0.05	45,000	40,000
2063	71,000	53,000	18,000	0.05	47,000	40,000
2064	44,000	69,000	14,000	0.33	73,000	40,000
2065	71,000	53,000	18,000	0.05	45,000	40,000
2066	73,000	40,000	18,000	0.00	24,000	40,000
2067	73,000	40,000	18,000	0.00	24,000	40,000
2068	44,000	69,000	14,000	0.58	49,000	40,000
2069	44,000	69,000	14,000	0.58	49,000	40,000
2070	73,000	40,000	18,000	0.00	24,000	40,000
Avg:	**59,000**	**56,000**	**16,000**	**-**	**48,000**	**41,000**

Table 34 - Projected Later Groundwater Flows

Projected Water Budget Change in Groundwater Storage:

The SJREC have prepared a Free-Body Diagram for surface water interaction. This data is primarily used to see if surface water supply is greater than demand.

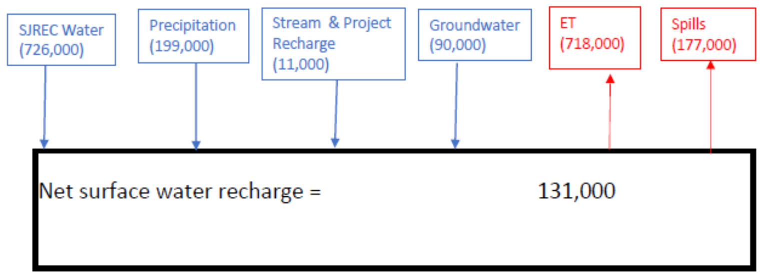

Figure 14 - Projected Free-Body Diagram for Surface Water Interaction

The results of the net surface water recharge shows an average annual recharge from direct, in-direct and in-lieu recharge of 131 TAF/year. The recharge includes but is not limited to; deep percolation from irrigation, deep percolation from precipitation, stream seepage, canal seepage and recharge projects.

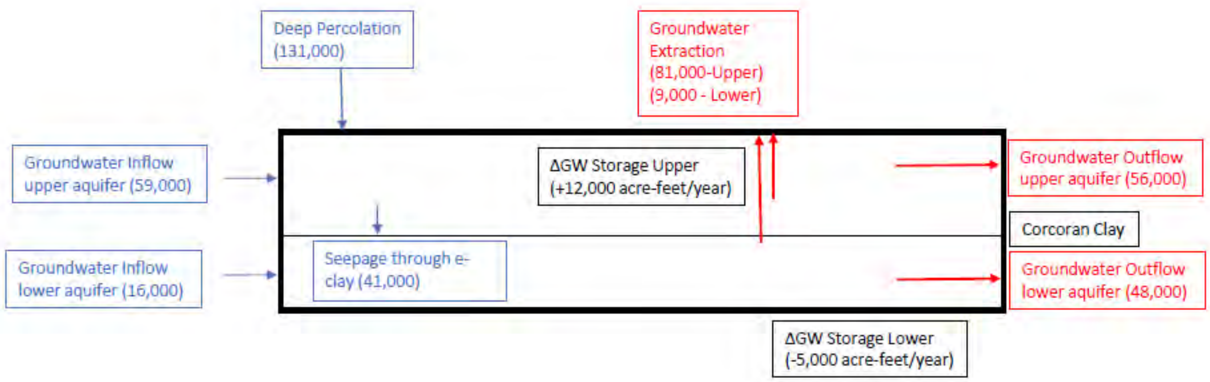

Figure 15 - Projected Free-Body Diagram for Groundwater Interaction

The results of the groundwater interaction show an overall annual average change in storage in the upper aquifer of +12 TAF/year. This indicates that the SJREC GSA will have a sustainable quantity of water in the upper aquifer through the year 2070. This positive change in groundwater storage is for the SJREC GSA only and does not account for groundwater extractions from the other GSA's in the SJREC GSP Group. Section 2.2.5 will describe the changes in groundwater storage for the entire SJREC GSP Group and will show a smaller increase in groundwater storage that is indicative of a reliable projection. The lower aquifer shows an average annual loss of 5 TAF in groundwater storage. The SJREC are extracting an average annual volume of 9 TAF from the lower aquifer which equates to an annual extraction of 0.04 AF/acre. It is reasonable to assert that any reduction in groundwater storage was caused by extractions occurring outside of the SJREC GSA area. The SJREC GSA has used a reduction in lateral groundwater outflow to indicate solving observed subsidence in the area. This equates to a total average subsidence across the SJREC GSP area of about 1.0', most of which has been observed in the first four years of the projected water budget during dry period of 2014-2016. The assumptions made indicate minimal reductions in groundwater storage in the lower aquifer after 2025 and zero reductions after 2035 to account for some lag time of inelastic subsidence. The method of reviewing the change in storage for the lower aquifer is similar to the historic water budget.

WATER YEAR	UPPER AQUIFER CHANGE IN STORAGE (AF)	LOWER AQUIFER CHANGE IN STORAGE (AF)
2014	-207,000	-89,000
2015	-194,000	-89,000
2016	13,000	-24,000
2017	128,000	0
2018	72,000	-2,000
2019	45,000	0
2020	-4,000	-24,000
2021	74,000	0
2022	105,000	0
2023	50,000	-2,000
2024	5,000	-9,000
2025	81,000	0
2026	-53,000	-6,000
2027	-55,000	-6,000
2028	-110,000	-6,000
2029	-93,000	-6,000
2030	-83,000	-23,000
2031	-46,000	-14,000
2032	139,000	0
2033	-67,000	-2,000
2034	117,000	0
2035	82,000	0
2036	147,000	0
2037	244,000	0
2038	35,000	0
2039	70,000	0
2040	47,000	0
2041	20,000	0
2042	8,000	0
2043	-46,000	0
2044	63,000	0
2045	38,000	0
2046	-99,000	0
2047	-80,000	0
2048	-60,000	0
2049	96,000	0
2050	56,000	0
2051	-42,000	0
2052	-45,000	0
2053	-147,000	0
2054	-85,000	0
2055	-21,000	0
2056	103,000	0
2057	50,000	0
2058	6,000	0
2059	69,000	0
2060	-13,000	0
2061	153,000	0
2062	54,000	0
2063	-40,000	0
2064	-29,000	0
2065	199,000	0
2066	30,000	0
2067	41,000	0
2068	-139,000	0
2069	-140,000	0
2070	178,000	0
Average:	**13,000**	**-5,000**

Table 35 - Change in Groundwater Storage for the Projected Water Budget

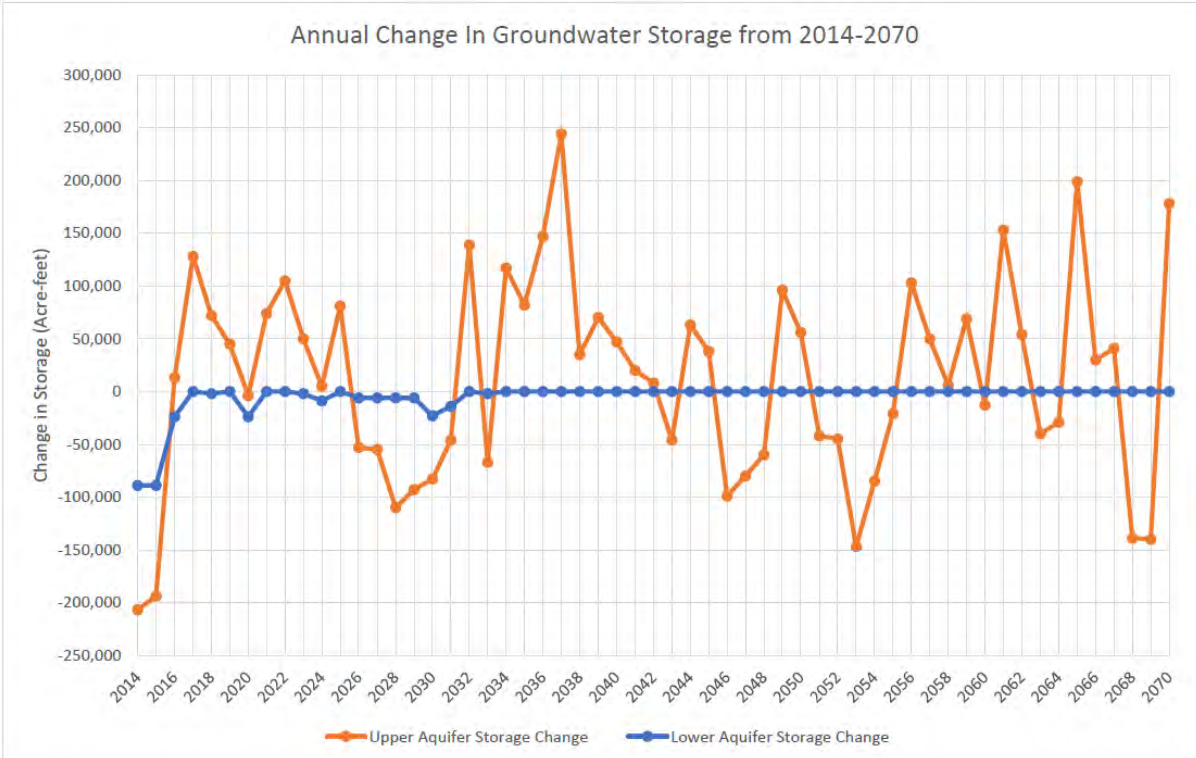

Figure 16 - Annual Projected Change in Groundwater Storage

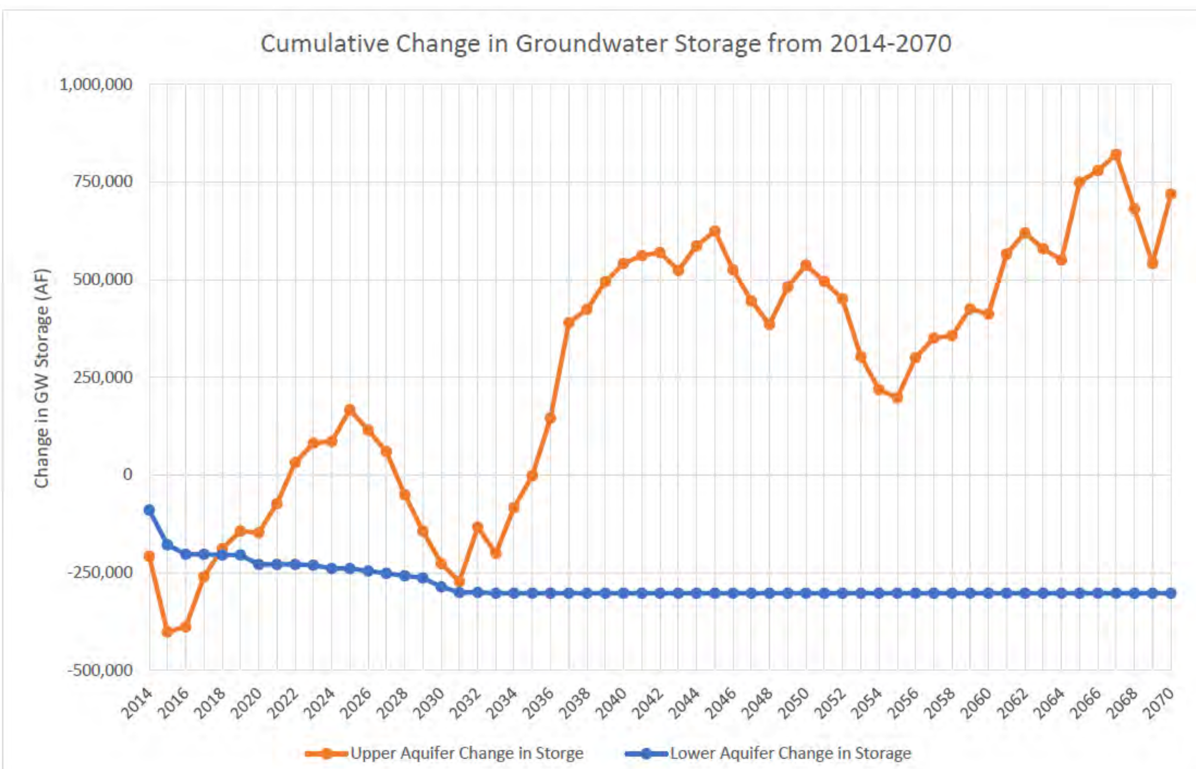

Figure 17 - Cumulative Projected Change in Groundwater Storage

2.2.4 Management Areas

In 1997 Kenneth D. Schmidt and Associates (KDSA) prepared a report for CCID titled "Groundwater Conditions In and Near the Central California Irrigation District". Subsequent to the 1997 CCID report, the SJRECWA worked with KDSA to develop a study titled "Groundwater Flows in the San Joaquin River Exchange Contractors Service Area". Additionally in 1997, KDSA prepared the AB 3030 GWMP for the SJRECWA. These reports, collectively referred to as the 1997 reports herein, coupled together formed a discrete understanding of the groundwater conditions in and around the SJREC service area. From these analyses, KDSA recommended the formation of management areas defined by water supply, aquifer and drainage characteristics.

SGMA defines a management area as an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors. Furthermore, water code section § 354.20. Management Areas allows for the creation of management areas to facilitate implementation of the plan.

2.2.4.1 Management Area A

This is the northernmost area in CCID comprising the communities of Crows Landing (DAC) and Newman (DAC). This area fully encompasses the Stanislaus County portion of CCID. The major geologic formation for this area is the Orestimba Creek. Management area A is both based on the jurisdictional County boundary as well as similar aquifer response and well construction. CCID wholly encompasses the SJRECWA service area in Stanislaus County.

2.2.4.2 Management Area B

This area comprises the Gustine (DAC) area of CCID in Merced County. This area has the Stanislaus/Merced County boundary to the north and Henry Miller Road to the south. The Gustine Drainage District (GDD) operates a number of drainage wells and tile systems to lower shallow water levels in the region to below the effective root zone. The aquifer in this area must be actively pumped to maintain healthy soil, which is the primary reason for the creation of this management area. Some of the major geologic formations are the Garzas Creek, Quinto Creek, Romero Creek and San Luis Creek.

2.2.4.3 Management Area C

This area includes the communities of Volta (DAC) and Los Banos (DAC) area of CCID in Merced County. This area is generally bound by Henry Miller Road to the north and the contiguous southern boundary of Class 1 ground to the southeast of Los Banos adjacent to management area K. The primary geologic formation in this area is the Los Banos Creek. Additionally, Ortigalita Creek also runs through the area.

2.2.4.4 Management Area D

This area includes the community of Dos Palos (SDAC) area of CCID in Merced County. This relatively small area encompasses the area surrounding Dos Palos in Merced County. The Dos Palos Drainage District (DPDD) operates several drainage facilities to lower shallow water levels in the region. In order to maintain healthy soils, this area must be actively managed. The area has been impacted by upslope drainage of poor quality groundwater. As a result, the City of Dos Palos worked with CCID to receive surface water for municipal use.

2.2.4.5 Management Area E

This area includes the southern portion of CCID east of Dos Palos, north of the CCID Main Canal and bordering the City of Firebaugh. This area is generally the Fresno/Merced County line eastward to the City of Firebaugh. Groundwater below the Corcoran Clay in this area is believed to be of poor quality and is generally not used for water supply. This management area was developed due to similar aquifer characteristics for both the upper and lower aquifers consistent with well construction in the area.

2.2.4.6 Management Area F

This area includes the Camp 13 portion of CCID in Fresno County. This area has been significantly impacted from upslope drainage of poor quality groundwater. Tile drainage and groundwater extractions are a vital tool to improve the overall health of the soil in this area. The principal reason for the formation of this management area is related to drainage. Camp 13 is actively managing groundwater to help mitigate the migration of poor quality groundwater from outside the area. Point source control and tile drainage have proven effective to mitigate the problems associated with drainage.

2.2.4.7 Management Area G

This area comprises the communities of Firebaugh (SDAC) and Mendota (SDAC) area of CCID in Fresno County. This area is more generally described as the CCID land between Firebaugh and Mendota. Groundwater below the Corcoran Clay in this area is believed to be of poor quality. This area has the potential to be impacted directly by the groundwater extractions resulting from the Mendota Pool Group pumping program. This area was established based on hydrogeologic conditions in the area between the two communities.

2.2.4.8 Management Area H

This area fully encompasses the SLCC in Merced County and very small portion in Fresno County. SLCC is bound by CCID to the south and east, the San Joaquin River to the north and the greater Grasslands area to the west. The formation of management area H is both jurisdictional and also based on the hydrogeologic characteristics of the aquifer. This area has a very shallow water table and must actively manage the aquifer to maintain healthy soils and keep the water level below effective root zones. The characteristics of the aquifer in this area is similar to management area E.

2.2.4.9 Management Area I

This area fully encompasses the FCWD in Fresno County. Similar to management area F, this area has been significantly impacted from upslope drainage of poor quality groundwater. Tile drainage and groundwater extractions are a vital tool to improve the overall health of the soil in this area. The principal reason for the formation of this management area is related to drainage. FCWD is actively managing groundwater to help mitigate the migration of poor quality groundwater from outside the area. Point source control and tile drainage have proven effective to mitigate the problems associated with drainage.

2.2.4.10 Management Area J

This area fully encompasses the CCC in Madera and Fresno Counties. CCC wholly encompasses all of the SJRECWA service area in Madera County. CCC is separated from CCID by the San Joaquin River and is the only district in the SJRECWA service area east of the river. The formation of management area J is both jurisdictional and also based on the hydrogeologic characteristics of the aquifers.

2.2.4.11 Management Area K

Prior to the development of this plan, all other management areas had already been established. Management Area K is the only new additional management area and was formed to include the CCID Class 2 lands between Management Areas C and F. CCID Class 2 land receives water from CCID on a "if and when available" basis. These lands were historically served by the water rights developed by Henry Miller. The groundwater conditions in this area are similar to management area D.

2.2.5 Combined Water Budgets for the SJREC GSP Group

This section will describe the cumulative water budgets for the SJREC GSP Group. Sections 7 through 16 of this plan describe each respective GSA's water budget. In order to sustainably managing groundwater at the local level it is vitally important to understand the impact each GSA has on groundwater management. This section is provided to represent the GSP Group as a whole. The data from each GSA was used and combined into one water budget.

2.2.5.1 Combined Historic Water Budget for the SJREC GSP Group

Water Year	Shasta Water Year Designation	Water Year Type (SJ Valley)	Surface Water Delivery	Groundwater Extraction	Total Consumptive Use (ET_{iw})	Change in Groundwater Storage (Upper Aquifer)	Change in Groundwater Storage (Lower Aquifer)
2003	Non-Critical	Below Normal	788,000	142,000	760,000	-33,000	-2,000
2004	Non-Critical	Dry	776,000	170,000	782,000	-74,000	-24,000
2005	Non-Critical	Wet	731,000	94,000	746,000	34,000	0
2006	Non-Critical	Wet	761,000	83,000	743,000	12,000	0
2007	Non-Critical	Critical	804,000	215,000	752,000	-96,000	-24,000
2008	Non-Critical	Critical	753,000	193,000	756,000	-75,000	-24,000
2009	Non-Critical	Below Normal	756,000	194,000	755,000	-28,000	-2,000
2010	Non-Critical	Above Normal	743,000	104,000	652,000	96,000	-2,000
2011	Non-Critical	Wet	753,000	109,000	714,000	72,000	0
2012	Non-Critical	Dry	795,000	174,000	702,000	-34,000	-24,000

Table 36 - Combined SJREC GSP Group Historic Water Budget

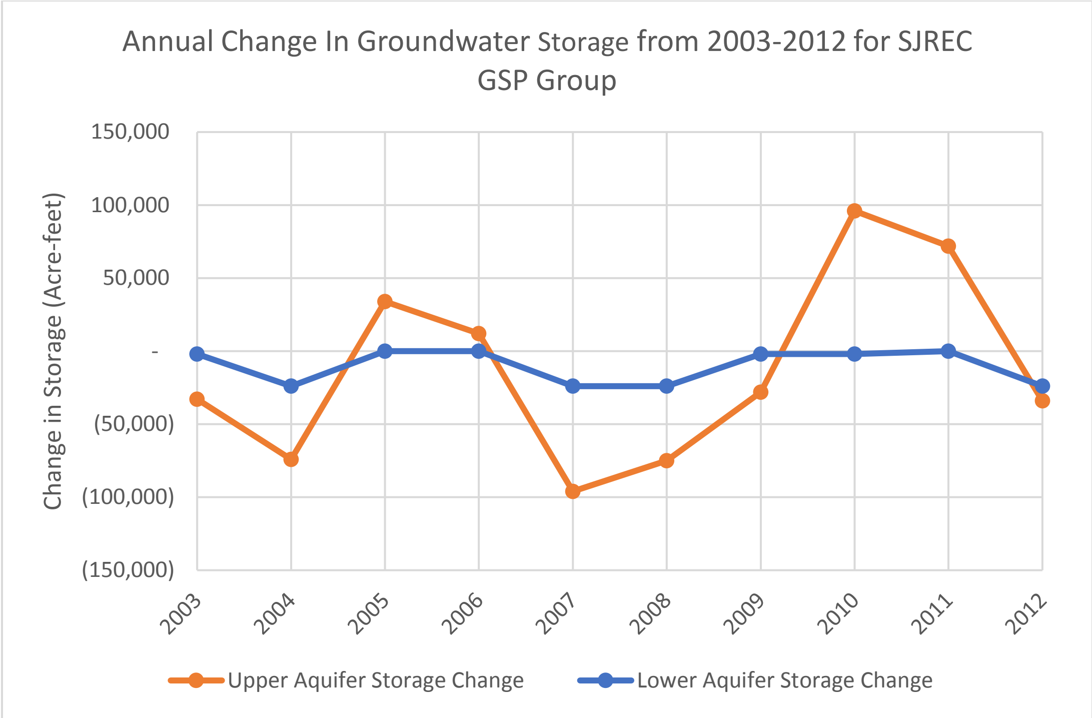

Figure 18 - Annual Historic Change in Groundwater Storage for SJREC GSP Group

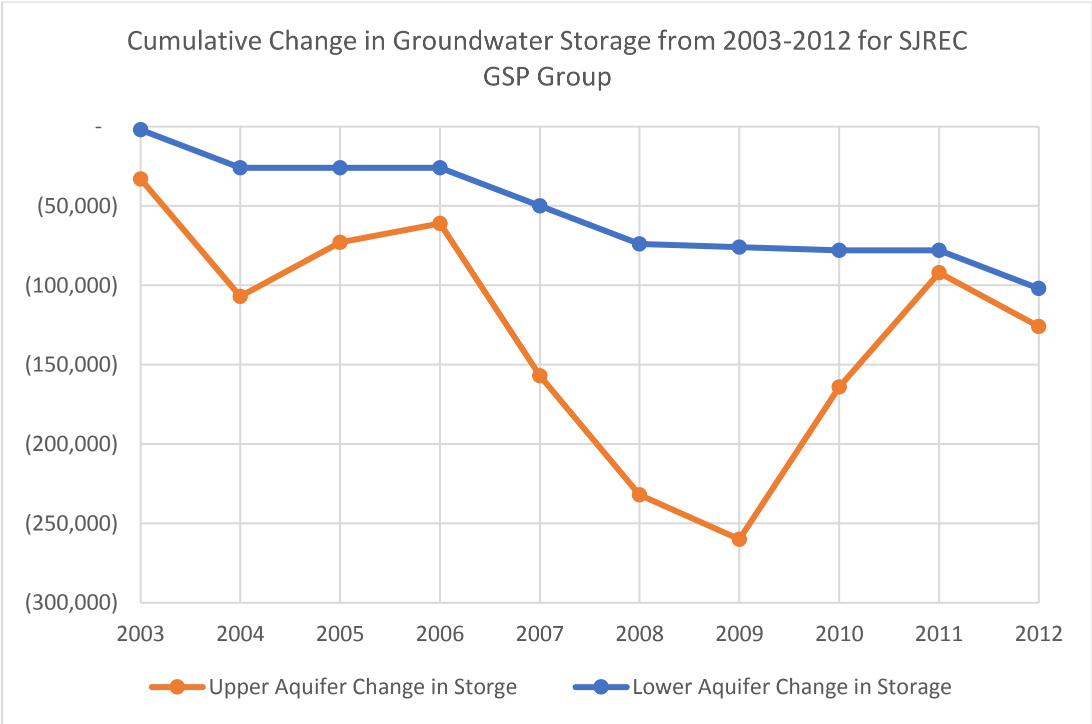

Figure 19 - Cumulative Historic Change in Groundwater Storage for SJREC GSP Group

2.2.5.2 Combined Current Water Budget for the SJREC GSP Group

Water Year	Shasta Water Year Designation	Water Year Type (SJ Valley)	Surface Water Delivery	Groundwater Extraction	Total Consumptive Use (ET_{iw})	Change in Groundwater Storage (Upper Aquifer)	Change in Groundwater Storage (Lower Aquifer)
2013	Non-Critical	Critical	748,000	210,000	687,000	-37,000	-24,000

Table 37 - Combined SJREC GSP Group Current Water Budget

2.2.5.3 Combined Projected Water Budget for the SJREC GSP Group

Water Year	Shasta Water Year Designation	Water Year Type (SJ Valley)	Surface Water Delivery	Groundwater Extraction	Total Consumptive Use (ET_{iw})	Change in Groundwater Storage (Upper Aquifer)	Change in Groundwater Storage (Lower Aquifer)
2014	Critical	Shasta Critical	493,000	219,000	638,000	-219,000	-89,000
2015	Critical	Shasta Critical	439,000	281,000	639,000	-207,000	-89,000
2016	Non-Critical	Dry	638,000	93,000	665,000	-1,000	-24,000
2017	Non-Critical	Wet	748,000	52,000	717,000	113,000	0
2018	Non-Critical	Above Normal	743,000	105,000	674,000	59,000	-2,000
2019	Non-Critical	Wet	748,000	53,000	742,000	30,000	0
2020	Non-Critical	Dry	795,000	96,000	727,000	-17,000	-24,000
2021	Non-Critical	Wet	748,000	54,000	740,000	59,000	0
2022	Non-Critical	Wet	748,000	54,000	743,000	90,000	0
2023	Non-Critical	Above Normal	743,000	107,000	671,000	37,000	-2,000
2024	Non-Critical	Dry	795,000	98,000	728,000	-8,000	-9,000
2025	Non-Critical	Wet	748,000	55,000	745,000	66,000	0
2026	Non-Critical	Critically Dry	753,000	196,000	781,000	-65,000	-6,000
2027	Non-Critical	Critically Dry	753,000	196,000	781,000	-67,000	-6,000
2028	Non-Critical	Critically Dry	753,000	196,000	781,000	-122,000	-6,000
2029	Non-Critical	Critically Dry	753,000	197,000	776,000	-105,000	-6,000
2030	Critical	Shasta Critical	590,000	221,000	658,000	-95,000	-23,000
2031	Critical	Shasta Critical	590,000	217,000	659,000	-58,000	-14,000
2032	Non-Critical	Wet	748,000	58,000	740,000	124,000	0
2033	Non-Critical	Critically Dry	753,000	199,000	780,000	-79,000	-2,000
2034	Non-Critical	Wet	748,000	59,000	744,000	102,000	0
2035	Non-Critical	Wet	748,000	60,000	739,000	67,000	0
2036	Non-Critical	Wet	748,000	60,000	738,000	132,000	0
2037	Non-Critical	Wet	748,000	61,000	741,000	229,000	0
2038	Non-Critical	Above Normal	743,000	114,000	674,000	22,000	0
2039	Non-Critical	Above Normal	743,000	114,000	674,000	57,000	0
2040	Non-Critical	Dry	795,000	105,000	724,000	34,000	0
2041	Non-Critical	Dry	795,000	105,000	725,000	7,000	0
2042	Non-Critical	Below Normal	788,000	156,000	784,000	-5,000	0
2043	Non-Critical	Dry	776,000	107,000	805,000	-58,000	0
2044	Non-Critical	Wet	731,000	63,000	772,000	52,000	0
2045	Non-Critical	Wet	761,000	64,000	768,000	27,000	0
2046	Non-Critical	Critically Dry	804,000	224,000	810,000	-112,000	0
2047	Non-Critical	Critically Dry	753,000	224,000	814,000	-92,000	0
2048	Non-Critical	Below Normal	756,000	209,000	817,000	-73,000	0
2049	Non-Critical	Above Normal	743,000	121,000	706,000	83,000	0
2050	Non-Critical	Wet	753,000	69,000	774,000	44,000	0
2051	Non-Critical	Dry	795,000	113,000	753,000	-56,000	0
2052	Non-Critical	Critically Dry	748,000	228,000	745,000	-59,000	0
2053	Critical	Shasta Critical	590,000	235,000	691,000	-159,000	0
2054	Critical	Shasta Critical	590,000	231,000	690,000	-98,000	0
2055	Non-Critical	Dry	638,000	117,000	718,000	-35,000	0
2056	Non-Critical	Wet	748,000	74,000	777,000	88,000	0
2057	Non-Critical	Wet	748,000	75,000	776,000	35,000	0
2058	Non-Critical	Below Normal	756,000	217,000	819,000	-7,000	0
2059	Non-Critical	Wet	748,000	77,000	777,000	54,000	0
2060	Non-Critical	Dry	795,000	120,000	761,000	-26,000	0
2061	Non-Critical	Wet	748,000	78,000	777,000	138,000	0
2062	Non-Critical	Above Normal	743,000	132,000	703,000	41,000	0
2063	Non-Critical	Below Normal	756,000	222,000	822,000	-53,000	0
2064	Non-Critical	Dry	795,000	124,000	761,000	-42,000	0
2065	Non-Critical	Above Normal	743,000	135,000	704,000	186,000	0
2066	Non-Critical	Wet	748,000	84,000	778,000	15,000	0
2067	Non-Critical	Wet	748,000	85,000	778,000	26,000	0
2068	Critical	Shasta Critical	590,000	249,000	692,000	-151,000	0
2069	Critical	Shasta Critical	590,000	245,000	690,000	-152,000	0
2070	Non-Critical	Wet	748,000	88,000	768,000	163,000	0

Table 38 - Combined SJREC GSP Group Projected Water Budget

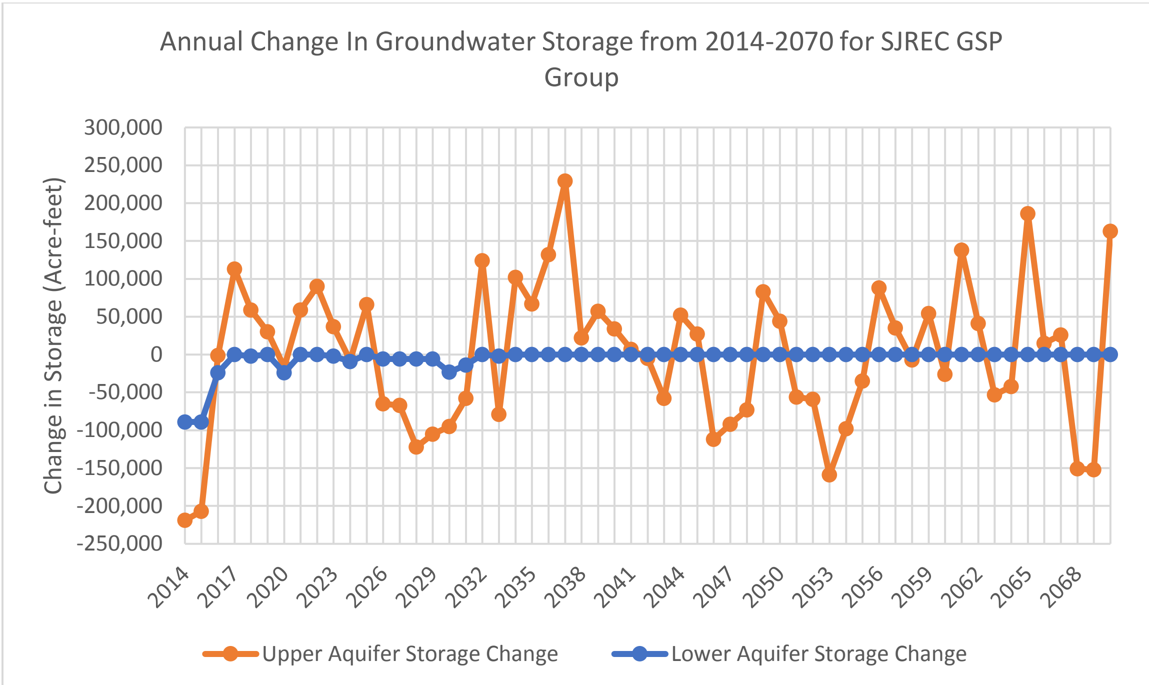

Figure 20 - Annual Projected Change in Groundwater Storage for SJREC GSP Group

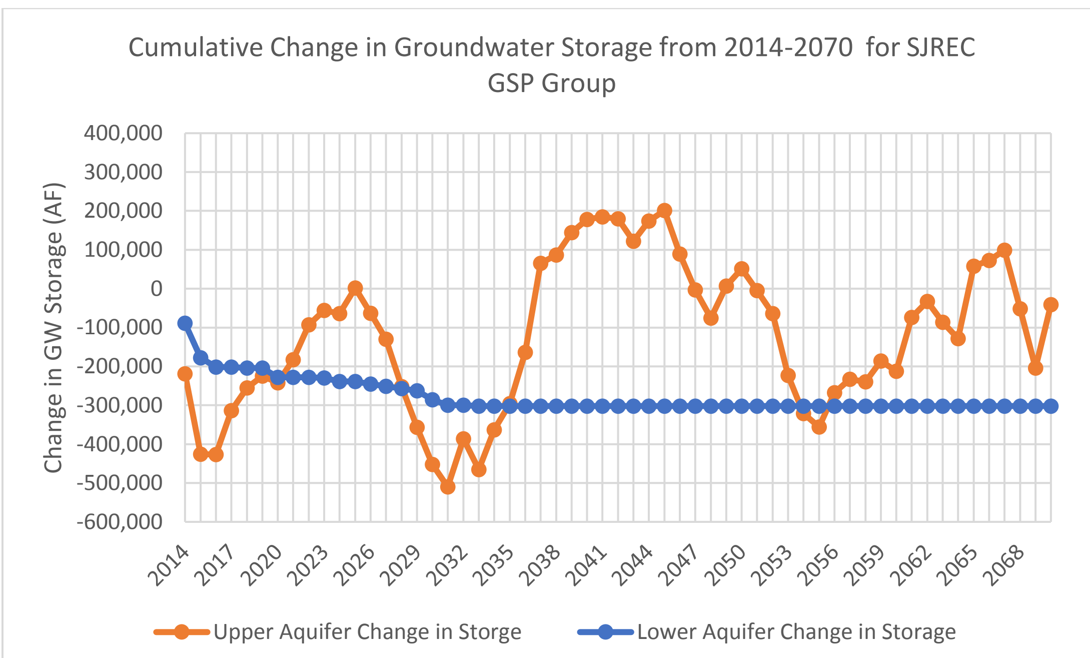

Figure 21 - Cumulative Projected Change in Groundwater Storage for SJREC GSP Group

3.0 SUSTAINABLE MANAGEMENT CRITERIA

This Section describes Sustainable Management Criteria (SMC). A monitoring network is used to establish a Sustainability Goal to avoid triggering Undesirable Results. Groundwater is managed with Measurable Objectives and Minimum Thresholds to ensure this plan operates within its sustainable yield. Appendix M provides the BMP for Sustainable Management Criteria.

3.1 Sustainability Goal

Sustainability Goal is defined as the existence and implementation of one or more GSP's that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin (or plan) is operated within its sustainable yield. Sustainable Yield is defined as managing groundwater that culminates in the absence of undesirable results by 2040. Additionally, the goal of the SJREC GSP is to work with neighboring GSA's and neighboring subbasin, where by 2040 there is an absence of undesirable results impacting the Delta-Mendota Subbasin based on groundwater management within the Delta-Mendota Subbasin and in an adjacent Subbasin.

3.1.1 Upper Aquifer Sustainable Yield

The SJREC GSP Group has established a methodology to determine the upper aquifer sustainable yield in a manner consistent with the subbasin. During the historic water budget timeframe from 2003-2012, the average annual groundwater extractions from the upper aquifer was 122 TAF/year. The SJREC GSP Group had 40 TAF/year surface water delivery in excess of direct demand, which contributed to additional recharge in the area. The SJREC GSP Group has been managing a sustainable aquifer through each agency's various conservation and management efforts. Additionally, 27 TAF/year of the lateral outflow of groundwater from the SJREC GSP Group area could be conserved by capturing some canal seepage. Thus, the sustainable yield of the upper aquifer for the SJREC GSP Group is 189 TAF/year. Sustainable management criteria described in Sections 3.2 – 3.5 will be used to achieve sustainability. The sustainable yield is determined independent of sustainability criteria and is provided as a guide for water budget planning purposes. In 2015, the SJREC GSP group extracted 268 TAF without any lasting impacts to the aquifer. Moreover, the average groundwater extractions from the upper aquifer in 2014 & 2015 averaged 236 TAF. These values are important when managing groundwater impacts through the planning and implementation horizon. Based on current data the average annual sustainable yield has been determined at 189 TAF with a one year sustainable yield of at least 268 TAF. Any future projects and management actions will respectively increase the sustainable yield.

3.1.2 Lower Aquifer Sustainable Yield

The SJREC GSP Group has established a methodology consistent with the entire Subbasin as outlined in the Technical Memorandum #3 as part of the Delta-Mendota Subbasin Coordination Agreement (Appendix B) to determine the lower aquifer sustainable yield. The lower aquifer sustainable yield is primarily driven by avoiding an Undesirable Result for land subsidence. As discussed, the SJREC GSP Group is not principally causing subsidence and have been working with landowners in impacted areas outside the SJREC service area, to mitigate/solve subsidence. The key to stopping subsidence is to reduce or eliminate groundwater extractions from the lower aquifer. The SJREC GSP Group has decided to take a more conservative approach than what has been discussed in some other subbasins and collectively decided in the Delta-Mendota Subbasin, by further limited the lower aquifer sustainable yield within the SJREC GSP area.

The SJREC GSP approach is to limit groundwater extractions to 0.25 AF/acre (which is less than the 0.33 AF/acre proposed by the Subbasin). The SJREC GSP Group is about 292,000 acres which results in a potential yield of 73 TAF/year. Practically speaking, review of the historic, current and projected water budget indicates the SJREC GSP had a one year maximum extraction from the lower aquifer of 29 TAF which equates to only 0.10 AF/acre. The lower aquifer sustainable yield is used as a guide to achieve sustainability for all six sustainability indicators and primarily stopping land subsidence.

The lower aquifer responds drastically different than the upper aquifer. Due to the elastic nature of the upper aquifer subsidence characteristics it can operate with successive years contributing to the overall average conditions without causing undesirable results. In other words, in the unconfined upper aquifer extractions for one year above the sustainable yield can be offset by a subsequent year with extractions less than the sustainable yield. The lower aquifer, however, cannot rely on averaging extractions above the sustainable yield to meet an average condition. Overdraft in the lower aquifer has the potential to instantly trigger inelastic land subsidence. The lower aquifer sustainable yield must be managed annually and more importantly site specifically to ensure significant and/or unreasonable land subsidence does not result from the overdraft.

3.2 Measurable Objectives

Measurable objectives refer to 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 (or plan). Measurable objectives shall provide a reasonable margin of operational flexibility.

3.2.1 Chronic Lowering of Groundwater Levels

The SJREC GSA has been sustainably managing groundwater levels for decades. As discussed in this GSP, the SJREC have prepared annual groundwater studies since the 1990's. Each year the district staff collects information on groundwater conditions for the previous year and consolidates the information into an annual report. This annual report is subsequently reviewed by KDSA who provides an analysis of the effects of the previous year's pumping. Management areas are established and groundwater triggers implemented in impacted regions within and adjacent to the SJREC service area.

The measurable objective for the SJREC GSP Group is to manage to avoid shallow groundwater while maintaining groundwater levels above the minimum threshold. Since the SJREC is already sustainably managing groundwater levels, there is no need to develop and implement Interim Milestones.

3.2.2 Reduction of Groundwater Storage

Similar to the discussion in Section 3.2.1, the SJREC are sustainably managed groundwater storage through management of regional water levels to maintain adequate storage. The measurable objective for the SJREC GSP Group is to manage to avoid shallow groundwater while maintaining groundwater levels above the minimum threshold for each management area which will preserve groundwater storage. Since the SJREC are already sustainably managing groundwater levels, there is no need to develop and implement Interim Milestones.

3.2.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. Similar to § 354.28.e for minimum thresholds, the presence of an undesirable result for seawater intrusion is not likely to occur and therefore no measurable objectives have been established for this sustainability indicator.

3.2.4 Degraded Water Quality

The measurable objective for the SJREC GSP Group is to mitigate the impacts of the migration of high salinity groundwater from lands upslope of the SJREC GSA. Intercepting moderate to high salinity groundwater that is moving to the northeast in the area above the Corcoran Clay has proven feasible as further described in 4.2.4. Groundwater quality monitoring has been conducted for both the pumped wells and a number of wells in the SJREC GSA to the northeast. These results are reviewed and evaluated about every three years. The measurable objective is to maintain soil health from poor quality groundwater migrating into the SJREC GSP area from upslope lands. Water quality concerns are from the migration of saline water from outside the SJREC GSA and therefore no interim milestones have been developed.

3.2.5 Land Subsidence

The SJREC GSP Group has extracted very minimal amounts of groundwater from the lower aquifer and are pumping significantly below the extractions limits set across the subbasin. The measurable objective of the SJREC GSP Group is to continue working with landowners in areas known to cause subsidence to reduce the compaction of the soils. The measurable objective for land subsidence is to significantly reduce inelastic land subsidence to less than 0.005 ft/year. Since the SJREC are already sustainably managing land subsidence, there is no need to develop and implement Interim Milestones.

3.2.6 Depletions of Interconnected Surface Water

The goal of the SJREC GSP Group is to mitigate observed reductions of interconnected surface and groundwater in the San Joaquin River due to pumping in the SJREC GSP Group Area. The measurable objective for the SJREC GSP Group is the same as the minimum threshold described in more detail in Section 3.3.6. The Interim milestones for each five year increment is to collect and analyze additional data to ensure an Undesirable Result for depleted surface water does not occur.

3.3 Minimum Thresholds

This Section will describe minimum thresholds for each sustainability indicator. Minimum Threshold refers to a numeric value for each sustainability indicator used to define undesirable results.

3.3.1 Chronic Lowering of Groundwater Levels

The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation, for a given area, that indicates a depletion of supply that may lead to undesirable results. The minimum threshold must be supported by historical trends of groundwater elevation without causing potential negative effects on the other sustainability indicators. The SJREC have established management areas, as described in Section 2.2.4, to sustainably manage our aquifers. Each management area has a representative well whose groundwater levels are reviewed annually to determine if a given area is experiencing chronic lowering of groundwater levels. Long-term hydrographs (Refer to Appendix I for more details) are used to establish water level trend over time and trigger levels. Historically, the SJREC have developed detailed hydrogeologic analyses in areas impacted by overdraft in and adjacent to the SJREC member entities. Management areas A and C have been impacted during extended dry periods and trigger water levels at representative sites were established to maintain a healthy aquifer. The established trigger level curtailed groundwater extractions from leaving the defined management area.

This management action stopped the transfer of groundwater out of the sub-area. Extraction limits were not established for groundwater use on over-lying land.

Management Area G has historically been impacted by regional pumping. The response of a three-day aquifer test from a few wells in management area G indicated that the aquifer responded as a confined aquifer. Due to this, setting triggers based solely on winter/spring water level measurements is not advisable. Pumping for transfer from this area is annually analyzed and based on anticipated pumpage, drawdown and timing of extractions to determine the potential effects.

Most recently in the drought of 2013-2016, water elevations at the representative sites were below the established trigger. Subsequently, groundwater was prohibited from leaving the sub-area. As a result of the management action alone, the aquifers have recovered by 2018 and no long-term significant or unreasonable impacts were experienced. This highlights the engagement and experience of the SJREC successfully managing groundwater levels for the beneficial users in the area. In the remaining management areas (B, C outside of the Los Banos Creek Sub-area, D, E, F, H, I, J, K), in order to comply with SGMA, a water level threshold was established using the historical low water level trend extended to represent an additional year of critical water supply for the SJREC. The surrogate water level is used since the SJREC have not historically observed the need to establish management actions to limit groundwater extractions due to lack of long-term overdraft. Many of these management areas are impacted by shallow groundwater and some pumping is encouraged to keep from inundating the root zone. The established trigger water level is intended to curtail transfer pumping before an undesirable result would ever occur by limiting the transfer of groundwater from outside the management area.

As highlighted in the SJREC Water budget in Section 2.2.3, the SJREC have and continue to manage a sustainable aquifer specifically addressing the potential of chronic lowering of water levels. Figure 22 shows the locations of the Representative monitor sites established for the undesirable result of chronic lowering of groundwater levels. Water elevation triggers have been established at each site. The water level trigger limits groundwater extractions leaving the management area. As mentioned previously, this management action has proven effective through historical droughts. It is further anticipated that areas outside of the SJREC will resolve overdraft within their respective areas leading to an even more stable water level elevations in the SJREC service area. Table 39 shows the water level trigger for each representative well. The established trigger levels are designed to not impact a neighboring GSP's ability to achieve sustainability. The SJREC have historically managed groundwater levels sustainably and are proposing additional extraction limitations, as necessary, to avoid any impacts to an adjacent GSP. Groundwater levels will be monitored and managed consistent with the other sustainability indicators and the more restrictive management will be implemented to ensure this plan area is absent of any undesirable results. Due to the active management by the SJREC, groundwater levels have maintained higher than what would constitute a minimum threshold. Therefore, there is no historical reference of an experienced water level indicative of a minimum threshold and an assumption of decreased water levels of 25% below the trigger levels (see note [2] in Table 39 below) in each management area A-K is used as a potential indicator of a minimum threshold. The minimum threshold for chronic lowering of groundwater levels will be periodically reviewed and updated by a Professional Engineer/Geologist as needed or to propose additional triggers and thresholds. If the SJREC notice a negative impact on the aquifer, an interim plan update will be initiated to update trigger water levels to maintain a healthy aquifer.

Section 4.0 discusses additional Projects and Management Actions that will promote a healthy aquifer and increase groundwater levels.

WELL NUMBER	MANAGEMENT AREA	SUB-AREA[3]	REFERENCE POINT ELEVATION	MEASUREMENT DEPTH FROM REFERENCE	TRIGGER WATER SURFACE ELEVATION[1]	MINIMUM THRESHOLD (WSE)[2]
1002 (CCID Well #2)	A		107.5	85.02	22.48	1.22
1014 (CCID Well #14)	B		114.5	43.74	70.76[1]	59.83
1008 (CCID Well #8)	C	Los Banos Creek	146.5	35.00	111.50	48.08
1008 (CCID Well #8)	C		146.5	78.74	67.76[1]	48.08
10413 (MC15-2)	Outside SJREC	Los Banos Creek	175.38	75.00	100.38	Outside GSP Area
1006 (CCID Well #6)	D		103.4	26.36	77.04[1]	70.44
1011 (CCID Well #11)	E		123.7	39.35	84.35[1]	74.52
1043 (CCID Well #43)	F		128.5	72.49	56.01[1]	37.89
1005 (CCID Well #5)	G		153.1	67.20	85.90[1]	69.10
2410 (SLCC Well T-02)	H		112.447	50.50	61.95[1]	49.32
1043 (CCID Well #43)	I		128.5	72.49	56.01[1]	37.89
3199 (Well 1199)	J		147.8	52.96	94.84[1]	81.61
1043 (CCID Well #43)	K		128.5	72.49	56.01[1]	37.89

Table 39 - Water Level Triggers for Chronic Lowering of Groundwater Levels

Notes:

[1] The trigger water surface elevation is based on a three year water level trend. The trend is used to extrapolate an additional drought year beyond the observed historic low. The trigger is imposed as a management tool to mitigate the potential of experiencing an minimum threshold.

[2] The minimum threshold represents a 25% increase in the depth to water (25% deeper than "measurement depth from reference") than the trigger water surface elevation.

[3] The Sub-area represents a smaller specific area along the Los Banos Creek that has been actively managed with triggers for years prior to SGMA.

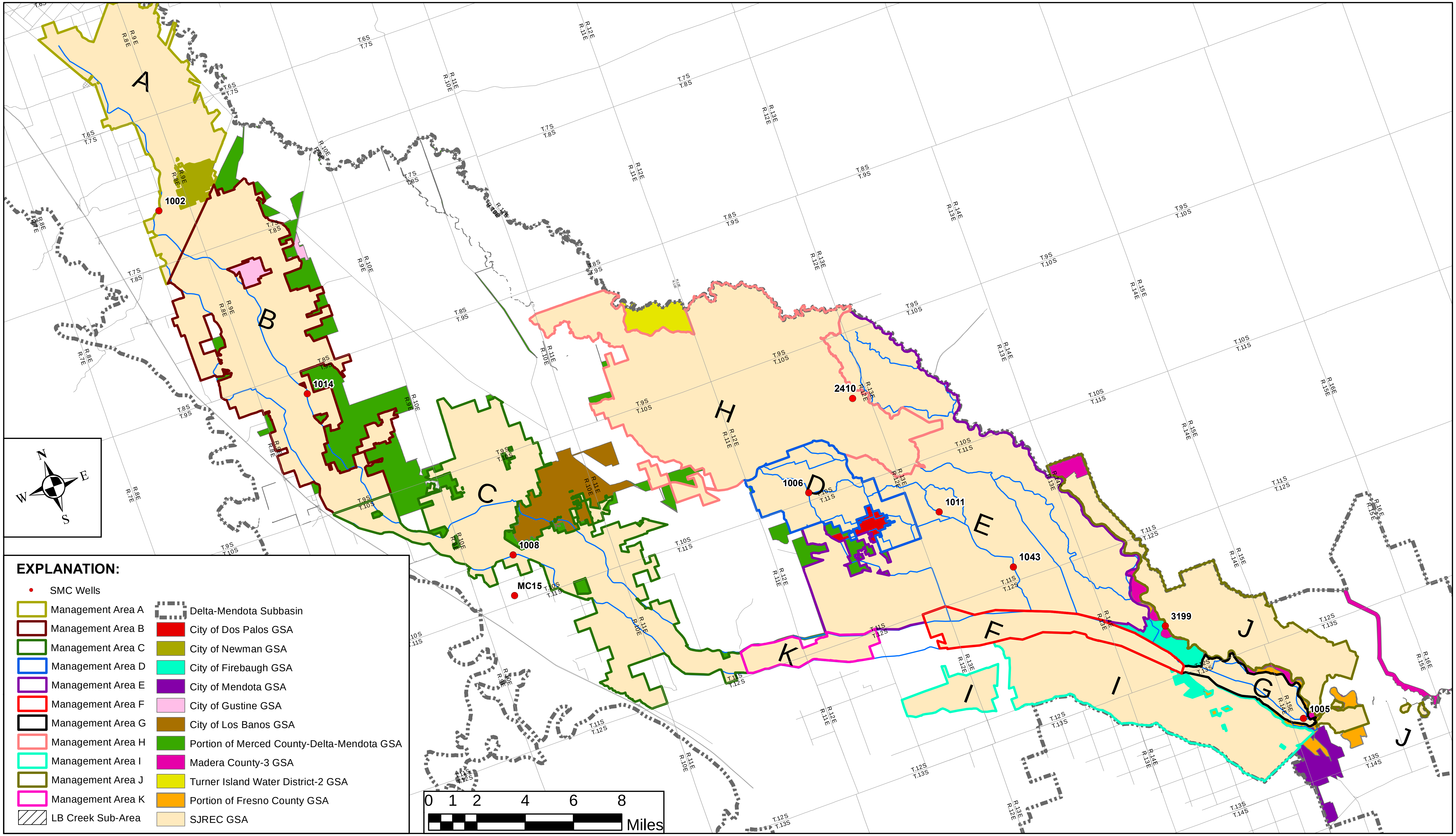

FIGURE 22 - MONITOR LOCATIONS FOR CHRONIC LOWERING OF GROUNDWATER LEVELS

3.3.2 Reduction of Groundwater Storage

The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from this GSP area without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of this plan, calculated based on historical trends, water year type and projected water use in the plan area.

The SJREC have implemented management strategies to maintain groundwater storage by using groundwater levels as a proxy. While there is a difference between managing chronic lowering of groundwater levels and managing a reduction in groundwater storage, the SJREC plan to implement SMC consistent for both of these criteria. Refer to Section 3.3.1 for details on establishing trigger levels and management actions to ensure any reduction in groundwater storage will not result in undesirable results. As discussed in Appendix I, each management area has a specific yield provided in the USGS Water Supply Paper 1469. The most accurate method to estimate changes in groundwater storage is to evaluate water level trends and specific yields for the upper aquifer. The change in groundwater storage will be monitored and managed consistent with the other sustainability indicators and the more restrictive management will be implemented to ensure this plan area is absent of any undesirable results. The minimum threshold for reduction in groundwater storage will be periodically reviewed and updated by a Professional Engineer/Geologist as needed or to propose additional triggers and thresholds. Any reduction in groundwater storage in the lower aquifer is caused by inelastic land subsidence. Refer to Section 3.3.5 for an explanation on Minimum Thresholds for Land Subsidence and the criteria will be the same for changes in groundwater storage for the lower aquifer.

Section 4.0 discusses additional Projects and Management Actions that will promote a healthy aquifer and increase groundwater storage.

3.3.3 Seawater Intrusion

The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results. The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. As defined in § 354.28. Minimum Thresholds: part (e) An Agency 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. For these reasons, the SJREC GSP Group has not established any triggers for this sustainability indicator.

3.3.4 Degraded Water Quality

There are generally four types of groundwater quality problems that are important to the SJREC GSP Group. Refer to Appendix I for more details on managing groundwater quality and a map of known contamination sites.

1. Naturally occurring chemical constituents: Most of these constituents are important when developing public and domestic supply wells. Typically, a test well is drilled and vertical water quality trends are determined. The well is ultimately constructed to mitigate naturally occurring groundwater quality concerns. No Minimum Threshold is recommended for this type.
2. Point source contamination: These contaminated sites are typically defined as long and narrow and fall under the jurisdiction of the CVRWQCB. It is recommended that this plan does not

implement its own independent cleanup requirements that may contradict existing orders. Rather, the SJREC GSP Group will continue to work with the CVRWQCB through the normal public process. No Minimum Threshold is recommended for this type.

3. Non-point source contamination: This type of contamination is typical of surface application of constituents including soil amendments and fertilizers. The CVRWQCB has implemented the Irrigated Lands Regulatory Program (ILRP) to address water quality concerns. This type of contamination is not directly related to the groundwater management described in the SGMA and in this plan. The SJREC GSA will continue to work with landowners to comply with ILRP. No Minimum Threshold is recommended for this type.
4. Hydrogeologic modification: The SJREC GSP Group can develop independent groundwater management to mitigate the migration of poor quality groundwater (saline) in the upper aquifer. The poor quality groundwater is migrating northeasterly. A minimum threshold is recommended for this type. The SJREC GSP Group cannot stop the migration of poor quality water from moving into the SJREC GSA and must implement management strategies to mitigate the potential damage. The minimum threshold described here is not intended to define an undesirable result for the SJREC GSP Group since the saline groundwater has originated from upslope lands and has migrated due to irrigation of the upslope lands. This minimum threshold is intended to signify when an adjacent GSP is having a negative impact on this GSP's ability to maintain healthy soils and a sustainable aquifer. It is not advisable to have a representative monitoring location for this type of water quality concern. Rather, the SJREC will continue to monitor wells in and around the area to monitor the migration and degradation of water quality. Additionally, tile drainage systems will be maintained to reduce the impacts of the migration of saline water into the SJREC service area. The minimum threshold is defined as the amount of poor quality groundwater that is greater than what can be successfully managed through the management action described in Section 4.2.4 of this plan.

3.3.5 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 shall be supported by maps and graphs showing the extent and rate of subsidence and the potential impact to land use and property interests. There are two types of subsidence observed in this area; elastic and inelastic. Elastic subsidence is typically on a significantly smaller magnitude than its inelastic counterpart. Elastic subsidence also doesn't typically have major impacts to infrastructure. For the purposes of this plan and addressing SMC for significant and unreasonable land subsidence, the focus will be on inelastic land subsidence.

Land subsidence is described as a gradual or instantaneous sinking of the earth's surface. The Delta-Mendota Subbasin has two major principal aquifers defined as the Upper and Lower aquifers. Separating the two aquifers is a thick bluish colored clay termed the Corcoran Clay. The Corcoran Clay is mapped and further defined in Appendix I. Land subsidence in the Delta-Mendota Subbasin is typically caused from groundwater extractions from the lower aquifer. The Corcoran Clay confines the lower aquifer creating a pressurized zone. As groundwater pumping is initiated, the water level in the well and surrounding area declines creating a decrease in pressure. This decrease may lead to inelastic land subsidence.

As mentioned previously in Section 2.2.3, the SJREC have very limited groundwater extractions which are well below the Delta-Mendota Subbasin sustainable yield. Additionally, maps depicting the extent and magnitude of land subsidence indicate that most, if not all, of the land subsidence observed is a result of groundwater extractions from outside the SJREC GSA boundary.

While the SJREC may not be causing subsidence, arresting observed subsidence in and around the Delta-Mendota Subbasin has proven an important task. CCID and SLCC are working with the Triangle T Water District (Chowchilla Subbasin 5-022.05) to establish a shallow recharge and recovery aquifer to reduce their dependence on groundwater pumping from the lower aquifer. This project is further detailed in Section 4.1.8 of this plan. As a result of completing about 50% of the project, the observed subsidence at the Sack Dam has reduced by about 66%. The SJREC will continue to reach out and help the neighboring areas mitigate subsidence.

Setting minimum thresholds requires a certain amount of data that needs to be analyzed by a certified Engineer/Geologist. There is lack of data in the SJREC area regarding water levels in the lower aquifer. The lack of data is not resultant of lack of monitoring on existing sites. The lack of data truly stems from very few wells perforated below the Corcoran Clay which is another indicator of sustainably managing groundwater in the area. The current goal for the SJREC is to limit groundwater extractions from the lower aquifer to less than 0.25 acre-feet/acre, which is conservative compared to the subbasin, and coupled with the worst case of 0.10 AF/acre in this plan, our management will limit extractions rather than setting water level thresholds. These thresholds may be modified over time as more is learned about the subbasin and the response to pumping from the lower aquifer.

The SJREC will continue to work with the counties to ensure that new wells will be constructed consistent with SMC for our area.

The SJREC have already been majorly impacted by subsidence originating outside of its boundaries. SLCC had lost 30% of its capacity to deliver surface water to its growers by 2017. The groundwater will be impacted if surface water deliveries are impacted. CCID has also lost significant conveyance capacity in its canals and has gone through a efforts to restore capacity. Millions of dollars have been spent internally to mitigate the damage caused from subsidence due to groundwater extractions outside of this GSA. The SJREC has zero tolerance from impacts caused by subsidence to its infrastructure, without appropriate mitigation. The minimum threshold for land subsidence for the SJREC GSP Group is that which doesn’t reduce our conveyance capacity without appropriate mitigation and/or damage to other critical infrastructure without appropriate mitigation. The minimum threshold is intended to signify when an adjacent GSP is having a negative impact on this GSP’s ability to maintain sustainability.

The member entities of the SJRECWA will continue to perform surveys to determine conveyance capacity through the canals. Additionally, the publicly accessible data sets will be used to monitor subsidence so appropriate measures can be taken to mitigate potential damages. Land subsidence will be monitored and managed consistent with the other sustainability indicators and the more restrictive management will be implemented to ensure this plan area is absent of any undesirable results.

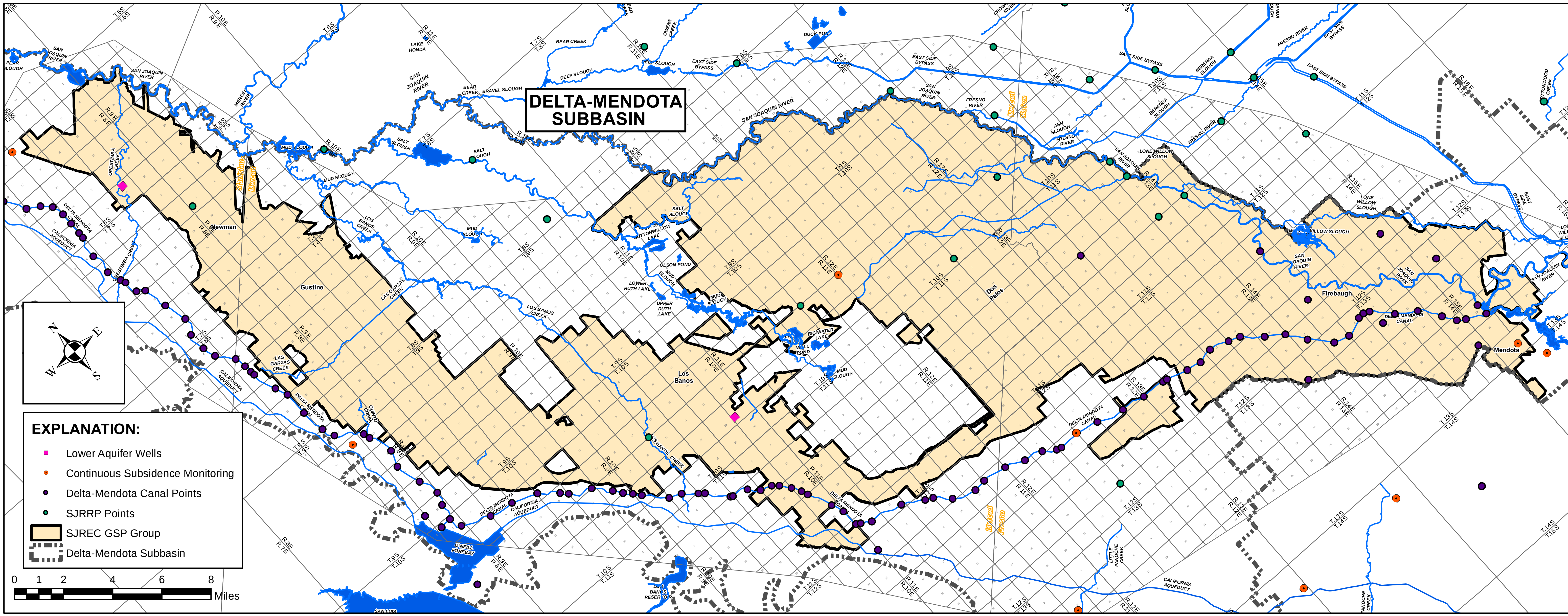

FIGURE 23 - MONITORING SITES FOR LAND SUBSIDENCE

3.3.6 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 minimum threshold established shall support the location, quantity and timing of potential depletions of interconnected surface water.

The SJRRP and the SJREC have established a series of shallow monitor wells near the San Joaquin River as part of the Seepage Management Plan for the Program. Data from these wells were used to determine the location of potentially connected surface water and groundwater. Figure 52 in Appendix I has a map that shows the potential locations of the interconnected portions of the San Joaquin River. The SJREC will continue to monitor water levels near the San Joaquin River and expand the understanding of the shallow groundwater in the area.

The San Joaquin River has historically been referred to as the trough of the valley. At this location some fined grained materials have been deposited creating a separation of groundwater adjacent to the river and the zone that is actively pumped. This separation of the two zones provides disconnection from the interconnected surface water and the zone of the aquifer where extractions occur. The SJREC intends to work with the various counties to establish criteria consistent with the County well construction procedures, that requires the wells drilled within a certain distance of the San Joaquin River, as recommended by KDSA, to have the first encountered perforations be deep enough limit the connection with surface waters.

This management technique will not only ensure that *significant and unreasonable* depletions of interconnected surface water are avoided but also mitigates the potential to have any direct depletion of surface water. This is consistent with maintaining the viability of those beneficial users, primarily GDE's, along the riparian corridor of the San Joaquin River. This management is also consistent with the long standing Herminghaus Agreement in Reach 2 (Gravelly Ford to Mendota Dam) of the San Joaquin River which put a prohibition on perforating any wells above the constricting clay layer in the area referred to as the A-Clay. Monitoring and management of this sustainability indicator over the next five years will provide essential information to maintain historical water levels. Depletions of interconnected surface water will be monitored and managed consistent with the other sustainability indicators and the more restrictive management will be implemented to ensure this plan area is absent of any undesirable results.

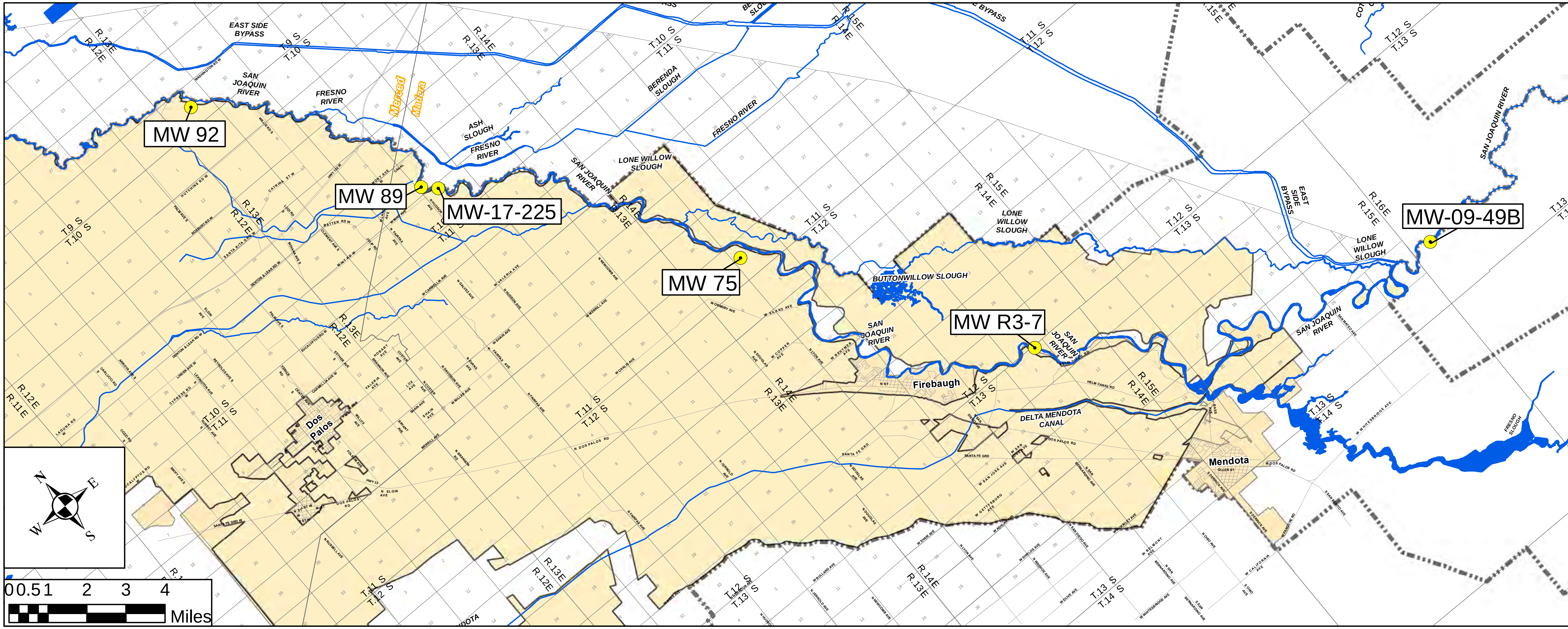

FIGURE 24 - MONITORING SITES FOR DEPLETIONS OF INTERCONNCETED SURFACE WATER

3.4 Undesirable Results

This section describes undesirable results for each sustainability indicator. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions throughout the basin. Groundwater conditions were analyzed to determine the potential effects on beneficial uses and users of groundwater. An Undesirable Result must be defined at the Subbasin level. The SJREC worked with the other GSA's in the Delta-Mendota Subbasin to define Undesirable Results for each sustainability indicator.

3.4.1 Chronic Lowering of Groundwater Levels

An undesirable result for chronic lowering of groundwater levels is defined as: significant and unreasonable chronic change in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.

The SJREC GSP Group does not experience and is not likely to experience a significant and unreasonable lowering of groundwater levels. Even so, sustainable management criteria have been established for this sustainability indicator. The SJREC GSP Group recharges more water than is extracted. Trigger levels have been established to recover aquifer water levels before nearing an Undesirable Result. Significant and unreasonable lowering of groundwater levels in the SJREC GSP Group occurs when water levels in all of the management areas, drop below the minimum threshold shown on Table 39 and the SJREC GSP Group has extracted more than their sustainable yield of 189 TAF/year over the most recent 10 year period; described in Section 3.1.1. In management areas not experiencing impacts on groundwater levels prior to the submittal of this plan, sustainable areas, a three year water level trend was used to extrapolate what the water level for an additional drought year beyond the historic low would be. The minimum threshold represents a 25% increase in depth to water below the trigger water level established based on an additional drought year beyond the historic low water level. This section will be periodically reviewed and updated with the best available information.

3.4.2 Reduction of Groundwater Storage

An undesirable result for reduction of groundwater storage is defined as: significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.

The SJREC GSP Group does not experience and is not likely to experience a significant and unreasonable reduction of groundwater storage. Even so, sustainable management criteria have been established for this sustainability indicator. The SJREC GSP Group recharges more water than is extracted. As mentioned previously, reduction in groundwater storage will be managed consistent with the sustainability indicator for chronic lowering of water levels. See Section 3.4.1 for details on what constitutes significant and unreasonable for reduced groundwater storage. This section will be periodically reviewed and updated with the best available information.

3.4.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. As defined in § 354.26. Undesirable Results: part (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. For these reasons, the SJREC GSP Group has not established any triggers for this sustainability indicator.

3.4.4 Degraded Water Quality

Significant and unreasonable degraded water quality is defined as groundwater extractions inducing the migration of a contamination plume that makes the water unusable for beneficial use. The biggest groundwater quality concern for the SJREC is the migration of saline water from upslope drainage areas. An Undesirable Result would occur if the migration of the poor quality groundwater that exceeds the amount that can be feasibly mitigated by the SJREC. As mentioned previously, this Undesirable Result is indicative of a neighboring GSP's inability to not impact another GSP's ability to achieve sustainability and will serve as an indicator of enhanced monitoring and management collaboration.

3.4.5 Land Subsidence

An undesirable result for land subsidence is defined as: changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conveyance capacity, damage to personal property, impacts to natural resources or create conditions that threaten public health and safety.

An Undesirable Result for the SJREC GSP Group is highly unlikely to occur as a direct result of groundwater extractions from the lower aquifer from the GSA's in the SJREC GSP Group. This sustainability indicator is more likely to highlight a neighboring GSP's impact of land subsidence and their need to address the concern. Significant and unreasonable land subsidence is defined as the reduction in conveyance capacity for water distribution and/or damage to critical infrastructure without appropriate mitigation as a result of groundwater extractions. The SJREC are committed to working with the neighboring GSA/GSP to arrest subsidence affecting infrastructure. Refer to Section 4.0 for more details on how the SJREC are working to solve regional subsidence stemming from groundwater extractions outside the Delta-Mendota Subbasin.

3.4.6 Depletions of Interconnected Surface Water

An undesirable result of depletions of interconnected surface water is defined as: depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water.

Significant and unreasonable depletion of interconnected surface water occurs when groundwater extraction from the SJREC GSP Group decreases streamflow to a significant and unreasonable level for beneficial users in a stretch of the San Joaquin River that was historically losing (seeping from the river).

3.5 Monitoring Network

The monitoring network shall be developed including monitoring objective, 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 plan and evaluate changing conditions that occur through implementation of the plan.

3.5.1 Description of Monitoring Network

Some water level monitoring sites have continuous monitoring while most of the other sites are either measured in the field every month or quarterly. Water quality samples are taken at least annually in agriculture wells and significantly more frequently in the small community supply wells. The SJRRP conducts semi-annual land subsidence surveys. This monitoring network has proven vital for successful implementation of this plan. Long-term hydrographs (over 20 years) and water quality trends over time are reviewed each year to determine seasonal conditions, short-term hydrologic cycle conditions and long-term impacts on groundwater.

The shallow monitor wells near the San Joaquin River will be used to determine groundwater and surface water related conditions and the potential impact to interconnected water. The goal of this plan is to mitigate the potential to impact interconnected waters through well construction standards. This management is preferable to the long-term sustainability of the San Joaquin River by mitigating the risk in advance.

The current monitoring network and associated management strategies worked through the drought of 2013-2016 to protect the local beneficial users of groundwater. The SJREC GSP Group has annually collected data necessary to prepare annual updates to the water budget including the annual change in groundwater storage.

Representative sites have been chosen for each management area to determine if chronic lowering of groundwater levels or significant reduction in groundwater storage has occurred. The wells used for these representative sites typically have water level readings each month. Seawater Intrusion is not likely to occur in the Delta-Mendota Subbasin. The Camp 13 area and FCWD have an elaborate groundwater management program to help control the migration of poor quality shallow groundwater due to upslope drainage. The management includes point source control, installation of tile drainage lines and tile interceptor lines, drainage interceptor wells, and blending of poor quality groundwater. The electrical conductivity in this area is typically not useable for agriculture without blending and the monitoring is typically to control the water levels below the effective root zone to keep the soil and crops healthy. The current monitoring network for land subsidence includes the DMC (western boundary) and the SJRRP subsidence monitoring points (eastern boundary) along with continuous monitoring sites monitored by the USGS. These sites will highlight areas of concern that warrant an in-depth investigation to mitigate inelastic land subsidence. The monitoring network for interconnected surface water will utilize the shallow monitor wells near the San Joaquin River installed as part of the USBR's SJRRP. The quantification of potential gains and losses in the San Joaquin River is challenging since various creeks and sloughs intertwine with the San Joaquin River and provide an unmetered point source introduction of water. In order to avoid complicated and costly monitoring, the SJREC GSP Group has proposed to mitigate the risk of significantly and unreasonably depleting interconnected surface water through well construction procedures.

Each sustainability indicator has a representative site, described in section 3.5.3, with the exception of degraded groundwater quality which is actively managed through water level control as mentioned above.

The SJREC GSP Group collects data and has reported consistent with the standards prescribed in the SGMA. Refer to Appendix O for more details on the BMP for the monitoring network. For more details regarding the how the monitoring network works with the SMC and maps of the representative monitoring sites, refer to Sections 3.3 and 3.4.

3.5.2 Monitoring Protocols for Data Collection and Monitoring

The SJREC updated the DWR BMP for monitoring protocols to describe the consistency of technical standards, data collection methods and other procedures to ensure comparable data and methodologies. When reviewing data the first and foremost step is to ensure that the person reviewing the data has the correct units and is using the correct reference. For more details on the SJREC BMP for monitoring protocols refer to Appendix N of this GSP.

3.5.3 Representative Monitoring

In the 1990's, the SJRECWA developed an AB 3030 Groundwater Management Plan. One aspect of that plan was the development of groundwater management areas. Those management areas have proven effective managing groundwater and have carried over into this GSP. The SJREC have sentinel wells (representative monitoring) established in each management area for the sustainability indicators for Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage; refer to Section 3.3 for more details and a map of the sites. Each representative site was chosen in cooperation with KDSA. Numerous hydrographs were reviewed for each management area to determine the representative site. Each management area has a specific yield for the upper aquifer that was defined in the USGS water supply paper 1469. Each management area has a specific yield and a water level from a representative site which are used conjunctively to determine the change in groundwater storage. Therefore, groundwater elevations are used as a proxy for determining the SMC for a Reduction in Groundwater Storage.

The SJREC are using the continuous land surface monitoring sites to represent the Land Subsidence network. Additionally, the SJREC will refer to the SJRRP subsidence monitoring network and the subsidence surveys on the DMC to look at subsidence in the region. The subsidence network along the DMC will establish the western boundary conditions while the SJRRP program will establish the eastern boundary conditions. In areas of land subsidence, a detailed review of groundwater levels including drawdown are vitally important to develop a sustainable plan to stop subsidence. Since the SJREC have minimal pumping from the lower aquifer, the land subsidence representative monitoring network will be reviewed to determine 1) the amount of subsidence occurring, 2) where subsidence may be originating and 3) potential impacts to critical infrastructure. Refer to the previous sections for more details and a map of the representative land subsidence monitoring locations.

The SJREC will be reviewing shallow monitor wells near the San Joaquin River to determine impacts to interconnected surface water and groundwater. The representative monitoring network and map are detailed in the previous sections. The primary goal described in the SMC for this sustainability indicator is to use well construction procedures to mitigate the potential for undesirable results. It is anticipated that a representative monitoring network will likely not be needed in the future since the SJREC plan is to prevent the possibility of the undesirable result occurring and therefore limited the necessity for a robust monitoring network.

The representative monitoring for Degraded Groundwater Quality is further described in Section 3.3 and Appendix I. The major groundwater quality concern described in this GSP is the migration of shallow, saline groundwater from upslope lands. This saline water has mostly effected Management Areas F and I; respectively CCID Camp 13 area and FCWD. For more details refer to Section 4.2.4 of this plan. The migration of saline water is a regional problem that can cause site specific concerns. For this reason, a representative site has not been selected and the growers in this area actively manage water levels through the use of tile drainage systems to control the water level to keep the poor quality groundwater from inundating the crop root zone.

3.5.4 Assessment and Improvement of Monitoring Network

The SJREC have actively monitored and managed groundwater for decades. In the 1990's the Exchange Contractors embarked on several groundwater investigations to determine appropriate groundwater management and to maintain a healthy aquifer for the small communities adjacent to the service area. Through these investigations KDSA recommended to fill data gaps and improve the monitoring network in order to better understand the groundwater conditions and groundwater flows in and around the SJREC area.

The existing monitoring network was established to monitor groundwater conditions each year through the annual groundwater reports prepared over the last two decades. The results of the groundwater report are reviewed by KDSA. If a problem starts to present itself through the annual report, the SJREC worked with KDSA to develop a more in-depth and site specific analysis to determine the appropriate course of action to mitigate the concern. One such example of the success of the monitoring network is the Red Top Area Subsidence Mitigation Project. The USBR thought that subsidence may be occurring in the Red Top Area. The SJREC had experience in recognizing and dealing with subsidence and started to do a detailed investigation. The analysis showed that there were wells perforated below the Corcoran Clay that were causing subsidence in the area. The SJREC worked with the local landowners to study the problem and work on a solution to stop subsidence near Sack Dam, the headworks of SLCC. This project is further described in Section 4.1.7.

The SJREC GSP Group does not have any data gaps that could affect the ability of the SJREC GSP to achieve sustainability. Active groundwater management for decades has afforded the SJREC GSP Group a robust groundwater monitoring system.

Although the SJREC GSP Group is not the cause of inelastic subsidence in the area, a more robust lower aquifer groundwater monitoring network could help the Delta-Mendota Subbasin along with the neighboring subbasins gain a better understanding of the lower aquifer. The main reason for the lack of water level data in the lower aquifer is due to the lack of wells perforated in that zone. Drilling monitor wells in the lower aquifer is an expensive task. Since the SJREC GSP Group has limited groundwater extractions from the lower aquifer, the group has historically chosen to use resources to monitor and manage in other locations. An expanded lower aquifer groundwater monitoring network will not impact the SJREC groundwater management and is therefore not considered a data gap. Rather, the SJREC will continue to work with the neighboring GSA's to enhance a lower aquifer groundwater monitoring network to help solve subsidence originating outside of the SJREC service area.

While the current SJREC groundwater monitoring network has proven effective in managing the local aquifers, the SJREC GSP Group is committed to reviewing the network each year and to make any necessary modifications to maintain sustainability. Furthermore, during the drought of 2013-2016, water levels in parts of the SJREC dropped below trigger levels and management actions were implemented to protect the beneficial users of groundwater in the area.

4.0 PROJECTS AND MANAGEMENT ACTIONS TO ACHIEVE SUSTAINABILITY GOAL

4.1 Projects

The SJREC GSA, working conjunctively with the San Joaquin River Exchange Contractors Water Authority, has developed a Water Resource Plan to avoid potential impacts from Critical Years under the Exchange Contract and to meet peak irrigation demand. The SJREC are sustainably managing our aquifers and these projects are not intended to mitigate Undesirable Results in this plan. Rather, these projects will provide better management of our surface water supplies, which have the additional benefit of buttressing our groundwater supply, and helps the neighboring agencies in managing their water portfolio's. Many of these projects are done in collaboration between the SJREC and neighboring agencies to provide regional sustainability. These Projects have either been fully developed or are currently under development.

- 4.1.1 Los Banos Creek Diversion Facility (Complete)
- 4.1.2 Los Banos Creek Recharge and Recovery (Expansion Under Development)
- 4.1.3 Los Banos Creek Storage Project (Under Development)
- 4.1.4 Orestimba Creek Recharge and Recovery (Expansion Under Development)
- 4.1.5 BB Limited Groundwater Recharge and Recovery (Under Development)
- 4.1.6 Farmers Water District Groundwater Recharge and Recovery (Under Development)
- 4.1.7 Summary of Active Water Resource Projects 4.1.1-4.1.5
- 4.1.8 Red Top Area Subsidence Mitigation (Complete on-going)

4.1.1 Los Banos Creek Diversion Facility

The Los Banos Creek Diversion Facility is located southwest of the City of Los Banos where the Los Banos Creek crosses the DMC. The project participants for this facility include the San Luis Water District, Grassland Water District, and the member agencies of the SJRECWA. Construction for this project was completed in 2017. The facility has been tested and is operational. This project required close coordination with both state and federal agencies. CCID worked with the USBR to prepare a joint CEQA/NEPA environmental review resulting in a Mitigated Negative Declaration and Mitigated Finding of No Significant Impact (SCH# 2013021001). The following permits were also required prior to construction: California Department of Fish and Wildlife Section 1600 Streambed Alteration Permit, Central Valley Regional Water Quality Control Board Clean Water Act Section 401 Permit, and United States Army Corp of Engineers Clean Water Act Section 404 Permit. This project was made accessible to the public consistent with CEQA/NEPA requirements.

The Los Banos Creek Diversion Facility is located just upstream of where the DMC siphon crosses the Los Banos Creek. The project consists of a gated check structure spanning Los Banos Creek, a turnout structure on the creek, an outlet structure on the DMC, and a box culvert connecting the turnout and outlet. The operation of this facility will keep the first 50 cfs of flood flows released from the Los Banos Creek Detention Reservoir in the creek to maintain historical recharge and can divert up to 250 cfs of flood releases into the DMC. The source water for this project is from runoff in the Los Banos Creek watershed and will be put to beneficial use during times of reservoir releases. The project is designed to also deliver water from the DMC into the Los Banos Creek. This project will provide additional flood protection to the City of Los Banos, a Disadvantaged Community, and also provide wetland benefits through relieved pressure from flood flows on wetland habitat and an additional useable water supply. The Exchange Contractors average annual yield of the project is 3,500 acre-feet/year. Yield for the project will be split, as necessary, for in-lieu groundwater recharge within the SJREC service area or sent to the Los Banos Creek Recharge and Recovery Project. The total cost of the project was about $3,100,000.

The operation of this project will reduce the net extractions from the local aquifer through in-lieu use of the water and increased recharge, thereby increasing Groundwater Storage and raising Groundwater Levels.

The SJREC GSA is working with neighboring GSA's and Water Districts to implement this project, among others, in a sustainable manner. Successful and sustainable management of groundwater is best achieved through local collaboration with interested parties.

4.1.2 Los Banos Creek Recharge and Recovery

The Los Banos Creek Recharge and Recovery Project is along the Los Banos Creek between Pioneer Road and Sunset Avenue, southwest of the City of Los Banos. The feasibility of this project has been analyzed. The environmental review for this project will begin in 2019. A joint CEQA/NEPA Mitigated Negative Declaration and Mitigated Finding of No Significant Impact is expected on this project. Anticipated permits for this project include: Merced County Well Construction Permit, California Department of Fish and Wildlife Section 1600 Streambed Alteration Permit, Central Valley Regional Water Quality Control Board Clean Water Act Section 401 Permit, and United States Army Corp of Engineers Clean Water Act Section 404 Permit. This project will be made accessible to the public consistent with CEQA/NEPA requirements.

This project will use an existing abandoned gravel pit and an adjacent field as a recharge facility. Flood water and/or surface water from the San Joaquin River Exchange Contractor entities, will be delivered to the site from the CCID Outside Canal and/or down the Los Banos Creek from the Los Banos Creek Diversion Facility. The approximately 60-acre site can recharge upwards of 4,500 acre-feet per year. During a Critical Year, the entities of the San Joaquin River Exchange Contractors can extract up to 7,000 acre-feet of stored groundwater. This facility will be managed to recharge and store more water than will be extracted. The excess recharged water will help offset regional groundwater usage along Los Banos Creek. The operations of this facility will help achieve regional sustainability specifically contributing to raising groundwater levels, increasing groundwater storage and improving groundwater quality. The SJRECWA is expected to receive $3,200,00 in federal disaster relief funding through the California Office of Emergency Services to cover the total cost of the project of $4,600,000.

The SJREC GSA is working with neighboring GSA's and Water Districts to implement this project, among others, in a sustainable manner. Successful and sustainable management of groundwater is best achieved through local collaboration with interested parties.

4.1.3 Los Banos Creek Storage Project

The Los Banos Creek Storage Project makes use of the existing Los Banos Creek Detention Reservoir (LBCDR). The feasibility of this project has been analyzed. A joint CEQA/NEPA Mitigated Negative Declaration and Mitigated Finding of No Significant Impact is expected on this project. Anticipated permits for this project include: State Water Resources Control Board Point of Rediversion and Restorage, California Department of Fish and Wildlife Section 1600 Streambed Alteration Permit, Central

Valley Regional Water Quality Control Board Clean Water Act Section 401 Permit, United States Army Corp of Engineers Clean Water Act Section 404 Permit and access & use of the existing and proposed facilities within the USBR right of way. This project will be made accessible to the public consistent with CEQA/NEPA requirements.

The Los Banos Creek Detention Dam (LBCDD) and LBCDR are Federally owned and State operated facilities that were constructed jointly by the USBR and the California DWR as part of the San Luis Unit of the Central Valley Project (CVP) to provide flood control protection to the San Luis Canal. The LBCDR because of its proximity also provides flood protection to the City of Los Banos. The California Department of Parks and Recreation (DPR) operates the public recreational facilities at LBCDR. The dam and reservoir are located approximately six miles southwest of the City of Los Banos. The dam became operational in 1962 and the reservoir has a maximum storage of 34,500 acre-feet (AF). The LBCDR is currently operated near or below the United States Army Corp of Engineers (USACE) winter period conservation pool of 20,600 AF of storage, even though summer operations allow storage of 34,500 AF as authorized by the USACE guidance manual.

Currently the dam is strictly operated as a flood control facility during the late fall and winter months. A group of local agencies have proposed to operate the LBCDD in the spring to route natural Los Banos Creek flows to riparian lands downstream of the facility making space available for storage and thereby increasing the overall benefit of the Los Banos Creek Diversion Facility (See Section 4.1.1). The Project Participants consist of the San Luis Water District (SLWD), Grassland Water District (GWD), and the member agencies of the San Joaquin River Exchange Contractors Water Authority (SJRECWA or Exchange Contractors) which consists of Central California Irrigation District (CCID), San Luis Canal Company (SLCC), Firebaugh Canal Water District (FCWD) and Columbia Canal Company (CCC). The Project Participants would pump conserved water or groundwater into the available storage space in the spring and early summer and return the water to them in the summer or fall to meet peak irrigation or habitat water demands.

The purpose of the proposed Project is to more effectively manage LBCDR in order to maximize flood control and downstream benefits while maintaining recreational use of the reservoir. Project operations would be seasonal in nature and would still follow the current practice of limiting storage to the winter USACE flood control target at all times. The water pumped into the reservoir for storage by the Project Participants would be either conserved water or groundwater. During the flood control season, and potentially year-round, water in the reservoir would be allowed to accumulate and be released from the reservoir to meet Project Participant riparian demand. Starting in the spring, the project participants would pump their conserved water or groundwater into available LBCDD space for temporary storage and return to one or all participant to meet peak irrigation or wildlife water management demands. Some of the project benefits include: improved water supply management and reliability, development of additional Incremental Level 4 refuge water supply, increased flood control protection to downstream facilities, increased access to the LBCDR recreational facilities during most flood release scenarios, increased recreational opportunities at LBCDR, along LBC and in GWD, environmental enhancements at LBCDR, along LBC and in GWD, and Disadvantaged Community (DAC) water supply and water quality improvements.

The Project includes the installation of a pipeline to deliver water from the existing SLWD Reservoir #8, located on a ridge above LBCDR, into the reservoir. The boat ramp was entirely out of the water in 2015 which reduced access to the lake for recreational fishing during that time. This project proposes an extension to the existing boat ramp to ensure recreational opportunities during times of low reservoir elevation. The current access to the recreational facilities including a boat ramp, picnic area and campgrounds, is currently through a low water crossing in the Los Banos Creek below the dam. During times of releases above 50 cfs, all access to the reservoir is restricted. This project also proposes the installation of box culvert to provide access to the reservoir nearly year-round while also mitigating traffic traveling through the creek itself.

LBCDD would be operated in the October through February time period to release natural Los Banos Creek flow downstream for use by riparian lands consistent with the benefits described above and in Sections 4.1.1 and 4.1.2. The operation would also create space in the LBCDD to be used to temporarily store water. Then starting around March 15th of each year (outside flood control season) the Participants would begin temporarily storing up to 8,000 acre-feet of conserved water or groundwater in available LBCDD space. The stored water would be returned to the participating Districts during peak irrigation or wildlife water management times via the Los Banos Creek and Delta-Mendota Canal. The Dam operations would preserve and enhance but be consistent with the current flood control criteria and operation. The source of the water used to temporarily store in the reservoir is Project Participant water that is already south of the Sacramento-San Joaquin Delta and has no direct impacts to the San Joaquin River and outflow through the Delta. Furthermore, once the water is released from the reservoir it will be directly used for beneficial use for agriculture and wetland habitat. This project does not increase pumping at the Bill Jones Pumping Plant (CVP pumps in the Delta) or impact flows in the San Joaquin River out to the Delta. Rather, this project provides operational flexibility to water supply that has already moved through the Bill Jones Pumping Plant while increasing the overall beneficial use of the water.

4.1.4 Orestimba Creek Recharge and Recovery

The Orestimba Creek Recharge and Recovery Project is located west of the City of Newman on an existing farm field. The project participants for this facility include the Del Puerto Water District and the SJRECWA entities. This project consists of an existing 20-acre recharge facility that was constructed in 2018 and an additional 60-acre facility to be constructed by 2021. The 20-acre project required close coordination with both state and federal agencies. CCID worked with the USBR to prepare a joint CEQA/NEPA environmental review resulting in a Mitigated Negative Declaration and Mitigated Finding of No Significant Impact, and it was made accessible to the public consistent with CEQA/NEPA requirements (SCH# 2017042061). The proposed 60-acre project will require CCID to work with USBR to prepare a joint CEQA/NEPA environmental review likely resulting in a Mitigated Negative Declaration and Mitigated Finding of No Significant Impact. Anticipated permits for the 60-acre site include: Stanislaus County Well Construction Permit, California Department of Fish and Wildlife Section 1600 Streambed Alteration Permit, Central Valley Regional Water Quality Control Board Clean Water Act Section 401 Permit and United States Army Corp of Engineers Clean Water Act Section 404 Permit.

The Orestimba Creek Recharge and Recovery Project is located on existing farm land east of Eastin Road and north of Orestimba Road. Flood flows and surface water from Del Puerto Water District and/or the SJRECWA entities will be delivered to the site through an existing pipeline from the DMC. Another source of water for the recharge facility is excess flood flows from Orestimba Creek to be routed through a proposed pipeline to the project site. Diverting excess flood flows from Orestimba Creek will provide additional flood protection to the Disadvantaged Community of the City of Newman. The total 80-acre facility is expected to recharge up to 15,000 acre-feet in a given year. During a Critical Year, the member agencies of the San Joaquin River Exchange Contractors can extract up to 7,500 acre-feet of stored groundwater. This facility will be managed to recharge and store more water than will be extracted. The excess recharged water will help offset regional groundwater usage along Orestimba Creek. The operations of this facility will help achieve regional sustainability specifically contributing to raising groundwater levels, increasing groundwater storage and improving groundwater quality. The total cost to construct the existing 20-acre site was about $1,200,000. The SJRECWA is expected to receive $5,900,00 in federal disaster relief funding through the California Office of Emergency Services to cover the total cost of $7,900,000 for the 60-acre expansion to the project.

The SJREC GSA is working with neighboring GSA's and Water Districts to implement this project, among others, in a sustainable manner. Successful and sustainable management of groundwater is best achieved through local collaboration with interested parties.

4.1.5 BB Limited Recharge and Recovery

The BB Limited Recharge and Recovery project is located east of the City of Mendota along the eastside of the Fresno Slough and south of the San Joaquin River. This project is on an existing 13-acre recharge site. The environmental review for this project will begin in 2019. The project is anticipated to be fully functional in 2020. A joint CEQA/NEPA is expected for this project resulting in a Negative Declaration and Finding of No Significant Impact. Fresno County Well Construction Permits are required for this project. This project will be made accessible to the public consistent with CEQA/NEPA requirements.

The BB Limited Recharge and Recovery project is located in an existing 13-acre site north of the existing Meyers Water Bank. Surface water from the SJREC will be delivered to the site. Additionally, excess flood water from the Kings River and/or San Joaquin Rivers will be diverted to the site. The total 13-acre facility is expected to recharge upwards of 1,500 acre-feet in a given year. During a Critical Year, the member agencies of the San Joaquin River Exchange Contractors can extract up to 4,000 acre-feet of stored groundwater. It is anticipated that the Exchange Contractors will recharge over 4,000 acre-feet over three consecutive years and ultimately extract 4,000 acre-feet in a subsequent Critical Year. This facility will be managed to recharge and store more water than will be extracted. The excess recharged water will help offset regional groundwater usage near the Mendota Pool. The operations of this facility will help achieve regional sustainability specifically contributing to raising groundwater levels, increasing groundwater storage and improving groundwater quality. The total cost of the 13-acre facility is approximately $600,000.

The SJREC GSA is working with neighboring GSA's and Water Districts to implement this project, among others, in a sustainable manner. Successful and sustainable management of groundwater is best achieved through local collaboration with interested parties.

4.1.6 Farmers Water District Recharge and Recovery

The Farmers Water District Recharge and Recovery project is located east of the City of Mendota along the eastside of the Fresno Slough and south of the San Joaquin River in the Farmers Water District. The project participants for this facility include the Farmers Water District and the SJRECWA entities. This project consists of a proposed 90-acre recharge facility. The environmental review for this project will begin in 2019. The project is anticipated to be fully functional in 2020. A joint CEQA/NEPA is expected for this project resulting in a Mitigated Negative Declaration and a Mitigated Finding of No Significant Impact. This project will be made accessible to the public consistent with CEQA/NEPA requirements. Anticipated permits for the 90-acre site include: Fresno County Well Construction Permit, California Department of Fish and Wildlife Section 1600 Streambed Alteration Permit, Central Valley Regional Water Quality Control Board Clean Water Act Section 401 Permit and United States Army Corp of Engineers Clean Water Act Section 404 Permit.

The Farmers Water District Recharge and Recovery project is located on 90 acres of existing farm land north of the existing Meyers Water Bank and southeast of the proposed BB Limited Recharge and Recovery project. Surface water from SJRECWA entities will be delivered to the site. Additionally, excess flood water from the Kings River and/or San Joaquin River will be diverted to the site. The total 90-acre facility is expected to recharge upwards of 6,500 acre-feet in a given year. During a Critical Year, the SJRECWA entities can extract up to 4,000 acre-feet of stored groundwater. This facility will be managed to recharge and store more water than will be extracted. The excess recharged water will help offset regional groundwater usage near the Mendota Pool. The operations of this facility will help achieve regional sustainability specifically contributing to raising groundwater levels, increasing groundwater storage and improving groundwater quality. The total cost of the 90-acre facility is approximately $3,000,000.

The SJREC GSA is working with neighboring GSA's and Water Districts to implement this project, among others, in a sustainable manner. Successful and sustainable management of groundwater is best achieved through local collaboration with interested parties.

4.1.7 Summary of Active Water Resource Projects 1-6

The San Joaquin River Exchange Contractors Active Projects 1-6 will significantly contribute to the sustainability of the Delta-Mendota Subbasin. Not only will the SJREC leave more water in the Recharge and Recovery Projects than is extracted, additional water can be recharged through the project facilities to improve groundwater conditions. The SJREC are anticipating needing dispatchable storage approximately 7% of the time through the Planning and Implementation Horizon. In these years the Exchange Contractors will recover stored groundwater to meet demand in-lieu of pumping natural groundwater. Additionally, the Exchange Contractors will recover 8,000 acre-feet of conserved water stored in the LBCDR for use during Critical Years under the Exchange Contract. This has a direct positive impact on groundwater levels and also has a benefit of 31,000 acre-feet for the regional change in groundwater storage.

4.1.8 Red Top Area Subsidence Mitigation

The Red Top Subsidence Mitigation project is located east of the San Joaquin River in the Red Top Area. The Project Participants for this project include the SJREC and the newly formed Triangle T Water District. This existing project was constructed in 2017 and primarily consists of a pipeline under the San Joaquin River to deliver surface water from the Central California Irrigation District's Poso Canal to the east side of the San Joaquin River. This project required close coordination with both state and federal agencies. CCID worked with the USBR to prepare a joint CEQA/NEPA environmental review resulting in a Mitigated Negative Declaration and Mitigated Finding of No Significant Impact (SCH# 2016021011). The following permits were also required prior to construction: California State Lands Commission Lease, Central Valley Flood Protection Board Permit, California Department of Fish and Wildlife Section 1600 Streambed Alteration Permit, Central Valley Regional Water Quality Control Board Clean Water Act

Section 401 Permit, and United States Army Corp of Engineers Clean Water Act Section 404 Permit. This project was made accessible to the public consistent with CEQA/NEPA requirements.

The Red Top Subsidence Mitigation project is in an area significantly impacted by subsidence due to extracting groundwater from the aquifer below the Corcoran Clay. The Triangle T Water District, historically solely relying on groundwater, will purchase and deliver surface water through the pipeline under the San Joaquin River. Water delivered to Triangle T Water District will either be used directly in-lieu of pumping groundwater or delivered to recharge ponds. As a direct result of delivering surface water and developing a shallow groundwater recharge and recovery facility, the area will use the stored shallow groundwater and pump less water from the aquifer below the Corcoran Clay. The subsidence contribution in the Red Top Area from the Triangle T Water District will significantly reduce as a result of great collaboration between the project participants. An expert panel will review the area and determine the sustainable yield from the aquifer below the Corcoran Clay that does not cause significant or unreasonable subsidence. There is also a mandatory step-down reduction each year from 2017-2021 for groundwater extractions from below the Corcoran Clay. The annual allowable extraction from below the Corcoran Clay per acre in the Triangle T Water District is respectively; 0.90, 0.75, 0.65, 0.60 and 0.50. The overall extraction will be limited by the lesser of the mandatory step-down reduction or recommendation from the expert panel. In addition to mitigating subsidence, this project will also contribute to regional sustainability, specifically raising groundwater levels and increasing groundwater storage. The total cost of the existing project was $1,125,000.

In addition, the Triangle T Water District is working on a proposed project to expand the acreage of recharge ponds and drill upper aquifer wells while abandoning lower aquifer wells. Pumps will be installed in the Eastside Bypass to capture flood flows and deliver to the Triangle T Water District for direct use or in-lieu use. The Triangle T Water District, through the SJRECWA, is expected to receive $9,500,00 in federal disaster relief funding through the California Office of Emergency Services, to cover the total cost of $12,600,000 for the proposed expansion to the existing project.

This project, while physically outside of the Delta-Mendota Subbasin, will have direct positive impacts on three Undesirable Results occurring outside the Subbasin. Recharging surface water into the Upper Aquifer will increase water levels and groundwater storage in the Chowchilla Subbasin. The major positive impact from this project will, and already has, reduce extractions from the Lower Aquifer resulting in mitigation of Land Subsidence. In 2015, Sack Dam, the headworks for SLCC, was subsiding at a rate of 0.5 feet/year. The subsidence rate at Sack Dam was reduced to about 0.17 feet/year after the first year of implementation of the existing project.

4.2 Management Actions

The SJREC have management actions that have been in place since the 1990’s to successfully manage groundwater in and around its service area.

4.2.1 Annual Groundwater Assessment Report

Each year the SJREC prepare an annual report (Report) of the current and historical conditions of groundwater. This report includes groundwater pumping within each member agency of the SJRECWA. The report includes: pumping volumes, pump tests, water quality, and water levels. The report also summarizes regional groundwater pumping. This report is reviewed by our Hydrogeologist, who prepares a supplemental assessment report (Recommendation). The hydrogeologist makes a recommendation on how each management area (or sub-area) within the SJREC area should be managed for the current year. The Report and Recommendation are annually reviewed and approved by the individual SJRECWA entity Board of Directors. The primary management tool is to review water levels in impacted areas. Historically, the hydrogeologist has recommended limiting the export of groundwater in those impacted areas if the groundwater elevation is below an established trigger level. This Report and Recommendation have proven essential in sustainably managing the aquifers around the districts.

4.2.2 Private Well Pumping for Credits

The member entities of the SJRECWA, allow landowners to pump private well water into the district facilities for credit. The SJREC entities have implemented a policy to regulate pumping and ensure a healthy aquifer while maintaining good service of surface water. Each year the entities work with a Hydrogeologist to prepare an annual groundwater assessment report. In the 1990's, the entities were divided up into management areas. Our Hydrogeologist recommended, and the boards adopted, establishing trigger water levels to restrict the mining of groundwater in impacted areas. Groundwater cannot be exported out of an impacted area if the water level is below the trigger level. During the recent drought from 2013-2016, water levels in impacted areas dropped below the trigger. In 2017, the water levels recovered. This management action has proven effective to mitigate Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage.

All water pumped for credit must meet water quality standards. Currently, the maximum allowable Total Dissolved Solids and Boron are 1,500 TDS and 2.0 ppm, respectively. In addition, the blended water quality downstream of the well shall not exceed 700 TDS, 0.5 ppm Boron and no additional detection of Selenium. A well pumper can pump for credits every two out of three years. There is also a maximum allowable total volume that can be pumped for credit. However, the maximum allowable credit is further limited by the amount of groundwater which can be pumped without damaging other landowners or depleting groundwater storage. A groundwater consultant may be required to determine the potential impacts of pumping the well for credit. Pumping for credit must be terminated if the pumping has a detrimental impact on neighboring wells or on the groundwater table.

Since 2000, about 70% of the total pumping was subject to the curtailment of these policies and recommendation, resulting from the Hydrogeologist annual groundwater assessment report. Note that the percentage was up to about 90% during the critical water years 2014 and 2015; years of highest stress for the local aquifers. The annual groundwater assessment report, coupled with the Districts policies, have proven effective in sustainably managing groundwater even through the most recent "historic" drought.

4.2.3 Joint Groundwater Conditions Studies Between CCID and Neighboring Cities

CCID nearly surrounds the following six cities: Newman, Gustine, Los Banos, Dos Palos, Firebaugh and Mendota. Three of these cities are DAC's and the other three are Severely DAC's. Maintaining a healthy aquifer was and is a high priority for the cities and the SJREC GSA. Starting in the early 1990's, CCID approached the neighboring cities to embark on a joint study of the groundwater conditions surrounding the City. The cities of Newman, Gustine, Los Banos, Firebaugh and Mendota rely entirely on groundwater to meet their demand. Note that the City of Dos Palos has poor quality groundwater and has an agreement with CCID to transfer and treat surface water. These studies, updated periodically, formed a great partnership and is the basis for including each City GSA as a partner in the

SJREC GSP Group. In addition, these studies form the foundation for development and implementation of sustainability criteria in and around each City. Successful implementation of the SGMA is best achieved locally through long-term partnerships.

4.2.4 Mitigation for Migration of Shallow Saline Groundwater

The SJRECWA, particularly FCWD and a portion of CCID (Camp 13), have been engaged in litigation over the migration of poor quality (high electrical conductivity and high selenium) from upslope drainage areas to the south and west. Resolving this issue is of the utmost concern for FCWD and CCID for healthy soils and groundwater and also successful implementation of the SGMA. While this issue remains unresolved at the moment, FCWD and CCID have developed several management actions to help control the further migration of this poor-quality groundwater.

FCWD and Camp 13 have a perched water table, that if not controlled, would cause the overlying land to be unfarmable. Landowners in CCID and FCWD have installed buried tile lines (subsurface drainage) to control the perched groundwater table in the area and are participating in the San Joaquin River Improvement Project (SJRIP) to manage subsurface drain water produced within the region.

One successful management action for the region has been the implementation of the various components of the Westside Regional Drainage Plan; see Appendix P. Four effective strategies have been implemented to reduce drainage discharge including 1) source control, 2) groundwater management, 3) drainage reuse and 4) treatment and disposal. Source control reduces the volume of water contributing to subsurface drainage by reducing deep percolation of applied water and reducing seepage from canals and ditches. In 2002, through a joint study between the SJRECWA and the USBR, it was determined that the pumping of strategically placed wells could lower the perched water table and reduce discharge of subsurface drainage systems. As a result, 18 wells have been installed are have successfully reduced the discharge from subsurface drainage systems. The operation of these wells have proven a vital tool for the FCWD and CCID to successfully manage groundwater and helps to control the further migration of the plume of poor-quality groundwater.

Drainage reuse is the primary function of the SJRIP. The SJRIP utilizes subsurface drain water as a source of irrigation water for salt tolerant crops. This management practice allows for the agricultural region to maintain the health of the soil with subsurface drainage lines while preventing the discharge of that drainage water to the San Joaquin River.

4.3 Implementation of Projects and Management Actions

The SJRECWA and SJREC GSA have actively managed their water resources through various Projects and Management Actions. The development of the SJREC GSP and implementation of the SGMA will work hand-in-hand with the historic practices of the member agencies of the SJRECWA. The SJREC GSA will continue to review new tools to improve management of both surface water and groundwater. One such new tool is the Soil Agricultural Groundwater Banking Index (SAGBI). Figure 25 shows the SAGBI rating for the SJREC GSP Group area.

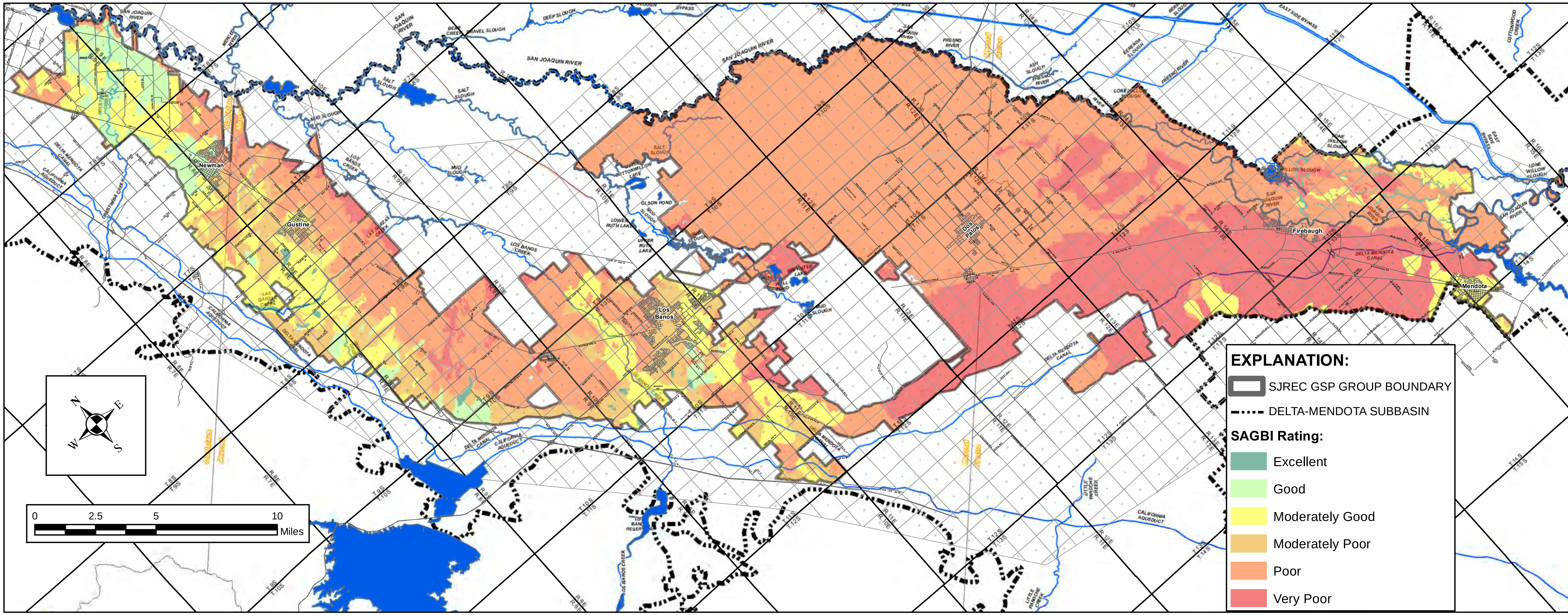

FIGURE 25 - SAGBI MAP

5.0 PLAN IMPLEMENTATION

5.1 Estimate of GSP Implementation Costs

Development for the SJREC GSP is anticipated to cost $700,000 which will be shared between the following GSA's: San Joaquin River Exchange Contractors, City of Newman, City of Gustine, City of Los Banos, City of Dos Palos, City of Firebaugh, City of Mendota, Turner Island Water District – 2, County of Madera – 3, Merced County – Delta Mendota (portion), Fresno County – Management Area B (portion), further described in numerous MOU's with the Exchange Contractors. The annual GSP cost is projected to be $50,000. During each of the five-year plan updates the projected cost is $200,000. The Exchange Contractors GSP Group has received $335,000 in funds from the Sustainable Groundwater Planning Grant Program. The Exchange Contractors have historically been actively managing groundwater and do not anticipate a significant increase in cost to monitor and report groundwater conditions. The SJREC also received Category 1 funding from the SGWP Grant to offset costs for SDAC's.

5.2 Schedule of Implementation

The SJRECWA, and subsequent SJREC GSA, has been sustainably managing groundwater for decades. The SJREC GSA is a net importer to groundwater. Many of the Projects and Management Actions described in Section 4.0 have already been implemented. Furthermore, the Projects and Management Actions that have yet to be implemented will only enhance the sustainability of the local aquifers and help neighboring GSA's and GSP Groups achieve and maintain sustainability.

5.3 Annual Reporting

Consistent with Water Code Section 10728, On the April 1 following the adoption of a GSP and annually thereafter, a GSA shall submit a report to the DWR containing the following information about the basin managed in the GSP:

a) Groundwater elevation data.
b) Annual aggregated data identifying groundwater extraction for the preceding water year.
c) Surface water supply used for or available for use for groundwater recharge or in-lieu use.
d) Total water use.
e) Change in groundwater storage.

5.4 Periodic Evaluations

The SJREC GSA will periodically evaluate its GSP, assess changing conditions in the basin that may warrant modification of the plan or management objectives, and may adjust components in the plan. An evaluation of the plan shall focus on determining whether the actions under the plan are meeting the plan's management objectives and whether those objectives are meeting the sustainability goal in the basin. Oftentimes, an iterative process proves most effective in managing complex plans. The SJREC GSA intends to continually update and progress groundwater management in and around its service area.

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7.0 CITY OF NEWMAN GSA AREA

7.1 Background for City of Newman

The City of Newman is an expanding urban area that relies entirely on groundwater. Mutual concerns of the quantity and quality of groundwater in terms of future growth, initiated conversations between CCID and the City to investigate the long-term reliability of the surrounding aquifer. In the early 1990's, CCID and the City jointly participated in a study of the groundwater conditions in and around the City, (KDSA 1992; Newman). Subsequent groundwater studies for the City of Newman have been completed in cooperation with CCID.

Over the years, CCID has invested in helping cities monitor, understand and manage the aquifers for the communities near the district. The relationship has resulted in a common understanding of the aquifer and a partnership which is the foundation of the SJREC GSA and the City of Newman GSA cooperating to develop this part of the GSP. Some potential impacts to the City include increased costs for the SWRCB to develop and implement a sustainable plan for the City and a standalone plan that isn't synchronous with the lands surrounding the City. CCID recognized the potential impacts to the City of Newman, a DAC, and worked with City leaders and technical staff to understand potential opportunities and constraints of SGMA to the City. Ultimately, the City decided to form its' own GSA with the help from the SJREC to appropriately file. The City of Newman welcomed the SJREC's assistance in developing the required elements in a GSP. It was mutually agreed that the SJREC work with the City to develop the requirements in the GSP and to include this in a discrete Section in the SJREC GSP. This was a seamless process due to the decades of cooperation of managing groundwater for the region.

The SJREC are committed to assist this DAC to maintain sustainability through the planning and implementation horizon. The City of Newman GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix Q for a discussion on the basin setting, sustainable management criteria and projects & management actions specific to the City. Some further details are provided below.

7.2 Water Budgets for the City of Newman

Presented herein is the compilation of the historic, current and projected water budgets specific to the City of Newman GSA.

7.2.1 Historic Water Budget for the City of Newman

The City of Newman solely relies on groundwater to provide its residents drinking water. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. Groundwater pumping during this timeframe ranged from 2,100 to 2,700 AF/year with an average pumping of 2,500 AF/year. The City sends effluent to its Waste Water Treatment Facility (WWTF). They have about 160 acres of holding ponds at the WWTF. Once treated in the holding ponds, water is used to irrigate 300-400 acres of pasture, alfalfa, oats and corn. The amount of effluent used for irrigation ranged from 800 to 1,600 AF/year with an average of 1,100 AF/year. There is approximately 250 AF/year evaporation from the effluent ponds. The irrigation efficiency of the effluent water used to irrigate crops is assumed to be 70% which equates to a net crop evapotranspiration of about 550 AF/year, for a total consumptive use of about 800 AF/year.

The City water use that does not result in the production of effluent was used to water lawns, parks, etc. The outdoor water use is the difference of pumpage and effluent and averaged about 1,400 AF/year. Typically, a 70% irrigation efficiency is applied to urban landscape watering which results in an average annual consumptive use of about 1,000 AF/year.

The total average annual consumptive use from outdoor water use and crop demand at the WWTF is 1,800 AF/year. The City of Newman GSA covers roughly 1,250 acres. The approximate sustainable yield for the City of Newman GSA is 0.40 acre-feet/acre or about 500 acre-feet/year.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2003	2,100	800	1,300	1,600
2004	2,400	800	1,600	1,800
2005	2,500	800	1,700	1,900
2006	2,700	1,100	1,600	2,000
2007	2,700	1,400	1,300	2,000
2008	2,700	1,400	1,300	1,900
2009	2,500	1,100	1,400	1,800
2010	2,300	800	1,500	1,700
2011	2,200	900	1,300	1,700
2012	2,600	1,600	1,000	1,900

Table 40 - City of Newman Historic Water Budget Data

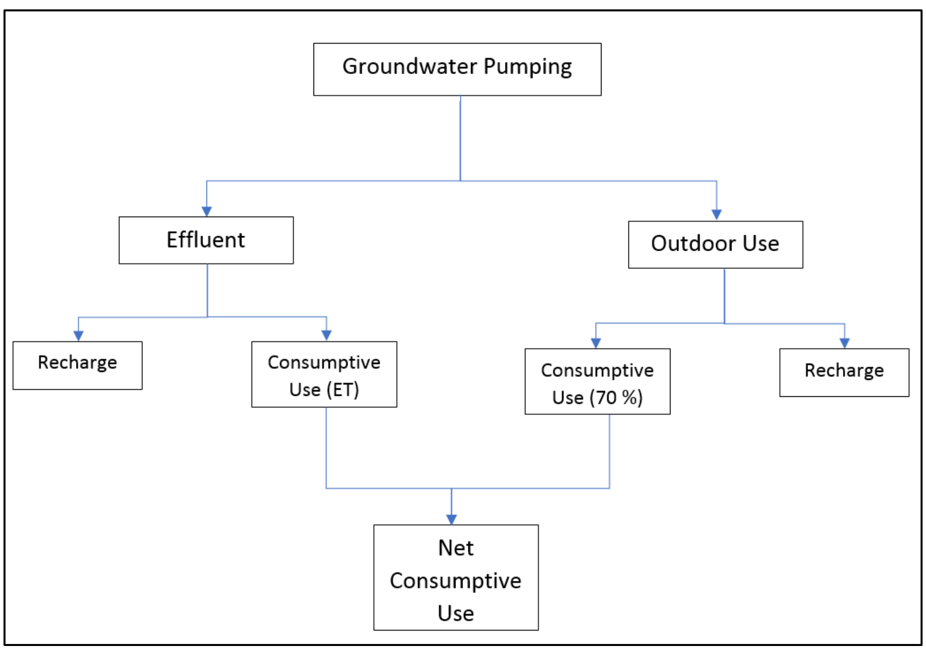

Figure 26 - City Water Use Diagram

7.2.2 Current Water Budget for the City of Newman

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2013	2,500	1,700	800	1,800

Table 41 - City of Newman Current Water Budget Data

7.2.3 Projected Water Budget for the City of Newman

The City of Newman General Plan projects 2% annual growth, which was used in this plan to determine the projected baseline demand on water. The average annual pumping from the historic water budget was used as a baseline to project the demand on water through the planning and implementation horizon. The same data and methodologies described in Section 7.2.1 were used to determine consumptive use of groundwater. Below is a table of the projected water budget. The projected consumptive use is anticipated to increase by 1,500 AF/year to a total of 3,200 AF by 2070. Section 7.3 will discuss SMC in order for the City of Newman to be sustainable. Section 7.4 will discuss projects and management actions to offset the increased demand.

WATER YEAR	PROJECTED PUMPAGE (AF)	PROJECTED CITY EFFLUENT (AF)	PROJECTED OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2014	2,300	1,500	800	1,700
2015	1,900	1,300	600	1,400
2016	2,000	1,000	1,000	1,500
2017	2,000	1,100	900	1,500
2018	2,300	1,100	1,200	1,700
2019	2,300	1,100	1,200	1,700
2020	2,400	1,100	1,300	1,800
2021	2,400	1,200	1,200	1,700
2022	2,500	1,200	1,300	1,800
2023	2,500	1,200	1,300	1,800
2024	2,600	1,200	1,400	1,800
2025	2,600	1,300	1,300	1,800
2026	2,700	1,300	1,400	1,800
2027	2,700	1,300	1,400	1,800
2028	2,800	1,300	1,500	1,900
2029	2,900	1,400	1,500	1,900
2030	2,900	1,400	1,500	1,900
2031	3,000	1,400	1,600	2,000
2032	3,000	1,500	1,500	1,900
2033	3,100	1,500	1,600	2,000
2034	3,200	1,500	1,700	2,100
2035	3,200	1,500	1,700	2,100
2036	3,300	1,600	1,700	2,100
2037	3,400	1,600	1,800	2,100
2038	3,400	1,600	1,800	2,100
2039	3,500	1,700	1,800	2,100
2040	3,600	1,700	1,900	2,200
2041	3,600	1,700	1,900	2,200
2042	3,700	1,800	1,900	2,200
2043	3,800	1,800	2,000	2,300
2044	3,800	1,800	2,000	2,300
2045	3,900	1,900	2,000	2,300
2046	4,000	1,900	2,100	2,300
2047	4,100	2,000	2,100	2,300
2048	4,200	2,000	2,200	2,400
2049	4,200	2,000	2,200	2,400
2050	4,300	2,100	2,200	2,400
2051	4,400	2,100	2,300	2,500
2052	4,500	2,200	2,300	2,500
2053	4,600	2,200	2,400	2,500
2054	4,700	2,200	2,500	2,600
2055	4,800	2,300	2,500	2,600
2056	4,900	2,300	2,600	2,700
2057	5,000	2,400	2,600	2,700
2058	5,100	2,400	2,700	2,800
2059	5,200	2,500	2,700	2,800
2060	5,300	2,500	2,800	2,800
2061	5,400	2,600	2,800	2,800
2062	5,500	2,600	2,900	2,900
2063	5,600	2,700	2,900	2,900
2064	5,700	2,700	3,000	3,000
2065	5,800	2,800	3,000	3,000
2066	6,000	2,800	3,200	3,100
2067	6,100	2,900	3,200	3,100
2068	6,200	3,000	3,200	3,100
2069	6,300	3,000	3,300	3,200
2070	6,400	3,100	3,300	3,200

Table 42 – City of Newman Projected Water Budget Data

7.3 Sustainable Management Criteria for the City of Newman

The City of Newman has historically relied completely on groundwater extraction to meet water demand. Groundwater overdraft around the City has primarily been offset by recharge from the SJREC service area. As mentioned previously, the SJREC are invested in helping the City to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the City of Newman on Projects and Management actions to offset groundwater extractions above the sustainable yield of the City.

The historical consumptive use for the City of Newman was about 1,800 AF/year which equates to an average use of about 1.5 AF/acre. The sustainable yield for the city is about 500 AF/year, which leaves a 1,300 AF/year consumptive use deficit that needs to be met through projects and management actions. While the City of Newman lies in the SJREC Management Area A, different SMC is developed in order for the City to achieve collective and independent groundwater sustainability.

7.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the City are positively impacted through recharge from the SJREC. Water levels in the SJREC Management Area A will be used to sustainably manage groundwater levels around the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

7.3.2 Reduction in Groundwater Storage

Groundwater storage under the City of Newman is positively impacted through recharge from the SJREC. Managing groundwater storage for the City will be accomplished through updated water budgets for the City. The SJREC are contributing recharge to maintain adequate groundwater storage to offset storage reductions caused by the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

7.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

7.3.4 Degraded Water Quality

The main concern for the City is the contamination resulting from naturally occurring constituents including nitrate, arsenic, hexavalent chromium, selenium, total dissolved solids, sulfate, chloride, and boron. These constituents are important in terms of developing public supply wells to meet Title 22 Standards. As part of the process to install new wells, the City does vertical trends in groundwater quality and completes the well opposite of the zones with quality concerns. One potential solution for water quality concerns and also to meet overdraft is for the City to receive a surface water transfer from the SJREC.

7.3.5 Land Subsidence

The City has two wells that solely tap strata in the lower aquifer and two composite wells that tap both the upper and lower aquifers. Wells pumping from a confined aquifer have the potential to cause inelastic land subsidence. To date, the land subsidence in and around the City has been minimal and is indicative that the City wells have not caused any significant land subsidence. The SJREC and the City will work together to ensure that significant and unreasonable land subsidence does not occur due to City pumping. Any future increase in pumping from below the Corcoran clay will be analyzed to determine the potential to cause land subsidence and appropriate mitigation measures will be implemented. One such mitigation measure could include a reduced pumping from the lower aquifer with the increase in demand offset by restricted watering and/or transfer of surface water to the City.

7.3.6 Depletions of Interconnected Surface Water

The presence of an undesirable result for depletions of interconnected surface water is not likely to occur in the City of Newman and therefore no SMC have been established for this sustainability indicator.

7.4 Projects and Management Actions for the City of Newman

The City is actively pursuing water conservation. In order to maintain sustainability for each GSA in the SJREC GSP group, the City is committed to offsetting an increase in demand based on projected population growth, by developing certain projects. Each project will be analyzed jointly with the City and the SJREC to maximize the regional benefits. The City will develop projects to offset overdraft including; 1) storm water capture, 2) demand reduction through reduced watering, 3) surface water transfer, 4) purchasing groundwater credits, 5) participation in recharge projects 6) reclaimed water for outdoor watering and 7) the city will continue to investigate other types of projects.

The groundwater quality, under natural conditions, under the City has some constituents of concern discussed in Appendix Q. The City currently pumps certain wells as needed to meet Title 22 water quality standards for the consumer. If the groundwater quality were to naturally degrade and/or the Title 22 standards for drinking water were to be updated with lower MCL's, the City may run the risk of exceeding allowable limits. In addition to the potential water quality concerns, with the SGMA, the City currently has a deficit water balance. To counteract both of these concerns, the City has started preliminary discussions with the SJREC on two possible projects mentioned above. One project to offset water quality concerns is to transfer surface water from the SJREC to the City in exchange for the City pumping groundwater into the CCID Main Canal.

Another project has been discussed to address both overdraft and water quality concerns for the City. The SJREC would make surface water available for transfer to the City, thereby reducing the City's need to pump groundwater while providing cleaner drinking water for the DAC's residents. The City of Dos Palos has been receiving surface water from CCID for decades due to groundwater quality concerns. The SJREC would anticipate mimicking that proven model to provide a sustainable water supply for the residents of Newman.

The SJREC will continue to work with the City to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources and providing safe and clean drinking water for this disadvantaged community.

7.5 Plan Implementation for the City of Newman

The cost to develop and implement the GSP specific to the City of Newman has been cost shared at 50% between the SJREC GSA and the City of Newman GSA. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the City of Newman GSA. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Newman area was the implementation of a representative well with a trigger level to limit groundwater transfers from the area. As a result of the annual groundwater investigations prepared by the SJREC, the problem presented itself along with a solution to mitigate the concern; resulting in the aquifer fully recovering after water levels dropped below established triggers and no long-term lowering of the aquifer was experienced. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the City, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

8.0 CITY OF GUSTINE GSA AREA

8.1 Background for City of Gustine

The City of Gustine is an expanding urban area that relies entirely on groundwater. Mutual concerns of the quantity and quality of groundwater in terms of future growth, initiated conversations between CCID and the City to investigate the long-term reliability of the surrounding aquifer. In the early 1990's, CCID and the City jointly participated in a study of the groundwater conditions in and around the City, (KDSA 1992; Gustine). Subsequent groundwater studies for the City of Gustine have been completed in cooperation with CCID.

Over the years, CCID has invested in helping cities monitor, understand and manage the aquifers for the communities near the district. The relationship has resulted in a common understanding of the aquifer and a partnership which is the foundation of the SJREC GSA and the City of Gustine GSA cooperating to develop this part of the GSP. Some potential impacts to the City include increased costs for the SWRCB to develop and implement a sustainable plan for the City and a standalone plan that isn't synchronous with the lands surrounding the City. CCID recognized the potential impacts to the City of Gustine, a DAC, and worked with City leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the City. Ultimately, the City decided to form its' own GSA with the help from the SJREC to appropriately file. The City of Gustine welcomed the SJREC's assistance in developing the required elements in a GSP. It was mutually agreed that the SJREC will work with the City to develop the requirements in the GSP and to include this in a discrete Section in the SJREC GSP. This was a seamless process due to the decades of cooperation of managing groundwater for the region.

The SJREC are committed to assist this DAC to maintain sustainability through the planning and implementation horizon. The City of Gustine GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix R for a discussion on the basin setting, sustainable management criteria and projects & management actions specific to the City. Some further details are provided below.

8.2 Water Budgets for the City of Gustine

Presented herein is the compilation of the historic, current and projected water budgets specific to the City of Gustine GSA.

8.2.1 Historic Water Budget for the City of Gustine

The City of Gustine solely relies on groundwater to provide its residents drinking water. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. Groundwater pumping during this timeframe ranged from 1,000 to 1,500 AF/year with an average pumping of 1,300 AF/year. The City sends effluent to its Waste Water Treatment Facility (WWTF). The City was unable to provide historic records of effluent discharged over the historic period and the records from 2015 was used as a surrogate. The City is working with staff to maintain better records for subsequent groundwater reports. A total of about 625 acre-feet of City effluent was discharged in 2015. Once treated in the holding ponds, about 100-200 acre-feet of effluent water is used to irrigate hay and pasture. The remaining water is either evaporated or percolated. Due to the fine grained soils in the area, KDSA estimated the consumptive use of the City effluent to be about 80% or about 500 AF/year. In 2015, groundwater pumping was 20% lower than the historic average. The assumed consumptive use in the WWTF for the City during the historic water budget may be 20% higher than what was observed in 2015 or about 625 AF/year

The City water use that does not result in the production of effluent was used to water lawns, parks, etc. The outdoor water use is the difference of pumpage and effluent and averaged about 525 AF/year. Typically, a 70% irrigation efficiency is applied to urban landscape watering which results in an average annual consumptive use of about 365 AF/year.

The total average annual consumptive use from outdoor water use and crop demand at the WWTF is 1,000 AF/year. The City of Gustine GSA covers roughly 900 acres. The approximate sustainable yield for the City of Gustine GSA is 0.40 acre-feet/acre or about 400 acre-feet/year.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2003	1,400	800	600	1,000
2004	1,400	800	600	1,000
2005	1,300	800	500	1,000
2006	1,300	800	500	1,000
2007	1,500	800	700	1,100
2008	1,300	800	500	1,000
2009	1,000	800	200	800
2010	1,200	800	400	900
2011	1,200	800	400	900
2012	1,300	800	500	1,000

Table 43 - City of Gustine Historic Water Budget Data

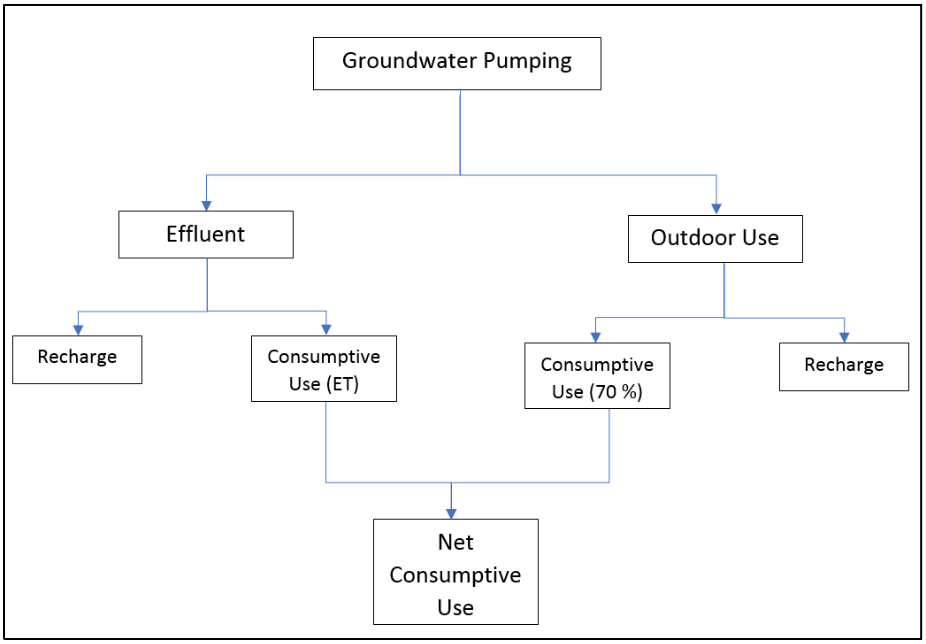

Figure 27 - City Water Use Diagram

8.2.2 Current Water Budget for the City of Gustine

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2013	1,300	800	500	1,000

Table 44 - City of Gustine Current Water Budget Data

8.2.3 Projected Water Budget for the City of Gustine

The City of Gustine General Plan projects 2.5% annual growth, which was used in this plan to determine the projected baseline demand on water. The average annual pumping from the historic water budget was used as a baseline to project the demand on water through the planning and implementation horizon. The same data and methodologies described in Section 8.2.1 were used to determine consumptive use of groundwater. Based on the Historic Water Budget, the effluent discharge is assumed at 60% of total groundwater pumping. Below is a table of the projected water budget. The projected consumptive use is anticipated to increase by 2,600 AF/year to a total of 3,600 AF by 2070. Section 8.3 will discuss SMC in order for the City of Gustine to be sustainable. Section 8.4 will discuss projects and management actions to offset the increased demand.

WATER YEAR	PROJECTED PUMPAGE (AF)	PROJECTED CITY EFFLUENT (AF)	PROJECTED OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2014	1,100	700	400	800
2015	1,100	700	400	800
2016	1,200	700	500	900
2017	1,300	800	500	1,000
2018	1,300	800	500	1,000
2019	1,300	800	500	1,000
2020	1,400	800	600	1,100
2021	1,400	800	600	1,100
2022	1,400	800	600	1,100
2023	1,500	900	600	1,100
2024	1,500	900	600	1,100
2025	1,500	900	600	1,100
2026	1,600	1,000	600	1,200
2027	1,600	1,000	600	1,200
2028	1,700	1,000	700	1,300
2029	1,700	1,000	700	1,300
2030	1,700	1,000	700	1,300
2031	1,800	1,100	700	1,400
2032	1,800	1,100	700	1,400
2033	1,900	1,100	800	1,400
2034	1,900	1,100	800	1,400
2035	2,000	1,200	800	1,500
2036	2,000	1,200	800	1,500
2037	2,100	1,300	800	1,600
2038	2,100	1,300	800	1,600
2039	2,200	1,300	900	1,700
2040	2,200	1,300	900	1,700
2041	2,300	1,400	900	1,800
2042	2,400	1,400	1,000	1,800
2043	2,400	1,400	1,000	1,800
2044	2,500	1,500	1,000	1,900
2045	2,500	1,500	1,000	1,900
2046	2,600	1,600	1,000	2,000
2047	2,700	1,600	1,100	2,100
2048	2,700	1,600	1,100	2,100
2049	2,800	1,700	1,100	2,100
2050	2,900	1,700	1,200	2,200
2051	2,900	1,700	1,200	2,200
2052	3,000	1,800	1,200	2,300
2053	3,100	1,900	1,200	2,400
2054	3,200	1,900	1,300	2,400
2055	3,200	1,900	1,300	2,400
2056	3,300	2,000	1,300	2,500
2057	3,400	2,000	1,400	2,600
2058	3,500	2,100	1,400	2,700
2059	3,600	2,200	1,400	2,700
2060	3,700	2,200	1,500	2,800
2061	3,800	2,300	1,500	2,900
2062	3,900	2,300	1,600	3,000
2063	3,900	2,300	1,600	3,000
2064	4,000	2,400	1,600	3,000
2065	4,100	2,500	1,600	3,100
2066	4,300	2,600	1,700	3,300
2067	4,400	2,600	1,800	3,300
2068	4,500	2,700	1,800	3,400
2069	4,600	2,800	1,800	3,500
2070	4,700	2,800	1,900	3,600

Table 45 - City of Gustine Projected Water Budget Data

8.3 Sustainable Management Criteria for the City of Gustine

The City of Gustine has historically relied completely on groundwater extraction to meet water demand. Groundwater overdraft around the City has primarily been offset by recharge from the SJREC service area. As mentioned previously, the SJREC are invested in helping the City to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the City of Gustine on Projects and Management actions to offset groundwater extractions by the City that is above their sustainable yield.

The historical consumptive use for the City of Gustine was about 1,000 AF/year which equates to an average use of about 1.1 AF/acre. The sustainable yield for the city is about 400 AF/year, which leaves a 600 AF/year consumptive use deficit that needs to be met through projects and management actions. While the City of Gustine lies in the SJREC Management Area B, different SMC is developed in order for the City to achieve collective and independent groundwater sustainability. Additionally, the Gustine Drainage District was formed to lower the high-water table in the area to maintain productive soils.

8.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the City are positively impacted through recharge from the SJREC. Water levels in the SJREC Management Area B will be used to sustainably manage groundwater levels around the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

8.3.2 Reduction in Groundwater Storage

Groundwater storage under the City of Gustine is positively impacted through recharge from the SJREC. Managing groundwater storage for the City will be accomplished through updated water budgets for the City. The SJREC are contributing recharge to maintain adequate groundwater storage to offset storage reductions caused by the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

8.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

8.3.4 Degraded Water Quality

The main concern for the City is the contamination resulting from naturally occurring constituents including nitrate, arsenic, hexavalent chromium, selenium, total dissolved solids, sulfate, chloride, and boron. These constituents are important in terms of developing public supply wells to meet Title 22 Standards. As part of the process of installing new wells, the City does vertical trends in groundwater quality and completes the well opposite of the zones with quality concerns. One potential solution for water quality concerns and also to meet overdraft is for the City to receive a surface water transfer from the SJREC.

8.3.5 Land Subsidence

The City has one well that solely taps strata in the lower aquifer and four wells that solely tap strata in the upper aquifer. Wells pumping from a confined aquifer have the potential to cause inelastic land subsidence. To date, the land subsidence in and around the City has been minimal and is indicative that the City wells have not caused any significant land subsidence. The SJREC and the City will work together to ensure that significant and unreasonable land subsidence does not occur due to City pumping. Any future increase in pumping from below the Corcoran clay will be analyzed to determine the potential to cause land subsidence and appropriate mitigation measures will be implemented. One such mitigation measure could include a reduced pumping from the lower aquifer with the increase in demand offset by restricted watering and/or transfer of surface water to the City.

8.3.6 Depletions of Interconnected Surface Water

The presence of an undesirable result for depletions of interconnected surface water is not likely to occur in the City of Gustine and therefore no SMC have been established for this sustainability indicator.

8.4 Projects and Management Actions for the City of Gustine

The City is actively pursuing water conservation. In order to maintain sustainability for each GSA in the SJREC GSP group, the City is committed to offsetting an increase in demand based on projected population growth, by developing certain projects. Each project will be analyzed jointly with the City and the SJREC to maximize the regional benefits. The City will develop projects to offset overdraft including; 1) storm water capture, 2) demand reduction through reduced watering, 3) surface water transfer, 4) purchasing groundwater credits, 5) participation in recharge projects, 6) reclaimed water for outdoor watering and 7) the city will continue to investigate other types of projects.

The groundwater quality, under natural conditions, under the City has some constituents of concern discussed in Appendix R. The City currently pumps certain wells as needed to meet Title 22 water quality standards for the consumer. If the groundwater quality were to naturally degrade and/or the Title 22 standards for drinking water were to be updated with lower MCL's, the City may run the risk of exceeding allowable limits. In addition to the potential water quality concerns, with the SGMA, the City currently has a deficit water balance. To counteract both of these concerns, the City has started preliminary discussions with the SJREC on two possible projects mentioned above. One project to offset water quality concerns is to transfer surface water from the SJREC to the City in exchange for the City pumping groundwater into the CCID Main Canal.

Another project has been discussed to address both overdraft and water quality concerns for the City. The SJREC would make surface water available for transfer to the City, thereby reducing the City's need to pump groundwater while providing cleaner drinking water for the DAC's residents. The City of Dos Palos has been receiving surface water from CCID for decades due to groundwater quality concerns. The SJREC would anticipate mimicking that proven model to provide a sustainable water supply for the residents of Gustine.

The SJREC will continue to work with the City to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources and providing safe and clean drinking water for this disadvantaged community.

8.5 Plan Implementation for the City of Gustine

The cost to develop and implement the GSP specific to the City of Gustine has been cost shared at 50% between the SJREC GSA and the City of Gustine GSA. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the City of Gustine GSA. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story was the development of the Gustine Drainage District. The Gustine Drainage District was formed to provide drainage of good water quality to the area around Gustine to maintain healthy soils. This area receives significant recharge from CCID, the ephemeral streams and the GWD and the GDD has actively managed groundwater levels to maintain healthy soils. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the City, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

9.0 CITY OF LOS BANOS GSA AREA

9.1 Background for City of Los Banos

The City of Los Banos is an expanding urban area that relies entirely on groundwater. Mutual concerns of the quantity and quality of groundwater in terms of future growth, initiated conversations between CCID and the City to investigate the long-term reliability of the surrounding aquifer. In the early 1990's, CCID and the City jointly participated in a study of the groundwater conditions in and around the City, (KDSA 1991; Los Banos). Subsequent groundwater studies for the City of Los Banos have been completed in cooperation with CCID and the USBR.

Over the years, CCID has invested in helping cities monitor, understand and manage the aquifers for the communities near the district. The relationship has resulted in a common understanding of the aquifer and a partnership which is the foundation of the SJREC GSA and the City of Los Banos GSA cooperating to develop this GSP. Some potential impacts to the City include increased costs for the SWRCB to develop and implement a sustainable plan for the City and a standalone plan that isn't synchronous with the lands surrounding the City. CCID recognized the potential impacts to the City of Los Banos, a DAC, and worked with City leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the City. Ultimately, the City decided to form its' own GSA with the help from the SJREC to appropriately file. The City of Los Banos welcomed the SJREC's assistance in developing the required elements in a GSP. It was mutually agreed that the SJREC will work with the City to develop the requirements in the GSP City and to include this in a discrete Section in the SJREC GSP. This was a seamless process due to the decades of cooperation of managing groundwater for the region.

The City of Los Banos, the largest City in the Delta-Mendota Subbasin, was originally a partner with the SJRECWA, GWD and SLWD on the Los Banos Creek Diversion Facility described in Section 4.1.1 of this GSP. The Los Banos Creek Recharge and Recovery Project developed jointly with the SJRECWA, GWD and SLWD, directly benefits the water quality for the City supply wells. The Hexavalent Chromium concentration dropped below the standard in one City well near the Los Banos Creek during the extended recharge in 2017. The City recognizes the value working with the local districts to jointly manage local water resources. In continuation of a great working relationship, the City has partnered with the SJREC GSA, GWD and SLWD to develop a sustainable plan for an area that extends beyond the City urban growth boundary and includes upgradient lands.

The SJREC are committed to assist this DAC to maintain sustainability through the planning and implementation horizon. The City of Los Banos GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix S for a discussion on the basin setting, sustainable management criteria and projects & management actions specific to the City. Some further details are provided below.

9.2 Water Budgets for the City of Los Banos

Presented herein is the compilation of the historic, current and projected water budgets specific to the City of Los Banos GSA.

9.2.1 Historic Water Budget for the City of Los Banos

The City of Los Banos solely relies on groundwater to provide its residents drinking water. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. Groundwater pumping during this timeframe ranged from 6,400 to 9,100 AF/year with an average pumping of 7,900 AF/year. The City sends effluent to its Waste Water Treatment Facility (WWTF). They have about 200 acres of holding ponds at the WWTF. Once treated in the holding ponds, water is used to irrigate 350 acres of pasture. There is approximately 600 AF/year evaporation from the effluent ponds. The amount of effluent used for irrigation ranged from 2,600 to 4,000 AF/year with an average of 3,400 AF/year. The consumptive use of the pasture averaged about 3.3 AF/acre for an average consumptive use of about 1,100 AF/year.

The City water use that does not result in the production of effluent was used to water lawns, parks, etc. The outdoor water use is the difference of pumpage and effluent and averaged about 4,000 AF/year. Typically, a 70% irrigation efficiency is applied to urban landscape watering which results in an average annual consumptive use of about 2,800 AF/year.

The total average annual consumptive use from outdoor water use and crop demand at the WWTF is 4,500 AF/year. The City of Los Banos GSA covers roughly 5,800 acres. The approximate sustainable yield for the City of Los Banos GSA is 0.40 acre-feet/acre or about 2,300 acre-feet/year.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2003	6,400	3,200	3,200	4,000
2004	6,900	3,500	3,500	4,200
2005	7,200	3,600	3,600	4,200
2006	7,500	3,800	3,800	4,400
2007	9,100	4,600	4,600	4,900
2008	8,900	4,500	4,500	4,900
2009	8,300	4,200	4,200	4,700
2010	7,700	3,900	3,900	4,500
2011	7,800	3,900	3,900	4,500
2012	8,900	4,500	4,500	4,900

Table 46 - City of Los Banos Historic Water Budget Data

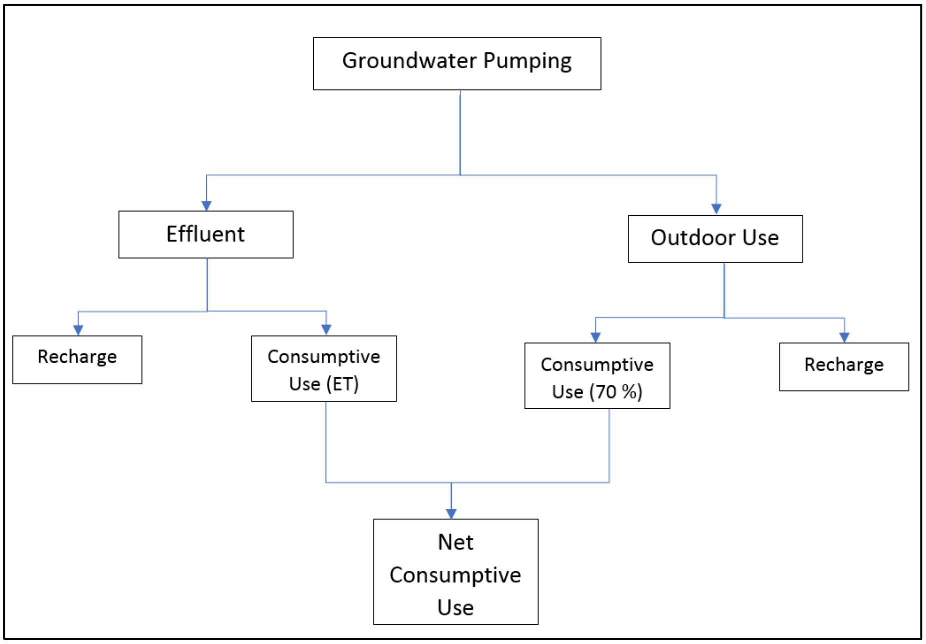

Figure 28 - City Water Use Diagram

9.2.2 Current Water Budget for the City of Los Banos

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2013	8,500	4,300	4,300	4,700

Table 47 - City of Los Banos Current Water Budget Data

9.2.3 Projected Water Budget for the City of Los Banos

The City of Los Banos General Plan projects 2% annual growth, which was used in this plan to determine the projected baseline demand on water. The average annual pumping from the historic water budget was used as a baseline to project the demand on water through the planning and implementation horizon. The same data and methodologies described in Section 9.2.1 were used to determine consumptive use of groundwater. Below is a table of the projected water budget. The projected consumptive use is anticipated to increase by 7,600 AF/year to a total of 12,100 AF by 2070. Section 9.3 will discuss SMC in order for the City of Los Banos to be sustainable. Section 9.4 will discuss projects and management actions to offset the increased demand.

WATER YEAR	PROJECTED PUMPAGE (AF)	PROJECTED CITY EFFLUENT (AF)	PROJECTED OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2014	7,900	4,000	3,900	4,500
2015	6,700	3,400	3,300	3,900
2016	6,100	3,100	3,000	3,600
2017	7,800	3,900	3,900	4,500
2018	8,000	4,000	4,000	4,600
2019	8,100	4,100	4,000	4,600
2020	8,300	4,100	4,200	4,800
2021	8,400	4,200	4,200	4,800
2022	8,600	4,300	4,300	4,900
2023	8,800	4,400	4,400	5,000
2024	9,000	4,500	4,500	5,100
2025	9,100	4,600	4,500	5,100
2026	9,300	4,700	4,600	5,200
2027	9,500	4,800	4,700	5,300
2028	9,700	4,800	4,900	5,500
2029	9,900	4,900	5,000	5,600
2030	10,100	5,000	5,100	5,700
2031	10,300	5,100	5,200	5,800
2032	10,500	5,200	5,300	5,900
2033	10,700	5,400	5,300	6,000
2034	10,900	5,500	5,400	6,100
2035	11,100	5,600	5,500	6,200
2036	11,400	5,700	5,700	6,400
2037	11,600	5,800	5,800	6,500
2038	11,800	5,900	5,900	6,600
2039	12,100	6,000	6,100	6,700
2040	12,300	6,100	6,200	6,900
2041	12,500	6,300	6,200	6,900
2042	12,800	6,400	6,400	7,100
2043	13,100	6,500	6,600	7,300
2044	13,300	6,700	6,600	7,300
2045	13,600	6,800	6,800	7,500
2046	13,900	6,900	7,000	7,700
2047	14,100	7,100	7,000	7,800
2048	14,400	7,200	7,200	7,900
2049	14,700	7,300	7,400	8,100
2050	15,000	7,500	7,500	8,300
2051	15,300	7,600	7,700	8,400
2052	15,600	7,800	7,800	8,600
2053	15,900	8,000	7,900	8,700
2054	16,200	8,100	8,100	8,900
2055	16,600	8,300	8,300	9,100
2056	16,900	8,400	8,500	9,300
2057	17,200	8,600	8,600	9,400
2058	17,600	8,800	8,800	9,600
2059	17,900	9,000	8,900	9,800
2060	18,300	9,100	9,200	10,000
2061	18,600	9,300	9,300	10,100
2062	19,000	9,500	9,500	10,400
2063	19,400	9,700	9,700	10,600
2064	19,800	9,900	9,900	10,800
2065	20,200	10,100	10,100	11,000
2066	20,600	10,300	10,300	11,200
2067	21,000	10,500	10,500	11,400
2068	21,400	10,700	10,700	11,600
2069	21,800	10,900	10,900	11,800
2070	22,300	11,100	11,200	12,100

Table 48 – City of Los Banos Projected Water Budget Data

9.3 Sustainable Management Criteria for the City of Los Banos

The City of Los Banos has historically relied completely on groundwater extraction to meet water demand. Groundwater overdraft around the City has primarily been offset by recharge from the SJREC service area. As mentioned previously, the SJREC are invested in helping the City to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the City of Los Banos on Projects and Management actions to offset groundwater extractions by the City that is above their sustainable yield.

The historical consumptive use for the City of Los Banos was about 4,500 AF/year which equates to an average use of about 0.8 AF/acre. The sustainable yield for the city is about 2,300 AF/year, which leaves a 2,200 AF/year consumptive use deficit that needs to be met through projects and management actions. While the City of Los Banos lies in the SJREC Management Area C, different SMC is developed in order for the City to achieve collective and independent groundwater sustainability.

9.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the City are positively impacted through recharge from the SJREC, SLWD and seepage in the Los Banos Creek. Water levels in the SJREC Management Area C will be used to sustainably manage groundwater levels around the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

9.3.2 Reduction in Groundwater Storage

Groundwater storage under the City of Los Banos is positively impacted through recharge from the SJREC, SLWD and seepage in the Los Banos Creek. Managing groundwater storage for the City will be accomplished through updated water budgets for the City. The SJREC are contributing recharge to maintain adequate groundwater storage to offset storage reductions caused by the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

9.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

9.3.4 Degraded Water Quality

The main concern for the City is the contamination resulting from naturally occurring constituents including nitrate, arsenic, hexavalent chromium, selenium, total dissolved solids, sulfate, chloride, and boron. These constituents are important in terms of developing public supply wells to meet Title 22 Standards. As part of the process of installing new wells, the City does vertical trends in groundwater quality and completes the well opposite of the zones with quality concerns. One potential solution for water quality concerns and also to meet overdraft is for the City to receive a surface water transfer from the SJREC.

9.3.5 Land Subsidence

The City has one active composite well that taps both the upper and lower aquifers. Wells pumping from a confined aquifer have the potential to cause inelastic land subsidence. To date, the land subsidence in and around the City has been minimal and is indicative that the City wells have not caused any significant land subsidence. The SJREC and the City will work together to ensure that significant and unreasonable land subsidence does not occur due to City pumping. Any future increase in pumping from below the Corcoran clay will be analyzed to determine the potential to cause land subsidence and appropriate mitigation measures will be implemented. One such mitigation measure could include a reduced pumping from the lower aquifer with the increase in demand offset by restricted watering and/or transfer of surface water to the City.

9.3.6 Depletions of Interconnected Surface Water

The presence of an undesirable result for depletions of interconnected surface water is not likely to occur in the City of Los Banos and therefore no SMC have been established for this sustainability indicator.

9.4 Projects and Management Actions for the City of Los Banos

The City is actively pursuing water conservation. In order to maintain sustainability for each GSA in the SJREC GSP group, the City is committed to offsetting an increase in demand based on projected population growth, by developing certain projects. Each project will be analyzed jointly with the City and the SJREC to maximize the regional benefits. The City will develop projects to offset overdraft including; 1) storm water capture, 2) demand reduction through reduced watering, 3) surface water transfer, 4) purchasing groundwater credits, 5) participation in recharge projects and 6) the city will continue to investigate other types of projects.

The groundwater quality, under natural conditions, under the City has some constituents of concern discussed in Appendix S. The City currently pumps certain wells as needed to meet Title 22 water quality standards for the consumer. If the groundwater quality were to naturally degrade and/or the Title 22 standards for drinking water were to be updated with lower MCL's, the City may run the risk of exceeding allowable limits, particularly for the hexavalent chromium standard. In addition to the potential water quality concerns, with the SGMA, the City currently has a deficit water balance. To counteract both of these concerns, the City has started preliminary discussions with the SJREC on two possible projects mentioned above. One project to offset water quality concerns is to transfer surface water from the SJREC to the City in exchange for the City pumping groundwater into the CCID Main Canal.

Another project has been discussed to address both overdraft and water quality concerns for the City. The SJREC would make surface water available for transfer to the City, thereby reducing the City's need to pump groundwater while providing cleaner drinking water for the DAC's residents. The City of Dos Palos has been receiving surface water from CCID for decades due to groundwater quality concerns. The SJREC would anticipate mimicking that proven model to provide a sustainable water supply for the residents of Los Banos.

The SJREC will continue to work with the City to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources and providing safe and clean drinking water for this disadvantaged community.

9.5 Plan Implementation for the City of Los Banos

The cost to develop and implement the GSP specific to the City of Los Banos has been cost shared at 25% between the SJREC GSA, SLWD, GWD and the City of Los Banos GSA. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the City of Los Banos GSA. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Los Banos Creek area was the implementation of a representative well with a trigger level to limit groundwater transfers from the area. As a result of the annual groundwater investigations prepared by the SJREC, the problem presented itself along with a solution to mitigate the concern; resulting in the aquifer fully recovering after water levels dropped below established triggers and no long-term lowering of the aquifer was experienced. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the City, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

10.0 CITY OF Dos Palos GSA AREA

10.1 Background for City of Dos Palos

The City of Dos Palos is a Severely Disadvantaged Community that has completely relied on treated surface water. The quality of the groundwater around the City of Dos Palos was not suitable for residential use. Through an agreement dated May 8, 1936 the San Joaquin & Kings River Canal & Irrigation Company, the predecessor to CCID, agreed to provide surface water to the City of Dos Palos through the Canal Company's Colony Main Canal. Water deliveries from what is now the CCID Colony Main Canal continued until 1989 when the City of Dos Palos, through the Dos Palos Area JPA, worked with CCID and the USBR to change their point of diversion to the San Luis Canal (California Aqueduct). A pipeline was constructed to wheel water transferred from CCID from the San Luis Canal to the City's water treatment facility. CCID and the SJREC have a long history working with the local communities to solve regional water problems.

Over the years, CCID has invested in helping cities monitor, understand and manage water resources for the communities near the district. The relationship has resulted in a common understanding of the groundwater conditions and a partnership which is the foundation of the SJREC GSA and the City of Dos Palos GSA cooperating to develop this part of the GSP. Some potential impacts to the City include increased costs for the SWRCB to develop and implement a sustainable plan for the City and a standalone plan that isn't synchronous with the lands surrounding the City. CCID recognized the potential impacts to the City of Dos Palos, a SDAC, and worked with City leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the City. Ultimately, the City decided to form its' own GSA with the help from the SJREC to appropriately file. The City of Dos Palos welcomed the SJREC's assistance in developing the required elements in a GSP. The City requested the SJREC to develop the requirements in the GSP on behalf of the City and to include this in a discrete Section in the SJREC GSP. This was a seamless process due to the decades of cooperation of managing groundwater and surface water resources with the City and CCID.

The SJREC are committed to assist this SDAC to maintain sustainability through the planning and implementation horizon. The City of Dos Palos GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix T for a discussion on the basin setting, sustainable management criteria and projects & management actions specific to the City. Some further details are provided below.

10.2 Water Budgets for the City of Dos Palos

Presented herein is the compilation of the historic, current and projected water budgets specific to the City of Dos Palos GSA.

10.2.1 Historic Water Budget for the City of Dos Palos

The City of Dos Palos solely relies on treated surface water to provide its residents drinking water. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. The surface water delivery to the City ranged from 1,200 to 1,700 AF/year with an average delivery of 1,400 AF/year. The City sends effluent to its Waste Water Treatment Facility (WWTF). They have about 54 acres of ponds at the WWTF. The total City effluent is about 700 AF/year. The evaporation from the ponds is approximately 300 AF/year. The remaining treated effluent, about 400 AF/year, is used to irrigate crops near the WWTF. The irrigation efficiency of the effluent water used to irrigate crops is assumed to be 70% which equates to a net crop evapotranspiration of about 300 AF/year, for a total consumptive use of City effluent of 600 AF/year.

The City water use that does not result in the production of effluent was used to water lawns, parks, etc. The outdoor water use is the difference of pumpage and effluent and averaged about 700 AF/year. Typically, a 70% irrigation efficiency is applied to urban landscape watering which results in an average annual consumptive use of about 500 AF/year.

The total average annual consumptive use from outdoor water use and crop demand at the WWTF is 1,100 AF/year. The City of Dos Palos GSA covers roughly 750 acres. Although the City of Dos Palos does not pump groundwater, the approximate sustainable yield for the City of Dos Palos GSA is 0.40 acre-feet/acre or about 300 acre-feet/year.

WATER YEAR	SURFACE WATER DELIVERY (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2003	1,400	700	700	1,100
2004	1,500	700	800	1,200
2005	1,400	700	700	1,100
2006	1,500	700	800	1,200
2007	1,600	700	900	1,200
2008	1,700	700	1,000	1,300
2009	1,300	700	600	1,000
2010	1,300	700	600	1,000
2011	1,200	700	500	1,000
2012	1,300	700	600	1,000

Table 49 – City of Dos Palos Historic Water Budget

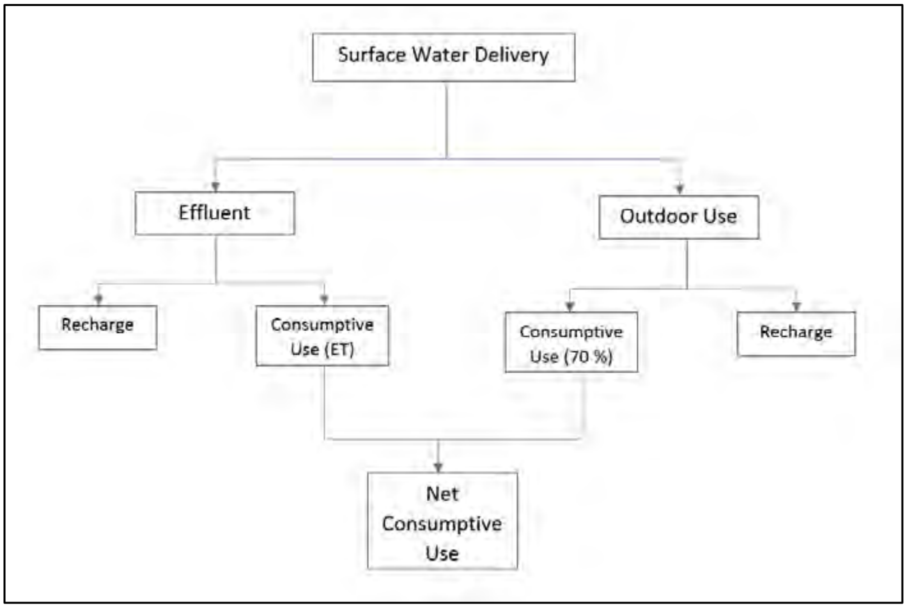

Figure 29 - City Water Use Diagram

10.2.2 Current Water Budget for the City of Dos Palos

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	SURFACE WATER DELIVERY (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2013	1,800	700	1,100	1,400

Table 50 - City of Dos Palos Current Water Budget Data

10.2.3 Projected Water Budget for the City of Dos Palos

The City of Dos Palos General Plan projects a 1% annual growth from 2025-2070, which was used in this plan to determine the projected baseline demand on water. The average annual pumping from the historic water budget was used as a baseline to project the demand on water through the planning and implementation horizon. The same data and methodologies described in Section 10.2.1 were used to determine the consumptive use. Below is a table of the projected water budget. The projected consumptive use is anticipated to increase by 500 AF/year to a total of 1,600 AF by 2070. Section 10.3 will discuss SMC in order for the City of Dos Palos to be sustainable. The current contract between CCID and the City of Dos Palos allows for the transfer of up to 2,500 AF/year of surface water which is below the total projected water delivery in 2070. The City of Dos Palos does not pump any groundwater and is sustainable. Section 10.4 will discuss projects and management actions to offset the increased demand.

WATER YEAR	PROJECTED SURFACE WATER DELIVERY (AF)	PROJECTED CITY EFFLUENT (AF)	PROJECTED OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2014	1,400	500	900	1,100
2015	1,000	500	500	800
2016	1,200	500	700	900
2017	1,400	700	700	1,100
2018	1,400	700	700	1,100
2019	1,400	700	700	1,100
2020	1,400	700	700	1,100
2021	1,400	700	700	1,100
2022	1,400	700	700	1,100
2023	1,400	700	700	1,100
2024	1,400	700	700	1,100
2025	1,400	700	700	1,100
2026	1,400	700	700	1,100
2027	1,400	700	700	1,100
2028	1,500	700	800	1,100
2029	1,500	700	800	1,100
2030	1,500	700	800	1,100
2031	1,500	800	700	1,100
2032	1,500	800	700	1,100
2033	1,500	800	700	1,100
2034	1,500	800	700	1,100
2035	1,600	800	800	1,200
2036	1,600	800	800	1,200
2037	1,600	800	800	1,200
2038	1,600	800	800	1,200
2039	1,600	800	800	1,200
2040	1,600	800	800	1,200
2041	1,700	800	900	1,300
2042	1,700	800	900	1,300
2043	1,700	800	900	1,300
2044	1,700	900	800	1,300
2045	1,700	900	800	1,300
2046	1,700	900	800	1,300
2047	1,800	900	900	1,400
2048	1,800	900	900	1,400
2049	1,800	900	900	1,400
2050	1,800	900	900	1,400
2051	1,800	900	900	1,400
2052	1,800	900	900	1,400
2053	1,900	900	1,000	1,400
2054	1,900	900	1,000	1,400
2055	1,900	1,000	900	1,400
2056	1,900	1,000	900	1,400
2057	1,900	1,000	900	1,400
2058	2,000	1,000	1,000	1,500
2059	2,000	1,000	1,000	1,500
2060	2,000	1,000	1,000	1,500
2061	2,000	1,000	1,000	1,500
2062	2,000	1,000	1,000	1,500
2063	2,100	1,000	1,100	1,600
2064	2,100	1,000	1,100	1,600
2065	2,100	1,100	1,000	1,600
2066	2,100	1,100	1,000	1,600
2067	2,100	1,100	1,000	1,600
2068	2,200	1,100	1,100	1,600
2069	2,200	1,100	1,100	1,600
2070	2,200	1,100	1,100	1,600

Table 51 – City of Dos Palos Projected Water Budget Data

10.3 Sustainable Management Criteria for the City of Dos Palos

The City of Dos Palos has historically relied completely on treated surface water to meet demand. As mentioned previously, the SJREC are invested in helping each of the communities in our area to achieve sustainability. The SJREC GSP Group is currently sustainable; collectively.

The historical consumptive use for the City of Dos Palos was about 1,800 AF/year which equates to an average use of about 2.3 AF/acre which is met by the importation of surface water. While the City of Dos Palos lies in the SJREC Management Area D, different SMC is developed in order for the City to achieve collective and independent groundwater sustainability.

10.3.1 Chronic Lowering of Groundwater Levels

The City does not own or operate production wells. Chronic lowering of groundwater levels for the City of Dos Palos GSA will not occur since the City doesn't pump groundwater and therefore no SMC have been established for this sustainability indicator.

10.3.2 Reduction in Groundwater Storage

The City does not own or operate production wells. Reduction in Groundwater Storage for the City of Dos Palos GSA will not occur since the City doesn't pump groundwater and therefore no SMC have been established for this sustainability indicator.

10.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

10.3.4 Degraded Water Quality

The City does not own or operate production wells. Degraded water Quality for the City of Dos Palos GSA will not occur since the City doesn't pump groundwater and therefore no SMC have been established for this sustainability indicator. Additionally, due to the poor quality of groundwater the City of Dos Palos has relied on treated surface water from the Colony Main Canal dating back to at least 1936, and more recently received water directly from the San Luis Canal.

10.3.5 Land Subsidence

The City does not own or operate production wells. Land subsidence for the City of Dos Palos GSA will not occur since the City doesn't pump groundwater and therefore no SMC have been established for this sustainability indicator.

10.3.6 Depletions of Interconnected Surface Water

The presence of an undesirable result for depletions of interconnected surface water is not likely to occur in the City of Dos Palos and therefore no SMC have been established for this sustainability indicator.

10.4 Projects and Management Actions for the City of Dos Palos

The City of Dos Palos took a proactive roll reaching out to CCID and its predecessor to provide drinking water to the severely disadvantaged community residents through developing a surface water treatment facility and associated appurtenances. The City will continue to work with the SJREC to ensure regional sustainability.

10.5 Plan Implementation for the City of Dos Palos

The cost to develop and implement the GSP specific to the City of Dos Palos has been cost shared at 50% between the SJREC GSA and the City of Dos Palos GSA. Additionally, the SJREC GSA has pursued additional grant funding to fully offset GSP development costs for SDAC's. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the City, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

11.0 CITY OF FIREBAUGH GSA AREA

11.1 Background for City of Firebaugh

The City of Firebaugh is a Severely Disadvantaged Community relies entirely on groundwater. In 2008 KDSA analyzed groundwater conditions in the vicinity of Firebaugh in support of the Draft EIR for the City's General Plan. The quality of the groundwater around the City of Firebaugh on the west side of the San Joaquin River was not suitable for residential use. In the early 2000's, the City of Firebaugh worked with Columbia Canal Company and the landowners on the east side of the river to drill domestic supply wells on the east side of the river where the water quality was significantly better. A pipeline was constructed to deliver water from lands in and adjacent to CCC (east side of the river) to the City (west side of the river). CCC and the SJREC have a long history working with the local communities to solve regional water problems. In this case, the district worked with the local landowners to provide sites for the City to construct wells to provide the residents with water.

Over the years, the CCC has invested in helping cities monitor, understand and manage the aquifers for the communities near the district. The relationship has resulted in a common understanding of the aquifer and a partnership which is the foundation of the SJREC GSA and the City of Firebaugh GSA cooperating to develop this part of the GSP. Some potential impacts to the City include increased costs for the SWRCB to develop and implement a sustainable plan for the City and a standalone plan that isn't synchronous with the lands surrounding the City. CCID recognized the potential impacts to the City of Firebaugh, a SDAC, and worked with City leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the City. Ultimately, the City decided to form its' own GSA with the help from the SJREC to appropriately file. The City of Firebaugh welcomed the SJREC's assistance developing the required elements in a GSP. It was mutually agreed that the SJREC will work with the City to develop the requirements in the GSP and to include this in a discrete Section in the SJREC GSP. This was a seamless process due to the decades of cooperation of managing groundwater for the region.

The SJREC are committed to assist this SDAC to maintain sustainability through the planning and implementation horizon. The City of Firebaugh GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix U for a discussion on the basin setting, sustainable management criteria and projects & management actions specific to the City. Some further details are provided below.

11.2 Water Budgets for the City of Firebaugh

Presented herein is the compilation of the historic, current and projected water budgets specific to the City of Firebaugh GSA.

11.2.1 Historic Water Budget for the City of Firebaugh

The City of Firebaugh solely relies on groundwater to provide its residents drinking water. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. Groundwater pumping during this timeframe ranged from 2,400 to 2,600 AF/year with an average pumping of 2,500 AF/year. The City sends effluent to its Waste Water Treatment Facility (WWTF). They have about 30 acres of holding ponds at the WWTF. The effluent ranges from 600 to 800 AF/year with an average effluent of 700 AF/year. Each year about 100 AF evaporates while the remaining 600 AF percolates in the ponded area. Additionally, the Tomatek processing plant provides about 500 AF/year of effluent which irrigates about 160 acres of sudan and cotton. The effluent water from Tomatek equates to a consumptive use of about 400 AF/year due to evapotranspiration. The total effluent consumptive use for the City of Firebaugh and Tomatek averages about 500 AF/year.

The City water use that does not result in the production of effluent was used to water lawns, parks, etc. The outdoor water use is the difference of pumpage and effluent and averaged about 1,300 AF/year. Typically, a 70% irrigation efficiency is applied to urban landscape watering which results in an average annual consumptive use of about 900 AF/year.

The City is adjacent to the San Joaquin River for about 4.5 river miles. The San Joaquin River is assumed to have about 4 cfs losses through this stretch, of which about 2 cfs is recharging the aquifer in the vicinity of the City. This stretch of river is typically wet year round which results in about 1,400 AF/year of recharge towards the City.

The total average annual consumptive use from outdoor water use and crop demand at the WWTF is 1,400 AF/year. The City of Firebaugh GSA covers roughly 1,850 acres. The approximate sustainable yield for the City of Firebaugh GSA is 0.40 acre-feet/acre or about 700 acre-feet/year in addition to recharge from the river of about 1,400 AF/year for a total of about 2,100 AF/year.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	TOMATEK EFFLUENT (AF)	OUTDOOR USE (AF)	SEEPAGE FROM THE SJR (AF)	CONSUMPTIVE USE (AF)
2003	2,400	800	500	1,100	1,400	1,300
2004	2,500	800	500	1,200	1,400	1,300
2005	2,400	800	500	1,100	1,400	1,300
2006	2,400	700	500	1,200	1,400	1,300
2007	2,600	800	500	1,300	1,400	1,400
2008	2,500	700	500	1,300	1,400	1,400
2009	2,500	600	500	1,400	1,400	1,500
2010	2,500	600	500	1,400	1,400	1,500
2011	2,500	600	500	1,400	1,400	1,500
2012	2,400	600	500	1,300	1,400	1,400

Table 52 - City of Firebaugh Historic Water Budget Data

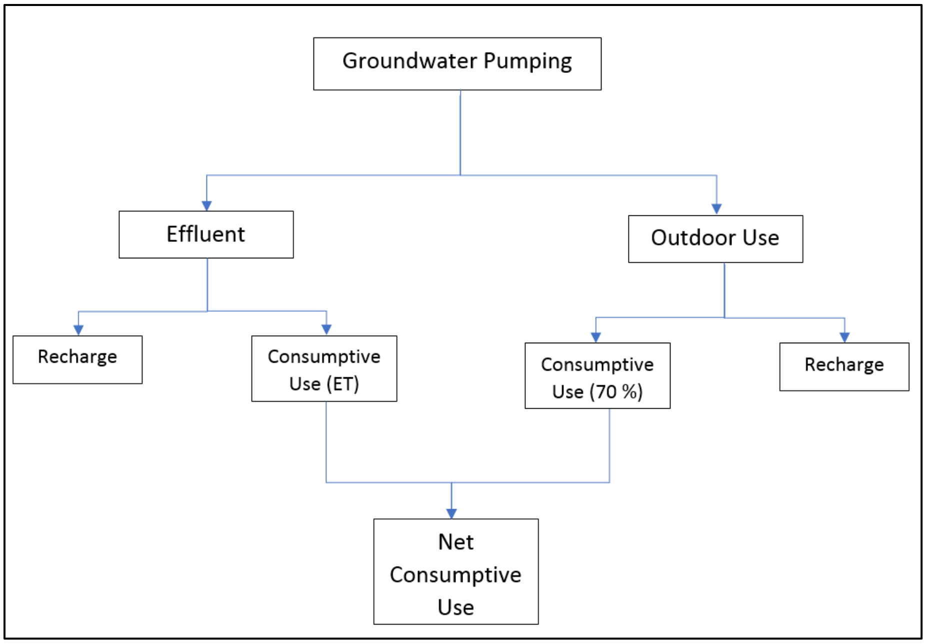

Figure 30 - City Water Use Diagram

11.2.2 Current Water Budget for the City of Firebaugh

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	TOMATEK EFFLUENT (AF)	OUTDOOR USE (AF)	SEEPAGE FROM THE SJR (AF)	CONSUMPTIVE USE (AF)
2013	2,400	700	500	1,200	1,400	1,300

Table 53 - City of Firebaugh Current Water Budget Data

11.2.3 Projected Water Budget for the City of Firebaugh

The City of Firebaugh General Plan projects 1.8% annual growth, which was used in this plan to determine the projected baseline demand on water. The average annual pumping from the historic water budget was used as a baseline to project the demand on water through the planning and implementation horizon. The same data and methodologies described in Section 11.2.1 were used to determine consumptive use of groundwater. Below is a table of the projected water budget. The projected consumptive use is anticipated to increase by 2,000 AF/year to a total of 3,500 AF by 2070. Section 11.3 will discuss SMC in order for the City of Firebaugh to be sustainable. Section 11.4 will discuss projects and management actions to offset the increased demand.

WATER YEAR	PROJECTED PUMPAGE (AF)	PROJECTED CITY EFFLUENT (AF)	PROJECTED TOMATEK EFFLUENT (AF)	PROJECTED OUTDOOR USE (AF)	SEEPAGE FROM THE SJR (AF)	CONSUMPTIVE USE (AF)
2014	2,600	700	500	1,400	1,400	1,500
2015	2,300	700	500	1,100	1,400	1,300
2016	2,200	700	500	1,000	1,400	1,200
2017	2,300	700	500	1,100	1,400	1,300
2018	2,500	700	500	1,300	1,400	1,400
2019	2,500	700	500	1,300	1,400	1,400
2020	2,600	700	500	1,400	1,400	1,500
2021	2,600	700	500	1,400	1,400	1,500
2022	2,700	800	500	1,400	1,400	1,500
2023	2,700	800	500	1,400	1,400	1,500
2024	2,800	800	500	1,500	1,400	1,600
2025	2,800	800	500	1,500	1,400	1,600
2026	2,900	800	500	1,600	1,400	1,600
2027	2,900	800	500	1,600	1,400	1,600
2028	3,000	800	500	1,700	1,400	1,700
2029	3,000	900	500	1,600	1,400	1,600
2030	3,100	900	500	1,700	1,400	1,700
2031	3,200	900	500	1,800	1,400	1,800
2032	3,200	900	500	1,800	1,400	1,800
2033	3,300	900	500	1,900	1,400	1,900
2034	3,300	900	500	1,900	1,400	1,900
2035	3,400	900	500	2,000	1,400	1,900
2036	3,400	1,000	500	1,900	1,400	1,900
2037	3,500	1,000	500	2,000	1,400	1,900
2038	3,600	1,000	500	2,100	1,400	2,000
2039	3,600	1,000	500	2,100	1,400	2,000
2040	3,700	1,000	500	2,200	1,400	2,100
2041	3,800	1,100	500	2,200	1,400	2,100
2042	3,800	1,100	500	2,200	1,400	2,100
2043	3,900	1,100	500	2,300	1,400	2,200
2044	4,000	1,100	500	2,400	1,400	2,200
2045	4,000	1,100	500	2,400	1,400	2,200
2046	4,100	1,200	500	2,400	1,400	2,200
2047	4,200	1,200	500	2,500	1,400	2,300
2048	4,300	1,200	500	2,600	1,400	2,400
2049	4,300	1,200	500	2,600	1,400	2,400
2050	4,400	1,200	500	2,700	1,400	2,500
2051	4,500	1,300	500	2,700	1,400	2,500
2052	4,600	1,300	500	2,800	1,400	2,500
2053	4,700	1,300	500	2,900	1,400	2,600
2054	4,800	1,300	500	3,000	1,400	2,700
2055	4,800	1,400	500	2,900	1,400	2,600
2056	4,900	1,400	500	3,000	1,400	2,700
2057	5,000	1,400	500	3,100	1,400	2,800
2058	5,100	1,400	500	3,200	1,400	2,800
2059	5,200	1,500	500	3,200	1,400	2,900
2060	5,300	1,500	500	3,300	1,400	2,900
2061	5,400	1,500	500	3,400	1,400	3,000
2062	5,500	1,500	500	3,500	1,400	3,100
2063	5,600	1,600	500	3,500	1,400	3,100
2064	5,700	1,600	500	3,600	1,400	3,100
2065	5,800	1,600	500	3,700	1,400	3,200
2066	5,900	1,600	500	3,800	1,400	3,300
2067	6,000	1,700	500	3,800	1,400	3,300
2068	6,100	1,700	500	3,900	1,400	3,400
2069	6,200	1,700	500	4,000	1,400	3,400
2070	6,300	1,800	500	4,000	1,400	3,500

Table 54 – City of Firebaugh Projected Water Budget Data

11.3 Sustainable Management Criteria for the City of Firebaugh

The City of Firebaugh has historically relied completely on groundwater extraction to meet water demand. Groundwater overdraft around the City has primarily been offset by recharge from the SJREC service area and seepage from the San Joaquin River. As mentioned previously, the SJREC are invested in helping the City to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the City of Firebaugh on Projects and Management actions to offset groundwater extractions by the City that is above their sustainable yield.

The historical consumptive use for the City of Firebaugh was about 1,400 AF/year which equates to an average use of about 0.7 AF/acre. The sustainable yield for the City is 700 AF/year plus the river recharged approximated at 1,400 AF/year for a total of 2,100 AF/year. Through the planning an implementation horizon the city may have a consumptive use deficit that will need to be met through projects and management actions. While the City of Firebaugh lies near SJREC Management Areas F, G and J, different SMC is developed in order for the City to achieve collective and independent groundwater sustainability.

11.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the City are positively impacted through recharge from the SJREC and seepage from the San Joaquin River and have remained fairly stable. Water levels in the SJREC Management Area J will be used to sustainably manage groundwater levels for the City since the City's wells are located within that area. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

11.3.2 Reduction in Groundwater Storage

Groundwater storage under the City of Firebaugh is positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Managing groundwater storage for the City will be accomplished through updated water budgets for the City. The SJREC are contributing recharge to maintain adequate groundwater storage to offset storage reduction caused by the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

11.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

11.3.4 Degraded Water Quality

The main concern for the City is the contamination resulting from naturally occurring constituents including nitrate, arsenic, hexavalent chromium, selenium, total dissolved solids, sulfate, chloride, and boron. These constituents are important in terms of developing public supply wells to meet Title 22 Standards. As part of the process of installing new wells, the City does vertical trends in groundwater quality and completes the well opposite of the zones with quality concerns. One potential solution for water quality concerns and also to meet overdraft is for the City to receive a surface water transfer from the SJREC.

11.3.5 Land Subsidence

The City does not operate any wells perforated below the Corcoran Clay. As a result, inelastic land subsidence is unlikely to occur as a result of pumping from the City of Firebaugh wells. Therefore, no SMC have been established for this sustainability indicator. The SJREC and the City will work together to ensure that significant and unreasonable land subsidence does not occur due to City pumping.

11.3.6 Depletions of Interconnected Surface Water

The City of Firebaugh plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. For more details refer to the following sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

11.4 Projects and Management Actions for the City of Firebaugh

The City is actively pursuing water conservation. In order to maintain sustainability for each GSA in the SJREC GSP group, the City is committed to offsetting an increase in demand based on projected population growth, by developing certain projects. Each project will be analyzed jointly with the City and the SJREC to maximize the regional benefits. The City will develop projects to offset overdraft including; 1) storm water capture, 2) demand reduction through reduced watering, 3) surface water transfer, 4) purchasing groundwater credits, 5) participation in recharge projects, 6) reclaimed water for outdoor watering and 7) the city will continue to investigate other types of projects.

The groundwater quality, under natural conditions, under the City has some constituents of concern discussed in Appendix U. The City currently pumps certain wells as needed to meet Title 22 water quality standards for the consumer. If the groundwater quality were to naturally degrade and/or the Title 22 standards for drinking water were to be updated with lower MCL's, the City may run the risk of exceeding allowable limits. In addition to the potential water quality concerns, with the SGMA, the City currently has a deficit water balance. To counteract both of these concerns, the City has started preliminary discussions with the SJREC on two possible projects mentioned above. One project to offset a water budget deficit would be for the City to work with the SJREC for groundwater recharge credits.

Another project has been discussed to address both overdraft and water quality concerns for the City. The SJREC would make surface water available for transfer to the City, thereby reducing the City's need to pump groundwater while providing cleaner drinking water for the DAC's residents. The City of Firebaugh has moved its well field to the other side of the river due to groundwater quality concerns.

The SJREC will continue to work with the City to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources and providing safe and clean drinking water for this disadvantaged community.

11.5 Plan Implementation for the City of Firebaugh

The cost to develop and implement the GSP specific to the City of Firebaugh has been cost shared at 50% between the SJREC GSA and the City of Firebaugh GSA. Additionally, the SJREC GSA has pursued additional grant funding to fully offset GSP development costs for SDAC's. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Mendota area was the implementation of monitoring and management program for well water transfers near the Mendota Pool. The SJREC worked with the regional water leaders to develop and implement a plan that would maximize water resources without sacrificing the needs of the local communities. As a result, water levels have remained fairly stable and none of the wells pumping as part of the program are contributing to land subsidence. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the City, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

12.0 CITY OF MENDOTA GSA AREA

12.1 Background for City of Mendota

The City of Mendota is a Severely Disadvantaged Community relies entirely on groundwater. In 1999, KDSA analyzed groundwater conditions in the vicinity of the City of Mendota. The quality of the groundwater around the City of Mendota was not suitable for public supply. In the early 2000's, the City of Mendota worked with Columbia Canal Company and the landowners on the east side of the river to drill domestic supply wells on the east side of the river where the water quality was significantly better. A pipeline was constructed to deliver water from lands in and adjacent to CCC (east side of the river) to the City (west side of the river). Additionally, the landowners provided the City access to use the Mowry bridge to access the City wells across the San Joaquin River. CCC and the SJREC have a long history working with the local communities to solve regional water problems. In this case, the district worked with the local landowners to provide sites for the City to construct wells to provide the residents drinking water.

Over the years, the CCC has invested in helping cities monitor, understand and manage the aquifers for the communities near the district. The relationship has resulted in a common understanding of the aquifer and a partnership which is the foundation of the SJREC GSA and the City of Mendota GSA cooperating to develop this part of the GSP. Some potential impacts to the City include increased costs for the SWRCB to develop and implement a sustainable plan for the City and a standalone plan that isn't synchronous with the lands surrounding the City. CCID recognized the potential impacts to the City of Mendota, a SDAC, and worked with City leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the City. Ultimately, the City decided to form its' own GSA with the help from the SJREC to appropriately file. The City of Mendota welcomed the SJREC's assistance in developing the required elements in a GSP. It was mutually agreed that the SJREC will work with the City to develop the requirements in the GSP and to include this in a discrete Section in the SJREC GSP. This was a seamless process due to the decades of cooperation of managing groundwater for the region.

The SJREC are committed to assist this SDAC to maintain sustainability through the planning and implementation horizon. The City of Mendota GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix V for a discussion on the basin setting, sustainable management criteria and projects & management actions specific to the City. Some further details are provided below.

12.2 Water Budgets for the City of Mendota

Presented herein is the compilation of the historic, current and projected water budgets specific to the City of Mendota GSA.

12.2.1 Historic Water Budget for the City of Mendota

The City of Mendota solely relies on groundwater to provide its residents clean drinking water. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-

Mendota Subbasin. Groundwater pumping during this timeframe ranged from 1,600 to 1,800 AF/year with an average pumping of 1,700 AF/year. The City sends effluent its Waste Water Treatment Facility (WWTF). They have about 76 acres of percolation ponds at the WWTF. The effluent flow from the City averages 1,200 AF/year. Each year about 300 AF evaporates while the remaining 900 AF percolates in the ponded area. The total effluent consumptive use for the City of Mendota averages about 300 AF/year.

The City water use that does not result in the production of effluent was used to water lawns, parks, etc. The outdoor water use is the difference of pumpage and effluent and averaged about 500 AF/year. Typically, a 70% irrigation efficiency is applied to urban landscape watering which results in an average annual consumptive use of about 400 AF/year.

The total average annual consumptive use from outdoor water use and crop demand at the WWTF is 700 AF/year. The City of Mendota GSA covers roughly 2,100 acres. The approximate sustainable yield for the City of Mendota GSA is 0.40 acre-feet/acre or about 800 acre-feet/year.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2003	1,600	1,200	400	600
2004	1,700	1,200	500	700
2005	1,600	1,200	400	600
2006	1,600	1,200	400	600
2007	1,700	1,200	500	700
2008	1,800	1,200	600	700
2009	1,700	1,200	500	700
2010	1,800	1,200	600	700
2011	1,700	1,200	500	700
2012	1,800	1,200	600	700

Table 55 - City of Mendota Historic Water Budget Data

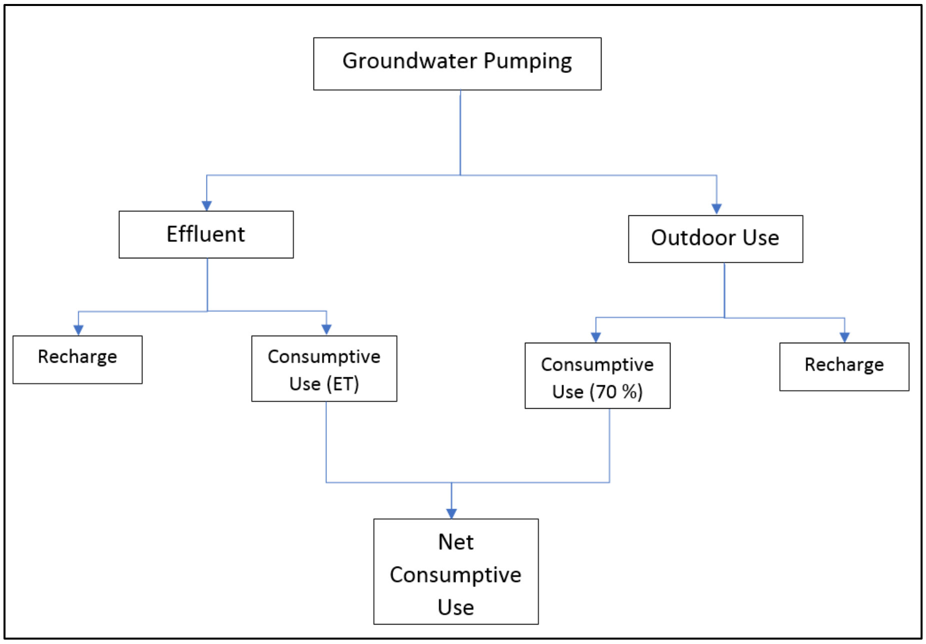

Figure 31 - City Water Use Diagram

12.2.2 Current Water Budget for the City of Mendota

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	PUMPAGE (AF)	CITY EFFLUENT (AF)	OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2013	1,500	1,200	300	500

Table 56 - City of Mendota Current Water Budget Data

12.2.3 Projected Water Budget for the City of Mendota

The City of Mendota General Plan projects the City to have a pumping demand of 10,600 AF by 2070 which equates to a 3.6% annual growth, which was used in this plan to determine the projected baseline demand on water. The average annual pumping from the historic water budget was used as a baseline to project the demand on water through the planning and implementation horizon. The same data and methodologies described in Section 12.2.1 were used to determine consumptive use of groundwater. Below is a table of the projected water budget. The projected consumptive use is anticipated to increase by 3,300 AF/year to a total of 4,000 AF by 2070. Section 12.3 will discuss SMC in order for the City of Mendota to be sustainable. Section 12.4 will discuss projects and management actions to offset the increased demand.

WATER YEAR	PROJECTED PUMPAGE (AF)	PROJECTED CITY EFFLUENT (AF)	PROJECTED OUTDOOR USE (AF)	CONSUMPTIVE USE (AF)
2014	1,400	1,200	200	400
2015	1,400	1,200	200	400
2016	1,700	1,200	500	700
2017	1,800	1,200	600	700
2018	1,700	1,200	500	700
2019	1,800	1,200	600	700
2020	1,800	1,300	500	700
2021	1,900	1,300	600	700
2022	2,000	1,400	600	800
2023	2,000	1,400	600	800
2024	2,100	1,500	600	800
2025	2,200	1,500	700	900
2026	2,300	1,600	700	900
2027	2,300	1,600	700	900
2028	2,400	1,700	700	900
2029	2,500	1,800	700	900
2030	2,600	1,800	800	1,000
2031	2,700	1,900	800	1,000
2032	2,800	2,000	800	1,100
2033	2,900	2,000	900	1,100
2034	3,000	2,100	900	1,200
2035	3,100	2,200	900	1,200
2036	3,200	2,300	900	1,200
2037	3,300	2,300	1,000	1,300
2038	3,400	2,400	1,000	1,300
2039	3,600	2,500	1,100	1,400
2040	3,700	2,600	1,100	1,400
2041	3,800	2,700	1,100	1,400
2042	4,000	2,800	1,200	1,500
2043	4,100	2,900	1,200	1,600
2044	4,200	3,000	1,200	1,600
2045	4,400	3,100	1,300	1,700
2046	4,500	3,200	1,300	1,700
2047	4,700	3,300	1,400	1,800
2048	4,900	3,400	1,500	1,900
2049	5,100	3,600	1,500	2,000
2050	5,200	3,700	1,500	2,000
2051	5,400	3,800	1,600	2,100
2052	5,600	4,000	1,600	2,100
2053	5,800	4,100	1,700	2,200
2054	6,000	4,300	1,700	2,300
2055	6,200	4,400	1,800	2,400
2056	6,500	4,600	1,900	2,500
2057	6,700	4,700	2,000	2,600
2058	6,900	4,900	2,000	2,600
2059	7,200	5,100	2,100	2,700
2060	7,400	5,300	2,100	2,800
2061	7,700	5,400	2,300	3,000
2062	8,000	5,600	2,400	3,100
2063	8,300	5,800	2,500	3,200
2064	8,600	6,000	2,600	3,300
2065	8,900	6,300	2,600	3,400
2066	9,200	6,500	2,700	3,500
2067	9,500	6,700	2,800	3,600
2068	9,900	7,000	2,900	3,800
2069	10,200	7,200	3,000	3,900
2070	10,600	7,500	3,100	4,000

Table 57 – City of Mendota Projected Water Budget Data

12.3 Sustainable Management Criteria for the City of Mendota

The City of Mendota has historically relied completely on groundwater extraction to meet water demand. Groundwater overdraft around the City has primarily been offset by recharge from the SJREC service area and seepage from the San Joaquin River. As mentioned previously, the SJREC are invested in helping the City to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the City of Mendota on Projects and Management actions to offset groundwater extractions by the City that is above their sustainable yield.

The historical consumptive use for the City of Mendota was about 700 AF/year which equates to an average use of about 0.3 AF/acre. The sustainable yield for the city is about 800 AF/year. Currently, the City of Mendota GSA is sustainable but will likely have a consumptive use deficit through the planning and implementation horizon that will need to be offset through projects and management actions. While the City of Mendota lies near SJREC Management Areas G and J, different SMC is developed in order for the City to achieve collective and independent groundwater sustainability.

12.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the City are positively impacted through recharge from the SJREC and seepage from the San Joaquin River and have remained fairly stable. Water levels in the SJREC Management Area J will be used to sustainably manage groundwater levels for the City since the City's wells are located within that area. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

12.3.2 Reduction in Groundwater Storage

Groundwater storage under the City of Mendota is positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Managing groundwater storage for the City will be accomplished through updated water budgets for the City. The SJREC will contribute to recharge to maintain adequate groundwater storage to offset reductions caused by the City. Sustainable groundwater management for the City is best achieved by offsetting overdraft through the implementation of projects and management actions.

12.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

12.3.4 Degraded Water Quality

The main concern for the City is the contamination resulting from naturally occurring constituents including nitrate, arsenic, hexavalent chromium, selenium, total dissolved solids, sulfate, chloride, and boron. These constituents are important in terms of developing public supply wells to meet Title 22 Standards. As part of the process of installing new wells, the City does vertical trends in groundwater quality and completes the well opposite of the zones with quality concerns. One potential solution for water quality concerns and also to meet overdraft is for the City to receive a surface water transfer from the SJREC.

12.3.5 Land Subsidence

The City does not operate any wells perforated below the Corcoran Clay. As a result, inelastic land subsidence is unlikely to occur as a result of pumping from the City of Mendota wells. Therefore, no SMC have been established for this sustainability indicator. The SJREC will continue to work with the City to monitor subsidence and work with regional partners on solutions if subsidence is observed and may cause damage to critical infrastructure.

12.3.6 Depletions of Interconnected Surface Water

The City of Mendota plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

12.4 Projects and Management Actions for the City of Mendota

The City is actively pursuing water conservation. In order to maintain sustainability for each GSA in the SJREC GSP group, the City is committed to offsetting an increase in demand based on projected population growth, by developing certain projects. Each project will be analyzed jointly with the City and the SJREC to maximize the regional benefits. The City will develop projects including; 1) storm water capture, 2) demand reduction through reduced watering, 3) surface water transfer, 4) purchasing groundwater credits, 5) participation in recharge projects, 6) reclaimed water for outdoor watering and 7) the city will continue to investigate other types of projects.

The groundwater quality, under natural conditions, under the City has some constituents of concern discussed in Appendix V. The City currently pumps certain wells as needed to meet Title 22 water quality standards for the consumer. If the groundwater quality were to naturally degrade and/or the Title 22 standards for drinking water were to be updated with lower MCL's, the City may run the risk of exceeding allowable limits. In addition to the potential water quality concerns, with the SGMA, the City poses the risk of having a deficit water balance in the future. To counteract both of these concerns, the City has started preliminary discussions with the SJREC on two possible projects mentioned above. One project to offset a water budget deficit would be for the City to work with the SJREC for groundwater recharge credits.

Another project has been discussed to address both overdraft and water quality concerns for the City. The SJREC would make surface water available for transfer to the City, thereby reducing the City's need to pump groundwater while providing cleaner drinking water for the DAC's residents. The City of Firebaugh has moved its well field to the other side of the river due to groundwater quality concerns.

The SJREC will continue to work with the City to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources and providing safe and clean drinking water for this disadvantaged community.

12.5 Plan Implementation for the City of Mendota

The cost to develop and implement the GSP specific to the City of Firebaugh has been cost shared at 50% between the SJREC GSA and the City of Firebaugh GSA. Additionally, the SJREC GSA has pursued additional grant funding to fully offset GSP development costs for SDAC's. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Mendota area was the implementation of monitoring and management program for well water transfers near the Mendota Pool. The SJREC worked with the regional water leaders to develop and implement a plan that would maximize water resources without sacrificing the needs of the local communities. As a result, water levels have remained fairly stable and none of the wells pumping as part of the program are contributing to land subsidence. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the City, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

13.0 TURNER ISLAND WATER DISTRICT – 2 GSA AREA

13.1 Background for Turner Island Water District

The Turner Island Water District (TIWD) is in an area bound by the San Joaquin River to the north (boundary of the Delta-Mendota Subbasin) and the SJREC GSA to the east, west and south. Every acre of the area has historically been farmed. This area receives drain water (surface water spills) from the SLCC to meet the crop consumptive use.

Over the years, the SJREC have invested in working with other local agencies to monitor, understand and manage the aquifers around the Exchange Contractors service area. The SLCC has a long-standing relationship with TIWD to jointly manage water in the area including surface water, groundwater and drain water. This relationship has resulted in a common understanding of the local water resources and a partnership which is the foundation of the SJREC GSA and the Turner Island Water District - 2 GSA cooperating to develop this part of the GSP.

The SJREC and TIWD are committed to maintain sustainability through the planning and implementation horizon. The TIWD-2 GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix W for a discussion on the basin setting, sustainable management criteria and projects & management actions specific to the TIWD. Some further details are provided below.

13.2 Water Budgets for the Turner Island Water District

Presented herein is the compilation of the historic, current and projected water budgets specific to the Turner Island Water District - 2 GSA.

13.2.1 Historic Water Budget for the Turner Island Water District

TIWD relies on surface water from SLCC during non-critical years under the Exchange Contract. During Shasta Critical years, the TIWD supplements crop demand by pumping groundwater. Additionally, the TIWD pumps groundwater from their lands in the TIWD-2 GSA (Delta-Mendota Subbasin) and provides that water through an existing pipeline under the San Joaquin River to their lands on the other side of the river (Merced Subbasin). The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. Groundwater pumping during this timeframe ranged from 700 to 1,100 AF/year with an average pumping of 800 AF/year. Surface Water deliveries during this timeframe ranged from 4,300 to 6,500 AF/year with an average delivery of 5,600 AF/year. The total crop demand of irrigation water (ET_{iw}) ranged from 2,600 to 3,700 AF/year with an average ET_{iw} of 3,200 AF/year. All of the crop ET was met with surface water. The change in groundwater storage during this timeframe averaged about +2,000 AF/year. The TIWD-2 GSA covers roughly 1,850 acres. The approximate sustainable yield for the Turner Island Water District – 2 GSA is 0.40 acre-feet/acre or about 700 acre-feet/year.

WATER YEAR	SHASTA WATER YEAR DESIGNATION	SURFACE WATER APPLIED	GROUNDWATER PUMPING	TOTAL CROP ET_c	TOTAL CROP ET_{iw}	DEEP PERCOLATION OF IRRIGATION	CHANNEL RECHARGE	CHANGE IN GROUNDWATER STORAGE
2003	Non-Critical	6,300	700	4,500	3,600	2,700	700	2,700
2004	Non-Critical	5,700	900	4,200	3,200	2,500	700	2,300
2005	Non-Critical	6,000	800	3,700	2,700	3,300	700	3,200
2006	Non-Critical	6,500	800	4,700	3,600	2,900	700	2,800
2007	Non-Critical	6,300	900	4,400	3,700	2,600	700	2,400
2008	Non-Critical	5,800	900	3,800	3,200	2,600	700	2,400
2009	Non-Critical	4,900	700	3,700	2,900	2,000	700	2,000
2010	Non-Critical	4,700	700	3,500	2,600	2,100	700	2,100
2011	Non-Critical	5,200	800	4,400	3,500	1,700	700	1,600
2012	Non-Critical	4,300	1,100	4,200	3,400	900	700	500

Table 58 - TIWD Historic Water Budget Data

13.2.2 Current Water Budget for the Turner Island Water District

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	SHASTA WATER YEAR DESIGNATION	SURFACE WATER APPLIED	GROUNDWATER PUMPING	TOTAL CROP ET_c	TOTAL CROP ET_{iw}	DEEP PERCOLATION OF IRRIGATION	CHANNEL RECHARGE	CHANGE IN GROUNDWATER STORAGE
2013	Non-Critical	5,000	900	4,300	3,400	1,600	700	1,400

Table 59 - TIWD Current Water Budget Data

13.2.3 Projected Water Budget for the Turner Island Water District

The TIWD is currently fully planted. Any increase in demand is directly tied to Climate Change. The same process outlined in Section 2.2.3.3 was used to determine climate change factors. Below is a table of the projected water budget. The projected consumptive use of applied water is anticipated to increase from 3,200 AF/year to a maximum of 4,000 AF by 2070. Since the TIWD receives drain water in excess of 4,000 on an average annual basis, it is reasonable to assume that the TIWD water budget is sustainable. Section 13.3 will discuss SMC in order for TIWD to maintain sustainability. Section 13.4 will discuss projects and management actions.

WATER YEAR	HISTORICAL REFERENCE USED FOR HYDROLOGY	HISTORICAL REFERENCE FOR WATER DELIVERY/DEMAND	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)
2014	-	2014	Critical	Critically Dry
2015	-	2015	Critical	Critically Dry
2016	-	2016	Non-Critical	Dry
2017	-	2011	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2011	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2011	Non-Critical	Wet
2022	1983	2011	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2011	Non-Critical	Wet
2026	1987	2013	Non-Critical	Critically Dry
2027	1988	2013	Non-Critical	Critically Dry
2028	1989	2013	Non-Critical	Critically Dry
2029	1990	2013	Non-Critical	Critically Dry
2030	1991	2014	Critical	Critically Dry
2031	1992	2015	Critical	Critically Dry
2032	1993	2011	Non-Critical	Wet
2033	1994	2013	Non-Critical	Critically Dry
2034	1995	2011	Non-Critical	Wet
2035	1996	2011	Non-Critical	Wet
2036	1997	2011	Non-Critical	Wet
2037	1998	2011	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2001	2012	Non-Critical	Dry
2052	1992	2013	Non-Critical	Critically Dry
2053	1976	2014	Critical	Critically Dry
2054	1977	2015	Critical	Critically Dry
2055	2002	2016	Non-Critical	Dry
2056	2011	2011	Non-Critical	Wet
2057	1965	2011	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2011	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2011	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2011	Non-Critical	Wet
2067	1975	2011	Non-Critical	Wet
2068	1976	2014	Critical	Critically Dry
2069	1977	2015	Critical	Critically Dry
2070	1978	2011	Non-Critical	Wet

Table 60 – TIWD Projected Water Budget Water Year Data

WATER YEAR	SURFACE WATER APPLIED	GROUNDWATER PUMPING	CLIMATE CHANGE FACTOR	TOTAL ET_C WITH CLIMATE CHANGE	TOTAL ET_{IW} WITH CLIMATE CHANGE	DEEP PERCOLATION OF IRRIGATION WATER	CHANNEL SEEPAGE (RECHARGE)	CHANGE IN GROUNDWATER STORAGE
2014	4,600	3,300	1.000	4,000	3,200	1,400	700	-1,200
2015	4,000	2,500	1.000	2,600	1,900	2,100	700	300
2016	4,400	1,400	1.000	3,900	3,000	1,400	700	700
2017	5,200	800	1.000	4,400	3,500	1,700	700	1,600
2018	4,700	700	1.034	3,600	2,700	2,000	700	2,000
2019	5,200	800	1.035	4,600	3,600	1,600	700	1,500
2020	4,300	1,100	1.037	4,400	3,500	800	700	400
2021	5,200	800	1.034	4,500	3,600	1,600	700	1,500
2022	5,200	800	1.037	4,600	3,600	1,600	700	1,500
2023	4,700	700	1.030	3,600	2,700	2,000	700	2,000
2024	4,300	1,100	1.038	4,400	3,500	800	700	400
2025	5,200	800	1.039	4,600	3,600	1,600	700	1,500
2026	5,000	900	1.033	4,400	3,500	1,500	700	1,300
2027	5,000	900	1.035	4,500	3,500	1,500	700	1,300
2028	5,000	900	1.033	4,400	3,500	1,500	700	1,300
2029	5,000	900	1.028	4,400	3,500	1,500	700	1,300
2030	4,600	3,300	1.029	4,100	3,300	1,300	700	-1,300
2031	4,000	2,500	1.032	2,700	2,000	2,000	700	200
2032	5,200	800	1.034	4,500	3,600	1,600	700	1,500
2033	5,000	900	1.035	4,500	3,500	1,500	700	1,300
2034	5,200	800	1.043	4,600	3,700	1,500	700	1,400
2035	5,200	800	1.028	4,500	3,600	1,600	700	1,500
2036	5,200	800	1.029	4,500	3,600	1,600	700	1,500
2037	5,200	800	1.035	4,600	3,600	1,600	700	1,500
2038	4,700	700	1.037	3,600	2,700	2,000	700	2,000
2039	4,700	700	1.034	3,600	2,700	2,000	700	2,000
2040	4,300	1,100	1.028	4,300	3,500	800	700	400
2041	4,300	1,100	1.029	4,300	3,500	800	700	400
2042	6,300	700	1.033	4,600	3,700	2,600	700	2,600
2043	5,700	900	1.028	4,300	3,300	2,400	700	2,200
2044	6,000	800	1.038	3,800	2,800	3,200	700	3,100
2045	6,500	800	1.038	4,900	3,700	2,800	700	2,700
2046	6,300	900	1.082	4,800	4,000	2,300	700	2,100
2047	5,800	900	1.079	4,100	3,500	2,300	700	2,100
2048	4,900	700	1.082	4,000	3,100	1,800	700	1,800
2049	4,700	700	1.086	3,800	2,800	1,900	700	1,900
2050	5,200	800	1.088	4,800	3,800	1,400	700	1,300
2051	4,300	1,100	1.074	4,500	3,700	600	700	200
2052	5,000	900	1.089	4,700	3,700	1,300	700	1,100
2053	4,600	3,300	1.087	4,300	3,500	1,100	700	-1,500
2054	4,000	2,500	1.082	2,800	2,100	1,900	700	100
2055	4,400	1,400	1.082	4,200	3,200	1,200	700	500
2056	5,200	800	1.088	4,800	3,800	1,400	700	1,300
2057	5,200	800	1.083	4,800	3,800	1,400	700	1,300
2058	4,900	700	1.086	4,000	3,100	1,800	700	1,800
2059	5,200	800	1.090	4,800	3,800	1,400	700	1,300
2060	4,300	1,100	1.086	4,600	3,700	600	700	200
2061	5,200	800	1.086	4,800	3,800	1,400	700	1,300
2062	4,700	700	1.080	3,800	2,800	1,900	700	1,900
2063	4,900	700	1.090	4,000	3,200	1,700	700	1,700
2064	4,300	1,100	1.078	4,500	3,700	600	700	200
2065	4,700	700	1.083	3,800	2,800	1,900	700	1,900
2066	5,200	800	1.086	4,800	3,800	1,400	700	1,300
2067	5,200	800	1.086	4,800	3,800	1,400	700	1,300
2068	4,600	3,300	1.087	4,300	3,500	1,100	700	-1,500
2069	4,000	2,500	1.082	2,800	2,100	1,900	700	100
2070	5,200	800	1.075	4,700	3,800	1,400	700	1,300

Table 61 - TIWD Projected Water Budget

13.3 Sustainable Management Criteria for the Turner Island Water District

The TIWD is a conjunctive use area that relies primarily on surface water. Water levels around TIWD have been fairly stable due to surface water deliveries and seepage from the San Joaquin River. The SJREC GSP Group, collectively, is currently sustainable. The TIWD is currently sustainable and the SJREC will continue to monitor and manage jointly with TIWD to ensure that we maintain sustainability through annual review of groundwater conditions.

The historical consumptive use for the TIWD was about 3,200 AF/year which equates to an average use of about 1.7 AF/acre, with an average pumping of about 800 AF/year. While the TIWD lies near SJREC Management Area H, different SMC is developed to specifically meet the needs of the district and to achieve collective and independent sustainability.

13.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the TIWD are positively impacted through recharge from the SJREC/TIWD and seepage from the San Joaquin River, and have remained fairly stable. Water levels in the SJREC Management Area H will be used to analyze potential chronic lowering of groundwater levels. The total groundwater extractions for the TIWD are less than the deep percolation of applied surface water. This indicates that extractions from this area will not have a negative impact on groundwater levels. Even so, the TIWD will manage this potential undesirable result consistent with the groundwater management established for the SJREC Management Area H; see Section 3.

13.3.2 Reduction in Groundwater Storage

Groundwater storage under the TIWD is positively impacted through recharge from the SJREC/TIWD and seepage from the San Joaquin River. Managing groundwater storage for the TIWD will be accomplished through updated water budgets for the district and offsetting storage reductions caused by TIWD.

13.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

13.3.4 Degraded Water Quality

TIWD is managing groundwater quality similar to the SJREC GSA. TIWD will monitor electrical conductivity and impose management actions as necessary. Currently no management actions are recommended to supplement the SJREC GSA management efforts. For more details refer to the following Sections in this GSP: 3.2.4, 3.3.4, and 3.4.4.

13.3.5 Land Subsidence

The TIWD does not operate any wells perforated below the Corcoran Clay. As a result, inelastic land subsidence is unlikely to occur as a result of pumping from the TIWD wells. Therefore, no SMC have been established for this sustainability indicator. The SJREC and the district will work together to ensure that significant and unreasonable land subsidence does not occur due to district pumping.

13.3.6 Depletions of Interconnected Surface Water

The TIWD plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

13.4 Projects and Management Actions for the Turner Island Water District

The TIWD is in an area with shallow groundwater. One current management action that TIWD proposes is to continue to pump groundwater to lower the water table below the crop root zone in order to maintain healthy soils. This management is consistent with the Measurable Objectives defined in Section 3.2. The TIWD will continue to work with SLCC to maintain regional sustainability. The projected water budget for TIWD with climate change indicates that the district will contribute to a positive change in groundwater storage through the planning and implementation horizon.

13.5 Plan Implementation for the Turner Island Water District

The cost to develop and implement the GSP specific to the TIWD-2 GSA has been solely funded by the TIWD-2 GSA. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the TIWD-2 GSA. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort in this area, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

14.0 MADERA COUNTY-3 GSA AREA

14.1 Background for County of Madera

There is about 3,100 acres of lands not in a public water district, white area, in the Madera County portion of the Delta-Mendota Subbasin. All of the lands with groundwater wells lie between the CCID and CCC. The historic groundwater management from the SJREC have directly and positively impacted the County islands within the SJREC service area. The SJREC worked with County leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the County White Areas. It was mutually agreed that the SJREC will work with the County to develop the requirements in the GSP and to include this in a discrete section of this plan.

The SJREC are committed to assist the County to maintain sustainability through the planning and implementation horizon. The County of Madera-3 GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 of this GSP describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix I for a discussion on the basin setting for the SJREC GSA and surrounding areas including the County of Madera-3 GSA area. The Water Budget, Sustainable Management Criteria and Projects & Management Actions are included below.

14.2 Water Budgets for the County of Madera

Presented herein is the compilation of the historic, current and projected water budgets specific to the County of Madera - 3 GSA.

14.2.1 Historic Water Budget for the County of Madera

The County of Madera - 3 GSA encompasses about 3,100 acres of land. Of that, about 2,000 acres are actively farmed, 700 acres covers the Chowchilla Bypass channel and the remaining acres are small slivers of land that are not actively farmed and do not pump groundwater. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. It is assumed that all of the ET_{iw} needed to grow the crops in the area was met by pumping groundwater. Groundwater pumping during this timeframe ranged from 4,000 to 5,000 AF/year with an average pumping of 4,400 AF/year. The approximate sustainable yield for the County of Madera - 3 GSA is 0.40 acre-feet/acre or about 1,200 acre-feet/year.

WATER YEAR	IRRIGATED ACRES	ET_c (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2003	2,000	5,300	4,500	4,500
2004	2,000	5,100	4,300	4,300
2005	2,000	4,900	4,000	4,000
2006	2,000	4,700	4,000	4,000
2007	2,000	5,700	5,000	5,000
2008	2,000	4,900	4,300	4,300
2009	2,000	5,400	4,600	4,600
2010	2,000	5,500	4,700	4,700
2011	2,000	5,100	4,300	4,300
2012	2,000	5,400	4,700	4,700

Table 62 - County of Madera Historic Water Budget Data

14.2.2 Current Water Budget for the County of Madera

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	IRRIGATED ACRES	ET_C (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2013	2,000	6,300	5,300	5,300

Table 63 - County of Madera Current Water Budget Data

14.2.3 Projected Water Budget for the County of Madera

The County of Madera - 3 GSA area that can be used for production is currently fully planted. Any increase in demand is directly tied to Climate Change. The same process outlined in Section 2.2.3.3 was used to determine climate change factors. Below is a table of the projected water budget. The projected consumptive use of applied water is anticipated to increase by 500 AF/year on average. The net groundwater extraction is equal to consumptive use and ranges from 4,100 to 6,200 AF/year. Section 14.3 will discuss SMC in order for the County of Madera - 3 GSA to be sustainable. Section 14.4 will discuss projects and management actions to offset the groundwater extractions in excess of the sustainable yield.

WATER YEAR	HISTORICAL REFERENCE USED FOR HYDROLOGY	HISTORICAL REFERENCE FOR WATER DELIVERY/DEMAND	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)
2014	-	2014	Critical	Critically Dry
2015	-	2015	Critical	Critically Dry
2016	-	2016	Non-Critical	Dry
2017	-	2011	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2011	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2011	Non-Critical	Wet
2022	1983	2011	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2011	Non-Critical	Wet
2026	1987	2013	Non-Critical	Critically Dry
2027	1988	2013	Non-Critical	Critically Dry
2028	1989	2013	Non-Critical	Critically Dry
2029	1990	2013	Non-Critical	Critically Dry
2030	1991	2014	Critical	Critically Dry
2031	1992	2015	Critical	Critically Dry
2032	1993	2011	Non-Critical	Wet
2033	1994	2013	Non-Critical	Critically Dry
2034	1995	2011	Non-Critical	Wet
2035	1996	2011	Non-Critical	Wet
2036	1997	2011	Non-Critical	Wet
2037	1998	2011	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2001	2012	Non-Critical	Dry
2052	1992	2013	Non-Critical	Critically Dry
2053	1976	2014	Critical	Critically Dry
2054	1977	2015	Critical	Critically Dry
2055	2002	2016	Non-Critical	Dry
2056	2011	2011	Non-Critical	Wet
2057	1965	2011	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2011	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2011	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2011	Non-Critical	Wet
2067	1975	2011	Non-Critical	Wet
2068	1976	2014	Critical	Critically Dry
2069	1977	2015	Critical	Critically Dry
2070	1978	2011	Non-Critical	Wet

Table 64 – County of Madera Projected Water Budget Water Year Data

WATER YEAR	IRRIGATED ACRES	CLIMATE CHANGE FACTOR	TOTAL ET_c WITH CLIMATE CHANGE	TOTAL ET_{IW} WITH CLIMATE CHANGE	EFFECTIVE PUMPING (AF)
2014	2,000	-	5,300	4,600	4,600
2015	2,000	-	5,500	4,700	4,700
2016	2,000	-	6,700	5,800	5,800
2017	2,000	-	5,100	4,300	4,300
2018	2,000	1.033	5,700	4,900	4,900
2019	2,000	1.034	5,300	4,400	4,400
2020	2,000	1.033	5,600	4,900	4,900
2021	2,000	1.028	5,200	4,400	4,400
2022	2,000	1.035	5,300	4,500	4,500
2023	2,000	1.027	5,600	4,800	4,800
2024	2,000	1.03	5,600	4,800	4,800
2025	2,000	1.037	5,300	4,500	4,500
2026	2,000	1.028	6,500	5,400	5,400
2027	2,000	1.027	6,500	5,400	5,400
2028	2,000	1.031	6,500	5,500	5,500
2029	2,000	1.024	6,500	5,400	5,400
2030	2,000	1.029	5,500	4,700	4,700
2031	2,000	1.03	5,700	4,800	4,800
2032	2,000	1.028	5,200	4,400	4,400
2033	2,000	1.03	6,500	5,500	5,500
2034	2,000	1.033	5,300	4,400	4,400
2035	2,000	1.028	5,200	4,400	4,400
2036	2,000	1.028	5,200	4,400	4,400
2037	2,000	1.032	5,300	4,400	4,400
2038	2,000	1.03	5,700	4,800	4,800
2039	2,000	1.033	5,700	4,900	4,900
2040	2,000	1.023	5,500	4,800	4,800
2041	2,000	1.028	5,600	4,800	4,800
2042	2,000	1.03	5,500	4,600	4,600
2043	2,000	1.028	5,200	4,400	4,400
2044	2,000	1.028	5,000	4,100	4,100
2045	2,000	1.033	4,900	4,100	4,100
2046	2,000	1.075	6,100	5,400	5,400
2047	2,000	1.078	5,300	4,600	4,600
2048	2,000	1.084	5,900	5,000	5,000
2049	2,000	1.082	6,000	5,100	5,100
2050	2,000	1.089	5,600	4,700	4,700
2051	2,000	1.07	5,800	5,000	5,000
2052	2,000	1.093	6,900	5,800	5,800
2053	2,000	1.081	5,700	5,000	5,000
2054	2,000	1.08	5,900	5,100	5,100
2055	2,000	1.07	7,200	6,200	6,200
2056	2,000	1.089	5,600	4,700	4,700
2057	2,000	1.083	5,500	4,700	4,700
2058	2,000	1.088	5,900	5,000	5,000
2059	2,000	1.085	5,500	4,700	4,700
2060	2,000	1.079	5,800	5,100	5,100
2061	2,000	1.086	5,500	4,700	4,700
2062	2,000	1.082	6,000	5,100	5,100
2063	2,000	1.088	5,900	5,000	5,000
2064	2,000	1.09	5,900	5,100	5,100
2065	2,000	1.083	6,000	5,100	5,100
2066	2,000	1.086	5,500	4,700	4,700
2067	2,000	1.093	5,600	4,700	4,700
2068	2,000	1.081	5,700	5,000	5,000
2069	2,000	1.08	5,900	5,100	5,100
2070	2,000	1.068	5,400	4,600	4,600

Table 65 - County of Madera Projected Water Budget

14.3 Sustainable Management Criteria for the County of Madera

The County of Madera - 3 GSA has historically relied completely on groundwater extraction to meet demand. Groundwater overdraft in this area has primarily been offset by recharge from the SJREC service area and seepage from the San Joaquin River. The SJREC are invested in helping the County to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the County of Madera on Projects and Management actions to offset groundwater extractions by the County white area that is above their sustainable yield.

The historical consumptive use for the County of Madera was about 4,400 AF/year which equates to an average use of about 2.2 AF/acre for irrigated acres and about 1.4 AF/acre for the total area covered by the GSA. The sustainable yield for the County is 1,200 AF/year which leave a 3,200 AF/year consumptive use deficit that needs to me bet through projects and management actions. While the County of Madera - 3 GSA lies in the SJREC Management Area J, different SMC is developed in order for the County to achieve independent groundwater sustainability.

14.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the County of Madera - 3 GSA are positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Water levels in the SJREC Management Area J will be used to sustainably manage groundwater levels around the County area. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

14.3.2 Reduction in Groundwater Storage

Groundwater storage under the County of Madera - 3 GSA is positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Managing groundwater storage for the County will be accomplished through updated water budgets for the County white areas. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

14.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

14.3.4 Degraded Water Quality

Madera County is managing groundwater quality similar to the SJREC GSA. Salinity is the major water quality concern in the area. Madera County will monitor electrical conductivity and impose management actions as necessary. Currently no management actions are recommended to supplement the SJREC GSA management efforts. For more details refer to the following Sections in this GSP: 3.2.4, 3.3.4, and 3.4.4.

14.3.5 Land Subsidence

It is anticipated that the County of Madera - 3 GSA does not operate any wells perforated below the Corcoran Clay. As a result, inelastic land subsidence is unlikely to occur as a result of pumping from the wells within the GSA area. Therefore, no SMC have been established for this sustainability indicator.

The SJREC will continue to work with the County of Madera to monitor subsidence and work with regional partners on solutions if subsidence is observed and may cause damage to critical infrastructure.

14.3.6 Depletions of Interconnected Surface Water

The County of Madera plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

14.4 Projects and Management Actions for the County of Madera

In order to maintain sustainability for each GSA in the SJREC GSP group, the County is committed to offsetting estimated groundwater overdraft. Each project will be analyzed jointly with the County and the SJREC to maximize the regional benefits. The County is pursuing the following projects as a way to offset demand; 1) purchasing groundwater credits and 2) participation in recharge projects.

The SJREC will continue to work with the County to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources.

14.5 Plan Implementation for the County of Madera

The cost to develop and implement the GSP specific to the County of Madera has been cost shared at 50% between the SJREC GSA and the County of Madera - 3 GSA. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the County of Madera - 3 GSA. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Mendota area was the implementation of monitoring and management program for well water transfers near the Mendota Pool. The SJREC worked with the regional water leaders to develop and implement a plan that would maximize water resources without sacrificing the needs of the local communities. As a result, water levels have remained fairly stable and none of the wells pumping as part of the program are contributing to land subsidence. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the County, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

15.0 PORTION OF MERCED COUNTY DELTA-MENDOTA GSA AREA

15.1 Background for County of Merced

There are 17,483 acres of lands not in a public water district, white area, in the portion of the County of Merced – Delta-Mendota GSA that has been included in the SJREC GSP; refer to Figure 2 for a graphical depiction of the area. The SJREC worked with County leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the County white areas. The County agreed to file as the GSA over the County white areas and worked with the SJREC and the GWD GSA to include the Merced County Delta-Mendota GSA lands in both the GGSA's GSP and the SJREC GSP. It was mutually determined that the logical approach would be to include most of the farming and industry lands in the SJREC GSP and include the managed duck clubs in the GGSA's GSP. The SJREC and the County of Merced agreed to include those lands in a discrete Section in the SJREC GSP.

The Merced County – Delta-Mendota GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 of this GSP describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix I for a discussion on the basin setting for the SJREC GSA and surrounding areas including the Portion of the County of Merced – Delta-Mendota GSA area in the SJREC GSP. The Water Budget, Sustainable Management Criteria and Projects & Management Actions are included below.

15.2 Water Budgets for the County of Merced

Presented herein is the compilation of the historic, current and projected water budgets specific to the portion of the County of Merced – Delta-Mendota GSA within the SJREC GSP.

Most of the data was collected using LandSAT, aerial imagery and local knowledge of the lands. While the portion of the County of Merced – Delta-Mendota GSA is fairly large, most of the lands aren't irrigated agriculture and predominantly rely on precipitation or are not actively using groundwater.

15.2.1 Historic Water Budget for the County of Merced

The portion of the County of Merced – Delta-Mendota GSA in the SJREC GSP encompasses 17,483 acres of land. Of that, about 5,000 acres are actively farmed, 2,500 acres encompass the footprint of three tomato processing plants (Industry) and about 10,000 acres are not actively farmed and do not pump groundwater. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. There are three tomato processing plants that pump groundwater for plant operations. The process water is used to irrigate crops and the plants also treat the process water and use for habitat. The consumptive use for the Industry includes pond evaporation. LandSAT data, aerial imagery and site visits were used to determine an approximated total irrigated acreage for this GSA. The crop coefficient method described in Section 2.2.3.1, similar to the SJREC GSA, was used to determine the crop consumptive use for irrigated agriculture. Consumptive use during this timeframe ranged from 6,100 to 8,000 AF/year with an average of approximately 7,000 AF/year. The approximate sustainable yield for the County of Merced – Delta-Mendota GSA is 0.40 acre-feet/acre or about 7,000 acre-feet/year. The estimated effective pumping of 7,000 AF/year is considered within the range of uncertainty of the estimate of sustainable yield for the portion of the Merced County – Delta-

Mendota GSA in the SJREC GSP. As such, no immediate actions are anticipated to reduce pumping or augment recharge in the GSA, and steps to achieve independent sustainability of the GSA are anticipated during Plan implementation.

WATER YEAR	MERCED COUNTY - GSA ACRES	IRRIGATED INDUSTRY ACRES	IRRIGATED AG ACRES	ET_C (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2003	17,500	1,800	5,000	8,600	6,700	6,700
2004	17,500	1,800	5,000	10,100	8,000	8,000
2005	17,500	1,800	5,000	9,000	6,200	6,200
2006	17,500	1,800	5,000	9,000	6,100	6,100
2007	17,500	1,800	5,000	9,200	7,800	7,800
2008	17,500	1,800	5,000	10,000	8,000	8,000
2009	17,500	1,800	5,000	10,100	7,700	7,700
2010	17,500	1,800	5,000	9,700	7,400	7,400
2011	17,500	1,800	5,000	9,400	7,200	7,200
2012	17,500	1,800	5,000	10,000	7,600	7,600

Table 66 - County of Merced Historic Water Budget Data

15.2.2 Current Water Budget for the County of Merced

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	MERCED COUNTY - GSA ACRES	IRRIGATED INDUSTRY ACRES	IRRIGATED AG ACRES	ETC (AF)	ETiw (AF)	EFFECTIVE PUMPING (AF)
2013	17,500	1,800	5,000	9,900	7,500	7,500

Table 67 - County of Merced Current Water Budget Data

15.2.3 Projected Water Budget for the County of Merced

The portion of the Merced County – Delta-Mendota GSA in the SJREC GSP, is not anticipated to increase the acreage of irrigated agriculture. Any increase in demand is more likely to be directly tied to Climate Change. The same process outlined in Section 2.2.3.3 was used to estimate climate change factors. Below is a table of the projected water budget. The projected consumptive use of applied water is anticipated to increase slightly during the projected water budget. The consumptive use of applied water ranges from 6,300 to 8,600 AF/year with an average of 7,700 AF/year. Section 15.3 will discuss SMC in order for the portion of Merced County - Delta-Mendota GSA in the SJREC GSP, to be sustainable. Section 15.4 will discuss projects and management actions to offset groundwater extractions in excess of the sustainable yield.

WATER YEAR	HISTORICAL REFERENCE USED FOR HYDROLOGY	HISTORICAL REFERENCE FOR WATER DELIVERY/DEMAND	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)
2014	-	2014	Critical	Critically Dry
2015	-	2015	Critical	Critically Dry
2016	-	2016	Non-Critical	Dry
2017	-	2011	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2011	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2011	Non-Critical	Wet
2022	1983	2011	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2011	Non-Critical	Wet
2026	1987	2013	Non-Critical	Critically Dry
2027	1988	2013	Non-Critical	Critically Dry
2028	1989	2013	Non-Critical	Critically Dry
2029	1990	2013	Non-Critical	Critically Dry
2030	1991	2014	Critical	Critically Dry
2031	1992	2015	Critical	Critically Dry
2032	1993	2011	Non-Critical	Wet
2033	1994	2013	Non-Critical	Critically Dry
2034	1995	2011	Non-Critical	Wet
2035	1996	2011	Non-Critical	Wet
2036	1997	2011	Non-Critical	Wet
2037	1998	2011	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2001	2012	Non-Critical	Dry
2052	1992	2013	Non-Critical	Critically Dry
2053	1976	2014	Critical	Critically Dry
2054	1977	2015	Critical	Critically Dry
2055	2002	2016	Non-Critical	Dry
2056	2011	2011	Non-Critical	Wet
2057	1965	2011	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2011	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2011	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2011	Non-Critical	Wet
2067	1975	2011	Non-Critical	Wet
2068	1976	2014	Critical	Critically Dry
2069	1977	2015	Critical	Critically Dry
2070	1978	2011	Non-Critical	Wet

Table 68 – County of Merced Projected Water Budget Water Year Data

WATER YEAR	MERCED COUNTY - GSA ACRES	IRRIGATED INDUSTRY ACRES	IRRIGATED AG ACRES	CLIMATE CHANGE FACTOR	ET_c (AF)	ET_{iw} (AF)	TOTAL ET_c WITH CLIMATE CHANGE	TOTAL ET_{IW} WITH CLIMATE CHANGE	EFFECTIVE PUMPING (AF)
2014	17,500	1,800	5,000	1	10,200	7,800	10,200	7,800	7,800
2015	17,500	1,800	5,000	1	8,800	6,700	8,800	6,700	6,700
2016	17,500	1,800	5,000	1	9,600	7,300	9,600	7,300	7,300
2017	17,500	1,800	5,000	1	9,400	7,200	9,400	7,200	7,200
2018	17,500	1,800	5,000	1.035	9,700	7,400	10,000	7,700	7,700
2019	17,500	1,800	5,000	1.034	9,400	7,200	9,700	7,400	7,400
2020	17,500	1,800	5,000	1.036	10,000	7,600	10,400	7,900	7,900
2021	17,500	1,800	5,000	1.034	9,400	7,200	9,700	7,400	7,400
2022	17,500	1,800	5,000	1.035	9,400	7,200	9,700	7,500	7,500
2023	17,500	1,800	5,000	1.026	9,700	7,400	10,000	7,600	7,600
2024	17,500	1,800	5,000	1.036	10,000	7,600	10,400	7,900	7,900
2025	17,500	1,800	5,000	1.041	9,400	7,200	9,800	7,500	7,500
2026	17,500	1,800	5,000	1.034	9,900	7,500	10,200	7,800	7,800
2027	17,500	1,800	5,000	1.032	9,900	7,500	10,200	7,700	7,700
2028	17,500	1,800	5,000	1.033	9,900	7,500	10,200	7,700	7,700
2029	17,500	1,800	5,000	1.027	9,900	7,500	10,200	7,700	7,700
2030	17,500	1,800	5,000	1.029	10,200	7,800	10,500	8,000	8,000
2031	17,500	1,800	5,000	1.034	8,800	6,700	9,100	6,900	6,900
2032	17,500	1,800	5,000	1.035	9,400	7,200	9,700	7,500	7,500
2033	17,500	1,800	5,000	1.031	9,900	7,500	10,200	7,700	7,700
2034	17,500	1,800	5,000	1.037	9,400	7,200	9,700	7,500	7,500
2035	17,500	1,800	5,000	1.029	9,400	7,200	9,700	7,400	7,400
2036	17,500	1,800	5,000	1.03	9,400	7,200	9,700	7,400	7,400
2037	17,500	1,800	5,000	1.033	9,400	7,200	9,700	7,400	7,400
2038	17,500	1,800	5,000	1.035	9,700	7,400	10,000	7,700	7,700
2039	17,500	1,800	5,000	1.034	9,700	7,400	10,000	7,700	7,700
2040	17,500	1,800	5,000	1.03	10,000	7,600	10,300	7,800	7,800
2041	17,500	1,800	5,000	1.032	10,000	7,600	10,300	7,800	7,800
2042	17,500	1,800	5,000	1.032	8,600	6,700	8,900	6,900	6,900
2043	17,500	1,800	5,000	1.027	10,100	8,000	10,400	8,200	8,200
2044	17,500	1,800	5,000	1.036	9,000	6,200	9,300	6,400	6,400
2045	17,500	1,800	5,000	1.034	9,000	6,100	9,300	6,300	6,300
2046	17,500	1,800	5,000	1.079	9,200	7,800	9,900	8,400	8,400
2047	17,500	1,800	5,000	1.077	10,000	8,000	10,800	8,600	8,600
2048	17,500	1,800	5,000	1.079	10,100	7,700	10,900	8,300	8,300
2049	17,500	1,800	5,000	1.083	9,700	7,400	10,500	8,000	8,000
2050	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2051	17,500	1,800	5,000	1.074	10,000	7,600	10,700	8,200	8,200
2052	17,500	1,800	5,000	1.086	9,900	7,500	10,800	8,100	8,100
2053	17,500	1,800	5,000	1.086	10,200	7,800	11,100	8,500	8,500
2054	17,500	1,800	5,000	1.078	8,800	6,700	9,500	7,200	7,200
2055	17,500	1,800	5,000	1.081	9,600	7,300	10,400	7,900	7,900
2056	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2057	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2058	17,500	1,800	5,000	1.086	10,100	7,700	11,000	8,400	8,400
2059	17,500	1,800	5,000	1.083	9,400	7,200	10,200	7,800	7,800
2060	17,500	1,800	5,000	1.085	10,000	7,600	10,900	8,200	8,200
2061	17,500	1,800	5,000	1.086	9,400	7,200	10,200	7,800	7,800
2062	17,500	1,800	5,000	1.076	9,700	7,400	10,400	8,000	8,000
2063	17,500	1,800	5,000	1.087	10,100	7,700	11,000	8,400	8,400
2064	17,500	1,800	5,000	1.085	10,000	7,600	10,900	8,200	8,200
2065	17,500	1,800	5,000	1.081	9,700	7,400	10,500	8,000	8,000
2066	17,500	1,800	5,000	1.087	9,400	7,200	10,200	7,800	7,800
2067	17,500	1,800	5,000	1.084	9,400	7,200	10,200	7,800	7,800
2068	17,500	1,800	5,000	1.086	10,200	7,800	11,100	8,500	8,500
2069	17,500	1,800	5,000	1.078	8,800	6,700	9,500	7,200	7,200
2070	17,500	1,800	5,000	1.072	9,400	7,200	10,100	7,700	7,700

Table 69 - County of Merced Projected Water Budget

15.3 Sustainable Management Criteria for the County of Merced

The portion of the Merced County – Delta-Mendota GSA in the SJREC GSP, has historically relied on groundwater extraction to meet demand due to lack of other supply options. Groundwater use in this area has primarily been offset by recharge from the SJREC service area, deep percolation from applied water and precipitation, and subsurface flows. The SJREC are invested in helping the Merced County – Delta-Mendota GSA to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the Merced County – Delta-Mendota GSA on Projects and Management actions to offset groundwater extractions by the County white area that are estimated to be above their sustainable yield.

Currently, the portion of the Merced County – Delta-Mendota GSA is sustainable from a water budget standpoint. The historical consumptive use for the County of Merced was about 7,000 AF/year which equates to an average use of about 1.0 AF/acre for irrigated acres and about 0.4 AF/acre for the total area covered by the GSA. The sustainable yield for the County is 7,000 AF/year. While a majority of the County of Merced GSA is mostly adjacent to the SJREC Management Areas B and C, different SMC is developed in order for the County to achieve independent groundwater sustainability.

15.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the portion of the County of Merced – Delta-Mendota GSA in the SJREC GSP are positively impacted through recharge from the SJREC service area. Water levels in the SJREC Management Areas will be used to sustainably manage groundwater levels around the County area. Sustainable groundwater management for the County is best achieved by offsetting use through the implementation of projects and management actions to avoid overdraft.

15.3.2 Reduction in Groundwater Storage

Groundwater storage under the portion of the Merced County – Delta-Mendota GSA in the SJREC GSP is positively impacted through recharge from the SJREC service area. Managing groundwater storage for the County will be accomplished through updated water budgets for the County white areas. Sustainable groundwater management for the County is best achieved by offsetting use through the implementation of projects and management actions to avoid overdraft.

15.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

15.3.4 Degraded Water Quality

Merced County is managing groundwater quality similar to the SJREC GSA. Salinity is the major water quality concern in the area. Electrical conductivity will be monitored and management actions will be developed as necessary. Currently no management actions are recommended to supplement the SJREC GSA management efforts. For more details refer to the following Sections in this GSP: 3.2.4, 3.3.4, and 3.4.4.

15.3.5 Land Subsidence

It is assumed that the portion of the Merced County – Delta-Mendota GSA in the SJREC GSP may have wells perforated below the Corcoran Clay. Even so, significant land surface subsidence has not been observed in this area. The SJREC GSA and the Merced County – Delta-Mendota GSA will work with the landowners to better understand well construction throughout the irrigated areas. The SJREC will continue to work with the County of Merced to monitor subsidence and work with regional partners on solutions if subsidence is observed and may cause damage to critical infrastructure.

15.3.6 Depletions of Interconnected Surface Water

The County of Merced plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. The portion of the Merced County – Delta-Mendota GSA in the SJREC GSP Group does not include lands adjacent to interconnected surface water. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

15.4 Projects and Management Actions for the County of Merced

In order to maintain sustainability for each GSA in the SJREC GSP group, the Merced County – Delta-Mendota GSA is committed to offsetting groundwater extractions above their sustainable yield. Each project will be analyzed jointly with the County and the SJREC to maximize the regional benefits. Options to offset demand include; 1) purchasing groundwater credits, 2) participation in recharge projects, and 3) reducing pumping elsewhere in the GSA.

The SJREC will continue to work with the County to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources.

15.5 Plan Implementation for the County of Merced

The cost to develop and implement the GSP specific to the portion of the Merced County – Delta-Mendota GSA has been fully funded by the County of Merced. The SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the portion of the Merced County – Delta-Mendota GSA in the SJREC GSP.

The SJREC GSP Group has been, and will continue to, sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Los Banos Creek area was the implementation of a representative well with a trigger level to limit groundwater transfers from the area. As a result of the annual groundwater investigations prepared by the SJREC, the problem presented itself along with a solution to mitigate the concern; resulting in the aquifer fully recovering after water levels dropped below established triggers and no long-term lowering of the aquifer was experienced. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the County, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

16.0 PORTION OF FRESNO COUNTY MANAGEMENT AREA B GSA AREA

16.1 Background for County of Fresno

There is about 1,800 acres of lands not in a public water district, white area, in the Portion of the Fresno County Management Area B that has been included in the SJREC GSP; refer to Figure 2 for a graphical depiction of the area. The SJREC worked with County leaders and technical staff to understand the potential opportunities and constraints of the SGMA to the County White Areas. It was mutually agreed that the SJREC will work with the County to develop the requirements in the GSP and to include this in a discrete section of this plan.

The SJREC are committed to assist the County to maintain sustainability through the planning and implementation horizon. The Fresno County Management Area B GSA is a party to the Delta-Mendota Subbasin Coordination Agreement and Cost Sharing Agreement (Appendices B & C; respectively).

Section 1 of this GSP discusses the purpose of this plan, sustainability goal, agency information and the organization of this plan for all GSA's in the SJREC GSP. Section 2.1 of this GSP describes the plan area for all of the GSA's in the SJREC GSP. Refer to Appendix I for a discussion on the basin setting for the SJREC GSA and surrounding areas including the portion of the County of Fresno Management Area B GSA area in the SJREC GSP. The Water Budget, Sustainable Management Criteria and Projects & Management Actions are included below.

16.2 Water Budgets for the County of Fresno

Presented herein is the compilation of the historic, current and projected water budgets specific to the Portion of the County of Fresno – Management Area B GSA within the SJREC GSP.

16.2.1 Historic Water Budget for the County of Fresno

The portion of the County of Fresno Management Area B GSA in the SJREC GSP encompasses about 1,800 acres of land. Of that, about 550 acres are actively farmed and the remaining acres are not actively farmed and do not pump groundwater. The historic water budget from 2003-2012 is consistent with the historic range selected by the entire Delta-Mendota Subbasin. It is assumed that all of the ET_{iw} needed to grow the crops in the area was met by pumping groundwater. Groundwater pumping during this timeframe ranged from 100 to 1,200 AF/year with an average pumping of 500 AF/year. The approximate sustainable yield for the Portion of the County of Fresno – Management Area B GSA is 0.40 acre-feet/acre or about 700 acre-feet/year.

WATER YEAR	IRRIGATED ACRES	ET_c (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2003	550	700	600	600
2004	550	800	700	700
2005	550	300	200	200
2006	550	300	200	200
2007	550	1,400	1,200	1,200
2008	550	1,100	900	900
2009	550	700	600	600
2010	550	200	100	100
2011	550	300	200	200
2012	550	900	700	700

Table 70 - County of Fresno Historic Water Budget Data

16.2.2 Current Water Budget for the County of Fresno

The same data and methodologies from the Historic Water Budget was used to develop the Current Water Budget.

WATER YEAR	IRRIGATED ACRES	ET_C (AF)	ET_{iw} (AF)	EFFECTIVE PUMPING (AF)
2013	550	900	700	700

Table 71 - County of Fresno Current Water Budget Data

16.2.3 Projected Water Budget for the County of Fresno

The Portion of the County of Fresno Management Area B GSA in the SJREC GSP, area that can be used for production is currently fully planted. Any increase in demand is directly tied to Climate Change. The same process outlined in Section 2.2.3.3 was used to determine climate change factors. Below is a table of the projected water budget. The projected consumptive use of applied water is anticipated to remain about the same during the projected water budget. The net groundwater extraction ranges from 100 to 1,300 AF/year. Section 16.3 will discuss SMC in order for the Portion of the County of Fresno Management Area B GSA in the SJREC GSP, to be sustainable. Section 16.4 will discuss projects and management actions to offset the groundwater extractions in excess of the sustainable yield.

WATER YEAR	HISTORICAL REFERENCE USED FOR HYDROLOGY	HISTORICAL REFERENCE FOR WATER DELIVERY/DEMAND	SHASTA WATER YEAR DESIGNATION	WATER YEAR TYPE (SJ VALLEY)
2014	-	2014	Critical	Critically Dry
2015	-	2015	Critical	Critically Dry
2016	-	2016	Non-Critical	Dry
2017	-	2011	Non-Critical	Wet
2018	1979	2010	Non-Critical	Above Normal
2019	1980	2011	Non-Critical	Wet
2020	1981	2012	Non-Critical	Dry
2021	1982	2011	Non-Critical	Wet
2022	1983	2011	Non-Critical	Wet
2023	1984	2010	Non-Critical	Above Normal
2024	1985	2012	Non-Critical	Dry
2025	1986	2011	Non-Critical	Wet
2026	1987	2013	Non-Critical	Critically Dry
2027	1988	2013	Non-Critical	Critically Dry
2028	1989	2013	Non-Critical	Critically Dry
2029	1990	2013	Non-Critical	Critically Dry
2030	1991	2014	Critical	Critically Dry
2031	1992	2015	Critical	Critically Dry
2032	1993	2011	Non-Critical	Wet
2033	1994	2013	Non-Critical	Critically Dry
2034	1995	2011	Non-Critical	Wet
2035	1996	2011	Non-Critical	Wet
2036	1997	2011	Non-Critical	Wet
2037	1998	2011	Non-Critical	Wet
2038	1999	2010	Non-Critical	Above Normal
2039	2000	2010	Non-Critical	Above Normal
2040	2001	2012	Non-Critical	Dry
2041	2002	2012	Non-Critical	Dry
2042	2003	2003	Non-Critical	Below Normal
2043	2004	2004	Non-Critical	Dry
2044	2005	2005	Non-Critical	Wet
2045	2006	2006	Non-Critical	Wet
2046	2007	2007	Non-Critical	Critically Dry
2047	2008	2008	Non-Critical	Critically Dry
2048	2009	2009	Non-Critical	Below Normal
2049	2010	2010	Non-Critical	Above Normal
2050	2011	2011	Non-Critical	Wet
2051	2001	2012	Non-Critical	Dry
2052	1992	2013	Non-Critical	Critically Dry
2053	1976	2014	Critical	Critically Dry
2054	1977	2015	Critical	Critically Dry
2055	2002	2016	Non-Critical	Dry
2056	2011	2011	Non-Critical	Wet
2057	1965	2011	Non-Critical	Wet
2058	1966	2009	Non-Critical	Below Normal
2059	1967	2011	Non-Critical	Wet
2060	1968	2012	Non-Critical	Dry
2061	1969	2011	Non-Critical	Wet
2062	1970	2010	Non-Critical	Above Normal
2063	1971	2009	Non-Critical	Below Normal
2064	1972	2012	Non-Critical	Dry
2065	1973	2010	Non-Critical	Above Normal
2066	1974	2011	Non-Critical	Wet
2067	1975	2011	Non-Critical	Wet
2068	1976	2014	Critical	Critically Dry
2069	1977	2015	Critical	Critically Dry
2070	1978	2011	Non-Critical	Wet

Table 72 – County of Fresno Projected Water Budget Water Year Data

WATER YEAR	IRRIGATED ACRES	CLIMATE CHANGE FACTOR	TOTAL ET_c WITH CLIMATE CHANGE	TOTAL ET_{IW} WITH CLIMATE CHANGE	EFFECTIVE PUMPING (AF)
2014	550	-	500	400	400
2015	550	-	300	300	300
2016	550	-	500	400	400
2017	550	-	300	200	200
2018	550	1.038	200	100	100
2019	550	1.034	300	200	200
2020	550	1.031	900	700	700
2021	550	1.034	300	200	200
2022	550	1.038	300	200	200
2023	550	1.035	200	100	100
2024	550	1.034	900	700	700
2025	550	1.038	300	200	200
2026	550	1.033	900	700	700
2027	550	1.027	900	700	700
2028	550	1.032	900	700	700
2029	550	1.03	900	700	700
2030	550	1.029	500	400	400
2031	550	1.032	300	300	300
2032	550	1.032	300	200	200
2033	550	1.031	900	700	700
2034	550	1.033	300	200	200
2035	550	1.026	300	200	200
2036	550	1.03	300	200	200
2037	550	1.034	300	200	200
2038	550	1.031	200	100	100
2039	550	1.033	200	100	100
2040	550	1.028	900	700	700
2041	550	1.028	900	700	700
2042	550	1.032	700	600	600
2043	550	1.032	800	700	700
2044	550	1.034	300	200	200
2045	550	1.03	300	200	200
2046	550	1.081	1,500	1,300	1,300
2047	550	1.081	1,200	1,000	1,000
2048	550	1.087	800	700	700
2049	550	1.088	200	100	100
2050	550	1.093	300	200	200
2051	550	1.08	1,000	800	800
2052	550	1.093	1,000	800	800
2053	550	1.084	500	400	400
2054	550	1.079	300	300	300
2055	550	1.075	500	400	400
2056	550	1.093	300	200	200
2057	550	1.093	300	200	200
2058	550	1.091	800	700	700
2059	550	1.087	300	200	200
2060	550	1.081	1,000	800	800
2061	550	1.089	300	200	200
2062	550	1.083	200	100	100
2063	550	1.093	800	700	700
2064	550	1.091	1,000	800	800
2065	550	1.084	200	100	100
2066	550	1.087	300	200	200
2067	550	1.098	300	200	200
2068	550	1.084	500	400	400
2069	550	1.079	300	300	300
2070	550	1.071	300	200	200

Table 73 - County of Fresno Projected Water Budget

16.3 Sustainable Management Criteria for the County of Fresno

The portion of the County of Fresno Management Area B GSA in the SJREC GSP, has historically relied on groundwater extraction to meet demand. Groundwater overdraft in this area has primarily been offset by recharge from the SJREC service area and seepage from the San Joaquin River. The SJREC are invested in helping the County to monitor, understand and manage groundwater. The SJREC GSP Group, collectively, is currently sustainable. In order for the group to maintain sustainability, the SJREC will work with the County of Fresno on Projects and Management actions to offset groundwater extractions by the County white area that is above their sustainable yield.

The historical consumptive use for the County of Fresno was about 500 AF/year which equates to an average use of about 1.0 AF/acre for irrigated acres and about 0.3 AF/acre for the total area covered by the GSA. The sustainable yield for the County is 700 AF/year. While the County of Fresno GSA is mostly adjacent to the SJREC Management Area J, different SMC is developed in order for the County to achieve independent groundwater sustainability.

16.3.1 Chronic Lowering of Groundwater Levels

Water levels in the vicinity of the portion of the County of Fresno Management Area B GSA in the SJREC GSP are positively impacted through recharge from the SJREC service area and seepage from the San Joaquin River. Water levels in the SJREC Management Area J will be used to sustainably manage groundwater levels around the County area. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

16.3.2 Reduction in Groundwater Storage

Groundwater storage under the portion of the County of Fresno Management Area B GSA in the SJREC GSP is positively impacted through recharge from the SJREC and seepage from the San Joaquin River. Managing groundwater storage for the County will be accomplished through updated water budgets for the County white areas. Sustainable groundwater management for the County is best achieved by offsetting overdraft through the implementation of projects and management actions.

16.3.3 Seawater Intrusion

The Delta-Mendota Subbasin does not currently experience seawater intrusion and does not anticipate this occurring. The presence of an undesirable result for seawater intrusion is not likely to occur and therefore no SMC have been established for this sustainability indicator.

16.3.4 Degraded Water Quality

Fresno County is managing groundwater quality similar to the SJREC GSA. Salinity is the major water quality concern in the area. Fresno County will monitor electrical conductivity and impose management actions as necessary. Currently no management actions are recommended to supplement the SJREC GSA management efforts. For more details refer to the following Sections in this GSP: 3.2.4, 3.3.4, and 3.4.4.

16.3.5 Land Subsidence

It is anticipated that the portion of the County of Fresno Management Area B GSA in the SJREC GSP does not operate any wells perforated below the Corcoran Clay. As a result, inelastic land subsidence is unlikely to occur as a result of pumping from the wells within the GSA area. Therefore, no SMC have been established for this sustainability indicator. The SJREC will continue to work with the County of

Fresno to monitor subsidence and work with regional partners on solutions if subsidence is observed and may cause damage to critical infrastructure.

16.3.6 Depletions of Interconnected Surface Water

The County of Fresno plans to work with the SJREC to sustainably manage interconnected surface water and groundwater. For more details refer to the following Sections in this GSP: 3.2.6, 3.3.6, and 3.4.6.

16.4 Projects and Management Actions for the County of Fresno

In order to maintain sustainability for each GSA in the SJREC GSP group, the County is committed to offsetting groundwater extractions above their sustainable yield. Each project will be analyzed jointly with the County and the SJREC to maximize the regional benefits. The County is pursuing the following projects as a way to offset demand; 1) purchasing groundwater credits and 2) participation in recharge projects.

The SJREC will continue to work with the County to not only meet the requirements of the SGMA but more importantly, to maximize the benefits of local water resources.

16.5 Plan Implementation for the County of Fresno

The cost to develop and implement the GSP specific to the portion of the County of Fresno has been cost shared at 50% between the SJREC GSA and the County of portion of the County of Fresno Management Area B GSA in the SJREC GSP. Additionally, the SJREC GSA has participated in the Sustainable Groundwater Planning Grant Program (SGWP) on behalf of the SJREC GSP Group and will offset up to 50% of the plan development costs for the portion of the County of Fresno Management Area B GSA in the SJREC GSP. The SJREC GSP Group has been, and will continue to sustainably manage groundwater through the planning and implementation horizon. The SJREC have annually evaluated groundwater conditions in this area for decades and have a proven track record of successfully implementing criteria to offset groundwater problems. One groundwater management success story in the Mendota area was the implementation of monitoring and management program for well water transfers near the Mendota Pool. The SJREC worked with the regional water leaders to develop and implement a plan that would maximize water resources without sacrificing the needs of the local communities. As a result, water levels have remained fairly stable and none of the wells pumping as part of the program are contributing to land subsidence. The SJREC GSP group will continue to sharpen our pencils to provide safe and reliable water. Although we are sustainable, if any issues are identified in our annual evaluations, we will work with our regional partners to promptly address the concerns. Consistent with our decades long relationship of leading the groundwater management effort with the County, the SJREC will take the lead preparing annual reports consistent with SGMA regulations.

APPENDICES

Appendix A. Senate Bill 372

Appendix B. Delta-Mendota Subbasin Common Chapter (including Coordination Agreement)

Appendix C. Cost Sharing Agreement – Delta-Mendota Subbasin Coordination

Appendix D. Notice of Intent to Develop a GSP

Appendix E. List of Public Meetings

Appendix F. List of Interested Parties

Appendix G. Delta-Mendota Subbasin Communications Plan

Appendix H. Comments and Response to Comments

Appendix I. Hydrogeologic Conceptual Model and Groundwater Conditions for the San Joaquin River Exchange Contractors Service Area GSP

Appendix J. HCM BMP

Appendix K. Water Budget BMP

Appendix L. Modeling BMP

Appendix M. SMC BMP

Appendix N. Monitoring Protocols BMP

Appendix O. Monitoring Network BMP

Appendix P. Grassland Bypass Project Summary

Appendix Q. Update on Groundwater Conditions in the Newman Sub-Area of the SJREC GSP

Appendix R. Update on Groundwater Conditions in the Gustine Sub-Area of the SJREC GSP

Appendix S. Hydrogeologic Conceptual Model, Groundwater Conditions, and Water Budget for the City of Los Banos GSA

Appendix T. Groundwater Conditions in the Dos Palos Sub-Area of the SJREC GSP

Appendix U. Updated Groundwater Conditions in the Vicinity of the City of Firebaugh

Appendix V. Update on Groundwater Conditions in the Mendota Sub-Area of the SJREC GSP

Appendix W. Groundwater Conditions in the Turner Island Water District – 2 GSA

Appendix A. Senate Bill 372

Senate Bill No. 372

CHAPTER 357

An act to amend Section 10723 of the Water Code, and to create the San Joaquin River Exchange Contractors Groundwater Sustainability Agency, and prescribing its boundaries, organization, operation, management, financing, and other powers and duties, relating to water districts, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor September 28, 2017. Filed with Secretary of State September 28, 2017.]

LEGISLATIVE COUNSEL'S DIGEST

SB 372, Cannella. San Joaquin River Exchange Contractors Groundwater Sustainability Agency.

Existing law, the Sustainable Groundwater Management Act, requires all groundwater basins designated as high- or medium-priority basins by the Department of Water Resources that are designated as basins subject to critical conditions of overdraft to be managed under a groundwater sustainability plan or coordinated groundwater sustainability plans by January 31, 2020, and requires all other groundwater basins designated as high- or medium-priority basins to be managed under a groundwater sustainability plan or coordinated groundwater sustainability plans by January 31, 2022, except as specified. The act authorizes any local agency or combination of local agencies overlying a groundwater basin to decide to become a groundwater sustainability agency for that basin. The act deems certain agencies created by statute to manage groundwater the exclusive local agencies within their respective statutory boundaries with powers to comply with the act and authorizes these agencies to opt out of being the exclusive groundwater management agency.

This bill would create the San Joaquin River Exchange Contractors Groundwater Sustainability Agency as the exclusive groundwater sustainability agency and successor in interest to the agency that submitted a notice of intent to become a groundwater sustainability agency to the department on December 22, 2015. The bill would establish the boundaries of the agency and would authorize the agency's boundaries to be changed. The bill would require the agency to develop and implement a groundwater sustainability plan to achieve sustainable groundwater management within the territory of the agency. The bill would generally specify the powers and purposes of the agency. The bill would prescribe the composition of the 4-member board of directors of the agency and would require members and alternates to be chosen by member agencies, as specified. By imposing duties on the agency and the member agencies, the bill would impose a state-mandated local program.

The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

This bill would declare that it is to take effect immediately as an urgency statute.

The people of the State of California do enact as follows:

SECTION 1. Section 10723 of the Water Code is amended to read:

10723. (a) Except as provided in subdivision (c), any local agency or combination of local agencies overlying a groundwater basin may decide to become a groundwater sustainability agency for that basin.

(b) Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant to Section 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin.

(c) (1) Except as provided in paragraph (2), the following agencies created by statute to manage groundwater shall be deemed the exclusive local agencies within their respective statutory boundaries with powers to comply with this part:

(A) Alameda County Flood Control and Water Conservation District, Zone 7.

(B) Alameda County Water District.

(C) Desert Water Agency.

(D) Fox Canyon Groundwater Management Agency.

(E) Honey Lake Valley Groundwater Management District.

(F) Kings River East Groundwater Sustainability Agency.

(G) Long Valley Groundwater Management District.

(H) Mendocino City Community Services District.

(I) Mono County Tri-Valley Groundwater Management District.

(J) Monterey Peninsula Water Management District.

(K) North Fork Kings Groundwater Sustainability Agency.

(L) Ojai Groundwater Management Agency.

(M) Orange County Water District.

(N) Pajaro Valley Water Management Agency.

(O) San Joaquin River Exchange Contractors Groundwater Sustainability Agency.

(P) Santa Clara Valley Water District.

(Q) Sierra Valley Groundwater Management District.

(R) Willow Creek Groundwater Management Agency.

(2) An agency identified in this subdivision may opt out of being the exclusive groundwater management agency within its statutory boundaries by sending a notice to the department, which shall be posted on the department's Internet Web site within 15 days of receipt. If an agency

identified in paragraph (1) opts out of being the exclusive groundwater management agency, any other local agency or combination of local agencies operating within the statutory boundaries of the agency that has opted out may notify the department pursuant to Section 10723.8 of its decision to be the groundwater sustainability agency.

(3) A local agency listed in paragraph (1) may comply with this part by meeting the requirements of Section 10733.6 or opting to become a groundwater sustainability agency pursuant to this section. A local agency with authority to implement a basin-specific management plan pursuant to its principal act shall not exercise any authorities granted in this part in a manner inconsistent with any prohibitions or limitations in its principal act unless the governing board of the local agency makes a finding that the agency is unable to sustainably manage the basin without the prohibited authority.

(d) The decision of a local agency or combination of agencies to become a groundwater sustainability agency shall take effect as provided in Section 10723.8.

SEC. 2. This section shall be known and may be cited as the San Joaquin River Exchange Contractors Groundwater Sustainability Agency Act.

San Joaquin River Exchange Contractors Groundwater Sustainability Agency Act

Article 1. Findings and Declarations

101. The Legislature hereby finds and declares that the preservation of the groundwater resources within the boundaries of the agency is in the public interest and that the creation of the agency pursuant to this act is for the common benefit.

102. The Legislature further finds and declares that the groundwater management activities of the agency benefit all operators of groundwater extraction facilities within the boundaries of the agency.

103. The Legislature further finds and declares that circumstances within the boundaries of the agency formed by this act, including longstanding joint action among the entities within the boundaries, justify the formation of the agency and the grant of powers contained in this act.

Article 2. Creation and Purposes

201. (a) A groundwater management agency is hereby created in the Counties of Fresno, Madera, Merced, and Stanislaus to be known as the San Joaquin River Exchange Contractors Groundwater Sustainability Agency.

(b) The agency shall be the successor in interest to the San Joaquin River Exchange Contractors Water Groundwater Sustainability Agency that submitted its notice of intent to become a groundwater sustainability agency to the Department of Water Resources on December 22, 2015.

(c) The agency shall only exercise the powers granted by this act and the Sustainable Groundwater Management Act (Part 2.74 (commencing with Section 10720) of Division 6 of the Water Code) for purposes of groundwater management activities within the boundaries of the agency, together with any other powers as are reasonably implied, necessary, and proper to carry out the objectives and purposes of the agency to implement the Sustainable Groundwater Management Act. The agency shall abide by the rules and regulations promulgated by the Department of Water Resources and the State Water Resources Control Board to implement the Sustainable Groundwater Management Act.

Article 3. Boundaries

301. (a) For purposes of this act, the boundaries of the agency shall be as follows:

(1) All land located within the boundaries of Central California Irrigation District, including Class II lands.

(2) All land located within the boundaries of Firebaugh Canal Water District, including Class II lands.

(3) All land located within the boundaries of San Luis Canal Company.

(4) All land located within the boundaries of Columbia Canal Company.

(b) The lands included within the boundaries of the agency are depicted in the revised map submitted by the San Joaquin River Exchange Contractors Water Authority Groundwater Sustainability Agency to the Department of Water Resources on October 18, 2016.

(c) In the event of any ambiguity between the narrative boundary described in subdivision (a) and the map described in subdivision (b), the boundary depicted in the map shall control.

302. (a) The initial boundaries of the agency may be changed in accordance with either of the following procedures:

(1) Upon completion of a change of organization or a reorganization to the Central California Irrigation District or the Firebaugh Canal Water District pursuant to the Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 (Division 3 (commencing with Section 56000) of Title 5 of the Government Code), the boundaries of the agency shall be automatically changed pursuant to Section 56120 of the Government Code.

(2) Upon a proposal for a change of organization or reorganization initiated by the adoption of a resolution of application by the board and approval of the proposal by the local agency formation commission pursuant to Part 3 (commencing with Section 56650) of Division 3 of Title 5 of the Government Code.

(b) The boundaries of the agency shall not be adjusted to include an area of the basin within the management area of another groundwater sustainability agency unless the agency has entered into a memorandum of agreement or other legal agreement with that groundwater sustainability agency that permits the area to be included.

Article 4. Definitions

401. Unless otherwise indicated by their context, the definitions set forth in this article govern the interpretation of this act.
402. "Agency" means the San Joaquin River Exchange Contractors Groundwater Sustainability Agency established by this act.
403. "Basin" has the same meaning as defined in Section 10721 of the Water Code.
404. "Board" means the board of directors of the agency, as more particularly described in Section 501.
405. "Delta-Mendota Subbasin" has the same meaning as described in the report entitled "California's Groundwater - Bulletin 118" updated in 2003, as it may be subsequently updated or revised by the Department of Water Resources in accordance with Section 12924 of the Water Code.
406. "Extraction" means the act of obtaining groundwater by pumping or other controlled means.
407. "Groundwater" has the same meaning as defined in Section 10721 of the Water Code.
408. "Groundwater management activities" means programs, measures, or actions taken to preserve, protect, and enhance groundwater resources within the boundaries of the agency.
409. "Member agency" means the mutual water companies, irrigation district, and water district entitled to representation on the agency's board of directors as specified in Section 501.
410. "Operator" has the same meaning as defined in Section 10721 of the Water Code.
411. "Person" has the same meaning as defined in Section 10735 of the Water Code.
412. "Plan" has the same meaning as defined in Section 10721 of the Water Code.

Article 5. General Provisions

501. (a) The agency shall be governed by a board of directors that shall consist of four members, as follows:
(1) One member shall be chosen by the Central California Irrigation District.
(2) One member shall be chosen by the Firebaugh Canal Water District.
(3) One member shall be chosen by the San Luis Canal Company.
(4) One member shall be chosen by the Columbia Canal Company.
(b) The governing board of each member agency shall choose a board member for the purpose of subdivision (a) from the member agency's board members.

(c) There shall be an alternate for each board member, chosen in the same manner and by the same entity as the board member. The alternate member shall act in place of the board member he or she is an alternate for in case of that board member's absence or inability to act.

(d) Initial members and their alternates shall be chosen on or before July 1, 2018.

502. It shall not be a conflict of interest for any board member to simultaneously serve on the agency board, the board of directors of the San Joaquin River Exchange Contractors Water Authority, and the board of directors of any member agency, or any combination of those offices.

503. Members of the board shall serve for a four-year term of office or until the member is no longer a board member of the member agency that appointed him or her. A member may serve for more than one term of office.

504. (a) The board may adopt an ordinance to provide compensation to members of the board in an amount not to exceed one hundred dollars ($100) per day for each day's attendance at meetings of the board or for each day's service rendered as a member of the board by request of the board. For purposes of this section, the determination of whether a board member's activities on any specific day are compensable shall be made pursuant to Article 2.3 (commencing with Section 53232) of Chapter 2 of Part 1 of Division 2 of Title 5 of the Government Code.

(b) Reimbursement for expenses of members of the board is subject to Sections 53232.2 and 53232.3 of the Government Code.

(c) The board, by ordinance adopted pursuant to Chapter 2 (commencing with Section 20200) of Division 10 of the Water Code, may increase the compensation received by members of the board above the amount of one hundred dollars ($100) per day. The increase shall not exceed an amount equal to 5 percent, for each calendar year following the operative date of the last adjustment, of the compensation that is received when the ordinance is adopted.

(d) A board member shall not be compensated for more than a total of 10 days in any calendar month.

505. (a) The board may adopt ordinances for the purpose of regulating, conserving, managing, and controlling the use and extraction of groundwater within the boundary of the agency.

(b) An ordinance adopted by the board shall become effective 30 days from the date of its passage.

(c) All ordinances shall be adopted at noticed, public hearings by a majority vote of the board. No ordinance shall be adopted by the board except at a public hearing. Notice of the hearing shall be published in a newspaper of general circulation pursuant to Section 6066 of the Government Code.

(d) The board shall provide notice of the adoption of all ordinances.

506. No provision of this act shall be construed as denying any member agency or the San Joaquin River Exchange Contractors Water Authority any rights or powers that they already have or that they may be granted.

507. The agency may hire contractors and consultants as it considers appropriate.

508. The agency shall enter into a coordination agreement with other local agencies for purposes of coordinating the agency's plan with other agencies or groundwater sustainability plans within the Delta-Mendota Subbasin as required by the Sustainable Groundwater Management Act (Part 2.74 (commencing with Section 10720) of Division 6 of the Water Code).

509. The agency may exclude from any of the requirements of this act, or the operation of any ordinance, any operator who annually extracts less than a minimum amount of groundwater as specified by an ordinance adopted by the board.

Article 6. Studies and Investigations

601. The agency may collect data and conduct technical and other investigations of all kinds in order to carry out the provisions of this act. All hydrological investigations and studies carried out by or on behalf of the agency shall be constructed by or under the supervision of licensed engineers, licensed hydrogeologists, or other persons qualified in groundwater geology or hydrology.

602. The agency may recommend and encourage water recycling and other water development projects, where those projects will enhance and contribute to the responsible management of groundwater resources, as part of its annual plan for implementation of groundwater management objectives.

Article 7. Sustainable Groundwater Management Powers

701. The agency shall develop and implement a groundwater sustainability plan pursuant to Chapter 6 (commencing with Section 10727) of Part 2.74 of Division 6 of the Water Code to achieve sustainable groundwater management within the territory of the agency.

702. The agency shall be the exclusive groundwater sustainability agency pursuant to Chapter 4 (commencing with Section 10723) of Part 2.74 of Division 6 of the Water Code for that portion of the Delta-Mendota Subbasin that lies within the boundaries of the agency.

703. The agency may exercise any of the powers described in Chapter 5 (commencing with Section 10725) of Part 2.74 of Division 6 of the Water Code and the enforcement powers described in Chapter 9 (commencing with Section 10732) of Part 2.74 of Division 6 of the Water Code.

Article 8. Fee Authority

801. Pursuant to Chapter 8 (commencing with Section 10730) of Part 2.74 of Division 6 of the Water Code, the agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other

regulated activity, to fund the costs of a groundwater sustainability program, that include, but are not limited to, the preparation, adoption, and amendment of a groundwater sustainability plan, investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve.

Article 9. Miscellaneous

901. The agency shall have the authority to sue and to be sued, including, but not limited to, as a party to an action pursuant to Chapter 7 (commencing with Section 830) of Title 10 of Part 2 of the Code of Civil Procedure.

902. In the event of any conflict between the San Joaquin River Exchange Contractors Groundwater Sustainability Agency Act and the provisions of the Sustainable Groundwater Management Act (Part 2.74 (commencing with Section 10720) of Division 6 of the Water Code), the provisions of the Sustainable Groundwater Management Act shall prevail.

SEC. 3. No reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution because a local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the program or level of service mandated by this act, within the meaning of Section 17556 of the Government Code.

SEC. 4. This act is an urgency statute necessary for the immediate preservation of the public peace, health, or safety within the meaning of Article IV of the California Constitution and shall go into immediate effect. The facts constituting the necessity are:

In order for the San Joaquin River Exchange Contractors Groundwater Sustainability Agency to establish itself as a groundwater sustainability agency and to begin managing the area within its boundaries without interrupting local control, it is necessary that this act take effect immediately.

O

Appendix B. Delta-Mendota Subbasin Common Chapter

DELTA-
MENDOTA
SGMA

Common Chapter

For the Delta-Mendota Subbasin Groundwater Sustainability Plan

August 2019

PROP 1 WATER BOND 2014

Department of Water Resources, State of California

San Joaquin River Exchange Contractors GSP Group

The County of Fresno 1856

Grassland Water District

Northern & Central Delta-Mendota

Aliso Water District Groundwater Sustainability Agency

FARMERS WATER DISTRICT

Delta-Mendota Groundwater Subbasin

Groundwater Sustainability Plan: Common Chapter

Prepared by:

Woodard & Curran

August 2019

Difficulty Accessing Material

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Los Banos, CA 93635
Telephone (209) 832-6229
Email: andrew.garcia@sldmwa.org

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Appendices

Acronyms

AB 3030	1992 California Assembly Bill 3030
AWMP	Agriculture Water Management Plan
BMP	Best Management Practice
CASGEM	California Statewide Groundwater Elevation Monitoring
CCC	Columbia Canal Company
CCF	Climate Change Factors
CCID	Central California Irrigation District
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DAC	Disadvantaged Community
DMC	Delta-Mendota Canal
DPWD	Del Puerto Water District
DWR	California Department of Water Resources
ET	Evapotranspiration
ET_c	Total Crop Evapotranspiration
ET_{iw}	Crop Evapotranspiration of Irrigation Water
ET_{misc}	Miscellaneous Evapotranspiration including; canal evaporation, consumptive use of phreatophytes, etc.
FCWD	Firebaugh Canal Water District
FNF	Full Natural Flow
GAMA	Groundwater Ambient Monitoring and Assessment
gpm	gallons per minute
GRCD	Grassland Resource Conservation District
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWD	Grassland Water District
HCM	Hydrogeologic Conceptual Model
HMRD	Henry Miller Reclamation District

Acronyms

IRWM	Integrated Regional Water Management
JPA	Joint Powers Authority
KDSA	Kenneth D. Schmidt and Associates
MAF	million acre-feet
MSL	Mean Sea Level
NASA JPL	National Aeronautics and Space Administration Jet Propulsions Laboratory
P&P	Provost and Pritchard Consulting Group
RCD	Resource Conservation District
RWQCB	Regional Water Quality Control Board
SB 372	2017 California Senate Bill 372
SGMA	Sustainable Groundwater Management Act
SGWP	Sustainable Groundwater Planning
SJREC	San Joaquin River Exchange Contractors
SJRECWA	San Joaquin River Exchange Contractors Water Authority
SJRIP	San Joaquin River Improvement Program
SJRRP	San Joaquin River Restoration Program
SLDMWA	San Luis & Delta-Mendota Water Authority
SMC	Sustainable Management Criteria
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	Total Dissolved Solids
TIWD	Turner Island Water District
TNC	The Nature Conservancy
UNAVCO	University NAVSTAR Consortium
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USF&WS	U.S. Fish & Wildlife Service
USGS	United States Geological Survey

Acronyms

UWMP	Urban Water Management Plan
WDL	Water Data Library
WMP	Water Management Plan
WSIP	Water Storage Investment Program
WWD	Westlands Water District

DISCLAIMER

The work products presented in this Common Chapter and associated Technical Memoranda (Appendix B) are a compilation of work completed by the six (6) individual Groundwater Sustainability Plan (GSP) regions under the direction of a Professional Geologist (PG) or Professional Engineer (PE) as indicated by the stamps on the respective GSP Executive Summaries. The signature here represents work completed in compiling the Common Chapter from these individual GSPs, and the signing Professional Engineer assumes no responsibility for any errors or misleading statements presented therein. Compilation of the Common Chapter, exclusive of work conducted for the individual GSPs, has been prepared under the oversight of Leslie Dumas, P.E. and the signature below is specifically for that compilation.

1. INTRODUCTION

1.1 Purpose of Common Chapter

The 23 Groundwater Sustainability Agencies (GSAs) overlying the Delta-Mendota Subbasin (Subbasin) have prepared six Groundwater Sustainability Plans (GSPs) that, together, encompass the entire Subbasin area (Error! Reference source not found.). These GSPs have been prepared in a coordinated manner under the oversight of the Delta-Mendota Subbasin Coordination Committee (Coordination Committee) and in accordance with the Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement) for the Subbasin. This Common Chapter has been prepared as means of integrating key parts of the six GSPs to meet subbasin-level requirements per the Sustainable Groundwater Management Act (SGMA) and the Emergency GSP regulations (DWR, 2016).

This Common Chapter, along with the six Subbasin GSPs, Coordination Agreement (**Appendix A**) and Common Technical Memoranda (**Appendix B**), meets regulatory requirements established by the California Department of Water Resources (DWR) as shown in the completed *Preparation Checklist for GSP Submittal* (**Appendix C**). The Common Technical Memoranda summarize the common data sets, assumptions and methodologies used during preparation of the six Subbasin GSPs. The reader is referred to the individual GSP (and their associated Executive Summaries) for information, data, and GSP requirements specific to each GSP Plan Area.

1.2 Delta-Mendota Subbasin

The Delta-Mendota Subbasin (DWR Basin 5-022.07) is located in the San Joaquin Valley Groundwater Basin and adjoins nine (9) subbasins of the San Joaquin Valley Groundwater Basin. The Delta-Mendota Subbasin boundaries generally corresponds to DWR's California's Groundwater Bulletin 118 – Update 2003 (Bulletin 118) groundwater basin boundaries. Changes made to the Subbasin boundaries as part of the SGMA planning process include the following:

- A jurisdictional internal boundary modification made in 2016 to extend the boundary of the Delta-Mendota Subbasin eastward to include all of Aliso Water District.
- A jurisdictional internal boundary modification made in 2016 to bring areas that straddle the Delta-Mendota Subbasin and adjacent subbasins fully within the Delta-Mendota Subbasin. This modification adjusted areas from the southern boundary of the Delta-Mendota Subbasin and the Westside Subbasin in coordination with Westlands Water District, and moved the eastern boundary of the Delta-Mendota Subbasin from the Madera Subbasin into the Delta-Mendota Subbasin in coordination with Aliso Water District. The modification also moved areas from the Tracy Subbasin into the Delta-Mendota Subbasin so that Del Puerto Water District and West Stanislaus Irrigation District were fully within the Delta-Mendota Subbasin, and cleaned up boundaries between the Delta-Mendota Subbasin and the Kings Subbasin to conform with the boundaries of Tranquillity Irrigation District and the Traction Ranch property (bounded on the east by Mid-Valley Water District).
- A jurisdictional internal boundary modification made in 2018 to modify the boundary between the Delta-Mendota and the Chowchilla Subbasins to follow the western boundary of Triangle T

Water District and the southern boundary of Clayton Water District. This modification moved approximately 700 acres of land from the Chowchilla Subbasin into the Delta-Mendota Subbasin.

The western San Joaquin Valley is a highly agricultural region with an economy dependent on that industry. There are no large cities or industries in the Delta-Mendota Subbasin to provide an alternative economic base; hence the availability of Central Valley Project (CVP) imported supplies and surface water supplies (primarily from the San Joaquin and Kings River) are essential elements to the economic health of the region. Other uses of CVP and surface water in the Subbasin are for municipal and industrial (M&I) purposes and wildlife refuge water supply.

Groundwater is a key component of overall water supplies in the Delta-Mendota Subbasin. Agricultural and wildlife refuge needs may be supplemented by groundwater for areas with access to CVP water. Other landowners within the Subbasin may rely wholly on groundwater for irrigation and/or potable purposes. Municipal and industrial (M&I) water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities and predominantly uses groundwater to meet those demands. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2015 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 21,498) and Los Banos (population 37,457) (U.S. Census Bureau, 2015).

As previously noted, most communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Paterson, Grayson, Tranquillity, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, Westley, Volta and Vernalis.

1.3 Disadvantaged Communities within the Delta-Mendota Subbasin

A disadvantaged community (DAC) is defined as a community with a Median Household Income (MHI) less than 80% of the California statewide MHI. The California Department of Water Resources (DWR) compiled U.S. Census Bureau’s American Community Survey (ACS) data from 2012 to 2016; these data were used in GIS to identify DACs within the Delta-Mendota Subbasin. California’s average statewide MHI from 2012 to 2016 is $63,783; thus, a community with an MHI less than or equal to $51,026 is considered a DAC. Based on these criteria, 93% of the geographic area of the Subbasin is considered disadvantaged. Furthermore, a community with an MHI of less than 60% of the California statewide MHI, meaning an MHI of less than or equal to $38,270, is considered a severely disadvantaged community (SDAC). According the U.S. Census ACS 2012-2016 data, there are a number of SDACs throughout the Subbasin. See **Figure CC-2** for a map of the DACs and SDACs throughout the Delta-Mendota Subbasin.

As noted above, a significant portion of the Subbasin contains DACs. Of the total population of 117,120 within the Subbasin, 80% of the population lives within a DAC, with 93% of the Subbasin’s total geographic area consisting of DACs. **Table CC-1** includes the proportion of DACs in the Subbasin based on population and geographic area.

Table CC-1: DACs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
DAC (including SDAC)	1,109	93%	93,786	80%
Delta-Mendota Subbasin	1,194		117,120	

Table CC-2 includes Census Designated Places that are DACs in the Delta-Mendota Subbasin, with their associated MHIs and percentage of the California MHI from the ACS 5-Year 2012-2016 average. Several DACs in the Subbasin have considerably lower MHI than 80% of the California Statewide MHI and are further designated as Severely Disadvantaged Communities (SDACs). In **Table CC-2**, SDACs are indicated in bold text. Note that according to the U.S. Department of the Interior Indian Affairs, as of January 2017, there are no listed federally recognized tribes within the Region (Mosley, 2017).

Table CC-2: DAC and SDAC Census Designated Places in Delta-Mendota Subbasin

Census Designated Place (CDP)	Median Household Income (MHI)	% of CA MHI
City of Dos Palos	**$36,509**	**57%**
City of Firebaugh	**$36,181**	**57%**
City of Gustine	**$37,770**	**59%**
City of Los Banos	$45,751	72%
City of Mendota	**$26,094**	**41%**
City of Newman	$52,783	83%
Crows Landing	**$26,786**	**42%**
Dos Palos Y (CDP)	**$16,656**	**26%**
Grayson	**$29,787**	**47%**
Madera County	$45,490	74%
Merced County	$43,066	70%
Fresno County	$45,963	72%
Santa Nella	**$27,778**	**44%**
South Dos Palos	$41,992	66%
Tranquillity	**$30,441**	**48%**
Volta	$48,250	76%
Westley	**$23,375**	**37%**

Data Sources:
1. U.S. Census ACS data from 2012 to 2016 provided by DWR Mapping Tool.
2. MHI data are from the 2016 Census, and percent of CA MHI is calculated based on the 2012-2016 Statewide MHI. Bold rows indicate severely disadvantaged communities (less than 60% of CA Statewide MHI).

1.4 Economically Disadvantaged Areas within the Delta-Mendota Subbasin

An economically distressed area (EDA) is defined by the State of California as a "municipality with a population of 20,000 persons or less, a rural county, or a reasonably isolated and divisible segment of a larger municipality where the segment of the population is 10,000 persons or less, with an annual median household income that is less than 85% of the statewide median household income, and with one or more of the following conditions as determined by the (sic) Department of Water Resources:

1. Financial hardship
2. Unemployment rate at least two percent higher than the statewide average
3. Low population density (CA Assembly, 2014)."

U.S. Census GIS data provided by DWR were used to identify EDAs in the Delta-Mendota Subbasin. **Figure CC-3** shows the location of EDAs within the Delta-Mendota Subbasin

A significant portion of the Subbasin contains EDAs. Of the total population of 117,120 within the Subbasin, 87% live in areas that meet EDA Criterion 2, 20% live in areas that meet EDA Criterion 3, and 87% live in areas that meet Criteria 2 or 3. In all, 93% of the geographic area within the Subbasin consists of areas considered to meet either EDA Criteria 2 or 3. **Table CC-3** includes the proportion of EDAs in Subbasin based on population and geographic area.

Table CC-3: EDAs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
EDA Criterion 2	1,112	93%	102,407	87%
EDA Criterion 3	1,004	84%	23,688	20%
EDA Criteria 2 or 3	1,112	93%	102,407	87%
Delta-Mendota Subbasin	1,194		117,120	

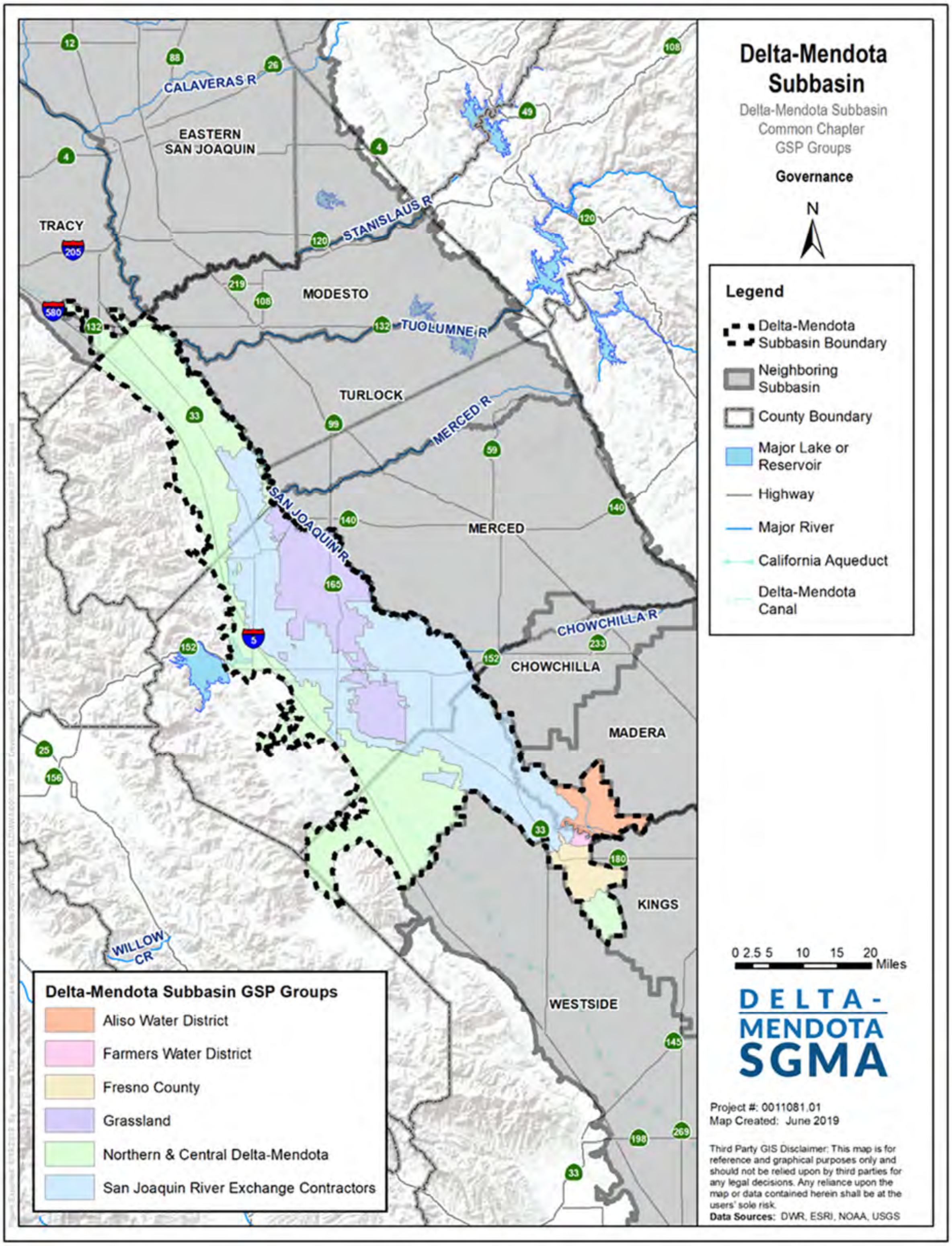


Figure CC-1: Delta-Mendota Subbasin and GSP Regions

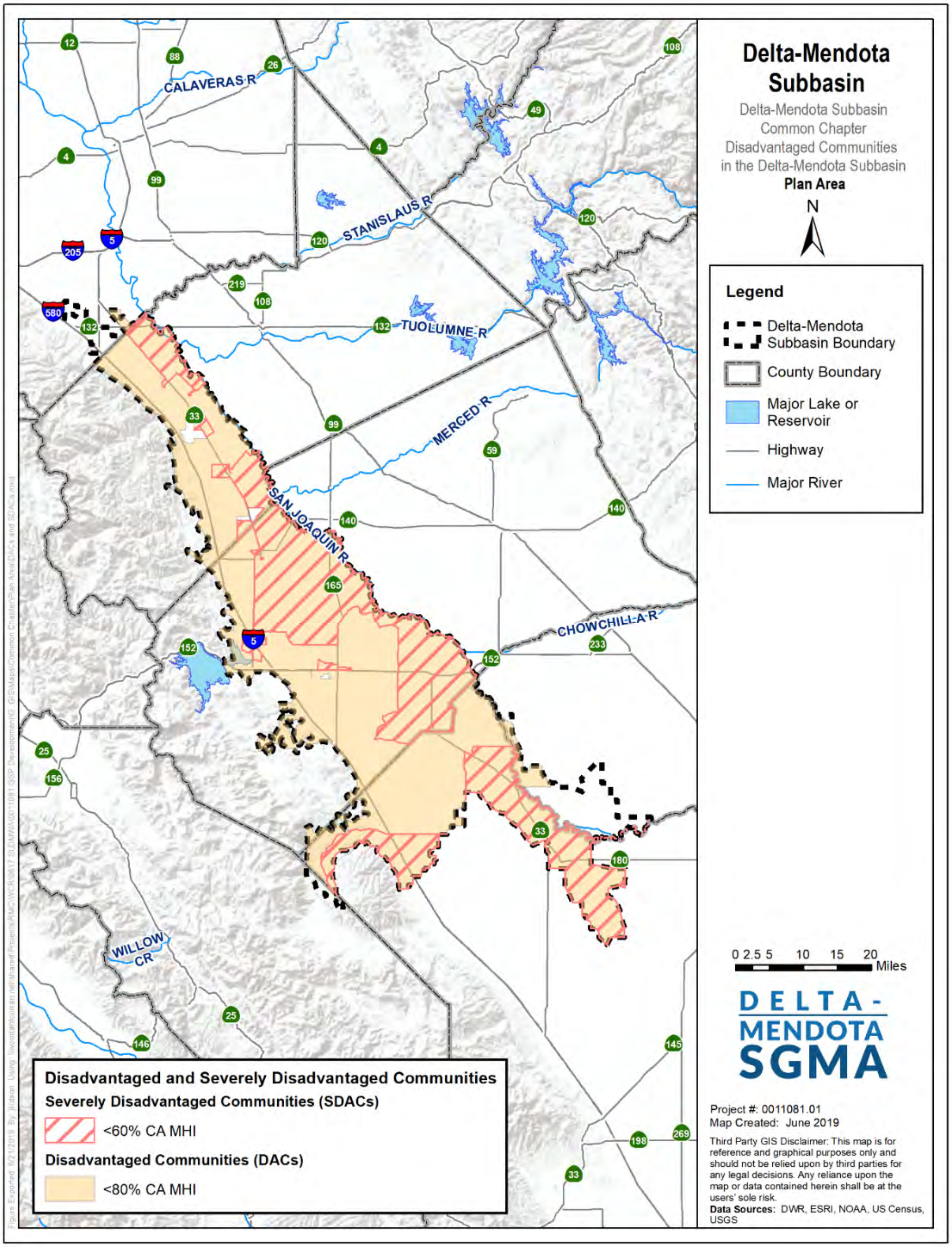


Figure CC-2: Disadvantaged and Severely Disadvantaged Communities in the Delta-Mendota Subbasin

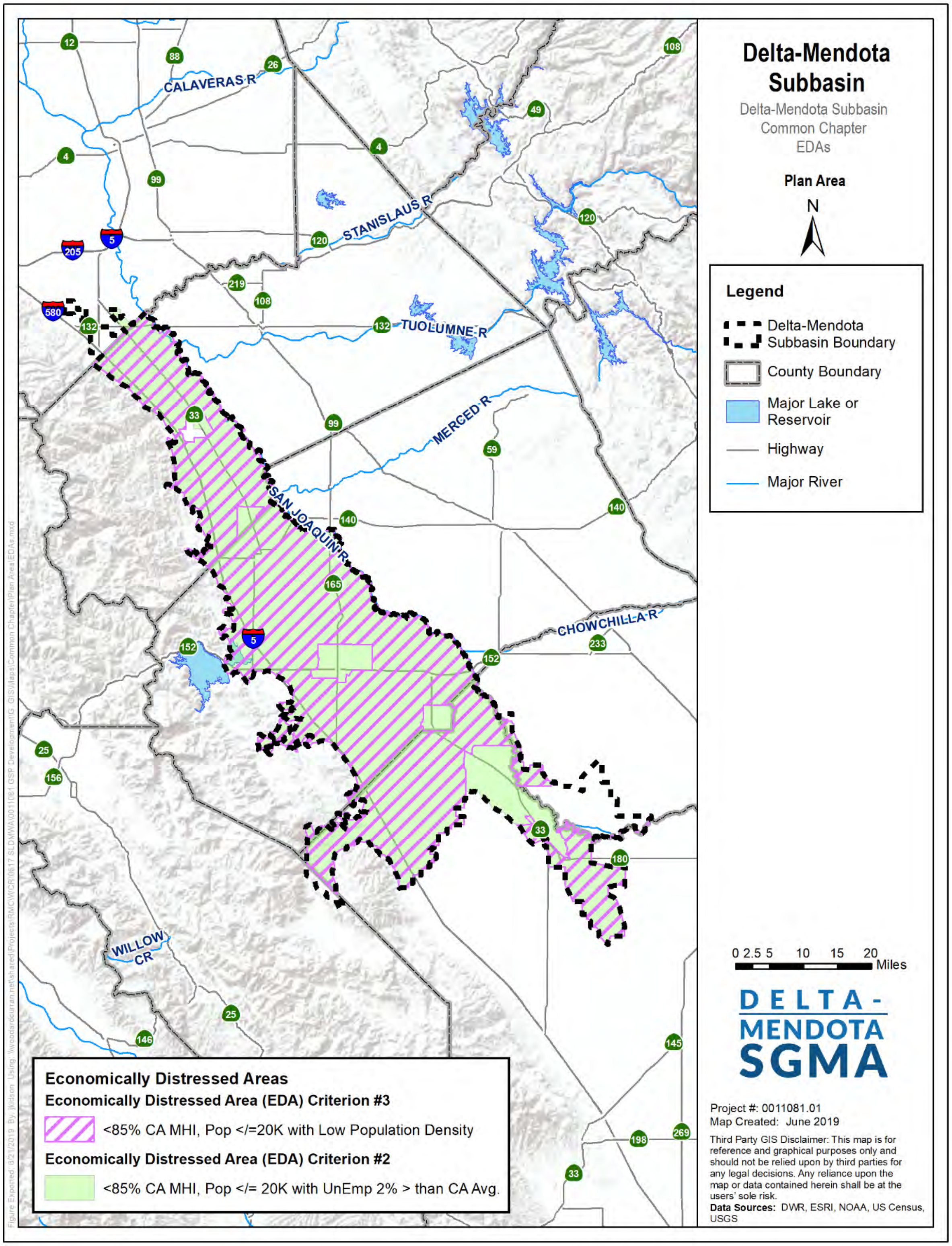


Figure CC-3: Economically Distressed Areas in the Delta-Mendota Subbasin

2. DELTA-MENDOTA SUBBASIN GOVERNANCE

This section includes information pursuant to Article 5. Plan Contents, Subarticle 1. Administrative Information, § 354.6 (Agency Information) as well as Subarticle 8. Interagency Agreements (§ 357.2 Interbasin Agreements and § 357.4 Coordination Agreements), as required by the Groundwater Sustainability Plan (GSP) Regulations. Agency Contact information for the Delta-Mendota Subbasin and the plan manager is included in this section. The organization and management structure, as well as the legal authority of each Groundwater Sustainability Agency (GSA) in the Delta-Mendota Subbasin, is detailed and accompanied by GSA boundary maps and a description of intra-basin and inter-basin coordination agreements in place for the development and implementation of the GSPs overlying the Delta-Mendota Subbasin.

Agency Contact Information

This Common Chapter to the six GSPs for the Delta-Mendota Subbasin has been prepared in a cooperative manner by the following GSAs in the Delta-Mendota Subbasin:

Northern & Central Delta-Mendota Region GSP

- Patterson Irrigation District GSA
- West Stanislaus Irrigation District GSA
- DM-II GSA
- City of Patterson GSA
- Northwestern Delta-Mendota GSA
- Central Delta-Mendota GSA
- Widren Water District GSA
- Oro Loma Water District GSA

San Joaquin River Exchange Contractors (SJREC) GSP

- San Joaquin River Exchange Contractors Water Authority GSA
- Turner Island Water District-2 GSA
- City of Mendota GSA
- City of Firebaugh GSA
- City of Los Banos GSA
- City of Dos Palos GSA
- City of Gustine GSA
- City of Newman GSA
- Madera County - 3 GSA
- Portion of Merced County – Delta-Mendota GSA
- Portion of Fresno County Management Area B GSA

Grassland GSP

- Grassland GSA
- Portion of Merced County – Delta-Mendota GSA

Aliso Water District GSP

- Aliso Water District GSA

Farmers Water District GSP

- Farmers Water District GSA

Fresno County GSP

- Fresno County Management Area A GSA
- Portion of Fresno County Management Area B GSA

The plan areas covered by each of the six Subbasin GSPs is show in **Figure CC-1**. **Figure CC-4** through **Figure CC-6** show the location of the GSAs comprising the six GSP regions. These GSAs are coordinating development and implementation of the six GSPs under the Coordination Agreement, as described below in Section 2.1.

The initial Plan Manager for the coordinated Delta-Mendota Subbasin GSPs is Andrew Garcia, Senior Civil Engineer for San Luis & Delta-Mendota Water Authority (SLDMWA). Mr. Garcia can be contacted as follows:

Mr. Andrew Garcia, Plan Manager
Delta-Mendota Subbasin
842 6th Street
Los Banos, CA 93635
Phone: (209)-832-6200 / Fax (209)-833-1034
andrew.garcia@sldmwa.org

Contact information for each GSP plan administrator can be found in the respective GSPs. The DWR Point of Contact is shown below.

Department of Water Resources (DWR) Point of Contact

The point of contact for the Delta-Mendota Subbasin is:

Christopher Olvera
Department of Water Resources
Christopher.Olvera@water.ca.gov
(559) 230-3373

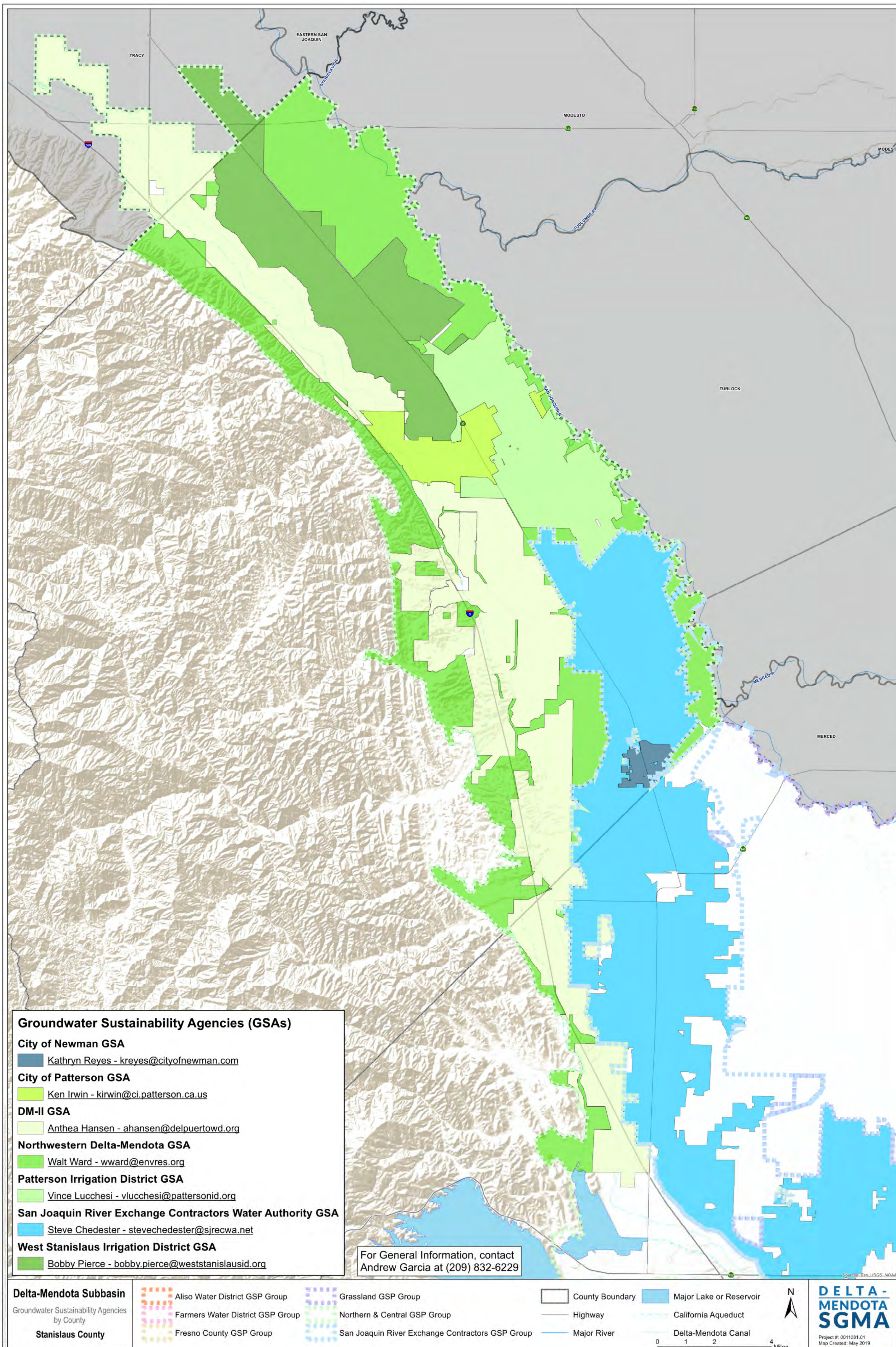


Figure CC-4: GSAs in the Delta-Mendota Subbasin – Stanislaus County

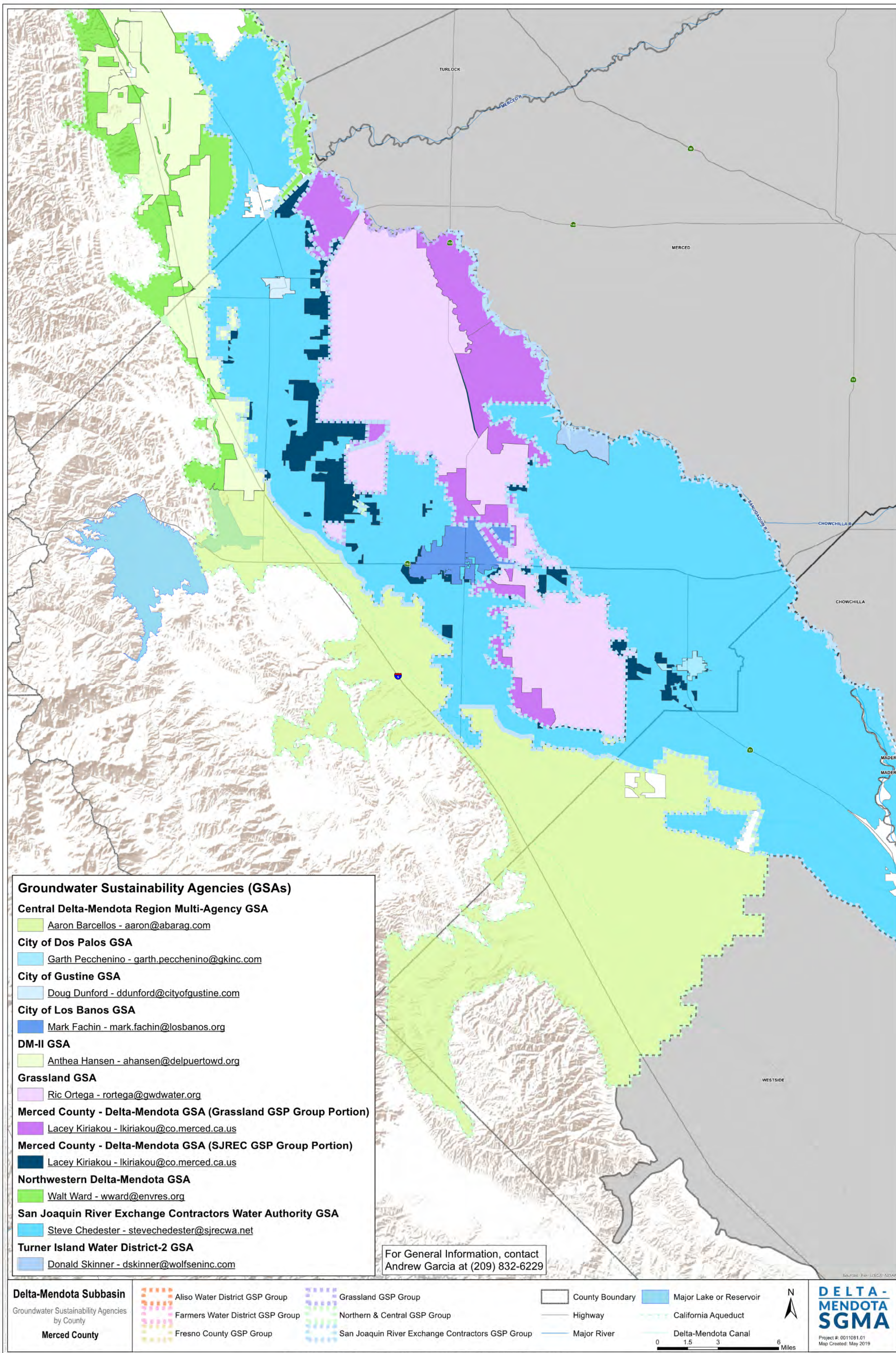


Figure CC-5: GSAs in the Delta-Mendota Subbasin – Merced County

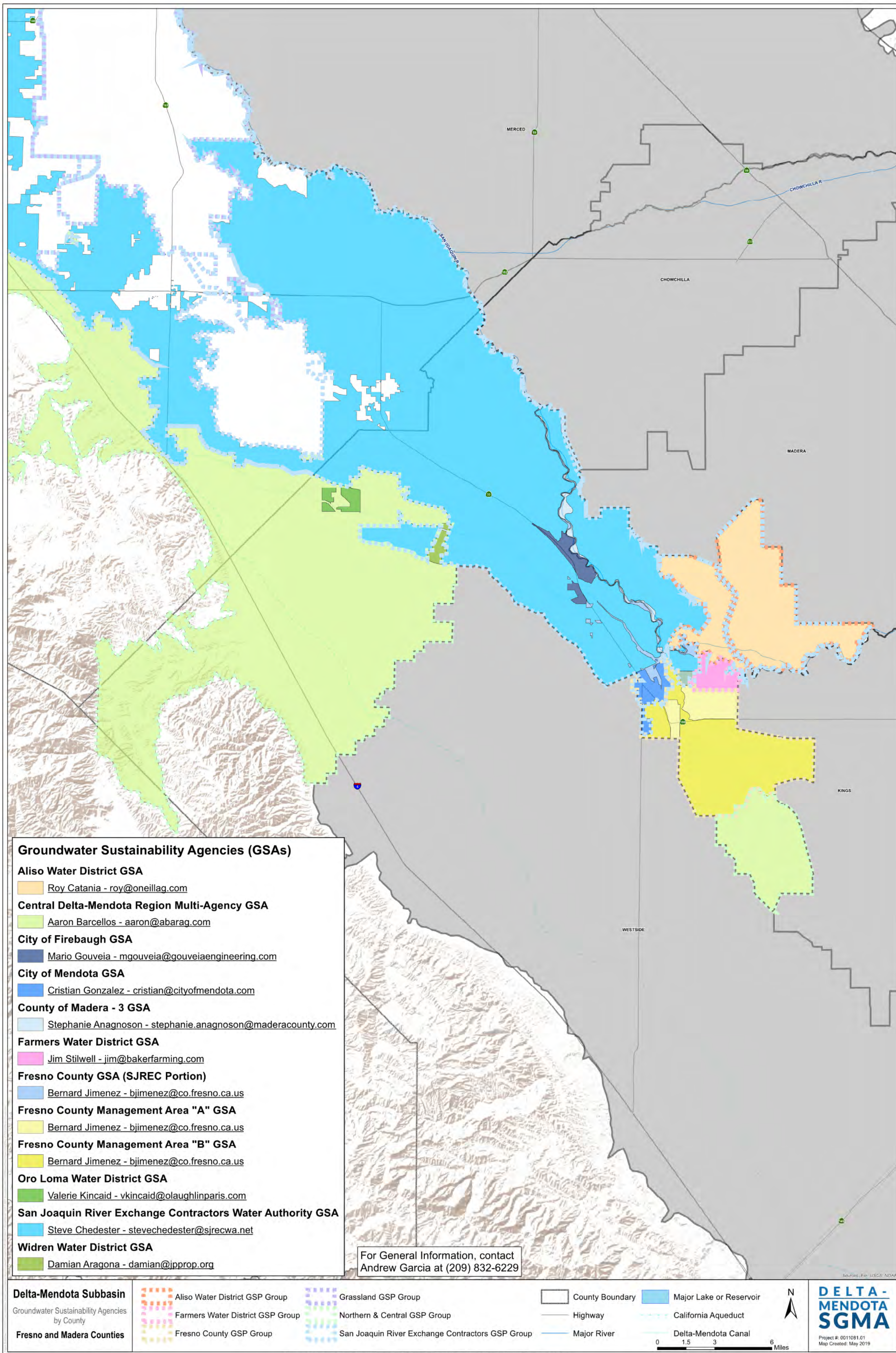


Figure CC-6: GSAs in the Delta-Mendota Subbasin – Fresno and Madera Counties

2.1 GSA and GSP Coordination and Governance

This section includes a description of intra-basin coordination agreements, which are required where there is more than one GSP prepared for a groundwater basin, and inter-basin coordination agreements, which are optional agreements between neighboring groundwater subbasins, pursuant to Article 8. Interagency Agreements, § 357.4. Coordination Agreements and § 357.2 Interbasin Agreements.

2.1.1 Delta-Mendota Subbasin SGMA Governance Structure

The GSAs within the Delta-Mendota Subbasin adopted and executed a Coordination Agreement on December 12, 2018 to comply with the SGMA requirement that multiple GSAs within a given subbasin must coordinate when developing and implementing their GSPs (see Intra-Agency Coordination subsection above for more information). Additionally, a Cost Sharing Agreement was signed and executed by the same parties on December 12, 2018. **Figure CC-5** shows the SGMA governance structure within the Delta-Mendota Subbasin. In addition to the two members appointed to represent each of the Northern & Central Delta-Mendota GSP Region and the San Joaquin River Exchange Contractors (SJREC) GSP Region on the Delta-Mendota Subbasin Coordination Committee as voting members, the Grassland GSP Region, Farmers Water District GSP Region, Fresno County Management Areas A & B GSP Region, and Aliso Water District GSP Region all have appointed one voting member each for a total of eight voting members.

Three working groups were formed under the auspices of the Delta-Mendota Subbasin Coordination Committee: the Technical Working Group, the Communications Working Group and the DMS Working Group. Representatives of each GSP region participate on each working group.

Table CC-4: Delta-Mendota Subbasin Coordination Committee Members

GSP		GSA	Agency	Coordination Committee Members	
				Primary	Alternate
Northern & Central Delta-Mendota Region GSP	Northern Delta Mendota Region Management Committee	Patterson Irrigation District GSA	Patterson Irrigation District	Vince Lucchesi	Walt Ward
			Twin Oaks Irrigation District		
		West Stanislaus Irrigation District GSA	West Stanislaus Irrigation District		
		DM-II GSA	Del Puerto Water District		
			Oak Flat Water District		
		City of Patterson GSA	City of Patterson		
		Northwestern Delta-Mendota GSA	Merced County		
			Fresno County		
	Central Delta-Mendota Region Management Committee	Central Delta-Mendota GSA	San Luis Water District	Ben Fenters	Lacey Kiriakou
			Panoche Water District		
			Tranquillity Irrigation District		
			Fresno Slough Water District		
			Eagle Field Water District		
			Pacheco Water District		
			Santa Nella County Water District		
			Mercy Springs Water District		
			Merced County		
			Fresno County		
		Widren Water District GSA	Widren Water District		
		Oro Loma Water District GSA	Oro Loma Water District		

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
San Joaquin River Exchange Contractors GSP	San Joaquin River Exchange Contractors Water Authority GSA	Central California Irrigation District	Jarrett Martin, Alejandro Paolini	Chris White, John Wiersma
		Columbia Canal Company		
		Firebaugh Canal Water District		
		San Luis Canal Company		
	Turner Island Water District-2 GSA	Turner Island Water District		
	City of Mendota GSA	City of Mendota		
	City of Firebaugh GSA	City of Firebaugh		
	City of Los Banos GSA	City of Los Banos		
	City of Dos Palos GSA	City of Dos Palos		
	City of Gustine GSA	City of Gustine		
	City of Newman GSA	City of Newman		
	County of Madera - 3 GSA	County of Madera		
	Portion of Merced County – Delta-Mendota GSA	County of Merced		
	Portion of Fresno County Management Area B GSA	County of Fresno		
Grassland GSP	Grassland GSA	Grassland Water District	Ric Ortega	Ken Swanson
		Grassland Resource Conservation District		
		County of Merced		
Farmers Water District GSP	Farmers Water District GSA	Farmers Water District	Jim Stilwell	Don Peracchi
Fresno County GSP	Fresno County - Management Area A	County of Fresno	Buddy Mendes	Glenn Allen or Augustine Ramirez
	Fresno County - Management Area B	County of Fresno		

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
Aliso Water District GSP	Aliso Water District GSA	Aliso Water District	Joe Hopkins	Board Secretary (Ross Franson)

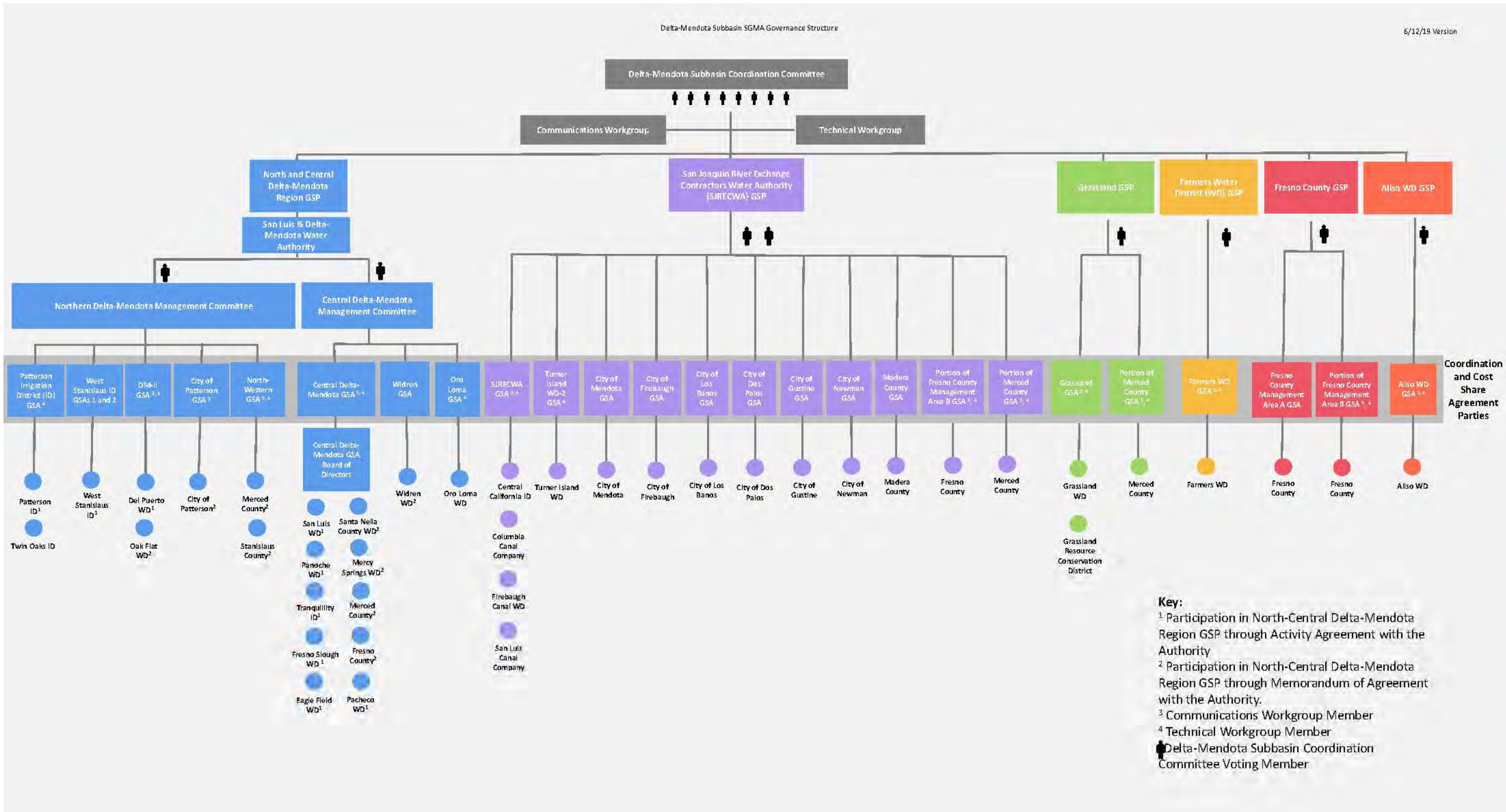


Figure CC-7: Governance Structure of the Delta-Mendota Subbasin

2.1.2 Intra-Basin Coordination

The Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement), effective as of December 12, 2018, has been signed by all participating agencies in the Delta-Mendota Subbasin; a copy of this agreement is included in **Appendix A**. The purpose of the Agreement, including technical reports to be developed after the initial execution of this Agreement, is to comply with SGMA requirements and to ensure that the multiple GSPs within the Subbasin are developed and implemented utilizing the same datasets, methodologies and assumptions, that the elements of the GSPs are appropriately coordinated to support sustainable subbasin management of groundwater resources, and to ultimately set forth the information necessary to show how the multiple GSPs in the Subbasin will achieve the sustainability goal as determined for the Subbasin in compliance with SGMA and its associated regulations.

A key goal of basin-wide coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies during their plan development and that elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting, as required by SGMA and associated regulations. The Coordination Agreement defines how the coordinated efforts will be achieved and documented, and also sets out the process for identifying the Plan Manager. The Coordination Agreement is part of each individual GSP within the Delta-Mendota Subbasin.

The Coordination Agreement for the Delta-Mendota Subbasin covers the following topics:

1. Purpose of the Agreement, including:
    a. Compliance with SGMA and
    b. Description of Criteria and Function;
2. General Guidelines, including:
    a. Responsibilities of the Parties and
    b. Adjudicated or Alternative Plans in the Subbasin;
3. Role of San Luis & Delta-Mendota Water Authority (SLDMWA), including:
    a. Agreement to Serve,
    b. Reimbursement of SLDMWA, and
    c. Termination of SLDMWA's Services;
4. Responsibilities for Key Functions, including:
    a. Coordination Committee,
    b. Coordination Committee Officers,
    c. Coordination Committee Authorized Action and Limitations,
    d. Subcommittees and Workgroups,
    e. Coordination Committee Meetings, and
    f. Voting by Coordination Committee;
5. Approval by Individual Parties;
6. Exchange of Data and Information, including:
    a. Exchange of Information and
    b. Procedure for Exchange of Information;
7. Methodologies and Assumptions, including:
    a. SGMA Coordination Agreements,

   b. Pre-GSP Coordination, and
   c. Technical Memoranda Required;
8. Monitoring Network
9. Coordinated Water Budget
10. Coordinated Data Management System
11. Adoption and Use of the Coordination Agreement, including:
   a. Coordination of GSPs and
   b. GSP and Coordination Agreement Submission;
12. Modification and Termination of the Coordination Agreement, including:
   a. Modification or Amendment of Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages),
   b. Modification or Amendment of Coordination Agreement, and
   c. Amendment for Compliance with Law;
13. Withdrawal, Term, and Termination;
14. Procedures for Resolving Conflicts;
15. General Provisions, including:
   a. Authority of Signers,
   b. Governing Law,
   c. Severability,
   d. Counterparts, and
   e. Good Faith; and
16. Signatories of all Parties

Coordination During GSP Implementation

The Coordination Agreement ensures that the multiple GSAs are working cooperatively and collaboratively to ensure GSPs within the Subbasin are developed and implemented utilizing the same methodologies and assumptions and to ultimately establish the processes necessary to show how the multiple GSPs in the Subbasin will be sustainably managed to achieve the Delta-Mendota Subbasin's sustainability goal. The Coordination Committee intends to continue to meet and confer following the submittal of the Subbasin's GSPs and will develop guidelines for GSP implementation between the GSP Groups and update the Coordination Agreement as the Parties to the Agreement deem necessary.

The Coordination Committee will continue meeting regularly following submittal of the Subbasin GSPs in order to develop the guidelines for coordinated implementation of GSPs. The intent of the guidelines will be to outline processes that will ensure the GSAs are progressing toward the Subbasin sustainability goal, while meeting the Annual Reporting requirements or any other requirements agreed upon for purposes of coordination.

Agency Responsibilities

In meeting the terms of the Coordination Agreement, all Parties (meaning the Delta-Mendota Subbasin GSAs) agree to work collaboratively to meet the objectives of SGMA and the Coordination Agreement. Each Party to the Agreement is a GSA and acknowledges that it is bound by the terms of the Coordination Agreement as an individual party.

The Parties have established a Coordination Committee to provide a forum to accomplish the coordination obligations of SGMA. The Coordination Committee operates in full compliance with the Brown Act and is composed of a Chairperson and Vice Chairperson, Secretary, Plan Manager, and a GSP Group Representative and Alternate Representative for each of the six GSP groups. The Chairperson and Vice Chairperson are rotated annually among GSP Groups in alphabetical order. The Secretary assumes primary responsibility for Brown Act compliance. The GSP Group Representatives, who are identified in **Table CC-4**, are selected by each respective GSP Group at the discretion of the respective GSP Group, and such appointments are effective upon providing written notice to the Secretary and to each Group Contact. The Coordination Committee recognizes each GSP Group Representative and GSP Group Alternate Representative until the Group Contact provides written notice of removal and replacement to the Secretary and to every other Group Contact. Each GSP Group is required to promptly fill any vacancy created by the removal of its Representative or Alternate Representative so that each GSP Group has the number of validly designated representatives.

Each GSP Group Representative is entitled to one vote at the Coordination Committee, where the Alternate Representative is authorized to vote in the absence of the GSP Group Representative. The unanimous vote of the GSP Representatives from all GSP Groups is required on most items upon which the Coordination Committee is authorized to act, with the exception of certain ministerial and administrative items. Voting procedures to address a lack of unanimity take place upon a majority vote of a quorum of the Coordination Committee and include: straw polls, provisional voting, and delay of voting (see Section 5.6.3 – *Voting Procedures to Address Lack of Unanimity* of the Coordination Agreement). Where the law or the Coordination Agreement require separate written approval by each of the Parties, such approval is evidenced in writing by providing the resolution, Motion, or Minutes of their respective Board of Directors to the Secretary of the Coordination Committee. Minutes of the Coordinate Committee are kept and prepared by the Secretary's appointee and maintained by the Secretary as Coordination Agreement records and are available to the Parties and the public upon request. Meeting agenda and minutes are posted on the Delta-Mendota website (www.deltamendota.org).

The Coordination Committee may appoint subcommittees, working groups, and otherwise direct staff made available by the Parties. Subcommittees or working groups may include qualified individuals possessing the knowledge and expertise to advance the goals of the Coordination Agreement on the topics being addressed by the subcommittee or working group, whether or not such individuals are GSP Group Representatives or Alternate Representatives. Tasks assigned to subcommittees, working groups, or staff made available by the Parties may include developing technical data, supporting information, and/or recommendations on specialized matters to the Coordination Committee. One GSP Group Representative or Alternate Representative is required to vote on behalf of the GSP Group at the subcommittee level. If no GSP Group Representative or Alternate Representative is present, one individual working on a subcommittee on behalf of the Parties in a GSP Group votes on behalf of the GSP Group. Subcommittees report voting results and provide information to the Coordination Committee but are not entitled to make determinations or decisions that are binding on the Parties.

The Coordination Committee is authorized to act upon the following items:

1. The Coordination Committee reviews, and consistent with the requirements of SGMA, approves the Technical Memoranda that compose the Common Chapter (see *Coordinated Data and Methodology*);
2. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda as needed; assuring submittal of annual reports; providing five-year assessments and recommending any needed revisions to the Coordination Agreement; and providing review and assistance with coordinated projects and programs, once the GSPs have been submitted to and approved by DWR;
3. The Coordination Committee reviews and approves work plans, and in accordance with the budgetary requirements of the respective Parties, approves annual budget estimates of Coordinated Plan Expenses presented by the Secretary and any updates to such estimates provided that such estimates or updates with supporting documentation are circulated to all Parties for comment at least thirty (30) days in advance of the meeting at which the Coordination Committee will consider approval of the annual estimate;
4. The Coordination Committee is authorized to approve changes to Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages) to the Agreement and to recommend amendments to terms of the Agreement;
5. The Coordination Committee may assign work to subcommittees and workgroups as needed, provide guidance and feedback and ensure that subcommittees and workgroups prepare work products in a timely manner;
6. The Coordination Committee directs the Plan Manager in the performance of its duties under SGMA; and
7. The Coordination Committee provides direction to its Officers concerning other administrative and ministerial issues necessary for the fulfillment of the above-enumerated tasks.

Additional information regarding the roles, responsibilities, and duties of the Coordination Committee can be found in Section 5 – *Responsibilities for Key Functions* of the Coordination Agreement.

Exchange of Information

Timely exchange of information is a critical aspect of GSP coordination. All parties to the Coordination Agreement have agreed to exchange public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. To the extent it is necessary to make a written request for information to another Party, each Party designates a representative to respond to information requests and provides the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine, or other electronic means to the appropriate representative as named in the Coordination Agreement. The designated representative is required to respond in a reasonably timely manner. Nothing in the Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Coordination Committee.

The Parties agree that each GSP Group shall provide the data required to develop the Subbasin-wide coordinated water budget but, unless required by law, will not be required to provide individual well or parcel-level information in order to preserve confidentiality of individuals to the extent authorized by law, including but not limited to Water Code Section 10730.8, subdivision (b). To the extent that a court order, subpoena, or the California Public Records Act is applicable to a party, the Party in responding to a request made pursuant to that Act for release of information exchanged from another Party shall notify each other Party in writing of its proposed release of information in order to provide the other Parties with the opportunity to seek a court order preventing such release of information.

Dispute Resolution

Procedures for conflict resolution have been established within the Coordination Agreement. In the event that a dispute arises among Parties as it relates to the Coordination Agreement, the disputing Party or Parties are to provide written notice of the basis of the dispute to the other Parties within thirty (30) calendar days of the discovery of the events giving rise to the dispute. Within thirty (30) days after such written notice, all interested Parties are to meet and confer in good faith to informally resolve the dispute. All disputes that are not resolved informally shall be settled by arbitration. In such an event, within ten (10) days following the failed informal proceedings, each interested Party is to nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties are to rank their top three among all nominated arbitrators, awarding three points to the top choice, two points to the second choice, and one point to the third choice and zero points to all others. Each interested Party will then forward its tally to the Secretary, who tabulates the points and notifies the interested Parties of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The Secretary may also develop procedures for approval by the Parties for selection of an arbitrator in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines to act. The arbitration is to be administered in accordance with the procedures set forth in the California Code of Civil Procedure, Section 1280, *et seq.*, and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring legal action relating to the controversy.

Coordinated Data and Methodology

Pursuant to SGMA, the Coordination Agreement ensures that the individual GSPs utilize the same data and methodologies for developing assumptions used to determine: 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield. The Parties have agreed to develop agreed-upon methodologies and assumptions for the aforementioned items prior to or concurrent with the individual development of GSPs. This development is facilitated through the Coordination Committee's delegation to a subcommittee or working group of the technical staff provided by some or all of the Parties. The basis upon which the methodologies and assumptions have been developed includes existing data/information, best management practices, and/or best modeled or projected data available and may include consultation with DWR as appropriate.

The data and methodologies for assumptions described in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans are set forth in Technical Memoranda prepared by the Coordination Committee for each of the following elements: Data and Assumptions; Hydrogeologic Conceptual Model; Coordinated Water Budgets; Sustainable Management Criteria; Coordinated Monitoring Network; Coordinated Data Management System, and Adoption and Use of the Coordination Agreement. The Technical Memoranda have been subject to the unanimous approval of the Coordination Committee and once approved, have been attached to and incorporated by reference into the Coordination Agreement without formal amendment of the Coordination Agreement being required. The Parties have agreed that they will not submit this Coordination Agreement to DWR until the Technical Memoranda described herein have been added to the Coordination Agreement. The Technical Memoranda created pursuant to the Coordination Agreement are to be utilized by the Parties during the development and implementation of their individual GSPs in order to assure coordination of the GSPs is in compliance with SGMA. The Technical Memoranda have been included as an appendix to this GSP as a part of the Common Chapter.

Plan Implementation and Submittal

Under the Coordination Agreement, the Parties have agreed to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. Subject to the subsequent attachment of the Technical Memoranda as appendices to the Common Chapter, the Parties intend that the described Coordination Agreement fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy the requirements of SGMA for the entire Subbasin. The Coordination Agreement does not otherwise affect each Party's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, this Coordination Agreement is the mechanism through which the Parties will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA.

Each Party is responsible for ensuring that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline. The Parties to this Coordination Agreement intend that their individual GSPs be coordinated together in order to satisfy the requirements of SGMA and to be in substantial compliance with the California Code of Regulations. The collective GSPs will satisfy the requirements of Water Code Sections 10727.2 and 10727.4 by providing a description of the physical setting and characteristics of the separate aquifer systems within the Subbasin, the measurable objectives for each such GSP, interim milestones, and monitoring protocols that together provide a detailed description of how the Subbasin as a whole will be sustainably managed.

The Parties agree to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. The Coordination Committee is responsible for assuring submittal of annual reports, five-year updates, and for providing assessments recommending any needed revisions to the Coordination Agreement.

Coordinated Data Management System

The Delta-Mendota Subbasin GSAs have developed and will maintain a coordinated Data Management System that is capable of storing and reporting information relevant to the reporting requirements and/or implementation of the GSPs and monitoring network of the Subbasin.

The Parties may also develop and maintain separate Data Management Systems. Each separate Data Management System developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

Adjudicated Areas and Alternative Plans

There are no adjudicated areas within the Delta-Mendota Subbasin, and no Alternative Plans have been submitted by the local agencies within the Subbasin.

Legal Bindings of the Delta-Mendota Subbasin Coordination Agreement

The Coordination Agreement, as contained herein, is reflected in the same manner and form as in the six Subbasin GSPs. All parties understand that the Delta-Mendota Subbasin Coordination Agreement is part of the GSPs for participating Subbasin GSAs and will be a primary mechanism by which the six Subbasin GSPs will be implemented in a coordinated fashion. Further, all parties to the Coordination Agreement understand that DWR will evaluate the agreement for compliance with the procedural and technical requirements of GSP Regulations § 357.4 (Coordination Agreement) to ensure that the agreement is binding on all parties and that provisions of the agreement are sufficient to address any disputes between or among parties to the agreement.

The Coordination Agreement will continue to be the framework under which the six Delta-Mendota Subbasin GSPs will be implemented and will be reviewed as part of the five-year assessment and revised as necessary, dated, and signed by all parties.

2.1.3 Inter-basin Agreements

SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, and the SJREC GSA executed inter-basin data sharing agreements with Westlands Water District (the lead entity encompassing the adjoining Westside Subbasin). The purpose of the agreement is to establish a set of common assumptions on groundwater conditions on either side of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin to be used for the development of GSPs in support of implementation of SGMA. In this agreement, the parties agree to provide each other with recorded, measured, estimated, and/or simulated modeling data located within five (5) miles of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin. A list of data types to be shared between the parties to the agreement can be found in **Appendix D**.

Data provided under this agreement are understood to be shared with consultants and other stakeholders in the respective basins (Delta-Mendota Subbasin and Westside Subbasin), and that the information will be made public through the development of the respective Parties' (meaning SLDMWA/SJREC and Westlands Water District) GSPs and the supporting documentation of the GSPs. Other than publishing information for those purposes, neither Party will disclose the other Party's information to any third party, except if the other Party determines, at its sole discretion, the disclosure is required by law. Each Party may review preliminary results before publishing the information.

It is recognized that many of the sustainability indicators, notably groundwater quality, inelastic land subsidence and change in storage, are regional issues that may require future inter-basin discussions and coordination. Memorandum of Intent (MOI) are being discussed with the surrounding subbasins to demonstrate/confirm the subbasins' desires to coordinate during GSP implementation. These agreements, to be discussed further following submittal of GSPs, will allow for thoughtful consideration of the intent, structure, and need for future coordination with respect to data collection, reporting, regular meetings, and updates prior to annual reporting.

3. DELTA-MENDOTA SUBBASIN PLAN AREA

This section describes the Delta-Mendota Subbasin, including major streams and creeks, institutional entities, agricultural and urban land uses, locations of state lands (including wetlands), and geographic boundaries of surface water runoff areas. The reader is referred to the individual Subbasin GSPs for descriptions of existing surface water and groundwater monitoring programs, existing water management programs, and general plans in the individual GSP Plan Areas. The information contained in this section reflects information from publicly available sources and may not reflect all information that will be used for GSP technical analysis.

This section of the GSP satisfies Section 354.8 of the SGMA regulations.

3.1 Plan Area Definition

The Plan Area for the six coordinated GSPs is the Delta-Mendota Subbasin (DWR Basin 5-022.07). As previously noted, the Delta-Mendota Subbasin is one of nine subbasins that lie completely within the San Joaquin Valley Hydrologic Region and adjoins the following subbasins (**Figure CC-8**):

- Tracy
- Eastern San Joaquin
- Modesto
- Turlock
- Merced
- Chowchilla
- Madera
- Kings
- Westside

As described in *California's Groundwater*, DWR Bulletin 1188 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley and includes portions of San Joaquin, Stanislaus, Merced, Fresno, San Benito and Madera Counties. The northern boundary begins just south of Tracy in San Joaquin County, and the eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin, and the Subbasin is bounded on the west by the Coast Range. The Subbasin boundaries are further described in Section 4.1.5, Basin Boundaries, and is shown in relation to each of the six counties in **Figure CC-9**.

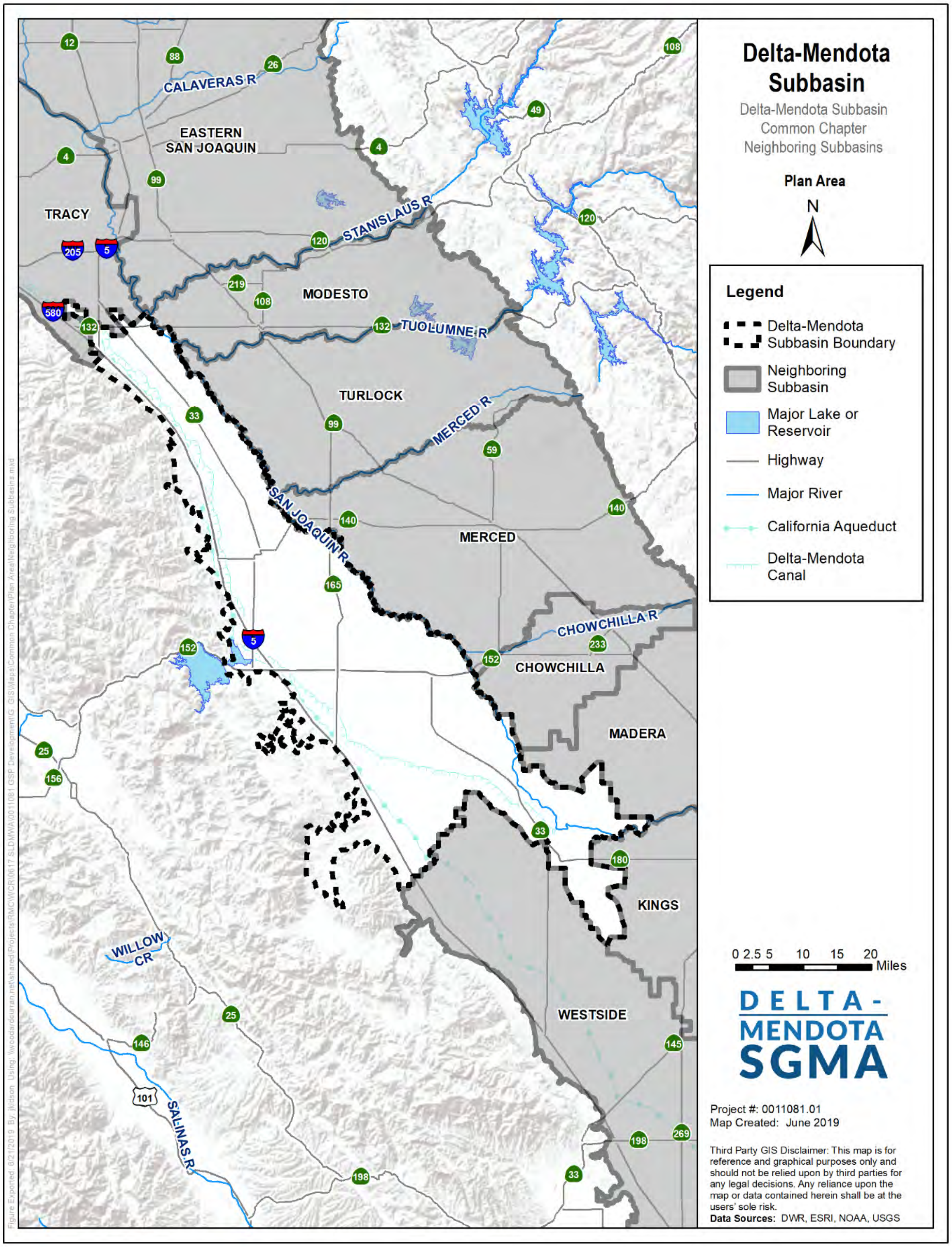


Figure CC-8: Neighboring Subbasins of the Delta-Mendota Subbasin

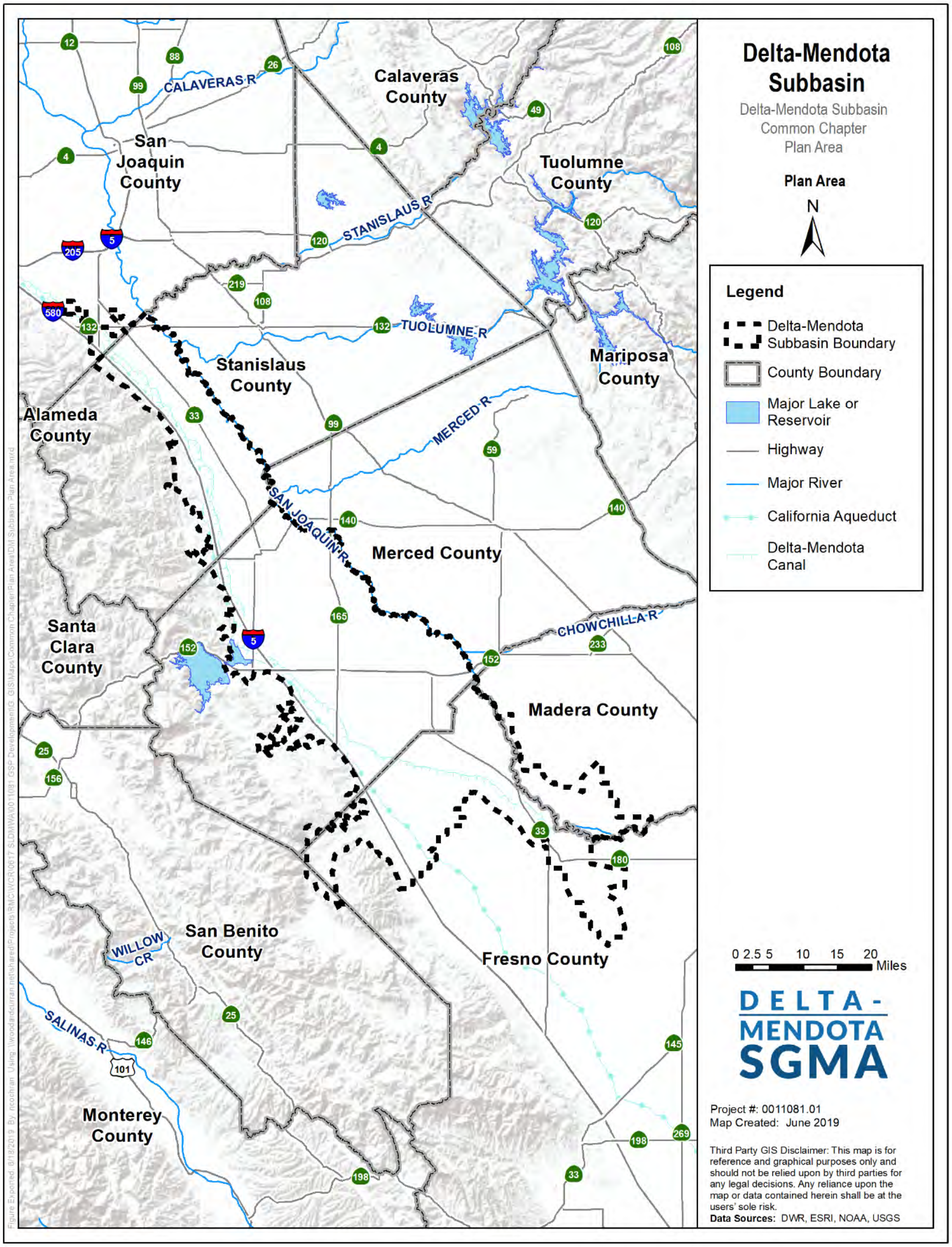


Figure CC-9: Delta-Mendota Groundwater Subbasin Plan Area

3.2 Plan Area Setting

As previously noted, the Delta-Mendota Subbasin lies along the western margin of the San Joaquin Valley. This valley is part of the large, northwest-to-southeast-trending asymmetric trough of the Central Valley, which has been filled with up to six vertical miles of sediment. This sediment includes both marine and continental deposits ranging in age from Jurassic to Holocene. The San Joaquin Valley lies between the Coast Range Mountains on the west and the Sierra Nevada on the east and extends northwestward from the San Emigdo and Tehachapi Mountains to the Sacramento-San Joaquin Delta (Delta) near the City of Stockton. The San Joaquin Valley is 250 miles long and 50 to 60 miles wide. The relatively flat alluvial floor is interrupted occasionally by low hills. Foothills adjacent on the west are composed of folded and faulted beds of mainly marine shale in the north and sandstone and shale in the south.

The San Joaquin Valley floor is divided into several geomorphic land types, including dissected uplands, low alluvial fans and plains, river floodplains and channels, and overflow lands and lake bottoms. Alluvial plains cover most of the valley floor and comprise some of the most intensely developed agricultural lands in the San Joaquin Valley. In general, alluvial sediments of the western and southern parts of the San Joaquin Valley tend to have lower permeability than east side deposits.

This section provides additional information relating to water resources in and around the Delta-Mendota Subbasin.

Watersheds

The Delta-Mendota Subbasin lies in the Middle San Joaquin-Lower Merced-Lower Stanislaus watershed and the Middle San Joaquin-Lower Chowchilla watershed (**Figure CC-10**). Historically, the San Joaquin Valley Basin was a large floodplain of the San Joaquin River that supported vast expanses of permanent and seasonal marshes, lakes, and riparian areas. Approximately 90 percent of the basin's wetlands have been lost, with approximately 58,000 flooded acres remaining on State, federal and private wildlife refuges. Approximately 100,000 acres of managed wetland, upland and riparian habitat is found within the Grassland Plan area, and together with the 12,000-acre Mendota Wildlife Area (found in the Fresno County Plan area), encompasses the vast majority of the remaining wetlands found in the basin (**Figure CC-11**).

The San Joaquin River Basin (Basin) includes the entire area drained by the San Joaquin River. The San Joaquin River Basin drains 13,513 square miles (mi^2) before it flows into the Sacramento-San Joaquin Delta near the town of Vernalis. The Merced, Tuolumne and Stanislaus Rivers are the three major tributaries that join the mainstream San Joaquin River from the east before it flows into the Delta.

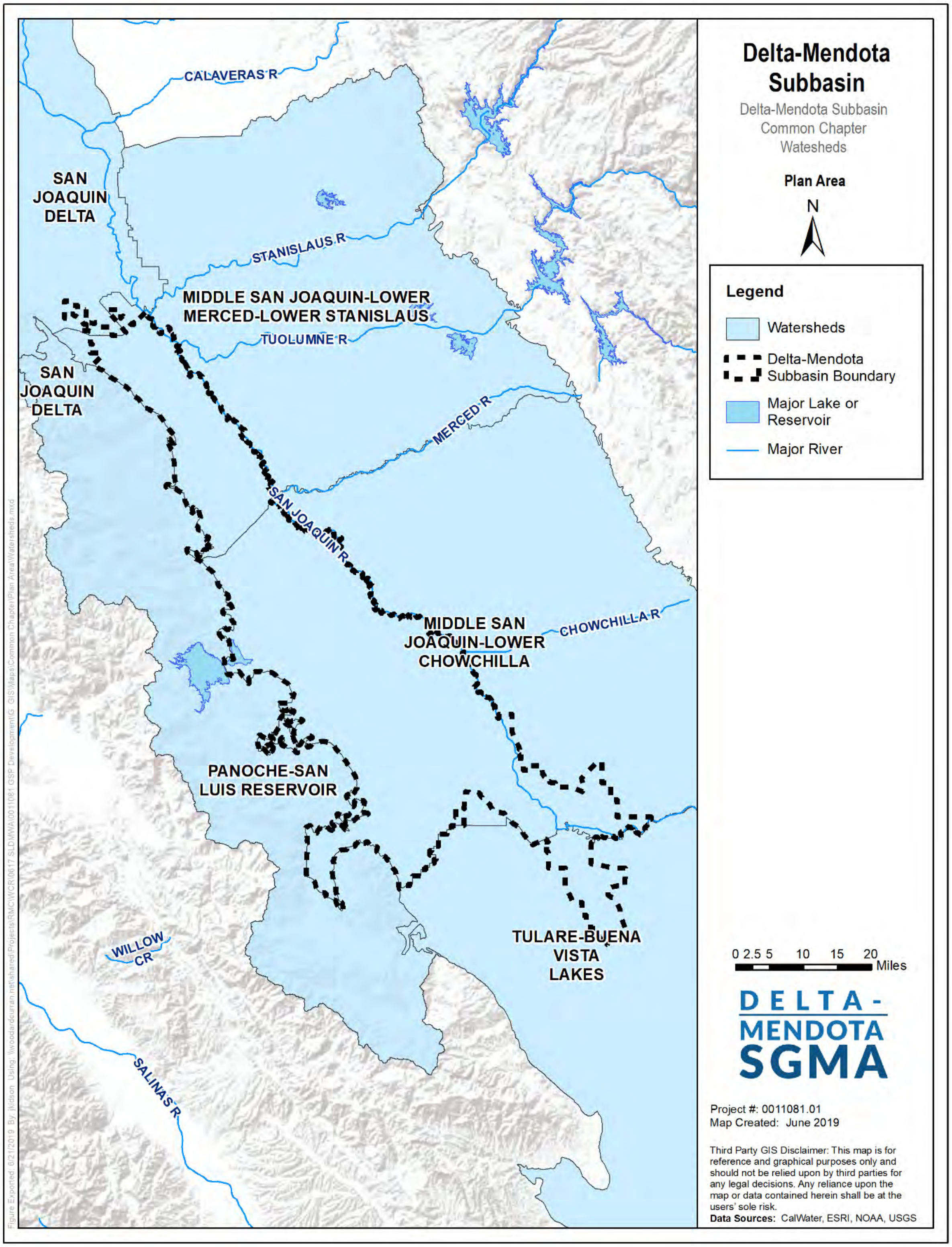


Figure CC-10: Local Watersheds

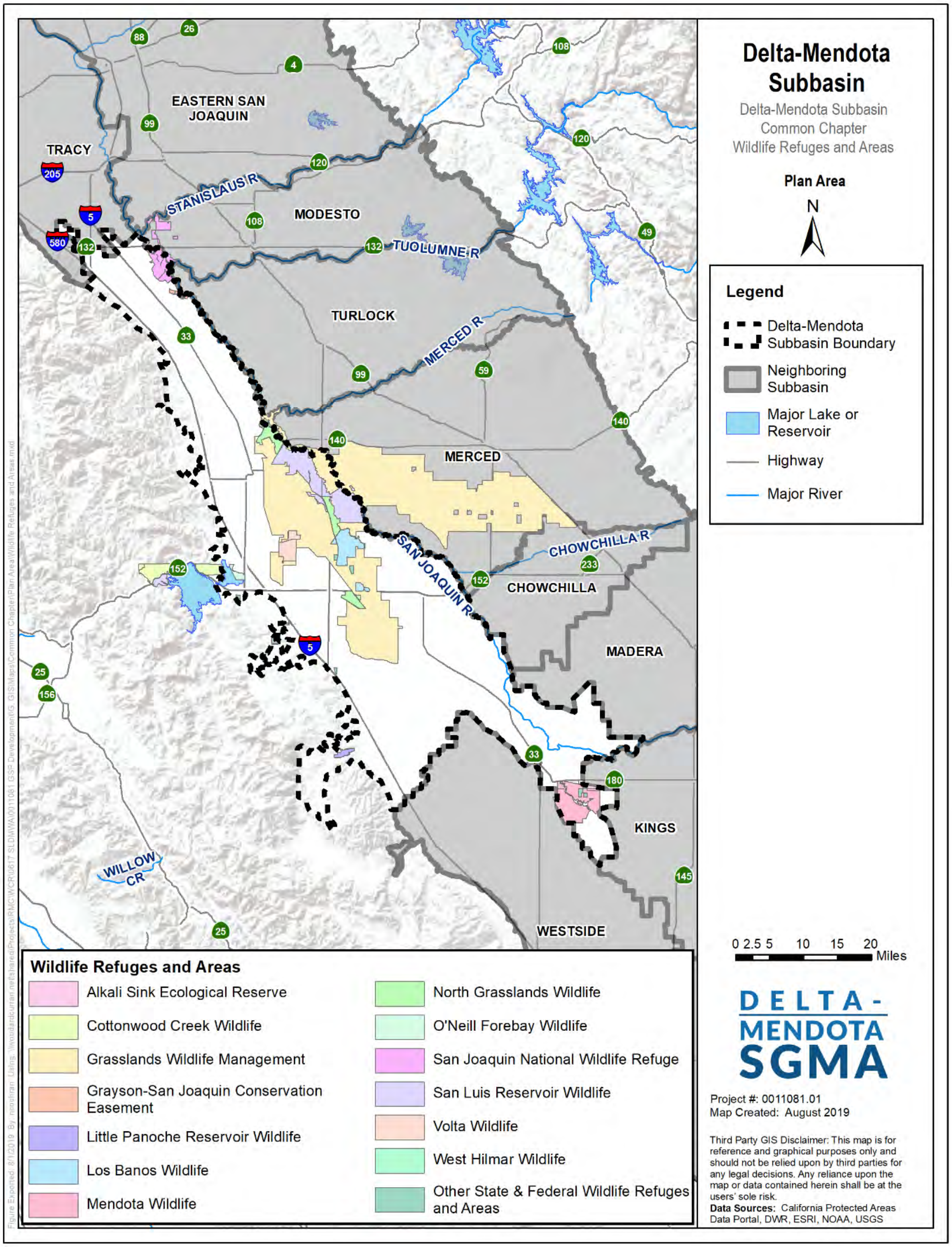


Figure CC-11: Wildlife Refuges and Wetland Habitat Areas in the Delta-Mendota Subbasin

Surface Water Use

Surface water is a primary water supply for agriculture within the Delta-Mendota Subbasin. Surface water supplies are brought into the Subbasin using an extensive series of water systems relied upon by multiple water agencies, cities, and private water users. Major water-related infrastructure in the Subbasin includes the facilities required to deliver Central Valley Project (CVP) supplies to CVP water supply contractors, in addition to key infrastructure of the State Water Project (SWP) utilized to deliver water to SWP water supply contractors and surface water diversions (e.g. intakes) to divert and distribute water from the San Joaquin and Kings Rivers.

The San Luis & Delta-Mendota Water Authority (SLDMWA) is a joint powers authority consisting of 28 member agencies that provide water to approximately 1.2 million acres of highly productive farmland, 2 million California residents, and millions of waterfowl dependent upon the nearly 200,000 acres of managed wetlands within this area of the Pacific Flyway. The SLDMWA operates and maintains portions of the CVP, including the Delta Cross Channel, the C.W. "Bill" Jones Pumping Plant, the Delta-Mendota Canal (DMC), O'Neill Pumping-Generating Plant, and the San Luis Drain, and provides emergency assistance when requested on the Delta Cross Channel and the Tracy Fish Collection Facility. The California Department of Water Resources (DWR) operates and maintains the SWP facilities, designed to deliver nearly 4.2 million acre-feet of water per year to 29 long-term SWP water supply contractors. Joint federal-state facilities include the California Aqueduct, Banks Pumping Plant, O'Neill Dam and Forebay, Sisk Dam and San Luis Reservoir, and Dos Amigos Pumping Plant. Surface water diversion facilities are owned and operated by individual water and irrigation districts and typically include some form of intake (e.g. fish screen, open water intake, flumes) plus facilities to convey the diverted surface water to a distribution system.

Groundwater Use

Groundwater is a key component of water supplies in the Delta-Mendota Subbasin. To protect the long-term sustainability of groundwater resources, pumping has significantly reduced in past years (2017-2019), allowing the groundwater levels in the Subbasin to recover to some extent. During the most recent drought period, groundwater was heavily relied upon throughout the Subbasin for irrigation as surface water deliveries were significantly severely reduced for many water users (especially those with junior surface water rights), resulting in increased groundwater pumping.

There are many communities within the Subbasin that are partially or completely reliant on groundwater for municipal and domestic water supplies, including the cities of Patterson, Newman, Gustine, Los Banos, Firebaugh, and Mendota and the communities of Grayson, Westley, Crows Landing, Santa Nella, Volta, Dos Palos Y, and Tranquillity (**Figure CC-12**). Other unincorporated areas of the Subbasin also rely on groundwater as the sole water supply source. There are several areas of *de minimis* groundwater extractors in the Subbasin, which are defined as well owners who extracts two acre-feet or less per year from a parcel for domestic purposes (SWRCB, n.d. (a)).

Figure CC-13, **Figure CC-14**, and **Figure CC-15** show the density per square mile (PLSS Section) of domestic, production, and public wells in the Delta-Mendota Subbasin as identified by DWR's Well Completion Report Map Application. Domestic wells are defined as individual domestic wells which supply water for the domestic needs of an individual residence or systems of four or less service connections (DWR, 1981). Within the Delta-Mendota Subbasin, the majority of PLSS Sections contain five or fewer domestic wells (**Figure CC-13**). Production well statistics include wells that are designated as irrigation, municipal, public, and industrial on well completion reports, generally indicating wells designed to obtain water from productive zones containing good-quality water (DWR, 1991). The majority of PLSS Sections in the Subbasin contain only zero, one, or two production wells (**Figure CC-14**). The highest concentration of production wells can be found in the south of the Subbasin, near Mendota. Public wells are defined as wells that provide water for human consumption to 15 or more connections or regularly serves 25 or more people daily for at least 60 days out of the year (SWRCB, n.d. (b)). Compared to domestic and production wells, public wells are less common in the Subbasin. The status of the wells (e.g. active, abandoned, destroyed) contained in the DWR Well Completion Report Map Application has not been independently confirmed. Additionally, the reader is referred to each of the six Subbasin GSPs for more information regarding wells in the Delta-Mendota Subbasin.

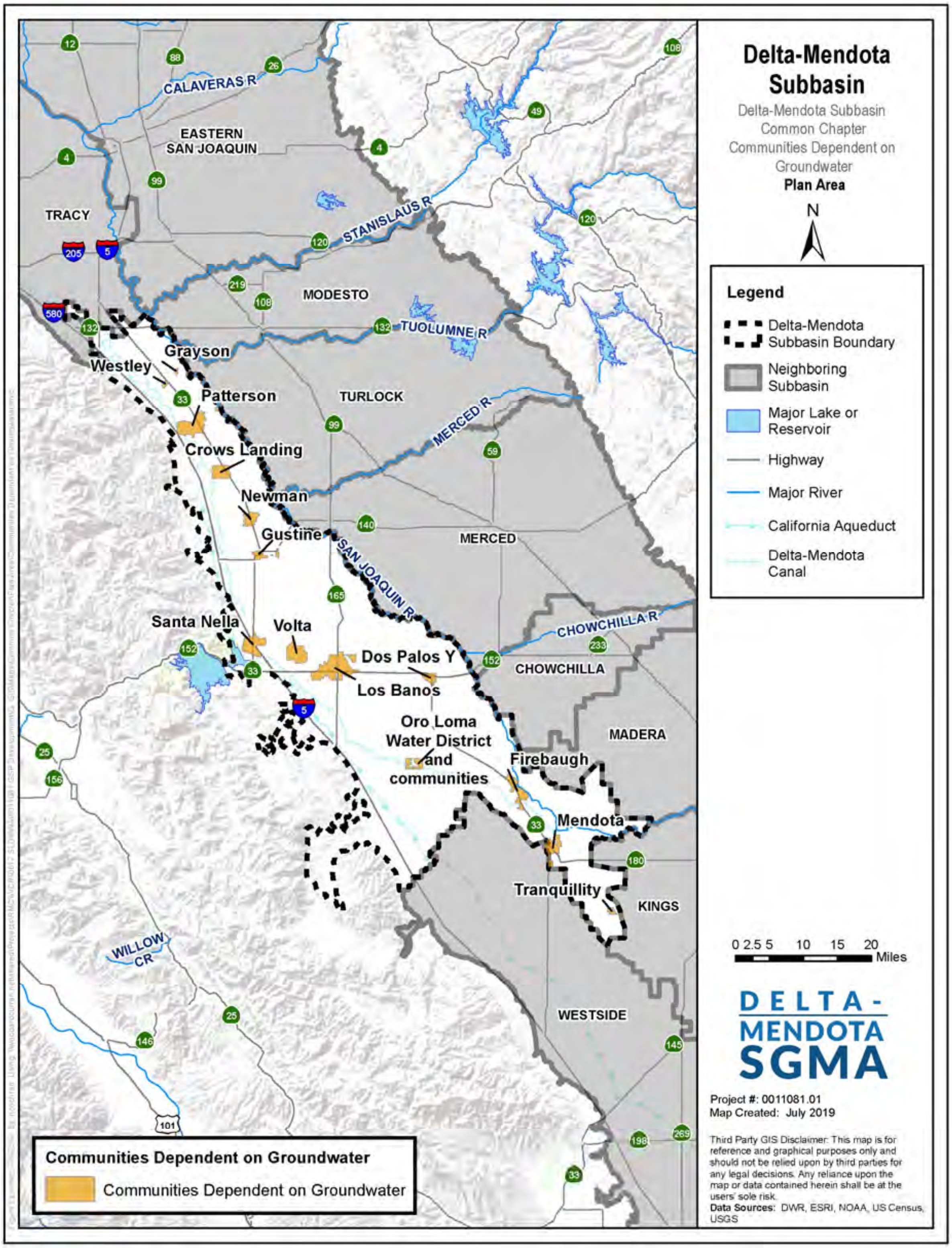


Figure CC-12: Communities Dependent on Groundwater

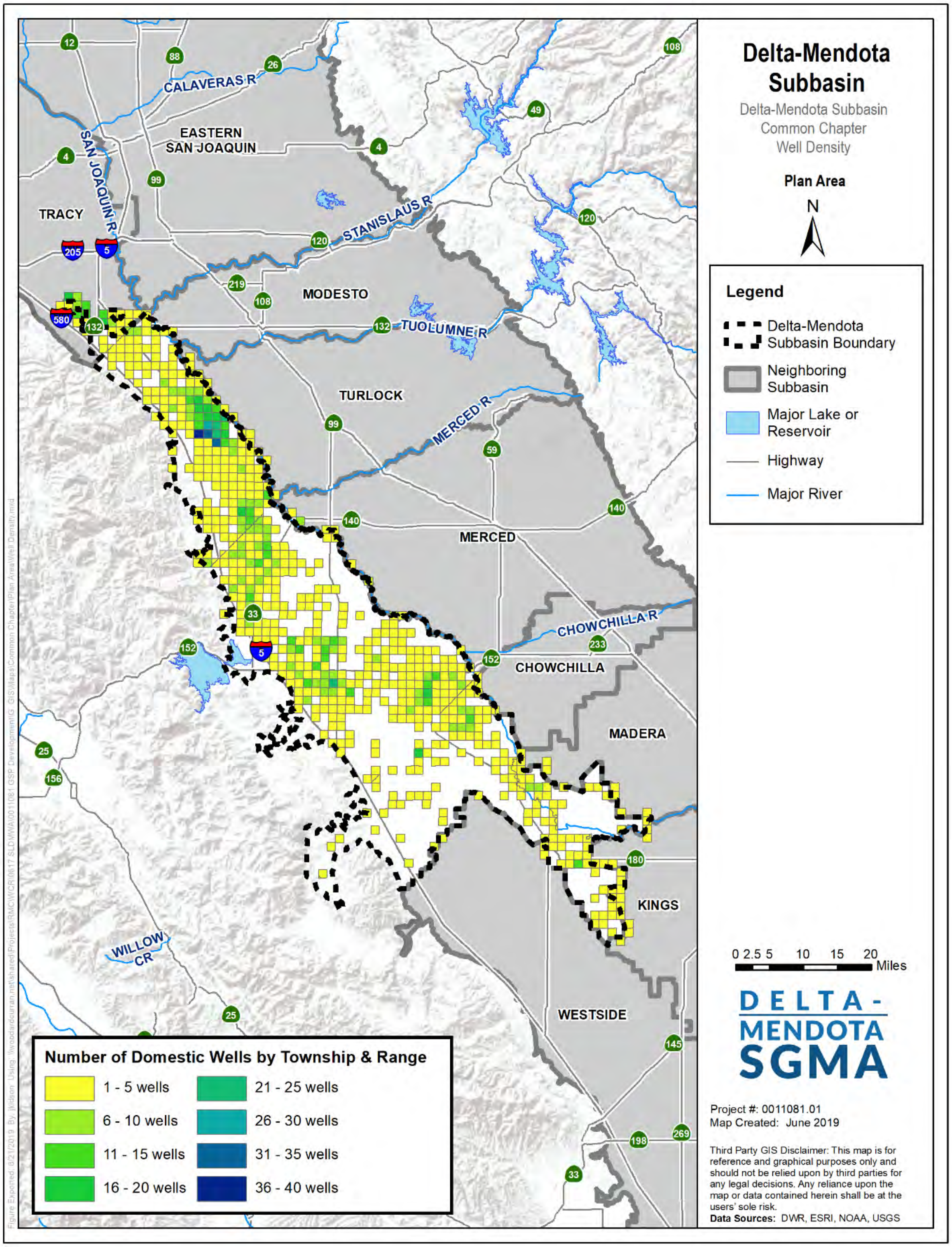


Figure CC-13: Domestic Well Density in the Delta-Mendota Subbasin

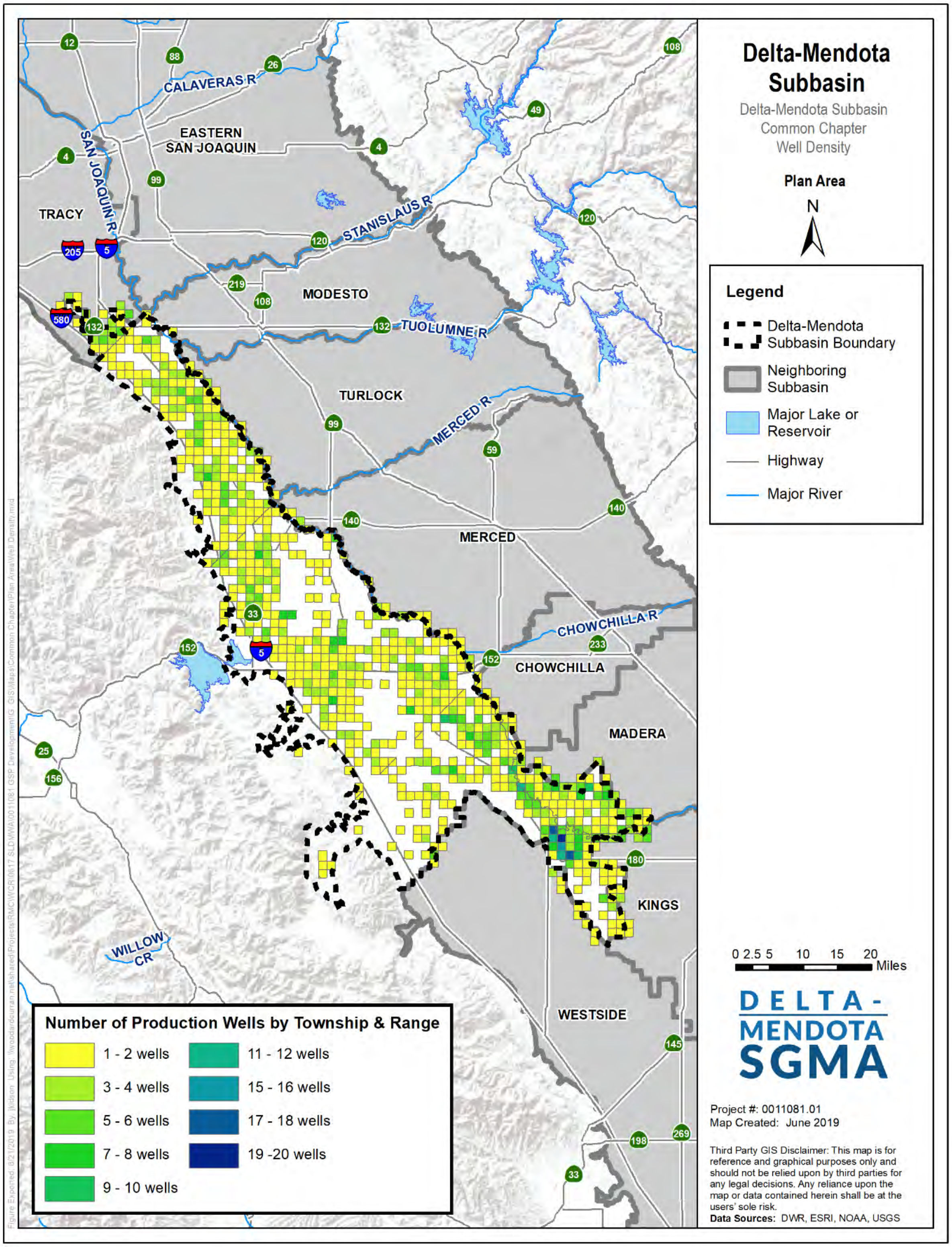


Figure CC-14: Production Well Density in the Delta-Mendota Subbasin

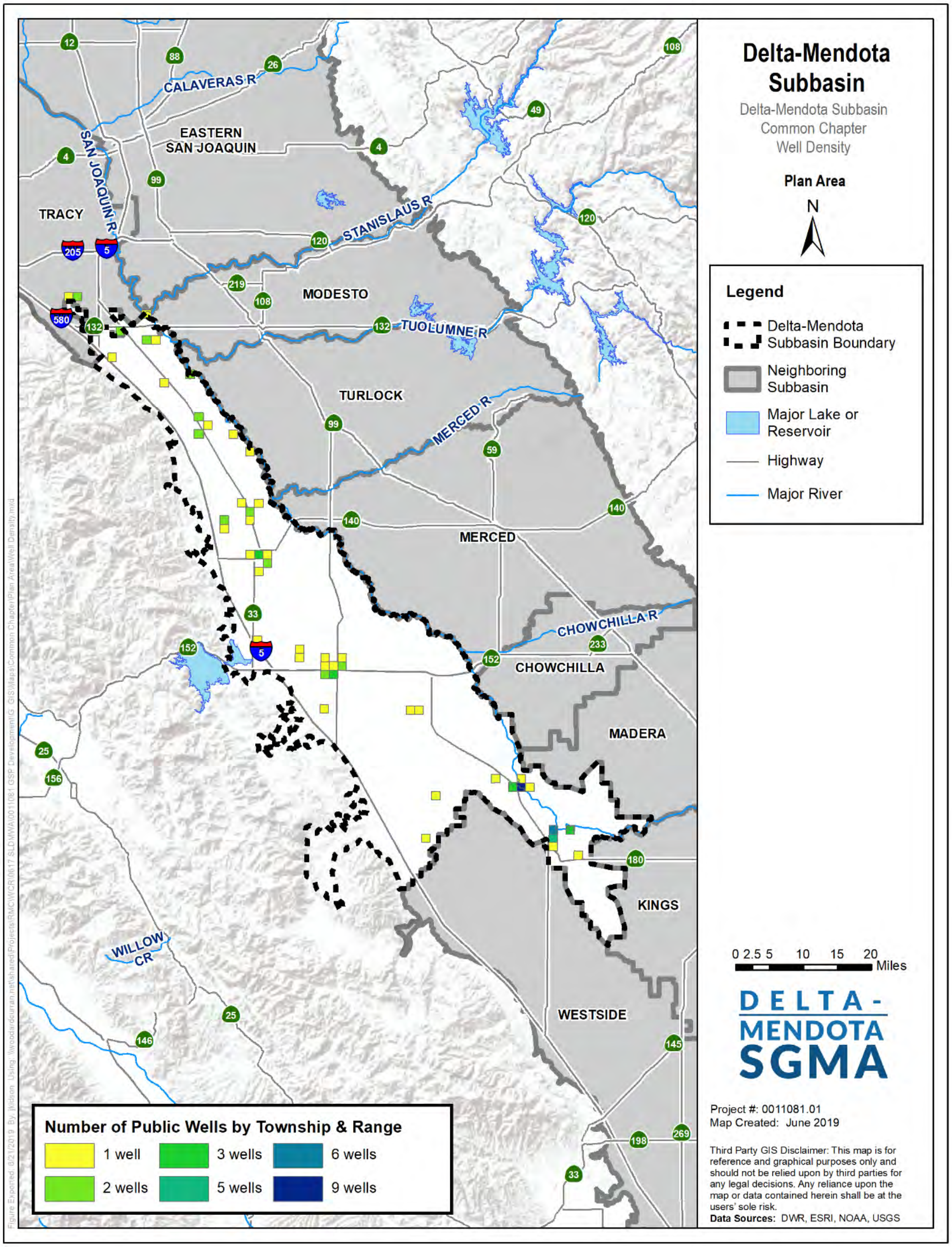


Figure CC-15: Public Well Density in the Delta-Mendota Subbasin

Flood Management

In general, the Delta-Mendota Subbasin slopes toward the San Joaquin River with steeper slopes along the western boundary (near the Coast Range), tapering off closer to the San Joaquin River. The flood management system in the San Joaquin Valley includes reservoirs to regulate snowmelt from elevations greater than 5,000 feet, bypasses at lower elevations, and levees that line major rivers.

Severe rain events in 1997/98, 2005/2006, 2011 and 2017 flooded communities, agricultural lands and refuges adjacent to the San Joaquin River in the Delta-Mendota Subbasin (specifically the communities of Firebaugh, Newman, Gustine and Mendota) and produced some localized flooding of farmland and refuges caused by runoff impoundment by elevated canal banks. Based on the recent historical events, the primary threat of flooding to urban areas will be for those along (and immediately adjacent to) the San Joaquin River. Areas within the 100-year floodplain within the Subbasin are shown in **Figure CC-16**.

Major Land Use Divisions

The Delta-Mendota Subbasin consists mostly of agricultural land use types (**Figure CC-17**). Typical land uses are described in the following sections and consist predominantly of the following:

- Pasture/Rangeland
- Agricultural Land (including rice, field crops and grains)
- Deciduous Forest
- Idle and Retired Farmland/Rangeland
- Riparian/Wetland
- Urban

The primary land use planning entities in the Delta-Mendota Subbasin include San Joaquin, Stanislaus, Merced, Fresno, and Madera Counties, as well as the cities of Patterson, Newman, Gustine, Los Banos, Dos Palos, Firebaugh, and Mendota, and Community of Santa Nella, as shown in **Figure CC-18**.

Pasture/Rangeland

Grasslands in the Central Valley were originally dominated by native perennial grasses such as needlegrass and alkali sacaton. Currently, grassland vegetation is characterized by a predominance of annual or perennial grasses in an area with few or no trees and shrubs. Annual grasses found in grassland vegetation include wild oats, soft chess, ripgut grass, medusa head, wild barley, red brome, and slender fescue. Perennial grasses found in grassland vegetation are purple needlegrass, Idaho fescue, and California oatgrass. Forbs commonly encountered in grassland vegetation include long-beaked filaree, redstem filaree, dove weed, clovers, Mariposa lilies, popcornflower, and California poppy. Vernal pools found in small depressions with an underlying impermeable layer are isolated wetlands within grassland vegetation. Pastures can consist of both irrigated and unirrigated lands dominated by perennial grasses used predominantly for grazing.

Rangeland communities are composed of similar grasses, grass-like plants, forbs, or shrubs which are grazed by livestock. Rangelands are classified into three basic types: shrub and brush rangeland, mixed rangeland, and herbaceous rangeland. The shrub and brush rangeland is dominated by woody vegetation and is typically found in arid and semiarid regions. Mixed rangelands are ecosystems where more than one-third of the land supports a mixture of herbaceous species and shrub or brush rangeland species. Herbaceous rangelands are dominated by naturally occurring grasses and forbs as well as some areas that have been modified to include grasses and forbs as their principal cover. Rangelands are, by definition, areas where a variety of commercial livestock are actively maintained.

Agricultural Land

General agricultural types occurring in the Delta-Mendota Subbasin include row crops, grains, orchards, and vineyards. Management of agricultural lands often includes intensive management, including soil preparation activities, crop rotation, grazing, and the use of chemicals.

Row Crops

Most row crops grown in the San Joaquin Valley and harvested for food are annual species and are managed with a crop rotation system. During the year, several different crops may be produced on a given parcel of land either concurrently or in succession. Typical crops grown in the Delta-Mendota Subbasin include tomatoes, melons, grain crops (such as barley, wheat, corn, and oats), rice, cotton, and beans.

Orchards and Vineyards

Orchard and vineyards consist of cultivated fruit or nut-bearing trees or grapevines. Orchards are typically open, single-species, tree-dominated habitats and are planted in a uniform pattern and intensively managed. Understory vegetation is usually sparse. Vineyards are typically managed in a similar manner for producing grapes for wine and/or direct consumption.

Deciduous Forest

Deciduous forests are composed of trees that lose their leaves in the winter. These include species such as the various California oaks, California buckeye, Fremont Cottonwoods, Goodding Willows, and California Sycamores. The interior live oak, which is not deciduous, is also found in deciduous forests. Valley oak woodlands are found in the Sacramento and San Joaquin Valleys and usually occur below elevations of 2,000 feet.

Idle or Retired Farmland/Rangeland

Lands of this category are similar to abandoned farmlands in ruderal (disturbed) areas. Plants on these parcels may consist of either native and/or non-native species.

Riparian/Wetland

Riparian and wetland communities are both natural and man-made. Managed wetlands are classified as riparian and are flooded for overwintering migratory bird habitat. In the spring the wetlands are drained to promote grasses such as swamp timothy and watergrass which are an important waterfowl food supply. Although some grazing continues on managed wetlands, historically, many of these lands were irrigated and used as rangeland throughout the summer months. Today, managed wetlands are irrigated in the spring to maximize wetland productivity and provide nesting and sensitive species habitat. Managed wetlands also contain emergent vegetation such as cattail and tule and are often adjacent to riparian corridors.

Urban

Urban land uses include cities and smaller communities, in addition to other lands used for industrial and/or commercial practices.

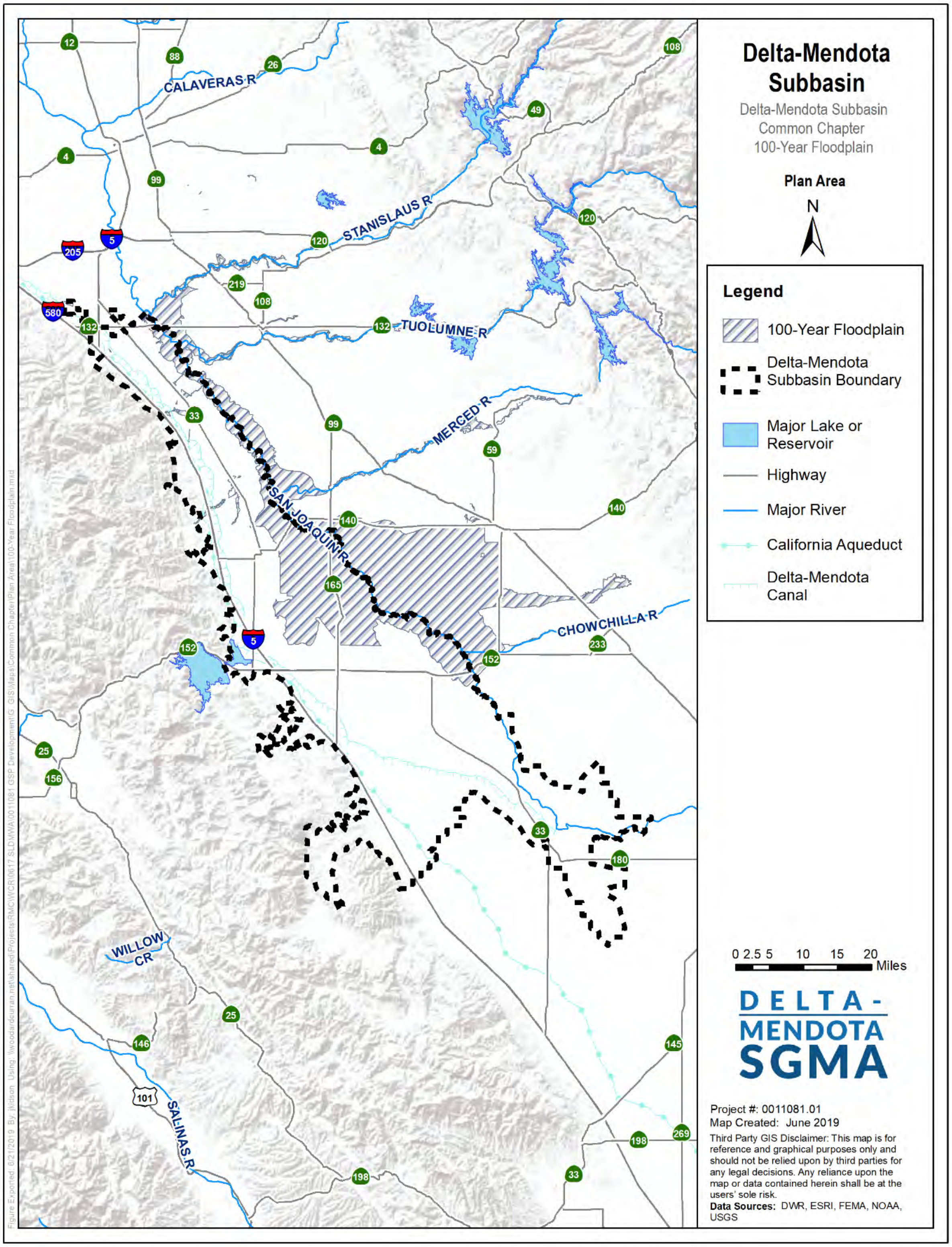


Figure CC-16: 100-Year Floodplain, Delta-Mendota Subbasin

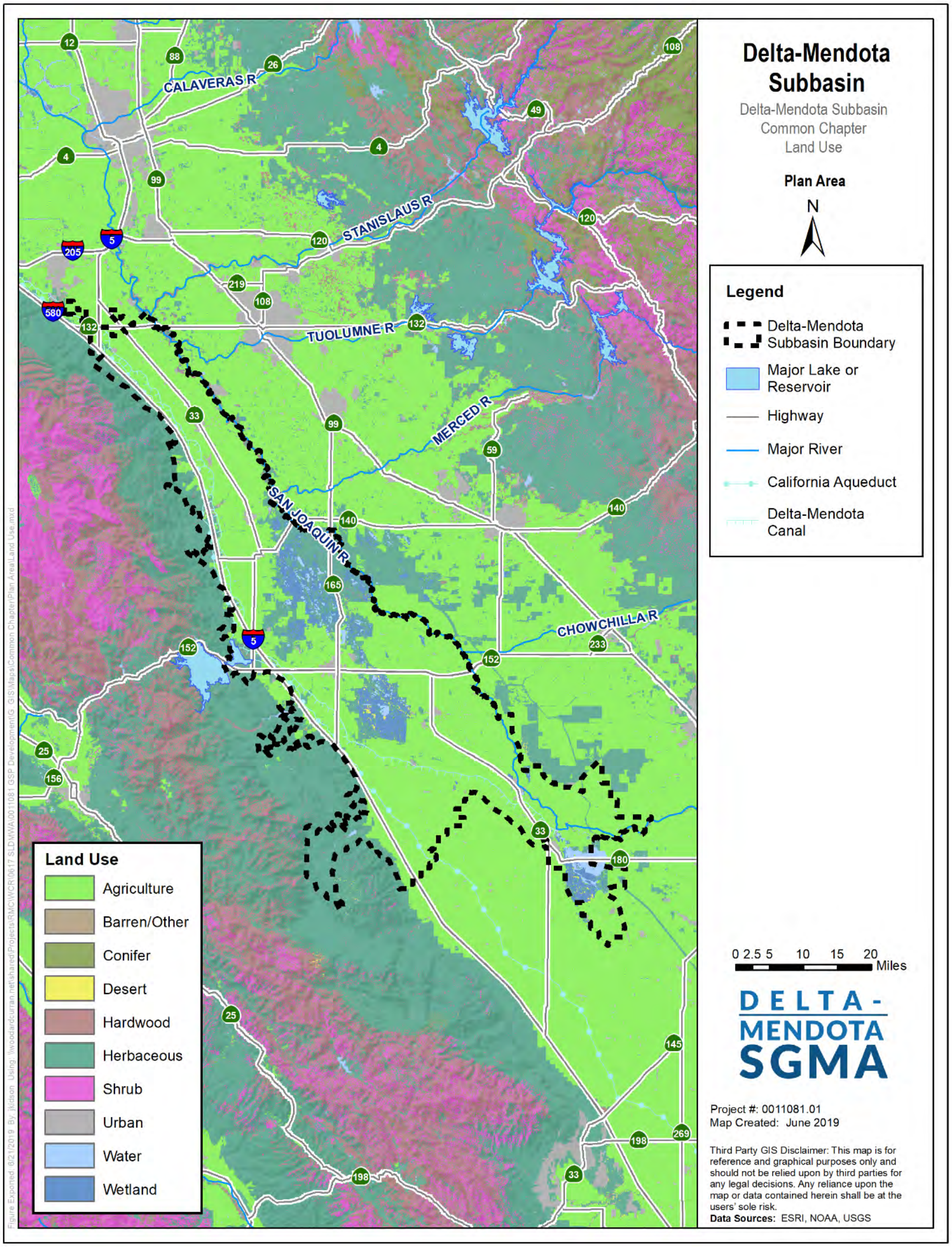


Figure CC-17: Typical Land Use

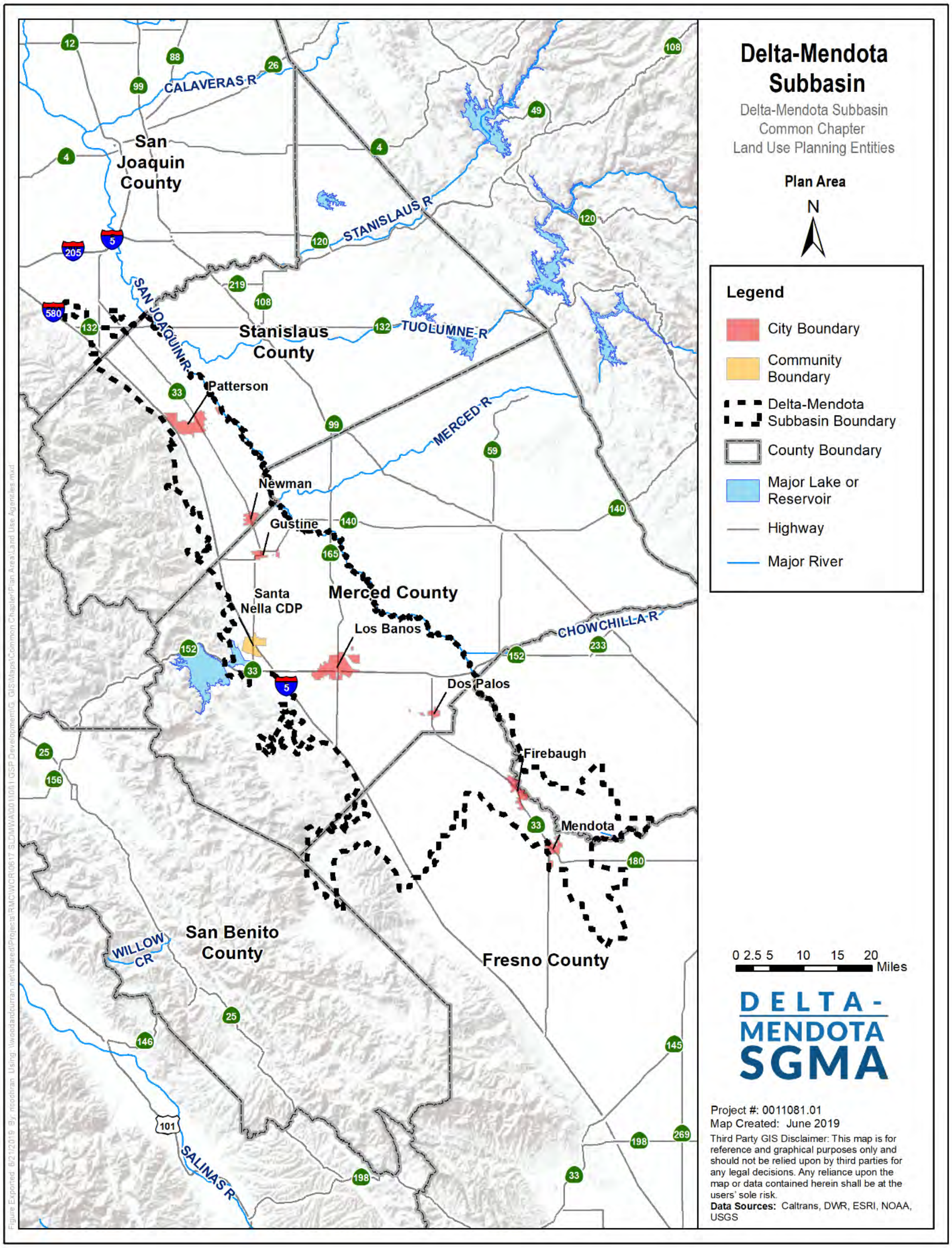


Figure CC-18: Land Use Planning Entities

Regional Economic Issues and Trends

The western San Joaquin Valley is a highly agricultural region. There are no large cities or industries in the Subbasin to provide an alternative economic base. The economy of this region is predominately driven by agricultural production and therefore, the availability of surface water supplies (predominantly in the form of CVP agricultural water and diversions from the San Joaquin and Kings Rivers) is an essential element to the economic health of the region. Other uses of surface water in the Subbasin are used for M&I purposes and wildlife refuge water supply.

Depending on water supply conditions, about 800,000 acres in the Delta-Mendota Subbasin are partially or solely irrigated with surface water. Other economic base industries include travel on the Interstate 5 (I-5) corridor, some petroleum extraction, and tourism. State, federal and private wildlife refuges benefit local economies by attracting hunters, anglers, outdoor recreationists to the region. Managed wetland water conveyance infrastructure is maintained and improved by many contractors and local agency staff. Large scale conveyance improvements and habitat restoration projects, including mitigation banks, are also common throughout the Subbasin. M&I water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities and smaller communities. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2018 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 22,352) and Los Banos (population 30,074) (U.S. Census Bureau, 2017).

All communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Tranquillity, Grayson, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, and Westley. All of these communities are strongly affected by the reliability of agricultural water supplies. Some of them are dependent upon groundwater for M&I use.

Plan Area Jurisdictional Boundaries

Jurisdictional areas within the Delta-Mendota Subbasin include counties, cities, water districts, irrigation districts, mutual water companies, and federal and state agencies. There are no federal- or state-recognized tribal communities in the Subbasin. Federal and State Lands are shown in **Figure CC-19**. More detail on specific jurisdictional areas within each GSP area can be found in the respective GSP.

In general, all municipal, water/irrigation districts and counties within the Delta-Mendota Subbasin are participating in GSP development either as a separate GSA or as members of a GSA. The California Department of Fish and Wildlife boundaries and the U.S. Fish and Wildlife Service boundaries overlay the wildlife refuges and areas and state parks within the Subbasin. DWR manages the SWP and the California Aqueduct, and the U.S. Bureau of Reclamation (USBR), through the SLDMWA, manages the CVP and the Delta-Mendota Canal. The California Department of Transportation (Caltrans) is responsible for managing the State and Interstate highways in the Subbasin, including Interstate- (I-) 5, and State Highways 132, 33, 140, 152, and 165.

Figure CC-9 depicts the Subbasin's extent relative to the boundaries of the various counties that overlie the Subbasin. Merced County has jurisdiction over the largest portion of the Subbasin (525 square miles), in the central portion of the Subbasin. Stanislaus County has jurisdiction over most of the area on the northern end of the Subbasin (covering 223 square miles). Fresno and Madera Counties have jurisdiction over the southern extent of the Delta-Mendota Subbasin (400 square miles). Finally, San Benito County covers the smallest portion of the Subbasin (5 square miles) in the southwestern portion of the Subbasin near San Luis Reservoir.

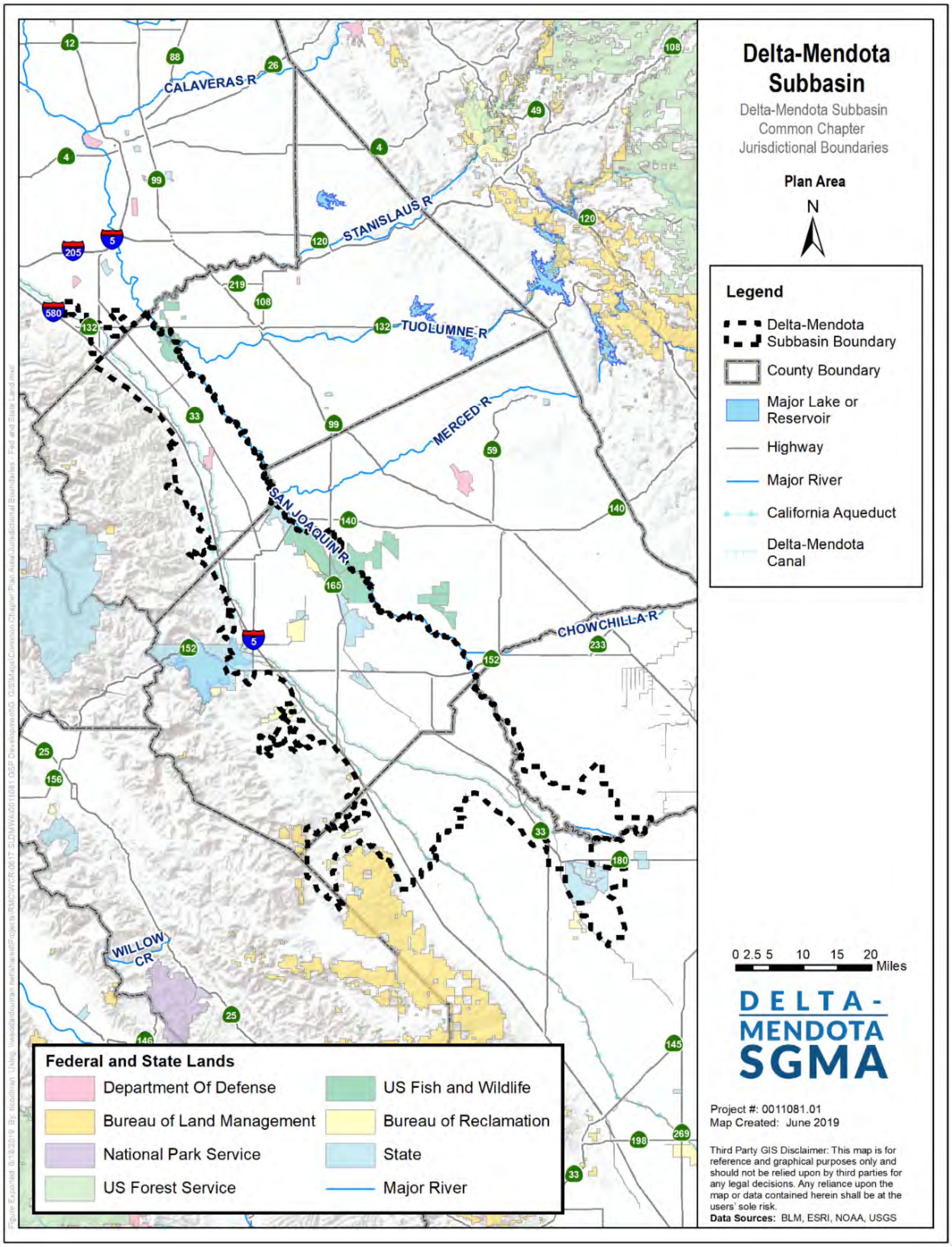


Figure CC-19: Federal and State Lands

Land Use Elements

Land use in the Delta-Mendota Subbasin is predominantly agricultural with wildlife habitat areas and areas of municipal, industrial and commercial use. Predominant crops grown in the region include grain and hay crops, nut and fruit trees, and row crops. **Figure CC-20** shows the distribution of different land use types across the Delta-Mendota Subbasin.

Conjunctive use of surface water and groundwater is practiced throughout much of the Delta-Mendota Subbasin. Urban centers, such as the City of Patterson, and most unincorporated county areas rely solely on groundwater for their water supplies. Several water and irrigation districts hold water rights to divert from the San Joaquin River and/or the Kings Rivers. Other water purveyors receive water from the CVP and use groundwater and non-CVP-acquired surface waters to supplement demand, while some water districts rely solely on groundwater for their supplies. Refer to each GSP for detailed discussions of the water sources used by each agricultural, wetland, and urban water supplier.

Agriculture is the predominant water use sector throughout the Delta-Mendota Subbasin (**Figure CC-20**). Urban water uses are mostly concentrated within and surrounding cities (such as Patterson and Los Banos). Non-irrigated land includes any idle or native riparian land classifications, which are scattered throughout the Regions.

3.3 General Plans in Plan Area

Within each GSP, General Plans and/or Community Specific Plans overlie the area. These include County general plans for Fresno, Merced, San Benito, San Joaquin, Stanislaus, and Madera Counties, and specific plans for cities and communities. Each GSP contains a detailed list of General Plan policies and objectives relevant to water resources management in the applicable GSP area. Refer to discussions in the individual GSPs which satisfy §354.8(f) of the GSP Emergency Regulations under SGMA.

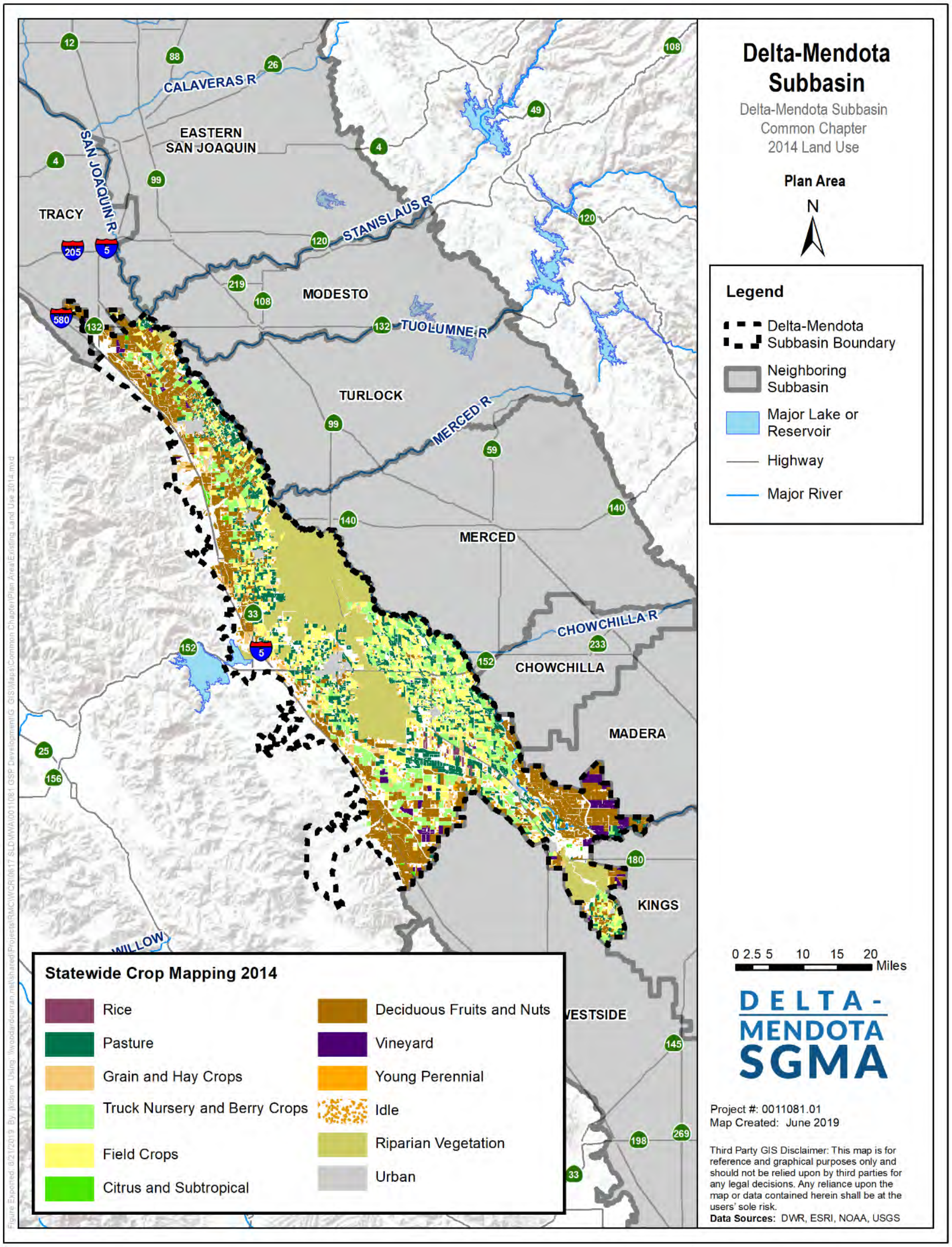


Figure CC-20: 2014 Land Use in the Delta-Mendota Subbasin

3.4 Existing Land Use Plans and Impacts to Sustainable Groundwater Management

Numerous policies in each County's and Community's General Plan compliment the GSPs' plans to conserve and sustainably manage groundwater resources. In general, the County and City General Plans guide future growth and development (and associated demands) within their respective jurisdictional areas. This additional growth may impact groundwater sustainability by placing additional demands on groundwater resources in an area where surface water resources are scarce or are otherwise unavailable. The General Plans also promote water conservation (in both the urban and agricultural sectors), which could potentially offset the additional demands associated with future urban development. In addition to conservation, some (though not all) General Plans promote groundwater recharge, the protection of recharge areas and wetlands, and the use of water transfers to further benefit groundwater sustainability.

Most General Plans within the Delta-Mendota Subbasin include goals focused on preserving agriculture, efficient use of existing and future water sources in both the urban and agricultural sectors, connecting smaller rural communities to larger water systems, and water quality protection. With respect to the protection of water quality and groundwater dependent ecosystems, the General Plans generally protect riparian and wetland habitats, encourage the protection of water quality (including through the remediation of contamination that may impact groundwater quality, requiring the use of septic systems in rural areas that are designed to be protective of groundwater quality and/or the use of community wastewater systems in urban areas), and promote flood control and management (including the associated impacts of erosion and sedimentation of surface water-courses).

The Fresno County General Plan, in particular, promotes sustainability by managing new wells in urban areas, supporting monitoring of water resources and associated habitats, and through the formation of a water resources document repository.

While the magnitude of impacts of these policies over the planning and implementation horizon are not known, such policies have been considered in this GSP, primarily through the use of the General Plans and associated zoning maps to identify future land use types and projected growth areas. These General Plans and mapping were used along with available water master plans, urban water management plans, agricultural water management plans, and other relevant planning documents to determine projected future land use and estimate future water demands by land use sector for use in the projected future water budgets.

Just as the General Plans complement the GSPs, the GSPs in the Delta-Mendota Subbasin may influence the General Plans' goals and policies. Sustainable management of groundwater resources through a GSP may change the pace, location and type of development and/or land use that will occur in the Subbasin. GSP implementation is anticipated to be consistent with the General Plans' goals to sustainably manage land development and water resources in the Subbasin.

3.5 Existing Water Resources Monitoring and Management Programs

As required by §354.8(c) and (d) of the GSP Emergency Regulations, the following section describes key existing water resources-related management and monitoring programs, and a discussion of how these programs will either impact GSP implementation and/or will be incorporated into the GSPs. The information shown below is a high-level summary of key existing programs; please see the individual GSPs for additional relevant management and monitoring programs.

Irrigated Lands Regulatory Program (ILRP)

In 1999, the California Legislature passed Senate Bill 390, which eliminated a blanket waiver of water quality regulations for agricultural waste discharges. The Bill required the Regional Water Quality Control Boards to develop a program to regulate agricultural lands under the Porter-Cologne Water Quality Control Act. In 2003, the Central Valley Regional Water Quality Control Board (CV-RWQCB) issued an order that sets Waste Discharge Requirements (WDRs) for irrigated lands to protect both surface and groundwater throughout the Central Valley, primarily to address nitrates, pesticides, and sediment discharge. The resulting Irrigated Lands Regulatory Program (ILRP) regulates wastes from commercial irrigated lands that discharge into surface and groundwater. The program is administered by the CV-RWQCB working directly with a regional or crop-based coalition as well as directly with irrigators. The goal of the ILRP is to protect surface water and groundwater and to reduce impacts of irrigated agricultural discharges to waters of the State. As a result of the ILRP, monitoring reports, assessment reports, management plans, surface water quality data, and groundwater quality data are made available to the public.

Implementation of the IRLP in the Delta-Mendota Subbasin is managed primarily by the Westside San Joaquin River Watershed Coalition and the Grassland Drainage Area Coalition under the San Joaquin Valley Drainage Authority, a California Joint Powers Authority (JPA). This region specifically emphasizes nitrogen, sediment, and erosion control.

CV-SALTS

The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is an initiative to reduce salt and nitrate impacts, restore groundwater quality, and provide safe drinking water supplies. Developed by a group of stakeholders (federal, state, and local agencies, dischargers and growers, and environmental groups) called the Central Valley Salinity Coalition, the Central Valley Salt and Nitrate Management Plan (SNMP) was released in 2017.

The Central Valley SNMP recommends revised and flexible regulations for existing Basin Plans and includes recommended interim solutions for salt and nutrient management in high priority basins in addition to long-term salt management strategies. Under the Central Valley SNMP, dischargers are provided two compliance pathways: (1) traditional permitting as an individual discharger or as a coalition (i.e. irrigated lands coalition), or (2) groundwater management zone permitting. Zone permitting allows dischargers to work as a collective in collaboration with the CV-RWQCB to provide safe drinking water with the option to extend time to achieve nitrogen balance. At this time, the Central Valley SNMP is not currently enforced.

Integrated Regional Water Management Program

Three Integrated Regional Water Management Plans (IRWMPs) overlie the Delta-Mendota Subbasin. The Westside-San Joaquin IRWMP covers most of the Subbasin, while smaller portions of the Subbasin are covered by the East Stanislaus and Madera IRWM Plans.

Integrated Regional Water Management (IRWM) is a collaborative effort to identify and implement water management solutions on a regional scale that increase regional self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives. Developed by Regional Water Management Groups, the IRWMPs seek to deliver higher value for investments in water resources and management by considering all interests, providing multiple benefits, and working across jurisdictional boundaries. Examples of multiple benefits include improved water quality, better flood management, restored and enhanced ecosystems, and more reliable surface and groundwater supplies. Please see the individual GSPs for additional details regarding the IRWM program in their GSP Plan areas.

California State Groundwater Elevation Monitoring Program (CASGEM)

Since 2009, the California Statewide Groundwater Elevation Monitoring (CASGEM) Program has tracked seasonal and long-term groundwater elevation trends in groundwater basins statewide. 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. This early attempt to monitor groundwater continues to exist as a tool to help achieve the goals set out under the Sustainable Groundwater Management Act (SGMA) with mandatory annual water elevation monitoring and reporting.

San Joaquin River Restoration Program (SJRR)

The San Joaquin River Restoration Program (SJRRP) is a comprehensive, long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from Restoration Flows. The program has two general goals resulting from the San Joaquin River Restoration Settlement reached in 2006:

- **Restoration:** To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management:** To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The program includes the implementation of projects, reintroduction activities and associated monitoring to assess progress towards achieving the Settlement goals.

USGS Land Subsidence Monitoring

The USGS maintains and monitors a large system of monitoring locations nationwide using interferometric synthetic aperture radar (InSAR), continuous GPS (CGPS) measurements, campaign global positioning system (GPS) surveying, and spirit-leveling surveying. Aquifer-system compaction is measured by using extensometers to aid in the understanding of the depths at which compaction is occurring. The USGS shares these results to support decision making relative to groundwater basin management with the goal of minimizing future inelastic land subsidence.

3.6 County Well Construction/Destruction Standards and Permitting

DWR has developed well standards for the state per California Water Code Sections 13700 to 13806. These standards have been adopted by the State Water Resources Control Board (SWRCB) into a statewide model well ordinance (Resolution No. 89-98) for use by the Regional Boards for enforcing well construction standards where no local well design ordinance exists that meets or exceeds the DWR standards. DWR's Well Standards are presented in Bulletin 74-81 and Bulletin 74-90.

Each GSP lists the counties within their GSP Plan areas and the respective permitting agencies and local ordinances for well construction and destruction standards. Discussion of these standards and the respective permitting process as well as well abandonment and destruction procedures can be found in the individual GSPs.

3.7 Existing and Planned Conjunctive Use Programs

Conjunctive use programs in the Subbasin are currently implemented and planned by single agencies as well as through multi-agency partnerships. Maximizing the beneficial use of surface water, groundwater, and recycled water resources is of critical concern to water managers throughout the Delta-Mendota Subbasin with the ultimate goal of using all of these water sources more efficiently to avoid overdraft and to sustainably manage groundwater resources. Each GSP describes efforts to utilize existing water resources conjunctively and demonstrate feasibility to continue to implement conjunctive use projects in the future. These may include projects such as groundwater recharge and conveyance facilities, new wells, improved monitoring systems, improved delivery efficiency, water recycling, and water quality improvements and treatment.

Underground recharge and storage occurs throughout the Delta-Mendota Subbasin through stormwater applied water and managed wetland recharge. Stormwater collects both naturally and artificially and eventually percolates through the ground and into aquifers for beneficial use for both urban and agriculture. Recharge from agricultural and wetland water conveyance and irrigation percolates into the ground and eventually into aquifers where it can be pumped again for use. This natural and unmanaged recharge creates future opportunities for conjunctive use programs; however, this recharge may decline as farmers move toward more precise and water efficient irrigation methods.

3.8 Plan Elements from California Water Code Section 10727.4

Each GSP may contain, as deemed appropriate, a detailed discussion of the additional plan elements as identified in California Water Code (CWC) Section 10727.4. These elements are:

- Control of saline water intrusion
- Wellhead protection areas and recharge areas
- Migration of contaminated groundwater
- Well abandonment and well destruction programs
- Activities implementing, opportunities for, and removing impediments to conjunctive use or underground storage
- Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects
- Efficient Water Management Practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use
- Efforts to develop relationships with state and federal regulatory agencies
- Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risk to groundwater quality or quantity
- Impacts on Groundwater Dependent Ecosystems

4. SUBBASIN SETTING

This Delta-Mendota Subbasin Settings section contains three main subsections as follows:

- **Hydrogeologic Conceptual Model (HCM)** – The HCM section (Section 4.1) provides the geologic information needed to understand the framework that water moves through in the Subbasin. It focuses on geologic formations, aquifers, structural features, and topography.
- **Groundwater Conditions** – The Groundwater Conditions section (Section 4.2) describes and presents groundwater trends, levels, hydrographs and level contour maps, estimates changes in groundwater storage, identifies groundwater quality issues, addresses subsidence, and addresses surface water interconnection.
- **Water Budget** – The Water Budget section (Section 4.3) describes the data used to develop the water budget. Additionally, this section discusses how the budget was calculated, provides water budget estimates for historical conditions, and current conditions and projected conditions

4.1 Hydrogeologic Conceptual Model

This section describes the hydrogeologic conceptual model (HCM) for the Delta-Mendota Subbasin based on technical studies and qualified maps that characterize the physical components and interaction of the surface water and groundwater systems, pursuant to Article 5, Plan Contents, Subarticle 2, Basin Setting, § 354.14 Hydrogeologic Conceptual Model of the GSP Emergency Regulations. The physical description of the Delta-Mendota Subbasin is based on information originally published in the *Western San Joaquin River Watershed Groundwater Quality Assessment Report* (GAR) (LSCE, 2015), *Grassland Drainage Area Groundwater Quality Assessment Report* (LSCE, 2016), and *Groundwater Overdraft in the Delta-Mendota Subbasin* (KDSA, 2015).

4.1.1 Regional Geologic and Structural Setting

The Delta-Mendota Subbasin is located in the northwestern portion of the San Joaquin Valley Groundwater Basin within the southern portion of the Central Valley (**Figure CC-21**). The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding Sierra Nevada and Coast Range mountains, respectively (DWR, 2006). Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is slightly west of the series of rivers, lakes, sloughs, and marshes which mark the current and historic axis of surface drainage in the San Joaquin Valley.

The Delta-Mendota Subbasin (DWR Basin No. 5-22.07) is bounded on the west by the tertiary and older marine sediments of the Coast Ranges, on the north generally by the San Joaquin-Stanislaus County line, on the east generally by the San Joaquin River and Fresno Slough, and on the south by the Tranquillity Irrigation District boundary near the community of San Joaquin. Surface waters converge from the Fresno, Merced, Tuolumne, and Stanislaus Rivers into the San Joaquin River, which drains to the north toward the Sacramento-San Joaquin Delta.

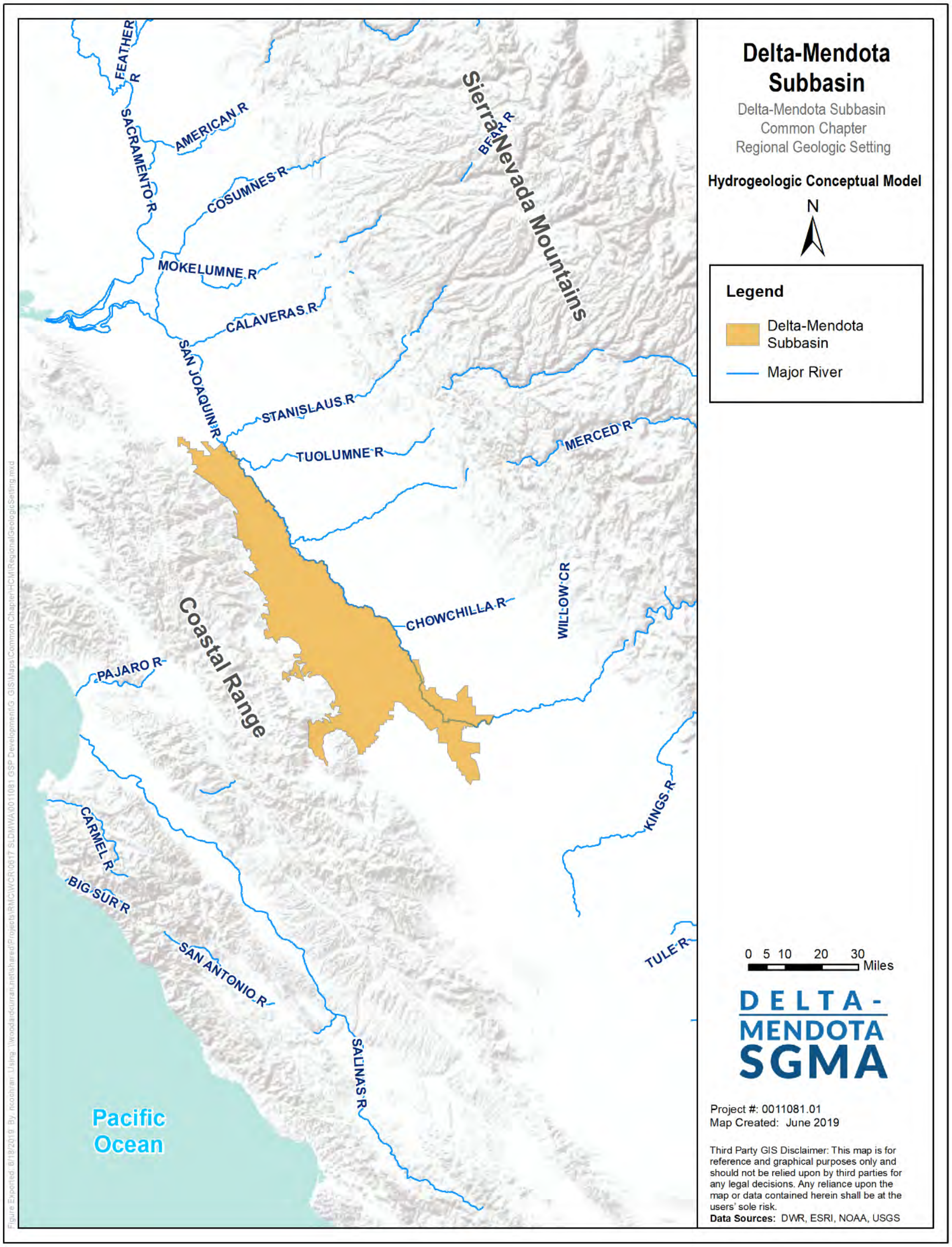


Figure CC-21: Regional Geologic Setting

4.1.2 Geologic History

Approximately three million years ago, tectonic movement of the Oceanic and Continental plates associated with the San Andreas Fault system resulted in the formation of the Coast Range which sealed off the Central Valley from the Pacific Ocean (LSCE, 2015). As this occurred, the floor of the San Joaquin Valley began to transition from a marine depositional environment to a freshwater system with ancestral rivers bringing alluvium to saltwater bodies (Mendenhall et al., 1916). The Coast Ranges on the western side of the San Joaquin Valley consist mostly of complexly folded and faulted consolidated marine and non-marine sedimentary and crystalline rocks ranging from Jurassic to Tertiary age, dipping eastward and overlying the basement complex in the region (Croft, 1972; Hotchkiss and Balding, 1971). The Central Valley Floor, in which the Delta-Mendota Subbasin lies, consists of Tertiary and Quaternary-aged alluvial and basin fill deposits (**Figure CC-22**). The fill deposits mapped throughout much of the valley extend vertically for thousands of feet, and the texture of sediments varies in the east-west direction across the valley. Coalescing alluvial fans have formed along the sides of the valley created by the continuous shifting of distributary stream channels over time. This process has led to the development of thick fans of generally coarse texture along the margins of the valley and a generally fining texture towards the axis of the valley (Faunt et al., 2009 and 2010).

Deposits of Coast Range and Sierra Nevada sources interfinger within the Delta-Mendota Subbasin. Steeper fan surfaces, with slopes as high as 80 feet per mile, exist proximal to the Coast Range, whereas more distal fan surfaces consist of more gentle slopes of 20 feet per mile (Hotchkiss and Balding, 1971). In contrast to the east side of the valley, the more irregular and ephemeral streams on the western side of the valley floor have less energy and transport smaller volumes of sediment resulting in less developed alluvial features, including alluvial fans which are less extensive, although steeper, than alluvial fan features on the east side of the valley (Bertoldi et al., 1991). Lacustrine and floodplain deposits also exist closer to the valley axis as thick silt and clay layers. Lakes present during the Pleistocene epoch in parts of the San Joaquin Valley deposited great thicknesses of clay sediments.

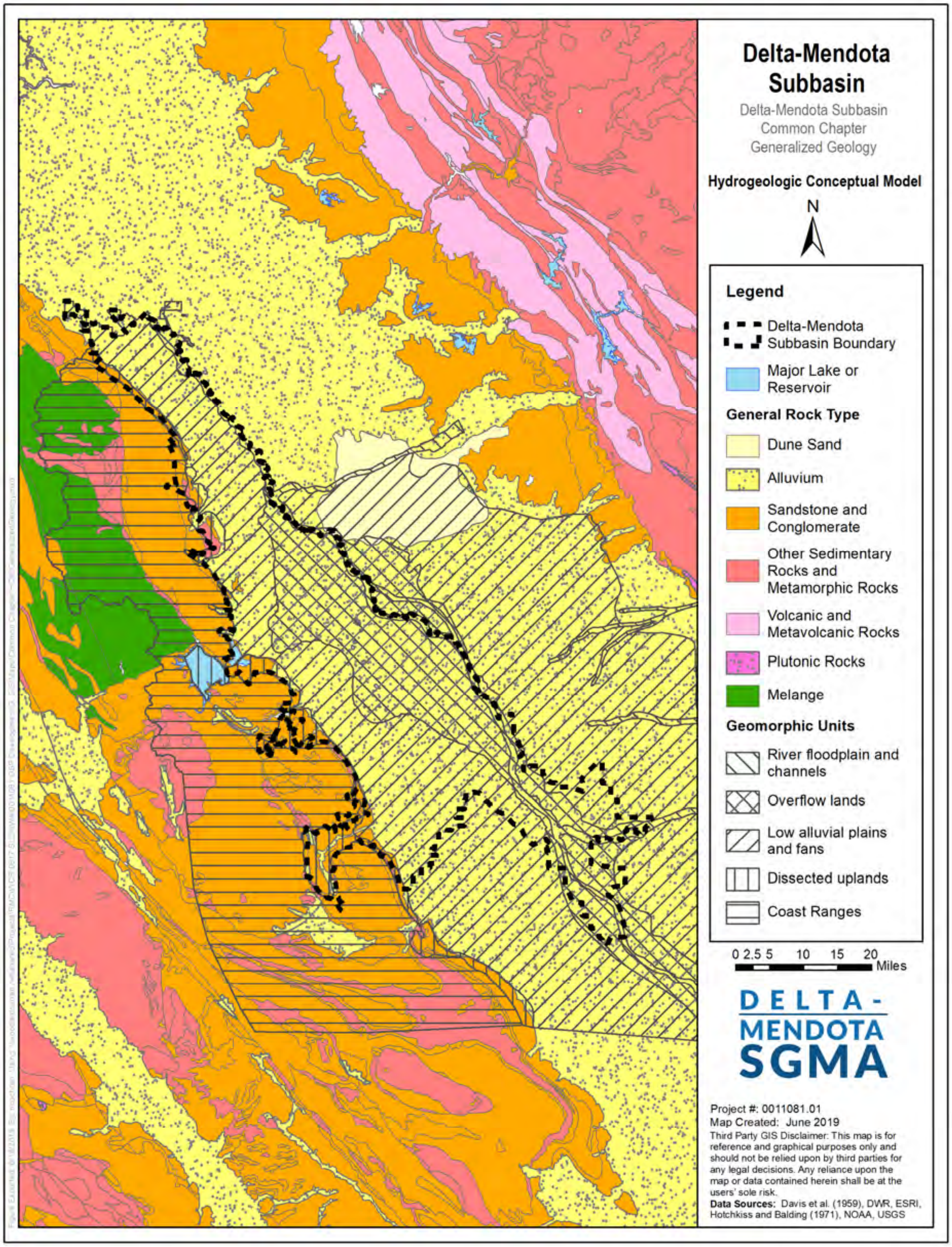


Figure CC-22: Generalized Geology

4.1.3 Geologic Formations and Stratigraphy

Distinct geomorphic units exist within the Delta-Mendota Subbasin defining areas of unique hydrogeologic environments. The geomorphic units are mapped and described by Hotchkiss and Balding (1971) and Davis et al. (1959) and are shown in **Figure CC-22**. The two primary geomorphic units within the Central Valley Floor area of the Delta-Mendota Subbasin include the overflow lands geomorphic unit and the alluvial fans and plains geomorphic unit. Overflow lands are defined as areas of relatively poorly draining soils with a shallow water table. The overflow lands geomorphic unit is located in the southeastern portion of the Subbasin and is dominated by finer-grained floodplain deposits that are the result of historical episodic flooding of this low-land area. This has formed poorly-draining soils with generally low hydraulic conductivity characteristics. In contrast, the alluvial fans and plains geomorphic unit is characterized by relatively better drainage conditions, with sediments comprised of coalescing and somewhat coarser-grained alluvial fan materials deposited by higher-energy streams flowing out of the Coast Range (Hotchkiss and Balding, 1971). The alluvial fans and plains geomorphic unit covers much of the Delta-Mendota Subbasin along the western margins of the Central Valley Floor at the base of the Coast Range.

The primary groundwater bearing units within the Delta-Mendota Subbasin consist of Tertiary and Quaternary-aged unconsolidated continental deposits and older alluvium of the Tulare Formation. Subsurface hydrogeologic materials covering the Central Valley Floor consist of lenticular and generally poorly sorted clay, silt, sand, and gravel that make up the alluvium and Tulare Formation. These deposits are thickest along the axis of the valley with thinning along the margins towards the Coast Range mountains (DWR, 2003; Hotchkiss and Balding, 1971). A zone of very shallow groundwater, generally within 25 feet of the ground surface, exists throughout large areas of the Subbasin, with considerable amounts (greater than 50 percent) of farmland in the area estimated to have very shallow depths to groundwater of less than 10 feet (Hotchkiss and Balding, 1971). Many of these areas are naturally swampy lands adjacent to the San Joaquin River.

The Tulare Formation extends to several thousand feet in depth and to the base of freshwater throughout most of the area and consists of interfingered sediments ranging in texture from clay to gravel of both Sierra Nevadan and Coast Range origin. The formation is composed of beds, lenses, and tongues of clay, sand, and gravel that have been alternatively deposited in oxidizing and reducing environments (Hotchkiss and Balding, 1971).

Terrace deposits of Pleistocene age lie up to several feet higher than present streambeds and are comprised of yellow, tan, and light-to-dark brown silt, sand, and gravel with a matrix that varies from sand to clay (Hotchkiss and Balding, 1971). The water table generally lies below the bottom of the terrace deposits; however, the relatively large grain size of the terrace deposits suggests their value as possible recharge sites. Alluvium is composed of interbedded, poorly to well-sorted clay, silt, sand, and gravel and is divided based on its degree of dissection and soil formation. The flood-basin deposits are generally composed of light-to-dark brown and gray clay, silt, sand, and organic material with locally high concentrations of salt and alkali. Stream channel deposits of coarse sand and gravel are also included.

The Tulare Formation also includes the Corcoran Clay (E-Clay) member, a diatomaceous clay or silty clay of lake bed origin which is a prominent aquitard in the San Joaquin Valley, separating the upper zone from the lower zone and distinguishing the semi-confined Upper Aquifer from the confined Lower Aquifer (Hotchkiss and Balding, 1971). The depth and thickness of the Corcoran Clay are variable within the Central Valley Floor, and it is not present in peripheral areas (outside the Central Valley Floor) of the Subbasin. Within the Upper Aquifer, additional clay layers exist and also provide varying degrees of confinement, including other clay members of the Tulare Formation and layers of white clay identified by

Hotchkiss and Balding (1971). These clays are variable in extent and thickness, but the white clay is noted to be as much as 60 feet thick in areas providing very effective confinement of underlying zones (Croft, 1972; Hotchkiss and Balding, 1971). The Tulare Formation is hydrologically the most important geologic formation in the Delta-Mendota Subbasin because it contains most of the fresh water-bearing deposits. Most of the natural recharge that occurs in the Subbasin is in the alluvial fan apex areas along Coast Range stream channels (Hotchkiss and Balding, 1971).

4.1.4 Faults and Structural Features

The valley floor portion of the Delta-Mendota Subbasin contains no known major faults and is fairly geologically inactive. There are few faults along the western boundary of the Subbasin within the Coast Range mountains, but they are not known to inhibit groundwater flow or impact water conveyance infrastructure (**Figure CC-23**).

4.1.5 Basin Boundaries

The Delta-Mendota Subbasin is defined by both geological and jurisdictional boundaries. The Delta-Mendota Subbasin borders all subbasins within the San Joaquin Valley Hydrologic Region with the exception of the Cosumnes Subbasin. The following subsections describe the lateral boundaries of the Subbasin, boundaries with neighboring subbasins, and the definable bottom of the Delta-Mendota Subbasin.

Lateral Boundaries

The Delta-Mendota Subbasin is geologically and topographically bounded to the west by the Tertiary and older marine sediments of the Coast Ranges, and to the east generally by the San Joaquin River. The northern, central, and southern portion of the eastern boundary are dictated by jurisdictional boundaries of water purveyors within the Delta-Mendota Subbasin.

As described in *California's Groundwater*, DWR Bulletin 118 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley. The northern boundary begins just south of Tracy in San Joaquin County. The eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin. The subbasin is bounded on the west by the coast range. The Subbasin boundary is defined by 20 segments detailed in the descriptions below. The Delta-Mendota Subbasin extends into six (6) counties: San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera and is shown in relation to each of the six counties in **Figure CC-9**.

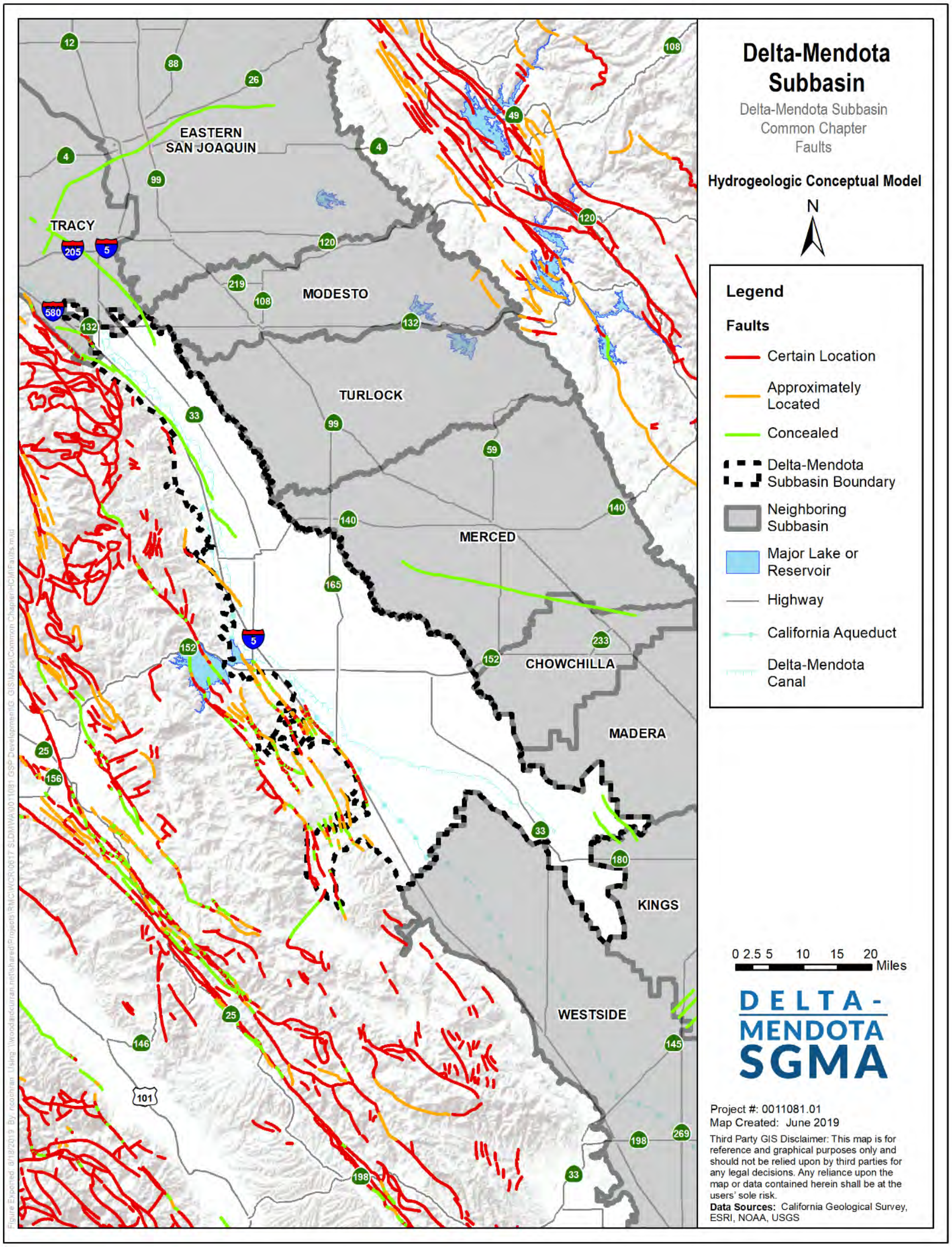


Figure CC-23: Subbasin Faults

4.1.6 Definable Bottom of Basin

In the San Joaquin Valley, the bottom of the Delta-Mendota Subbasin is defined as the interface of saline water of marine origin (base of fresh water) within the uppermost beds of the Tulare Formation. The Tulare Formation is characterized by blue and green fine-grained rocks and principally composed of fine-grained silty sands, silt, and clay (Foss and Blaisdell 1968). The Tulare Formation is predominantly marine in origin and is considered late Pliocene and possibly early Pleistocene in age. This formation is the upper shaley part of the Pliocene sequence. The top of the Tulare Formation is generally encountered around -2,000 feet mean sea level throughout the Delta-Mendota Subbasin. As agreed upon by the Delta-Mendota Subbasin GSP Groups, the base of freshwater is specifically defined by an electrical conductivity of 3,000 micromhos per centimeter at 25 °C, as presented by Page (1973). If and when significant use of water beyond the defined bottom takes place, the definition of the bottom will be revised appropriately.

4.1.7 Principal Aquifers and Aquitards

DWR's Groundwater Glossary defines an aquifer as "a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells, and springs". There are two primary aquifers within the Delta-Mendota Subbasin: a semi-confined aquifer above the Corcoran Clay and a confined aquifer below the Corcoran Clay, with the Corcoran Clay acting as the principal aquitard within the Delta-Mendota Subbasin. **Figure CC-24** shows the locations of the representative cross-sections for the Delta-Mendota Subbasin, where **Figure CC-25** through **Figure CC-30** show the hydrostratigraphy of the representative cross-sections.

While the two-aquifer system described above is generally true across the Delta-Mendota Subbasin, there are portions of the Subbasin where the Corcoran Clay does not exist (predominantly along the western margin of the Subbasin) and hydrogeology is generally controlled by localized interfingering clays, and/or where local hydrostratigraphy results in shallow groundwater conditions that differ, to some extent, from that seen in the Subbasin as a whole. Additionally, in the southern portion of the Subbasin in the Mendota, Aliso and Tranquillity areas, there are A and C Clay layers in addition to the Corcoran Clay that inhibit vertical groundwater flow. However, while there are localized complexities throughout the Subbasin, the Corcoran Clay (or E Clay) extends through much of the Delta-Mendota Subbasin, generally creating a two-aquifer system.

Principal Aquifers

In the Delta-Mendota Subbasin, there are two primary aquifers composed of alluvial deposits separated by the Corcoran Clay (KDSA, 2015): a semi-confined Upper Aquifer (generally the ground surface to the top of the Corcoran Clay), and a confined Lower Aquifer starting at the bottom of the Corcoran Clay to the base of fresh water. However, as previously described, the localized presence of the A and C Clay layers in the southern portion of the Subbasin, the absence of the Corcoran Clay at the western margin of the Subbasin, and/or local hydrostratigraphy result in differing shallow groundwater conditions and/or perched groundwater conditions in some portions of the Subbasin. See the individual GSPs for more detailed descriptions of hydrostratigraphy in the respective Plan areas.

Upper Aquifer

The Upper Aquifer is represented by materials extending from the upper groundwater table to the top of the Corcoran Clay. The Upper Aquifer includes shallow geologic units of younger and older alluvium and upper parts of the Tulare Formation. Sediments within the upper Tulare Formation have variable sources, and subdivision of units can be distinguished between eastern and western sourced materials. Alluvial fan materials above the Corcoran Clay in the Delta-Mendota Subbasin are generally more extensive than older alluvial fan deposits within the Tulare Formation below the Corcoran Clay. As shown in Figure CC-31 by the depth to the top of the Corcoran Clay, the Upper Aquifer extends to depths ranging between approximately 150 feet and greater than 350 feet. Other notable mapped clay units also exist within the upper part of the Tulare Formation in the Delta-Mendota Subbasin, including the A and C Clay members of the Tulare Formation and a white clay mapped by Hotchkiss and Balding (1971).

Lower Aquifer

The Lower Aquifer is the portion of the Tulare Formation that is confined beneath the Corcoran Clay, extending downward to the underlying San Joaquin Formation and the interface of saline water of marine origin within its uppermost beds. The Lower Aquifer is generally characterized by groundwater that tends to be dominantly sodium-sulfate type, which is often of better quality than the Upper Aquifer (Davis et al., 1957; Hotchkiss and Balding, 1971). Exceptions to this quality do exist in the Subbasin, particularly in the southwestern portion of the Subbasin. Because of its relatively shallow depth within the Delta-Mendota Subbasin and lower salinity in areas when compared to other groundwater resources, the Lower Aquifer is heavily utilized as a source of groundwater for agricultural and drinking water uses within the Subbasin.

The base of the Lower Aquifer generally decreases from south to north, changing in depth from about 1,100 to 1,200 feet deep in the south to about 600 feet to the north. Depth to the top of the Corcoran Clay ranges from less than 100 feet on the west near Interstate 5 (I-5) to more than 500 feet in the area near Tranquillity. The Corcoran Clay pinches out or is above the water level near the California Aqueduct in the western part of the Subbasin, where the Upper and Lower Aquifers merge into interfingered layers of sand, gravel, and clay.

Corcoran Clay

The Corcoran Clay, as a regional aquitard, is a notable hydrogeologic feature throughout most of the Delta-Mendota Subbasin, impeding vertical flow between the Upper and Lower Aquifers. The Corcoran Clay is present at varying depths across most of the Central Valley floor (**Figure CC-31** and **Figure CC-33**). The depths to the top of the Corcoran Clay ranges between approximately 100 and 500 feet below the ground surface throughout most of the Subbasin, with a general spatial pattern of deepening to the south and east. In the far southeastern area of the Subbasin, in the vicinity of Mendota and Tranquillity, the top of the Corcoran Clay is at depths of greater than 350 feet (**Figure CC-31**). The thickness of the Corcoran Clay, which likely influences the degree of hydraulic separation between the Upper and Lower Aquifers, is greater than 50 feet across most of the Delta-Mendota Subbasin with thicknesses of more than 75 feet in central Subbasin areas in the vicinity of Los Banos and Dos Palos, and 140 feet in the eastern portions of the Subbasin. The Corcoran Clay appears thinner in areas north of Patterson, between Patterson and Gustine, and also in the vicinity of Tranquillity to the south (**Figure CC-33**). Along the westernmost portions of the Delta-Mendota Subbasin, the Corcoran Clay layer is generally non-existent or it exists as Corcoran-equivalent clays (clays existing at the same approximate depth but not part of the mapped aquitard).

Aquifer Properties

The following subsections include discussion of generalized aquifer properties within the Delta-Mendota Subbasin. These include hydraulic conductivity, transmissivity, specific yield and specific storage.

DWR defines hydraulic conductivity as the "measure of a rock or sediment's ability to transmit water" and transmissivity as the "aquifer's ability to transmit groundwater through its entire saturated thickness" (DWR, 2003). High hydraulic conductivity values correlate with areas of transmissive groundwater conditions with transmissivity generally equaling hydraulic conductivity times the saturated thickness of the formation. Storage of water within the aquifer system can be quantified in terms of the specific yield for unconfined groundwater flow and the storage coefficient for confined flow, respectively (Faunt et al., 2009). Specific yield represents gravity-driven dewatering of shallow, unconfined sediments at a declining water table, but also accommodates a rising water table. The specific yield is dimensionless and represents the volume of water released from or taken into storage per unit head change per unit area of the water table. Specific yield is a function of porosity and specific retention of the sediments in the zone of water-table fluctuation.

Where the aquifer system is confined, storage change is governed by the storage coefficient, which is the product of the thickness of the confined-flow system and its specific storage. The specific storage is the sum of two component specific storages – the fluid (water) specific storage and the matrix (skeletal) specific storage, which are governed by the compressibility of the water and skeleton, respectively (Jacob, 1940). Specific storage has units of 1 over length and represents the volume of water released from or taken into storage in a confined flow system per unit change in head per unit volume of the confined flow system (Faunt et al., 2009). Therefore, the storage coefficient of a confined flow system is dimensionless and, similar to specific yield, represents the volume of water released from or taken into storage per unit head change.

Hydraulic Conductivity

Figure CC-34 shows the saturated C-horizon hydraulic conductivity of surficial soils within the Delta-Mendota Subbasin based on the National Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO). Soil survey data for counties within the Subbasin were combined using the weighted harmonic mean of these representative layers to depict the saturated hydraulic conductivity of the C-horizon for each soil map unit. The soil profile represented by these data is variable but commonly extends to a depth of six or more feet.

Floodplain deposits are evident as soils with relatively low hydraulic conductivity (less than 0.5 feet per day [ft/day]) blanket much of the Central Valley Floor, although localized areas of soils with higher hydraulic conductivity are present in association with modern and ancient surface waterways and alluvial fan features (**Figure CC-34**). Coarse soils of distributary alluvial fan sediments deposited by Del Puerto Creek, Orestimba Creek, Los Banos Creek, Ortigalita Creek, and Little Panoche Creek, in addition to other ephemeral northeasterly creek flows off the Coast Ranges, are notably apparent as areas of soils of high hydraulic conductivity located along active and inactive stream channels extending eastward from the fan apex areas along the Valley Floor margins to the current alignment of the San Joaquin River in the valley axis. Additionally, soils in areas adjacent to the active channel of the San Joaquin River also exhibit high hydraulic conductivities, including values of greater than 4 ft/day which are particularly apparent in an area north of Mendota. Soils of similarly high hydraulic conductivity trending as linear features in a general northwest-southeast alignment to the north of Dos Palos and Los Banos are likely the result of historical depositional processes and paleochannels associated with the San Joaquin River (**Figure CC-34**). In areas peripheral to the Central Valley floor, soils tend to be characterized by relatively low hydraulic conductivity, although soils of somewhat higher hydraulic conductivity associated with distinct geologic units are mapped across much of the peripheral area to the west of Patterson and Gustine and also in localized bands associated with surface water courses.

Transmissivity

Transmissivity varies greatly above the Corcoran Clay, within the Corcoran Clay, and below the Corcoran Clay within the Delta-Mendota Subbasin, with transmissivities in the confined Lower Aquifer generally being larger than those in the semi-confined Upper Aquifer. Based on testing conducted at multiple locations within both the Upper and Lower Aquifers of the Delta-Mendota Subbasin, average transmissivities in the Subbasin are approximately 109,000 gallons per day per square foot (gpd/ft^2) (KDSA, 1997b).

Specific Yield

DWR defines specific yield as the "amount of water that would drain freely from rocks or sediments due to gravity and describes the proportion of groundwater that could actually be available for extraction" (DWR, 2003). Specific yield is a measurement specific to unconfined aquifers.

The estimated specific yield of the Delta-Mendota Subbasin is 0.118 (DWR, 2006). Within the southern portion of the Delta-Mendota Subbasin, specific yield ranges from 0.2 to 0.3 (Belitz et al., 1993). Specific yield estimates for the Delta-Mendota Subbasin are fairly limited in literature since the Upper Aquifer above the Corcoran Clay is semi-confined and the Lower Aquifer below the Corcoran Clay is confined. Therefore, specific yield values only characterize the shallow, unconfined groundwater within the Subbasin.

Specific Storage

Values for specific storage were extracted from the Central Valley Hydrologic Model 2 (CVHM2), which is currently under development by the United States Geological Survey (USGS) and includes refinements for the Delta-Mendota Subbasin. Specific storage varies above, within, and below the Corcoran Clay with CVMH2. Above the Corcoran Clay, specific storage ranges from 1.34×10^{-6} to 6.46×10^{-2} $meters^{-1}$ (m^{-1}) with average values ranging from 6.16×10^{-3} to 1.97×10^{-2} m^{-1}. Specific storage within the Corcoran Clay is considerably smaller than above the Corcoran Clay, ranging between 1.41×10^{-6} and 2.35×10^{-6} m^{-1} and average values between 1.96×10^{-6} and 2.02×10^{-6} m^{-1}. Below the Corcoran Clay, specific storage is comparable to within the Corcoran Clay with overall ranges the same as within the Corcoran Clay and average values ranging from 1.86×10^{-6} to 2.01×10^{-6} m^{-1}. Therefore, specific storage is greatest within the semi-confined aquifer overlying the Corcoran Clay layer, with considerably smaller specific storage values within the low permeability Corcoran Clay and confined aquifer underlying the Corcoran Clay layer.

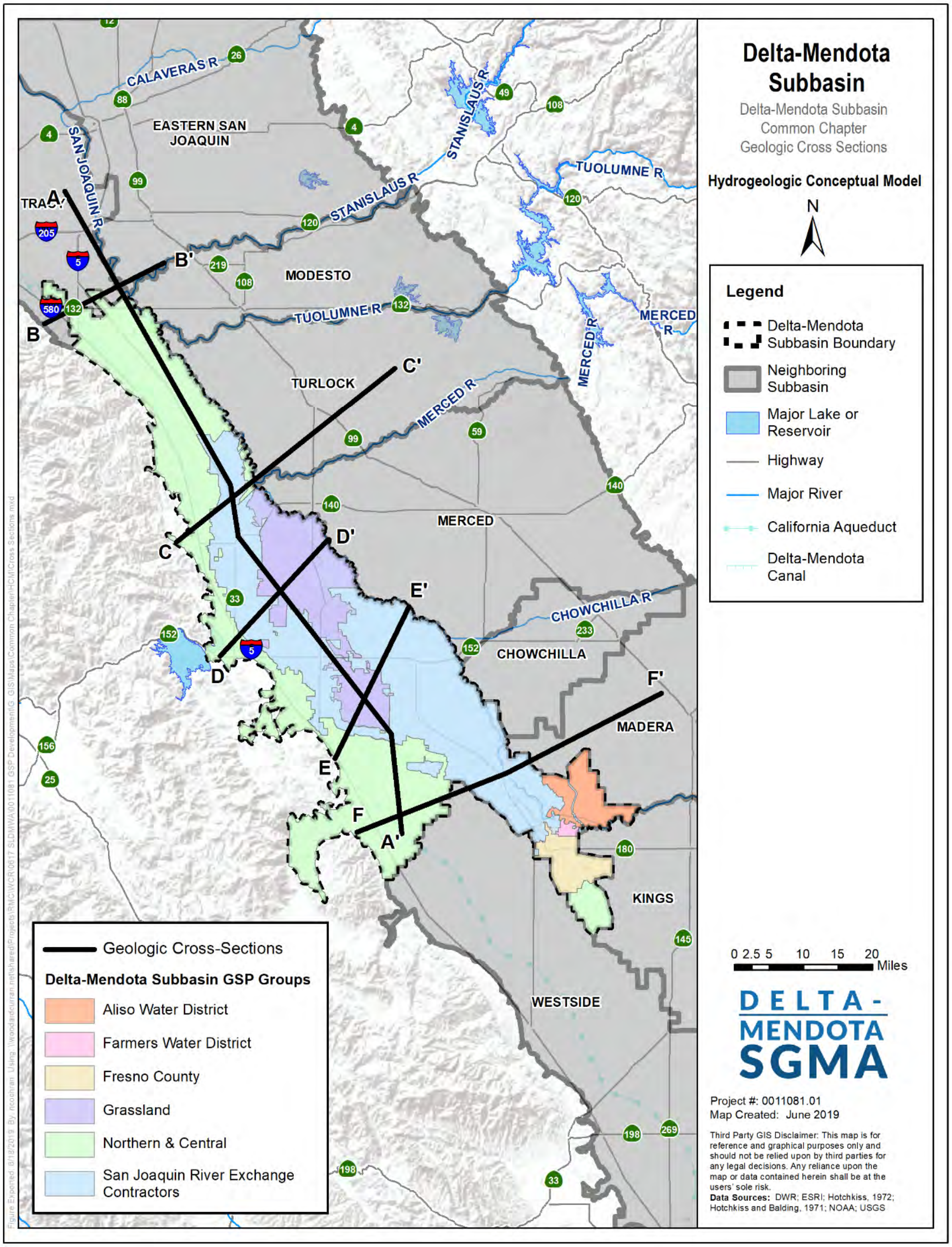


Figure CC-24: Representative Cross-Sections

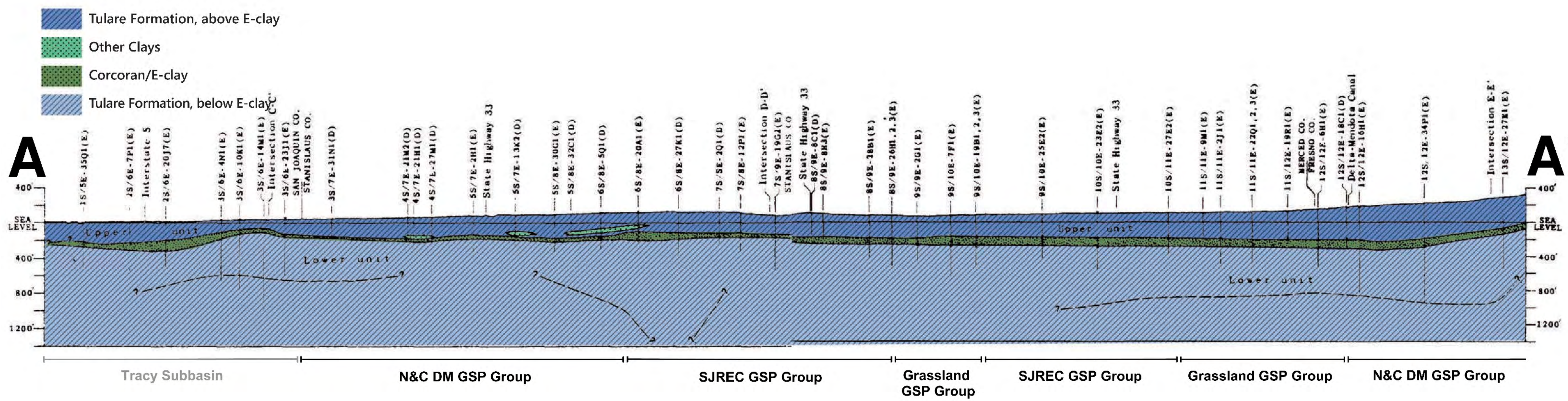


Figure CC-25: Cross-Section A-A' (Hotchkiss, 1972)

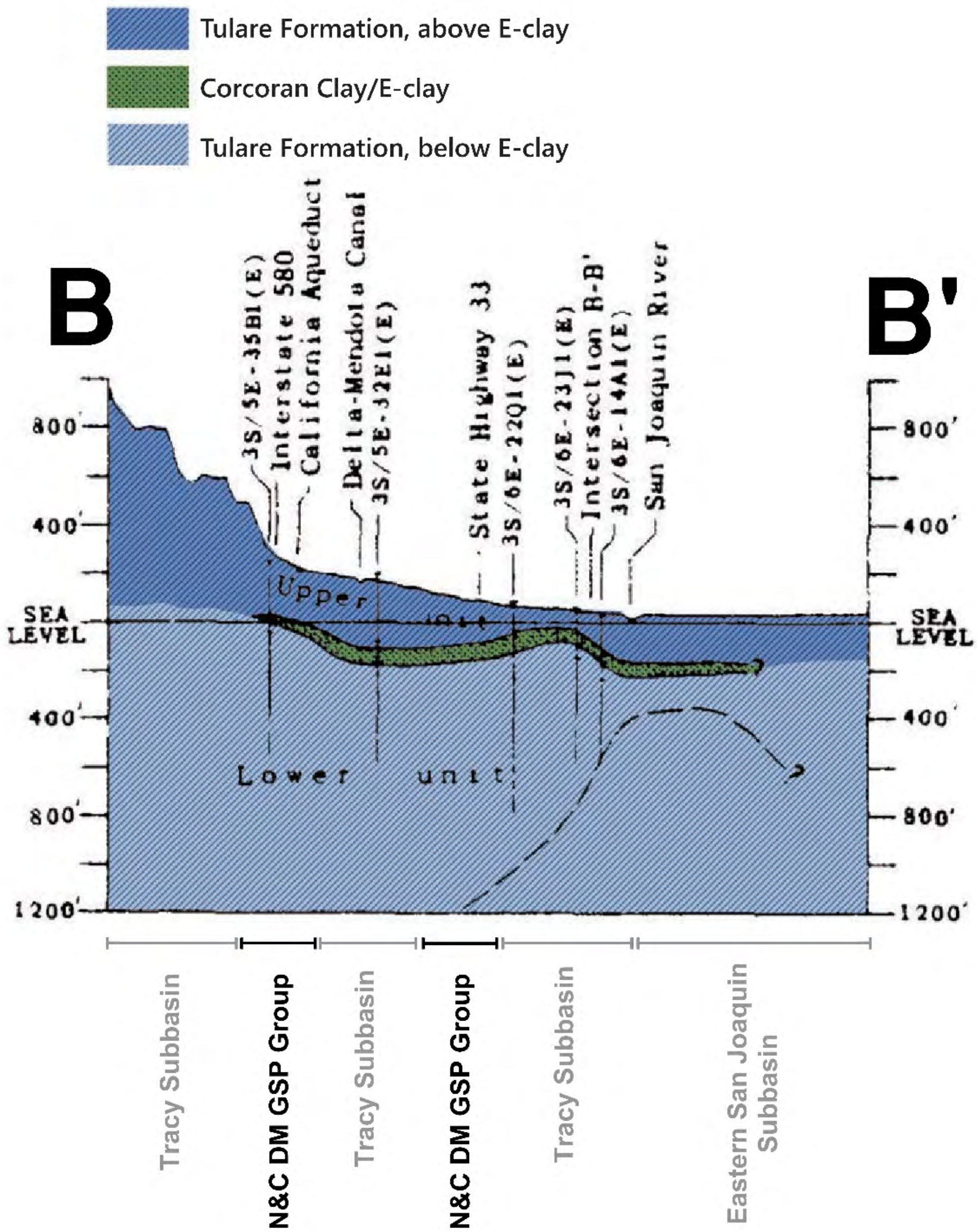


Figure CC-26: Cross-Section B-B' (Hotchkiss, 1972)

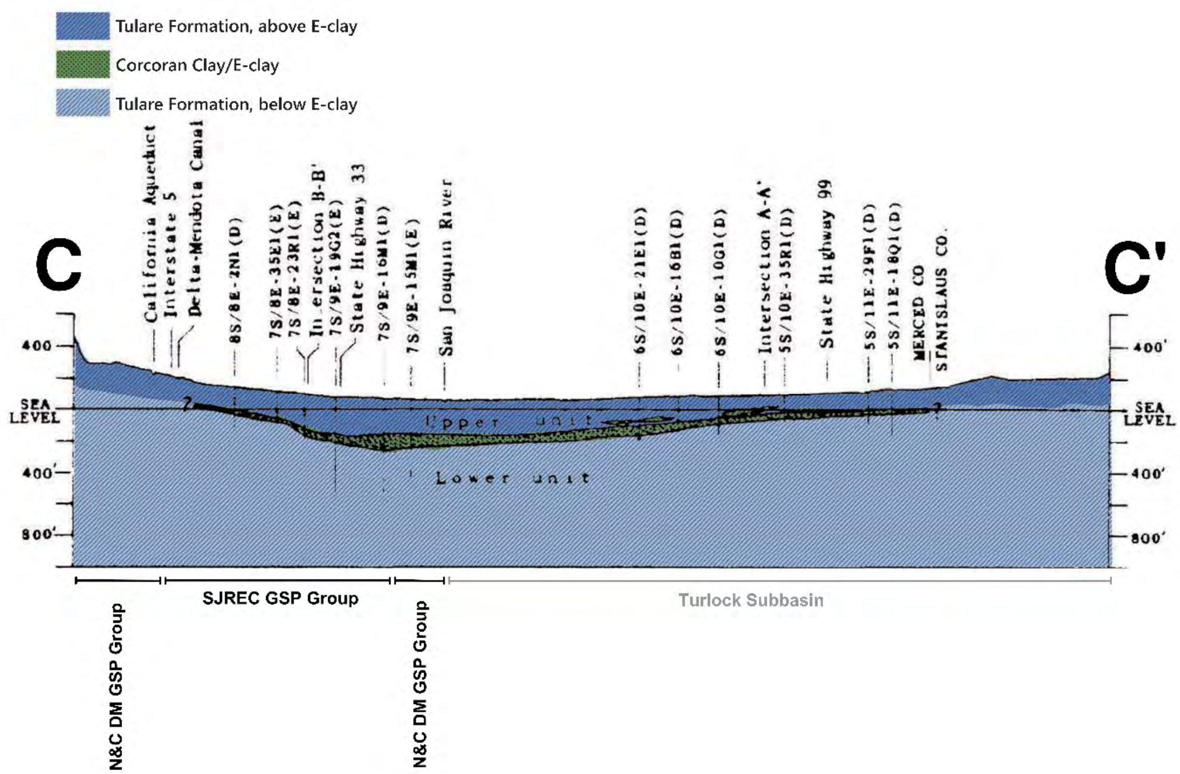


Figure CC-27: Cross-Section C-C' (Hotchkiss, 1972)

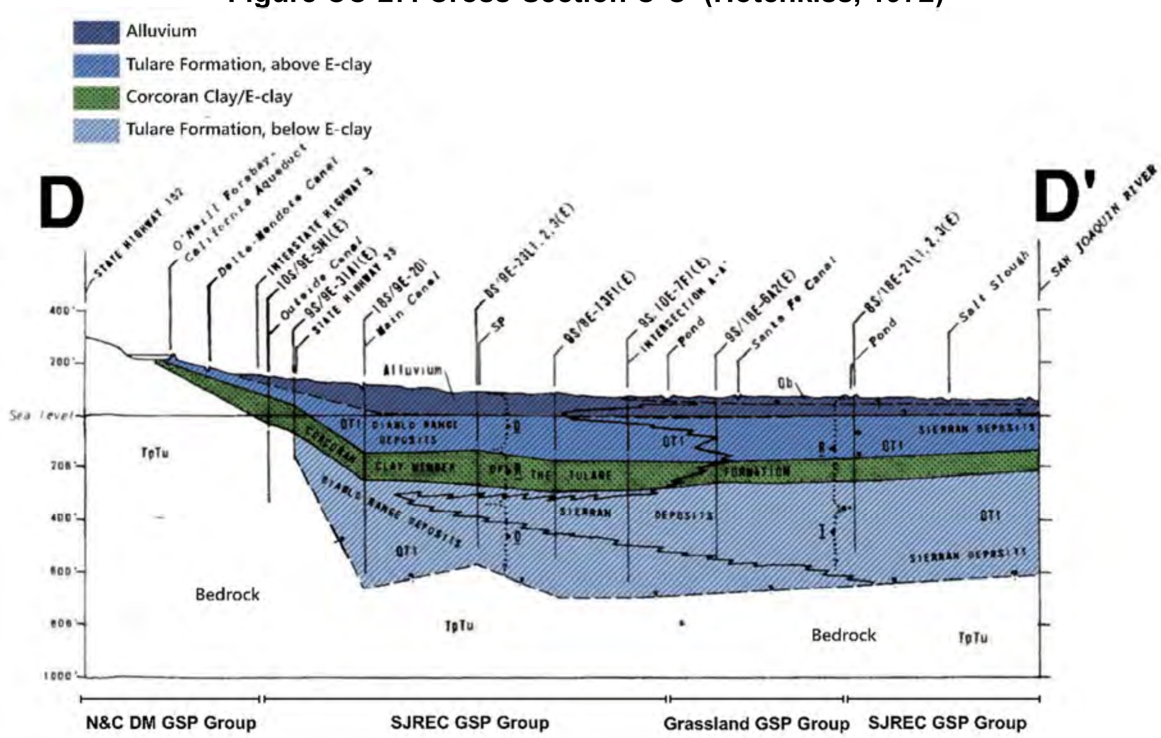


Figure CC-28: Cross-Section D-D' (Hotchkiss & Balding, 1971)

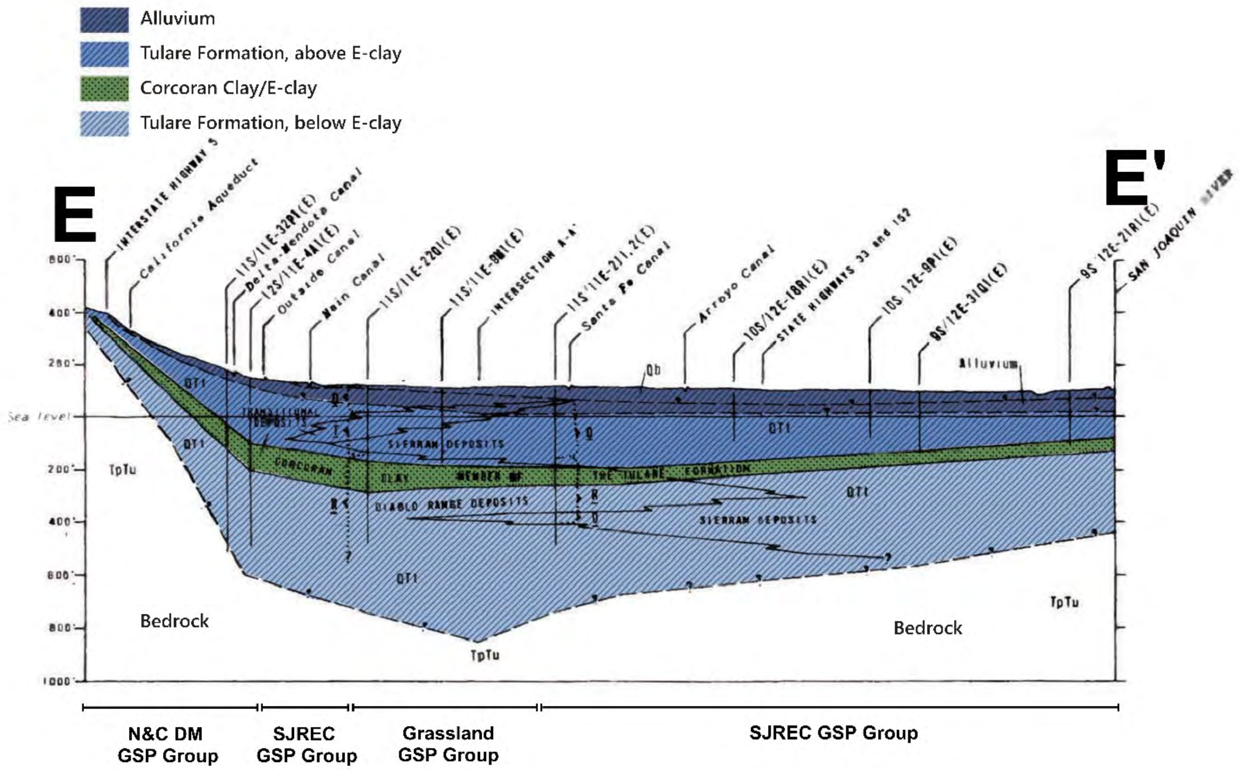


Figure CC-29: Cross-Section E-E' (Hotchkiss & Balding, 1971)

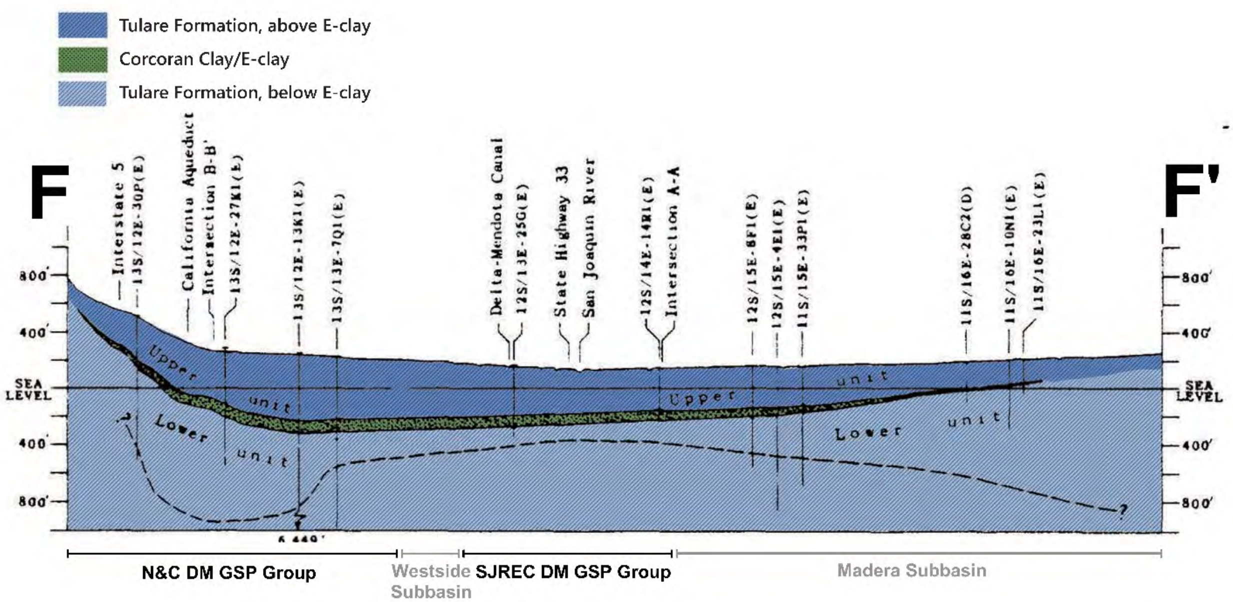


Figure CC-30: Cross-Section F-F' (Hotchkiss, 1972)

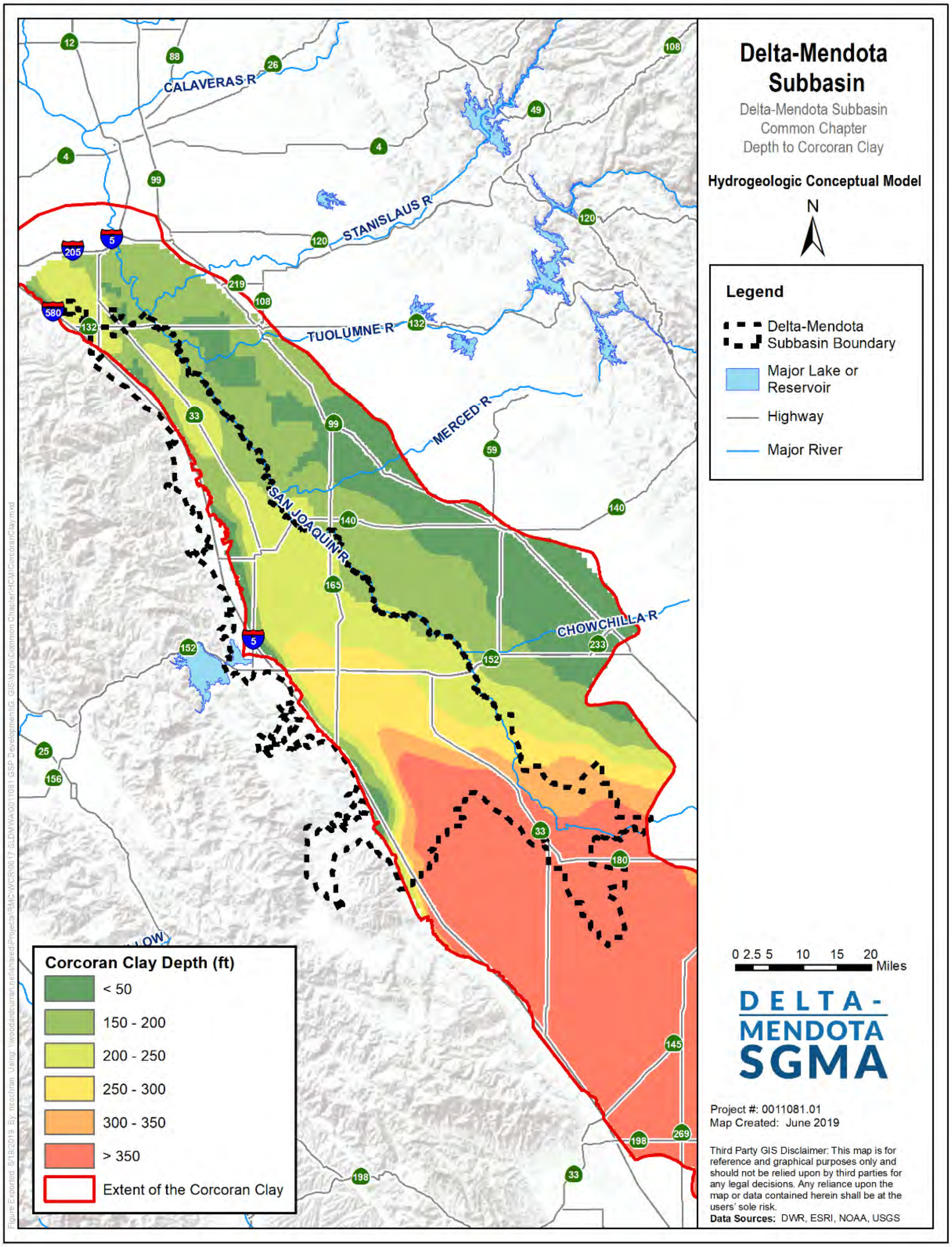


Figure CC-31: Depth to Corcoran Clay

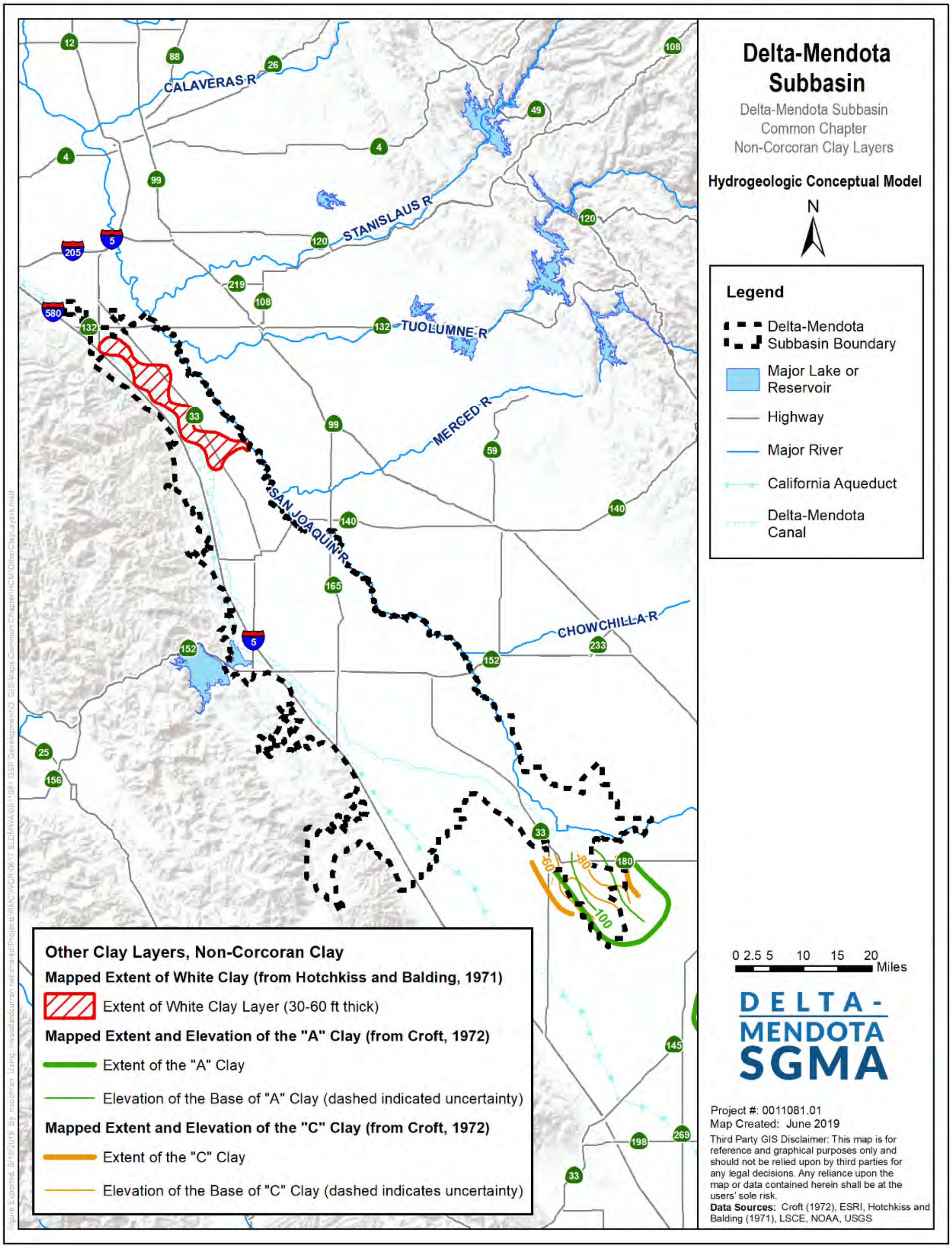


Figure CC-32: Non-Corcoran Clay Layers

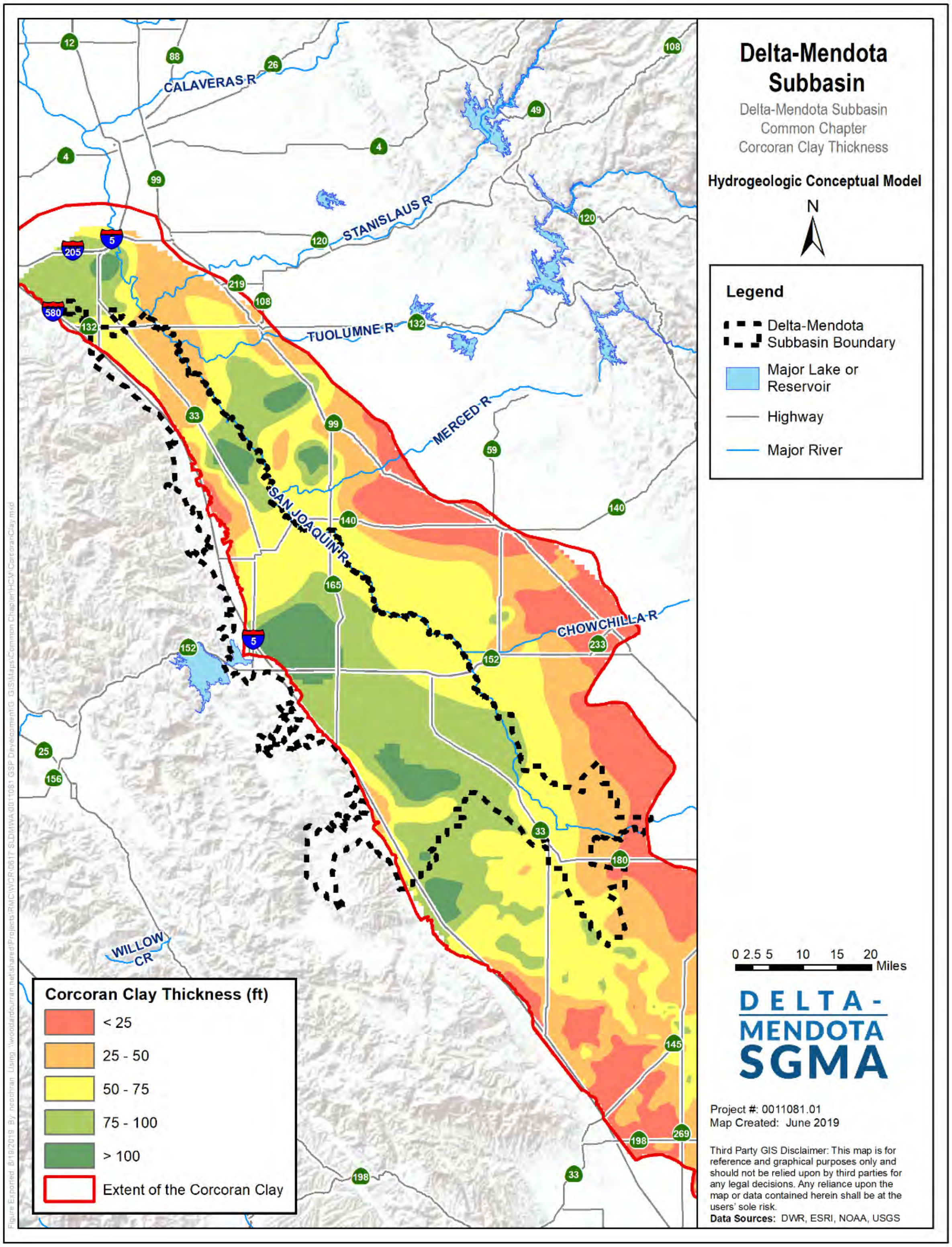


Figure CC-33: Thickness of Corcoran Clay

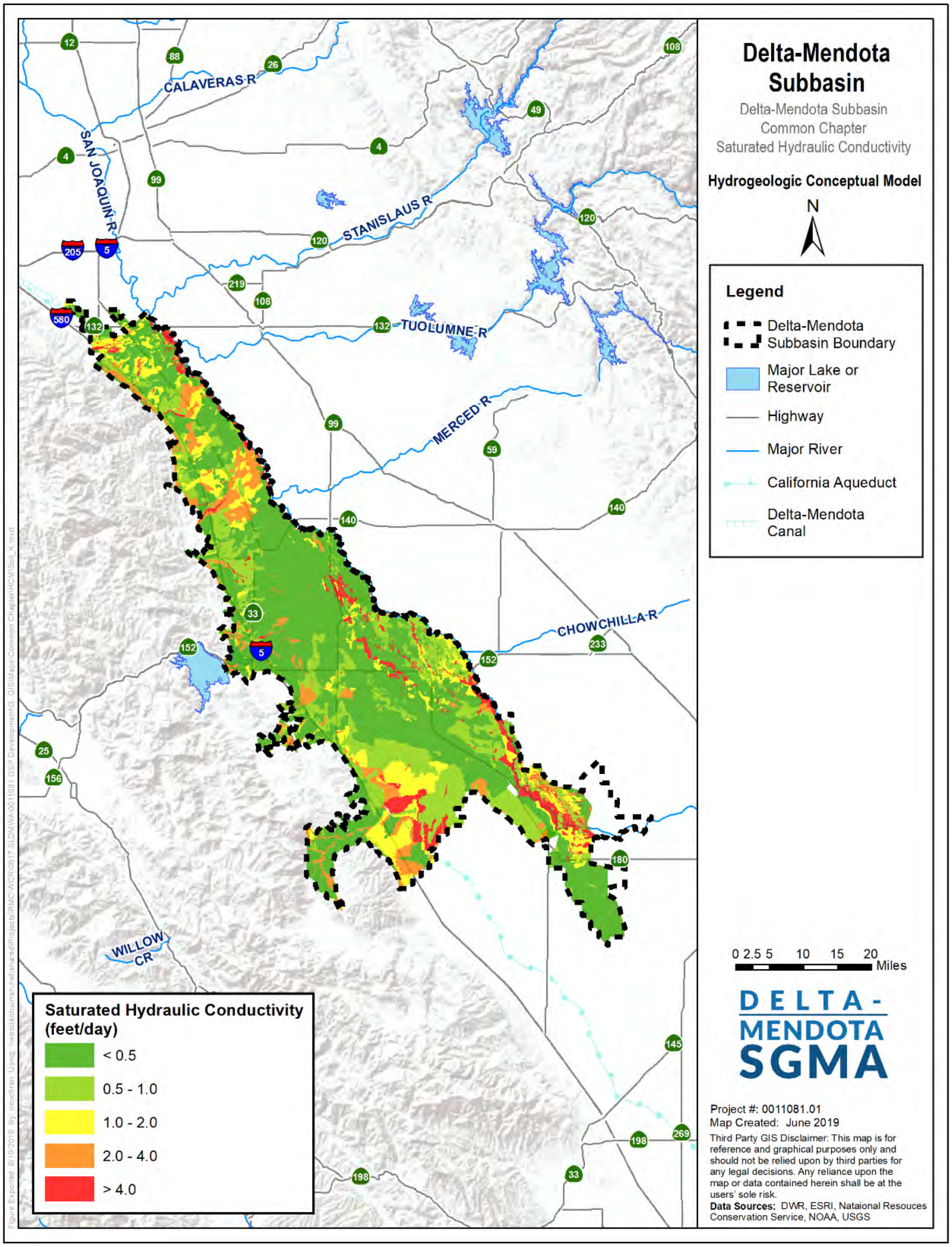


Figure CC-34: Soil Hydraulic Conductivity

4.1.8 Structural Properties and Restricted Groundwater Flow

Under natural (pre-development) conditions, the prevailing groundwater flow within the Upper and Lower Aquifer systems of the western San Joaquin Valley was predominantly in a generally northeasterly direction from the Coast Range towards and parallel to the San Joaquin River and the Sacramento-San Joaquin Delta (LSCE, 2015; Hotchkiss and Balding, 1971; KDSA, 2015). Historically, numerous flowing artesian wells within the Lower Aquifer existed throughout the Delta-Mendota Subbasin (Mendenhall et al., 1916) and the pressure gradient for groundwater flow was upward from the Lower Aquifer to the Upper Aquifer. These flowing artesian conditions have disappeared in many areas as a result of increased development of groundwater resources within the Tulare Formation (Hotchkiss and Balding, 1971). Additionally, the Delta-Mendota Subbasin has experienced periods of considerable decline in groundwater levels during which hydraulic heads in the Lower Aquifer decreased considerably in some areas due to heavy pumping (Bertoldi et al., 1991).

Despite the presence of local pumping depressions within parts of the Subbasin, the prevailing northeastward flow direction for groundwater in the Upper Aquifer within the region has remained (AECOM, 2011; DWR, 2010; Hotchkiss and Balding, 1971). Groundwater generally flows outward from the Delta-Mendota Subbasin, except along the southern and western margins where there is some recharge from local streams and canal seepage (KDSA, 2015), in addition to northward subbasin boundary flows. Within the Upper Aquifer, there are similar groundwater flow directions in most of the Subbasin with groundwater outflow to the northeast or towards the San Joaquin River in much of the Subbasin during wet and normal periods. One exception is in the Orestimba Creek area west of Newman where groundwater flows to the west during drought conditions and east during wet periods. Calculations based on aquifer transmissivity indicate the net groundwater outflow in the Upper Aquifer has been about three times greater during drought periods than during normal periods (KDSA, 1997a and 1997b).

Within the Lower Aquifer, there is a groundwater divide generally in the area between Mendota and the point near the San Joaquin River in the Turner Island area, northeast of Los Banos. Groundwater southwest of this divide generally flows southwest toward Panoche Water District and Westlands Water District. Groundwater northeast of this divide flows to the northeast into Madera and Merced Counties. Net groundwater outflow in the Lower Aquifer under drought conditions has been about two and a half times greater than for normal conditions (KDSA, 1997a and 1997b). Based on current and historical groundwater elevation maps, groundwater barriers do not appear to exist in the Delta-Mendota Subbasin (DWR, 2006).

The combined effect of pumping below the Corcoran Clay and increased leakage from the Upper Aquifer to the Lower Aquifer where the Corcoran Clay does not exist or has been perforated has developed a generally downward flow gradient in the Tulare Formation which changes with variable pumping and irrigation over time (Bertoldi et al., 1991). Periods of great groundwater level declines have also resulted in inelastic compaction of fine-grained materials in some locations, particularly between Los Banos and Mendota, potentially resulting in considerable decreases (between 1.5 and 6 times) in permeability of clay members within the Tulare Formation, including the Corcoran Clay (Bertoldi et al., 1991). However, the number of wells penetrating the Corcoran Clay may be enabling vertical hydraulic communication across the Corcoran Clay aquitard and other clay layers (Davis et al., 1959; Davis et al., 1964).

4.1.9 Water Quality

Groundwater in the Delta-Mendota Subbasin is characterized by mixed sulfate to bicarbonate water types in the northern and central portion of the Subbasin, with areas of sodium chloride and sodium sulfate waters in the central and southern portions (DWR, 2003). Total Dissolved Solids (TDS) values range from 400 to 1,600 mg/L in the northern portion, and 730 to 6,000 mg/L in the southern portion of the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971). The Department of Health Services (currently the Division of Drinking Water), which monitors Title 22 water quality standards, reports TDS values in 44 public supply wells in the Subbasin ranging in value from 210 to 1,750 mg/L, with an average value of 770 mg/L. Shallow, saline groundwater also occurs within about 10 feet of the ground surface over a large portion of the Delta-Mendota Subbasin. There are also localized areas of high iron, fluoride, nitrate, selenium, and boron in the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971).

Alluvial sediments derived from west-side streams are composed of material from serpentine, shale, and sandstone parent rock, which results in soil and groundwater types entirely different from those on the east side of the San Joaquin Valley (LSCE, 2015). In contrast with the siliceous mineralogy of the alluvial sands and gravels on the eastern side of the Central Valley that are derived from the Sierra granitic rocks (which are coarser and more resistant to chemical dissolution), the sulfate and carbonate shales and sandstones of Coast Range sediments on the western side are more susceptible to dissolution processes. Some soils and sediments within the western San Joaquin Valley that are derived from marine rocks of the Coast Range have notably high concentrations of naturally-occurring nitrogen, with particularly higher nitrate concentrations in younger alluvial sediments (Strathouse and Sposito, 1980; Sullivan et al., 1979). These naturally-occurring nitrogen sources may contribute to nitrate concentrations in groundwater within the Delta-Mendota Subbasin, although it is not well known where this may occur and to what degree. Naturally-high concentrations of TDS in groundwater are known to have existed historically within parts of the Subbasin due to the geochemistry of the Coast Range rocks and the marine depositional environment, the resulting naturally-high TDS of recharge derived from Coast Range streams, the dissolvable materials within the alluvial fan complexes, and the naturally-poor draining conditions which tend to concentrate salts in the system. The chemical quality of waters in the Coast Range streams can be closely correlated with the geologic units within their respective catchments. Groundwater flows discharging from these marine and non-marine rocks into streams introduce a variety of dissolved constituents resulting in variable groundwater types. The water quality and chemical makeup in westside streams can be highly saline, especially in more northern streams, including Corral Hollow, Panoche and Del Puerto Creeks, where historical baseflow TDS concentrations have typically exceeded 1,000 mg/L with measured concentrations as high as 1,790 mg/L (Hotchkiss and Balding, 1971). This is in contrast with TDS concentrations typically below 175 mg/L in streams draining from the Sierras. The contribution of water associated with these Coast Range sediments has resulted in naturally-high salinity in groundwater within and around the Delta-Mendota Subbasin, which has been recognized as early as the 1900s (Mendenhall et al., 1916). Groundwater in some areas within the immediate vicinity of the San Joaquin River is influenced by lower-salinity surface water discharging from the east side of the San Joaquin Valley Groundwater Basin (Davis et al., 1957).

Areas of historical high saline groundwater documented by Mendenhall *et al*. (1916) indicate somewhat high TDS concentrations approaching or greater than 1,000 mg/L in wells sampled throughout many parts of the Delta-Mendota Subbasin. Areas of locally higher TDS concentrations (1,500-2,400 mg/L) have existed between Mendota and Los Banos; whereas the trend in deeper groundwater (average well depth of 450 feet) south of Mendota near Tranquillity indicates slightly lower historical salinity conditions, but still somewhat high with an average TDS concentration of greater than 1,000 mg/L. In the northern part of the Subbasin, north of Gustine, the average historical TDS concentration of wells was also relatively high (930 mg/L). Historically low TDS concentrations (<500 mg/L) existed in groundwater from wells with an average depth of 209 feet in the central Subbasin area between Los Banos and Gustine.

The general chemical composition of groundwater in the Subbasin is variable based on location and depth. Groundwater within the Upper Aquifer is largely characterized as transitional type with less area characterized as predominantly of chloride, bicarbonate, and sulfate water types. Transitional water types, in which no single anion represents more than 50 percent of the reactive anions, occurs in many different combinations with greatly ranging TDS concentrations. Chloride-type waters occur generally in grassland areas east of Gustine and around Dos Palos, with sodium chloride water present in northern areas near Tracy and also extending south from Dos Palos. These waters also exhibit greatly varying salinity with typical TDS concentrations, ranging from less than 500 mg/L to greater than 10,000 mg/L and of high sodium makeup (50-75 percent of cations present) (Hotchkiss and Balding, 1971). Areas of bicarbonate groundwater within the Upper Aquifer of relatively lower TDS concentrations are directly associated with intermittent streams of the Coast Range near Del Puerto, Orestimba, San Luis, and Los Banos Creeks. Sulfate water in the central and southern Subbasin areas has TDS concentrations decreasing from west (1,200 mg/L) to east (700 mg/L) towards the San Joaquin River, similar to the bicarbonate water areas, although areas of sulfate water south of Dos Palos have much higher TDS concentrations (1,900 to 86,500 mg/L) (Hotchkiss and Balding, 1971).

Groundwater in the Lower Aquifer below the Corcoran Clay is also spatially variable, consisting of mostly transitional sulfate waters in the northern part of the Delta-Mendota Subbasin to more sodium-rich water further south in the grassland areas. In the northern part of the Delta-Mendota Subbasin, the Lower Aquifer exhibits relatively lower TDS concentrations, ranging from 400 to 1,600 mg/L, with a sulfate-chloride type makeup near the valley margin trending to sulfate-bicarbonate type near the valley axis. Farther south, TDS concentrations in the Lower Aquifer increase (Hotchkiss and Balding, 1971).

Natural conditions of groundwater salinity exist throughout the Upper and Lower Aquifers as a result of the contribution of salts from recharge off the Coast Range mountains. Surface water and groundwater flowing over and through Coast Range sediments of marine origin have dissolved naturally-occurring salts, contributing to the historical and current presence of salinity in groundwater within the Delta-Mendota Subbasin. In addition to natural salinity contributed from the Coast Range sediments, a number of other mechanisms are believed to further contribute to increased salinity in the groundwater in the region. Poorly draining soil conditions are extensive within some of the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine, and these types of soil, combined with a shallow water table, contribute to a build-up of soil salinity.

4.1.10 Topography, Surface Water, Recharge, and Imported Supplies

This section describes the topography, surface water, soils, and groundwater recharge potential in the Delta-Mendota Subbasin.

Topography

As previously described, the Delta-Mendota Subbasin lies on the western side of the Central Valley and extends from the San Joaquin River on the east, along the axis of the Valley, to the Coast Range on the west side (LSCE, 2015). The Subbasin has ground surface elevations ranging from less than 100 feet above mean sea level (msl) along parts of the eastern edge to greater than 1,600 feet msl in the Coast Range mountains (**Figure CC-35**). Most of the lower elevation areas occur east of Interstate 5, in the eastern parts of the Delta-Mendota Subbasin; although some lower elevation areas also extend westward into the Coast Range, such as in Los Banos Creek Valley. Low elevation areas generally coincide with the extent of the Central Valley floor. Topography within the Delta-Mendota Subbasin consists largely of flat areas across the Central Valley floor, where slopes are generally less than 2 percent, with steepening slopes to the west. The topography outside of the Central Valley floor in the Coast Range mountains is characterized by steeper slopes, generally greater than 6 percent.

Surface Water Bodies

The San Joaquin River and its tributaries is the primary natural surface water feature within the Delta-Mendota Subbasin, flowing from south to north along the eastern edge of the Subbasin (LSCE, 2015). During the 1960s, the San Joaquin River exhibited gaining flow conditions through much of the Subbasin (Hotchkiss and Balding, 1971). Numerous intermittent streams from the Coast Range enter the Delta-Mendota Subbasin from the west; however, none of these maintain perennial flow and only Orestimba Creek, Los Banos Creek and Del Puerto Creek have channels that extend eastward to a junction with the San Joaquin River. Most of the flow in other notable west-side creeks, including Quinto Creek, San Luis Creek, Little Panoche Creek, and Ortigalita Creek, is lost to infiltration (Hotchkiss and Balding, 1971). Flow from Los Banos and San Luis Creeks are impounded by dams on their respective systems. When flood releases are made from Los Banos Creek Reservoir, the vast majority of flows pass through Grassland Water District to the San Joaquin River as they tend to occur during times when agricultural and wetland demand is low. San Luis Reservoir on San Luis Creek, which is located along the western boundary of the Delta-Mendota Subbasin, is an artificial water storage facility for the Central Valley Project and California State Water Project and has no notable natural surface water inflows. Outflows from the reservoir go into the system of federal- and state-operated canals and aqueducts comprising the Central Valley and State Water Projects. Surface water use within the Delta-Mendota Subbasin is derived largely from water deliveries provided by these projects, including from the California Aqueduct (referred to as San Luis Canal in the joint-use area of the California Aqueduct) and Delta-Mendota Canal, and also from the San Joaquin River (**Figure CC-36**).

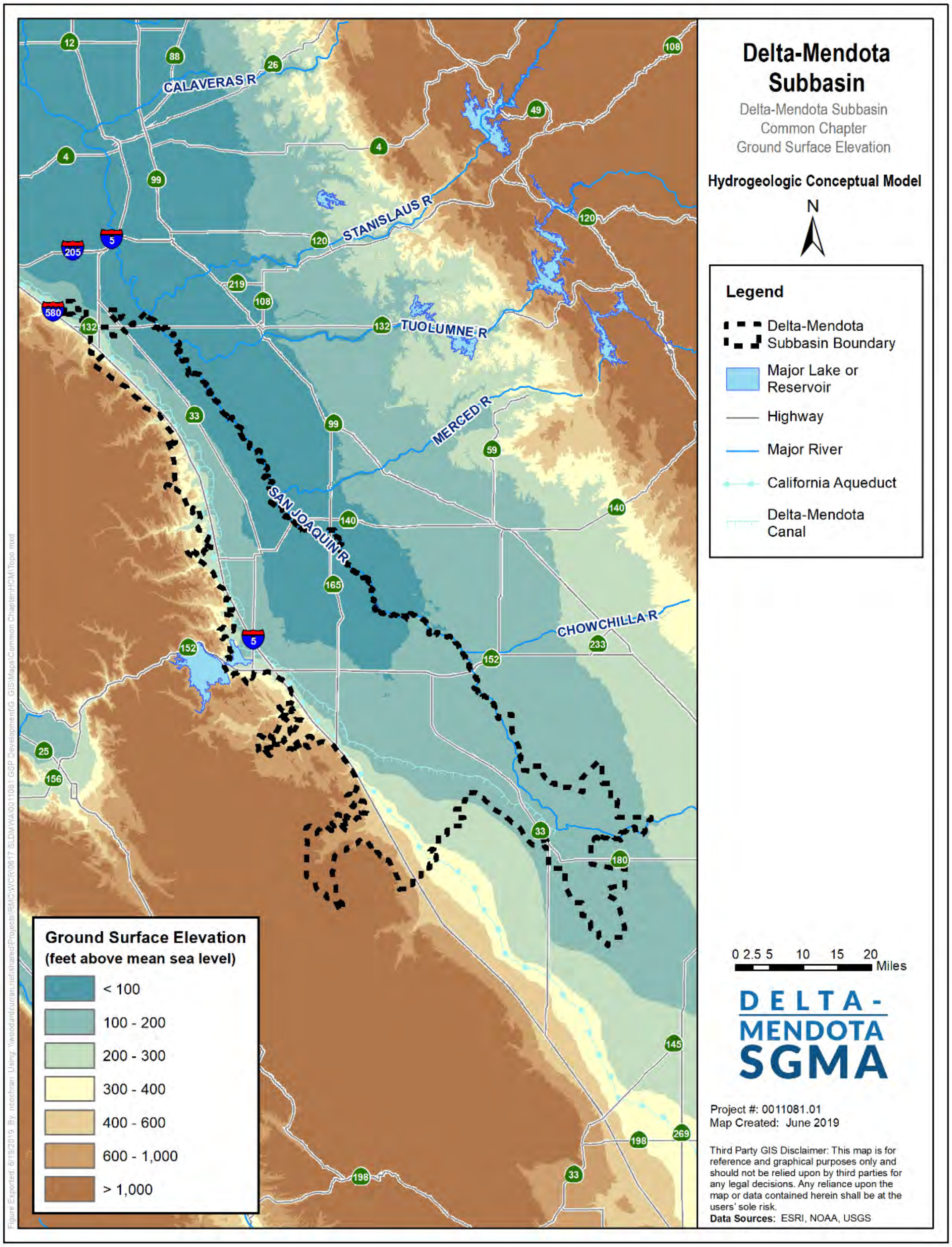


Figure CC-35: Ground Surface Elevation

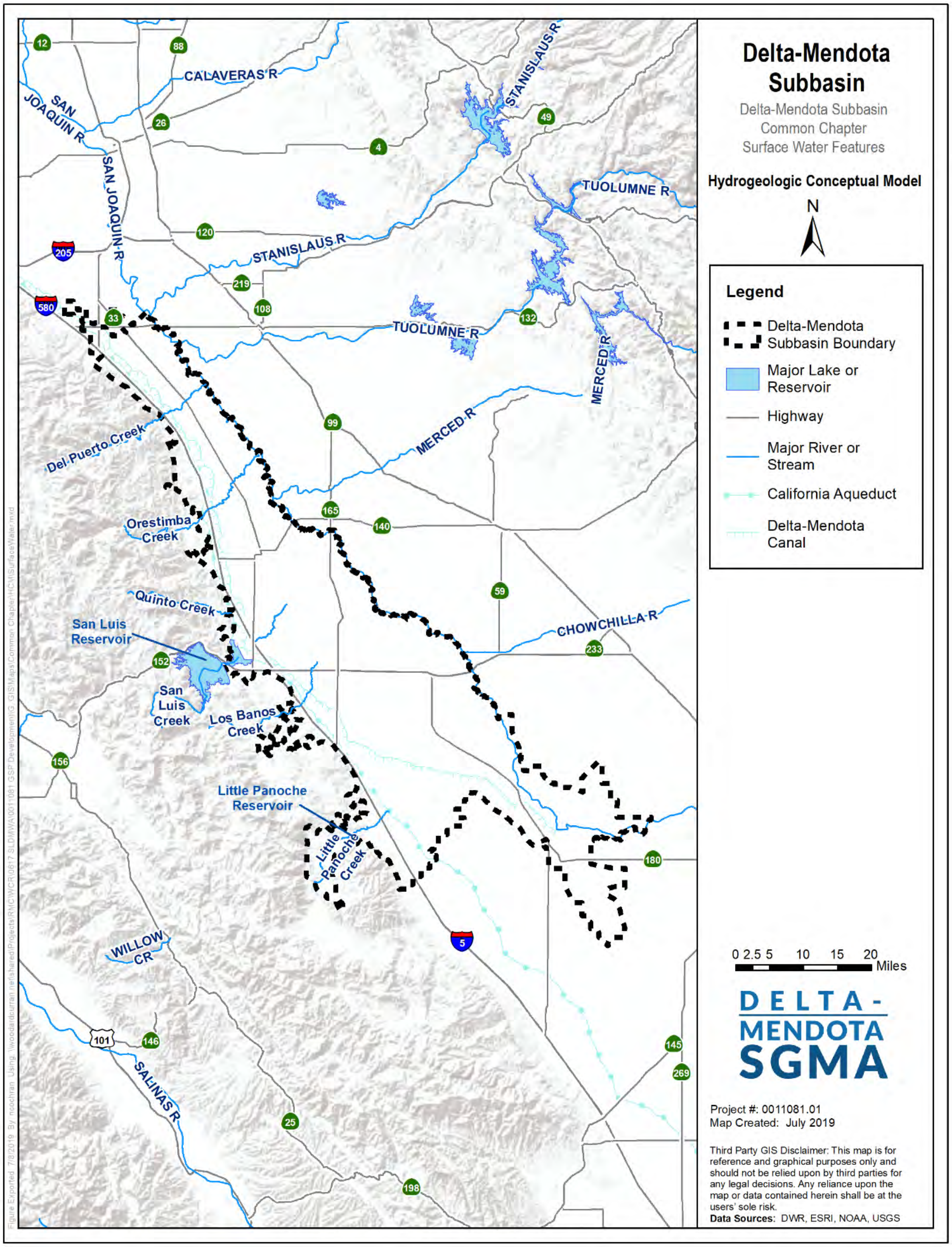


Figure CC-36: Surface Water Features

Soils

The NRCS provides soil mapping in the region. One of the combining soil groupings mapped includes hydrologic groups. The predominant soil hydrologic groups within the Delta-Mendota Subbasin are soil types C and D (**Figure CC-37**). Group C soils have moderately high runoff potential when thoroughly wet (NRCS, 2009) with water transmission through the soil somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Group D soils have a high runoff potential when thoroughly wet and water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

Soil hydraulic conductivity groups are closely related to soil drainage characteristics and hydraulic conductivity. The fine-grained floodplain deposits present across much of the southeastern area of the Subbasin are evidenced as soils with lower hydraulic conductivity in **Figure CC-37** and accordingly, these characteristics also make these areas poorly drained. Poorly draining soil conditions are extensive within the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine (Fio, 1994; Hotchkiss and Balding, 1971). Soils in the northern and western parts of the Delta-Mendota Subbasin exhibit better drainage characteristics, although areas of poorly drained soils are also present in the north and west in proximity to surface water courses, including most notably directly adjacent to portions of the San Joaquin River and Los Banos Creek channels. Many of the upland soils, which are of generally coarser texture and located proximal to sediment sources derived from the Coast Range hill slopes, are characterized as moderately well drained.

In areas with low hydraulic conductivity, corresponding to areas without adequate natural drainage, tile drains are present to remove shallow groundwater from the rooting zone. Known tile drain locations are shown in **Figure CC-38,** which are primarily located along the eastern boundary of the Delta-Mendota Subbasin as well as the southern portion of the Subbasin in the Grassland Drainage Area. The Grassland Drainage Area contains a tile drainage system connected to the San Joaquin River Improvement Project, which uses tile drainage water for irrigated agriculture with a high salinity tolerance.

Areas of Recharge, Potential Recharge, and Groundwater Discharge Areas

The primary process for groundwater recharge within the Central Valley floor area is from percolation of applied irrigation water and seepage from canals and stream beds, although some groundwater recharge does occur in the Delta-Mendota Subbasin along the western boundary of the Subbasin due to mountain front recharge. In sandier areas, recharge ponds have been constructed within certain districts (CCC, Aliso Water District, CCID and Del Puerto Water District) to promote managed aquifer recharge.

Groundwater recharge potential on agricultural land based on the Soil Agricultural Groundwater Banking Index (SAGBI) is shown in **Figure CC-39**. The SAGBI is based on five major factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface conditions. Within the Delta-Mendota Subbasin, SAGBI data categorizes 160,248 acres out of 744,237 acres (21%) of agricultural and grazing land within the regions as having Excellent, Good, and Moderately Good (**Figure CC-39**) recharge properties, and 571,573 acres out of 744,237 acres (or 77%) of agricultural and grazing land as having Moderately Poor, Poor, or Very Poor recharge properties. "Modified" SAGBI data shows higher potential for recharge than unmodified SAGBI data because the modified data assumes that soils have been or will be ripped to a depth of six feet, which can break up fine grained materials at the surface to improve percolation. The modified data set was determined to more accurately represent the Delta-Mendota Subbasin due to the heavy presence of agriculture. In almost all cases, recharge from applied water on irrigated lands recharges the Upper Aquifer of the Subbasin. However, the use of percolation ponds and other managed aquifer recharge techniques must consider existing water quality in addition to soil composition and may be limited in areas where poor water quality currently exists.

The Corcoran Clay is a known barrier restricting vertical flow between the Upper and Lower Aquifers; therefore, natural recharge of the Lower Aquifer from downward percolating water is most likely restricted where the Corcoran Clay is present, including across most of the Central Valley floor. Primary recharge areas to the Lower Aquifer are most likely in western parts of the Central Valley floor where percolating water can enter formations feeding the Lower Aquifer, particularly in the vicinity and west of Los Banos, Orestimba, and Del Puerto Creeks, along the western margin of the Subbasin.

Groundwater discharge areas are identified as springs located within the Delta-Mendota Subbasin and the San Joaquin River. **Figure CC-39** shows the location of historic springs identified by USGS. There are only six springs/seeps identified by USGS in their National Hydrograph Dataset, which are located in the southwestern corner of the Subbasin. The springs shown represent a dataset collected by USGS and are not a comprehensive map of springs in the Subbasin.

Imported Supplies

Both the California Aqueduct and Delta-Mendota Canal run the length of the Delta-Mendota Subbasin, primarily following the Interstate 5 corridor (**Figure CC-40**). The following water purveyors in the Delta-Mendota Subbasin are SLDMWA Member Agencies and thus receive water from the Central Valley Project via the Delta-Mendota Canal: California Department of Fish and Wildlife, Central California Irrigation District, Columbia Canal Company, Del Puerto Water District, Eagle Field Water District, Firebaugh Canal Water District, Fresno Slough Water District, Grassland Water District, Laguna Water District, Mercy Springs Water District, Oro Loma Water District, Pacheco Water District, Panoche Water District, Patterson Irrigation District, San Luis Canal Company, San Luis Water District, Tranquillity Irrigation District, Turner Island Water District, U.S. Fish and Wildlife Service, and West Stanislaus Irrigation District. Oak Flat Water District is the only recipient of State Water Project (SWP) water in the Delta-Mendota Subbasin; Oak Flat Water District initially bought into the SWP in 1968.

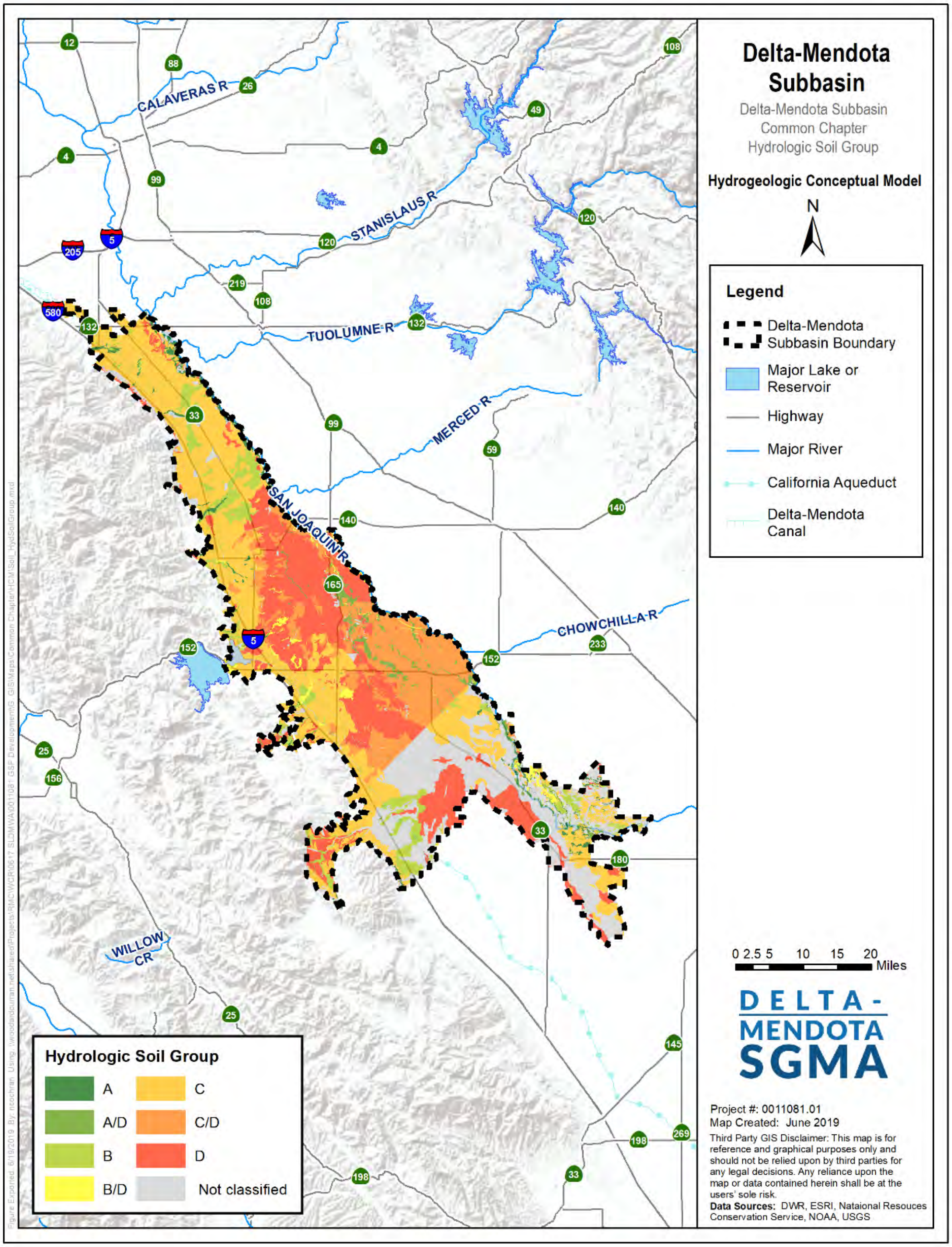


Figure CC-37: SAGBI Soils Map

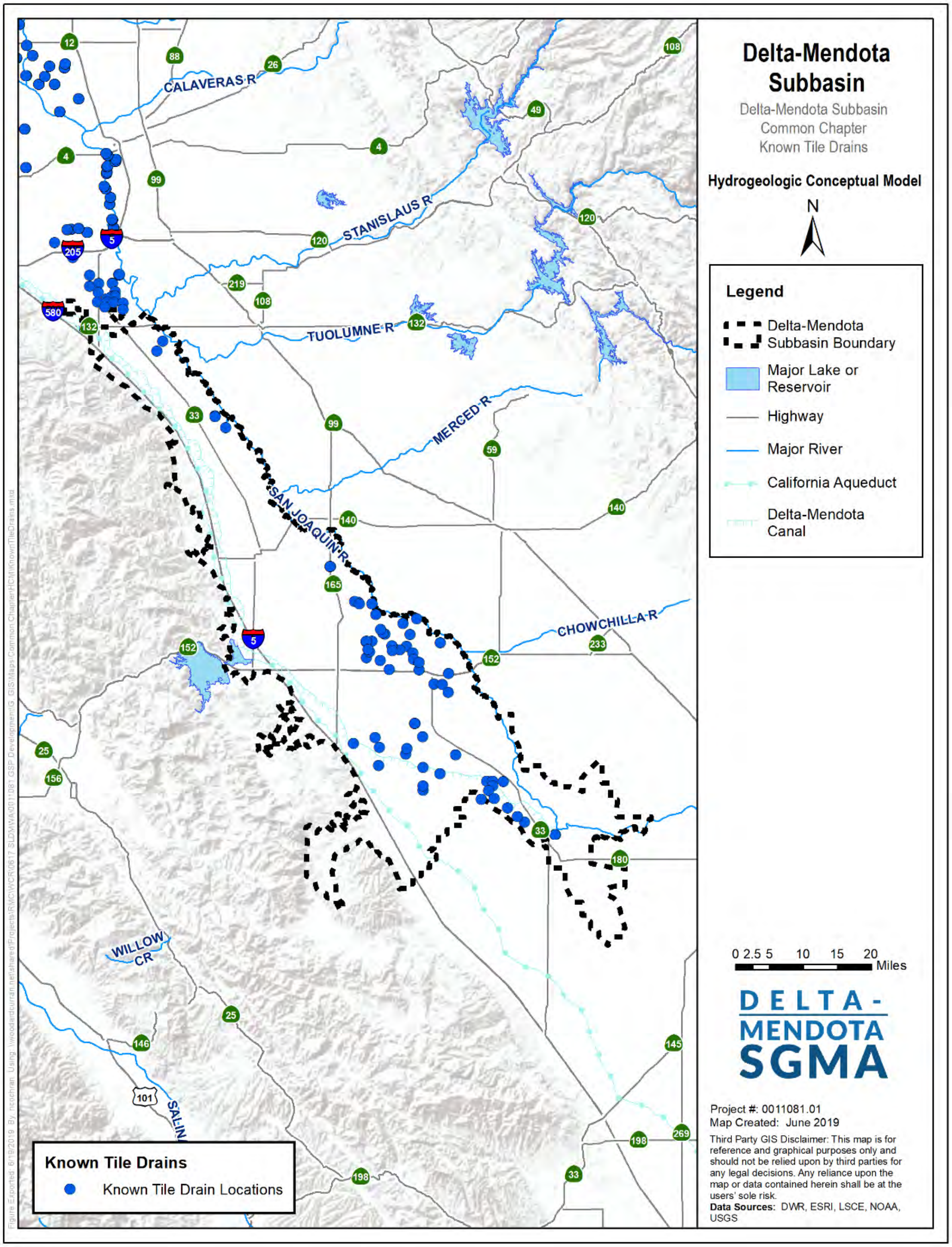


Figure CC-38: Tile Drains

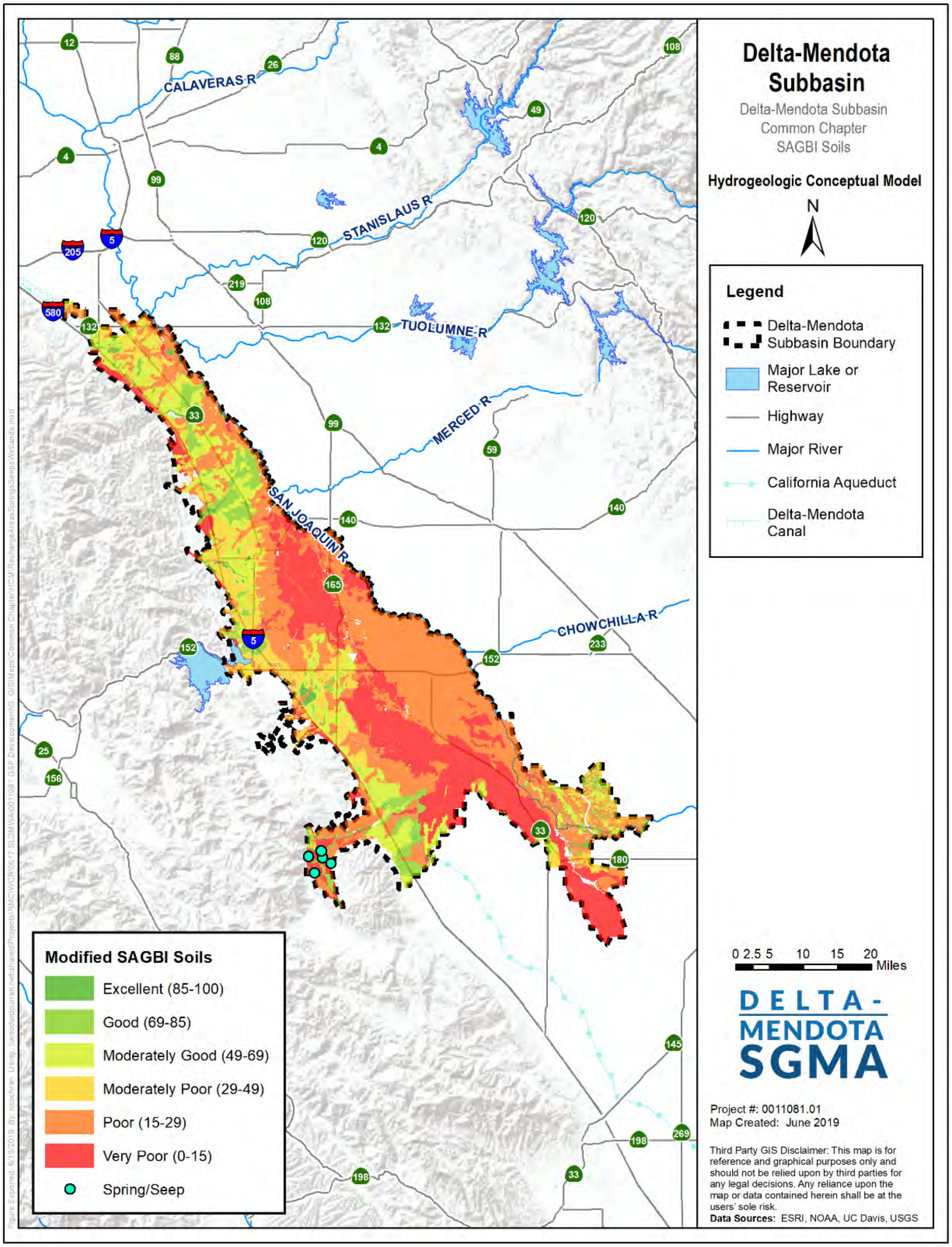


Figure CC-39: Recharge Areas, Seeps and Springs

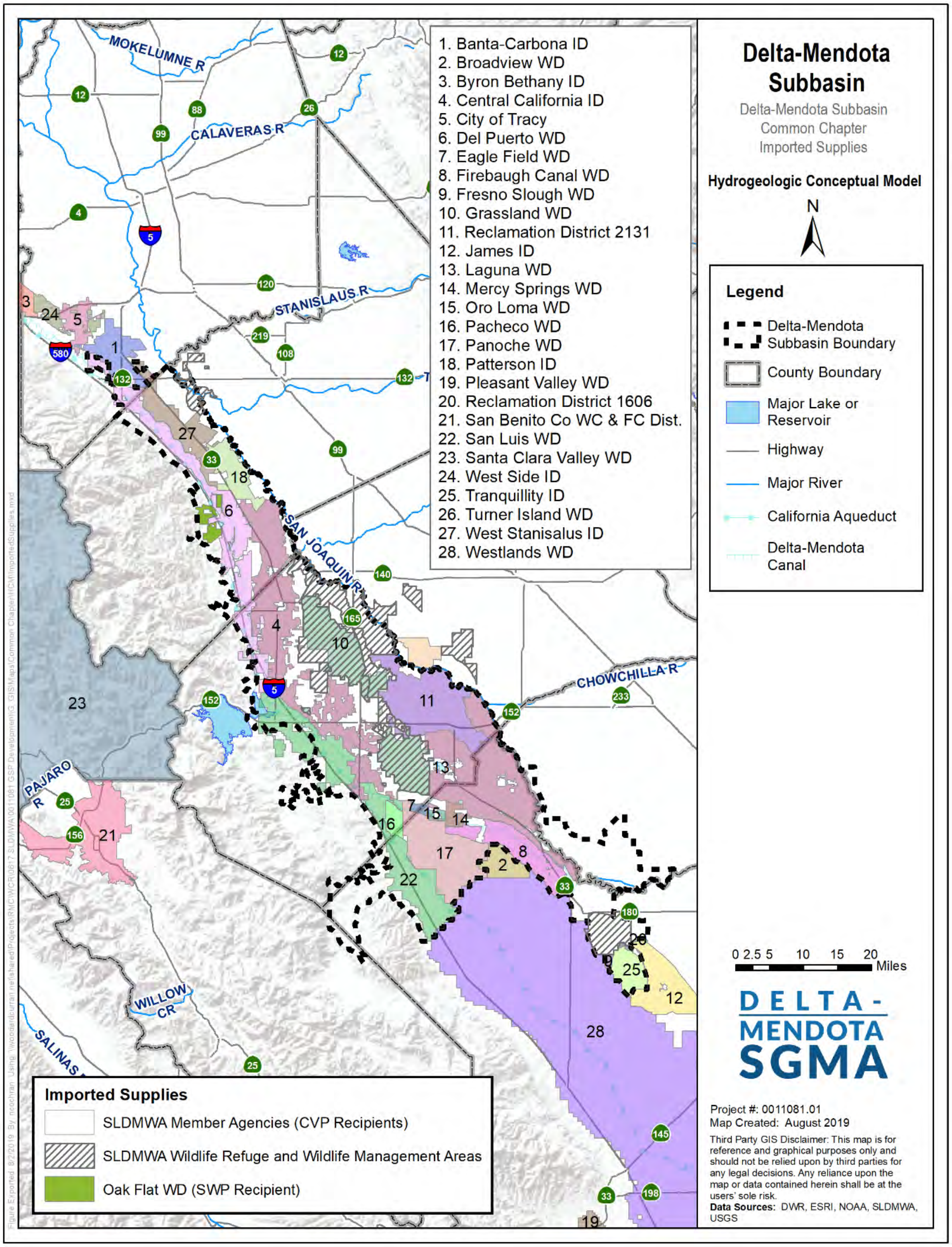


Figure CC-40: Imported Supplies

4.2 Delta-Mendota Subbasin Groundwater Conditions

This section describes the current and historic groundwater conditions in the Delta-Mendota Subbasin, including data from January 1, 2015 to recent conditions for the following parameters: groundwater elevations, groundwater storage, groundwater quality, land subsidence, interconnected surface water systems, and groundwater dependent ecosystems (GDEs) (pursuant to Article 5 Plan Contents, Subarticle 2 Basin Setting, § 354.16 Groundwater Conditions of the GSP Emergency Regulations). Seawater intrusion is not discussed herein as the Delta-Mendota Subbasin is inland and is not impacted by seawater intrusion. For the purposes of this GSP, "current conditions" is represented by Water Year (WY) 2013 conditions, which is consistent with the year representing the Current Conditions Water Budget (see Section 4.3 for more information about Water Budgets). Data post-WY 2013 through present day are presented when available.

The purpose of describing groundwater conditions, as contained in this section and described in the individual GSPs, is to establish baseline conditions that will be used to monitor changes relative to measurable objectives and minimum thresholds. Therefore, these established baseline conditions will help support monitoring to demonstrate measurable efforts in achieving the sustainability goal for the Delta-Mendota Subbasin.

4.2.1 Useful Terminology

This groundwater conditions section includes descriptions of the amounts, quality, and movement of groundwater, among other related components. A list of technical terms and a description of the terms are listed below. The terms and their descriptions are identified here to guide readers through the section and are not a definitive definition of each term:

- **Depth to Groundwater** – The distance from the ground surface to first-detected non-perched groundwater, typically reported at a well.
- **Upper Aquifer** – The alluvial aquifer above the Corcoran Clay (or E-clay) layer.
- **Lower Aquifer** – The alluvial aquifer below the Corcoran Clay (or E-clay) layer.
- **Horizontal gradient** – The slope of the groundwater surface from one location to another when one location is higher or lower than the other. The gradient is shown on maps with an arrow showing the direction of groundwater flow in a horizontal direction.
- **Vertical gradient** – Describes the movement of groundwater perpendicular to the ground surface. Vertical gradient is measured by comparing the elevations of groundwater in wells that are of different depths. A downward gradient is one where groundwater is moving down into the ground towards deeper aquifers and an upward gradient is one where groundwater is upwelling towards the ground surface.
- **Contour Map** – A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. The elevations are shown on the map with the use of a contour line, which represents groundwater being at the indicated elevation along the contour line. Contour maps can be presented in two ways:
    - o Elevation of groundwater above mean sea level (msl), which can be used to identify the horizontal gradients of groundwater, and
    - o Depth to water (i.e. the distance from the ground surface to groundwater), which can be used to identify areas of shallow or deep groundwater.

- **Hydrograph** – A graph that shows the changes in groundwater elevation or depth to groundwater over time at a specific location. Hydrographs show how groundwater elevations change over the years and indicate whether groundwater is rising or descending over time.
- **Maximum Contaminant Level (MCL)** – MCLs are standards that are set by the State of California and the U.S. Environmental Protection Agency for drinking water quality. MCLs are legal threshold limits on the amount of an identified constituent that is allowed in public drinking water systems. At both the State and Federal levels, there are Primary MCLs, set to be protective of human health, and Secondary MCLs for constituents that do not pose a human health hazard but do pose a nuisance through either smell, odor, taste, and/or color. MCLs are different for different constituents and have not been established for all constituents potentially found in groundwater.
- **Elastic Land Subsidence** – Reversible and temporary fluctuations in the elevation of the earth's surface in response to seasonal periods of groundwater extraction and recharge.
- **Inelastic Land Subsidence** – Irreversible and permanent decline in the elevation of the earth's surface resulting from the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system. This form of subsidence is what is required by SGMA to be monitored and reported.
- **Gaining Stream** – A stream in which groundwater flows into a streambed and contributes to a net increase in surface water flows across an identified reach.
- **Losing Stream** – A stream in which surface water is lost through the streambed to the groundwater, resulting in a net decrease in surface water flows across an identified reach.
- **Conjunctive Use** – The combined use of surface water and groundwater supplies, typically with more surface water use in wet years and more groundwater use in dry years.

4.2.2 Groundwater Elevations

This section describes groundwater elevation data utilized and elevation trends in the Delta-Mendota Subbasin. Groundwater conditions vary widely across the Subbasin. Historic groundwater conditions through present day conditions, the role of imported surface water in the Subbasin, and how conjunctive use has impacted groundwater trends temporally and spatially are discussed. Groundwater elevation contour maps associated with current seasonal high and seasonal low for each principal aquifer, as well as hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients (both horizontal and vertical), are also described.

Available Data

Groundwater elevation data, and accompanying well construction information, within the Delta-Mendota Subbasin from the following sources and associated programs were utilized in the development of the Delta-Mendota Subbasin GSPs:

- California Department of Water Resources (DWR)
    - California Statewide Groundwater Elevation Monitoring Program (CASGEM)
    - Water Data Library (WDL)
- Water level data from local monitoring programs

Data provided by these sources included well information (such as location, well construction, owner, ground surface elevation and other related components), as well as groundwater elevation data (including information such as date measured, depth to water, groundwater surface elevation, questionable measurement code, and comments). At the time that these analyses were performed, groundwater elevation data were available for the time period from 1930 through 2018. There are many wells with monitoring data from some time in the past but no recent data, while a small number of wells have monitoring data recorded for periods of greater than 50 years.

Not all groundwater elevation data received were used in preparing the groundwater elevation contour maps for both principal aquifers (defined in this Common Chapter as the Upper and Lower Aquifers which are divided by the Corcoran Clay or E-clay layer). Some groundwater elevation data were associated with wells with unknown screened depths and/or composite well screens constructed across the Corcoran Clay. Groundwater elevation data associated with wells with composite screens and/or unknown screened depths were removed from the data set in most instances, along with any data point that appears to be an outlier when compared with surrounding data from the same period. Select wells with unknown construction were evaluated for inclusion in contour mapping efforts in areas of limited data. Duplicate well measurements were also removed prior to contouring and only one observation for a given well was used for the identified season, rather than averaging all measurements at a given well during the same season.

Figure CC-41 shows the locations of wells with known screened depths within the Delta-Mendota Subbasin as well as known spatial gaps where no well information is currently available. These wells include those monitored under CASGEM, the Delta-Mendota Canal Well Pump-in Program, and by local owners or agencies. Monitoring data available for these wells varies by local owner and agency. Well locations were provided by local agencies to the best of their knowledge at the time of writing and may include wells that have been destroyed or are no longer in service.

Historic Conditions

Historic groundwater trends changed significantly with the first deliveries of imported water deliveries to the Delta-Mendota Subbasin. Construction of the Delta-Mendota Canal and the California Aqueduct heralded the introduction of significant surface water supplies into the Subbasin and reduced dependence on groundwater as the primary water supply. These conveyance systems have resulted in significant increases in the conjunctive use of surface water and groundwater throughout the Subbasin. Various drought periods and regulations reducing delivery of supplies from the Sacramento-San Joaquin Delta also punctuate critical understandings of groundwater use patterns throughout the Subbasin, as well as what is known regarding response and recovery of groundwater levels following notable droughts.

Prior to Imported Water Deliveries (1850-1950s)

Prior to 1850, the majority of agriculture and development in the San Joaquin Valley consisted of rain-fed grain and cattle production, with irrigated development beginning sporadically during this time via river (primarily San Joaquin River) and perennial stream diversions (SWRCB, 2011). Construction of the railroad through the San Joaquin Valley from 1869 through 1875 increased demand for more extensive agriculture, making markets in larger coastal cities more accessible to valley farmers. Significant irrigation sourced from surface water and resulting production began in the western side of the San Joaquin Valley in 1872 when the San Joaquin River was diverted through the Miller and Lux canal system west of Fresno (DWR, 1965). By the 1890s and early 1900s, sizable areas of the southern San Joaquin Valley were being forced out of production by salt accumulation and shallow water tables. Much of this land lay idle until the 1920s when development of reliable electric pumps and the energy to power them accelerated the expansion of irrigated agriculture with the availability of vast groundwater resources. The resultant groundwater pumping lowered the water table in many areas (SWRCB, 1977 and Ogden, 1988) and allowed the leaching of salts, particularly near the valley trough and western side of the valley. Groundwater pumping for irrigation from around 1920 to 1950 drew the water table down as much as 200 feet in areas along the westside of the San Joaquin River (Belitz and Heimes, 1990). Declining water tables were causing higher pumping costs and land subsidence, and farmers were finding poorer quality water as water tables continued to decline. These issues created a desire for new surface water supplies, which would be fulfilled by the Central Valley Project.

Post-Imported Water Deliveries (1950s-2012)

Surface water deliveries from the Central Valley Project via the DMC began in the early 1950s, and from the State Water Project via the California Aqueduct in the early 1970s (Sneed et al., 2013). The CVP is the primary source of imported surface water in the Delta-Mendota Subbasin, where only Oak Flat Water District receives deliveries from the SWP. Introduction of imported water supplies to the Delta-Mendota Subbasin resulted in a decrease in groundwater pumping from some parts of the Subbasin and the greater Central Valley, which was accompanied by a steady recovery of water levels. During the droughts of 1976-1977 and 1987-1992, diminished deliveries of imported surface water prompted increased pumping of groundwater to meet irrigation demands, bringing water levels to near-historic lows. Following periods of drought, recovery of pre-drought water levels has been rapid, especially in the Upper Aquifer. This trend has been observed in historic hydrographs for wells across the Subbasin.

Current Conditions

Trends similar to historic drought and subsequent recovery conditions were observed during the 2012 to 2016 drought and the 2016 to present recovery period.

Recent Drought (2012-2016)

During the most recent drought, from 2012 through 2016, similar groundwater trends were observed as during the 1976-1977 and 1987-1992 droughts. With diminished imported surface water deliveries, groundwater pumping increased throughout the Subbasin to meet irrigation needs. This resulted in historic or near-historic low groundwater levels during the height of the drought in 2014 and 2015, when CVP and SWP allocations for agricultural water service contractors were 0%, Exchange Contractors and refuge deliveries were less than 75%, and post-1914 surface water rights in the San Joaquin River watershed were curtailed. In June 2015, senior water rights holders with a priority date of 1903 or later in the San Joaquin and Sacramento watersheds and the Delta were ordered by the State Water Resources Control Board to curtail diversions (State of California, 2015). This marked the first time in recent history that pre-1914 water rights holders were curtailed.

Post-Drought (2016-present)

With wetter conditions following the 2012-2016 drought, groundwater levels began to recover. This was largely a result of increased surface water availability with CVP allocations reaching 100% and full water rights supplies available for diversion from the San Joaquin River in 2017. Additionally, inelastic land subsidence rates also drastically decreased in 2017 as imported water supplies were once again available, resulting in decreased groundwater pumping particularly from the Lower Aquifer. This pattern of increased drought-driven groundwater pumping, accompanied by declining groundwater elevations, followed by recovery is a predominant factor to be considered in the sustainable management of the Delta-Mendota Subbasin. Furthermore, subsidence mitigation projects were developed which drastically reduced the observed subsidence rate on the eastern and southern boundaries of the Subbasin.

Groundwater Trends

Groundwater levels can fluctuate greatly throughout time due to various natural and anthropogenic factors, including long-term climatic conditions, adjacent well pumping, nearby surface water flows, and seasonal groundwater recharge or depletion (LSCE, 2015). As discussed in the Hydrogeologic Conceptual Model section of this Common Chapter (Section 4.1), the Delta-Mendota Subbasin is generally a two-aquifer system consisting of an Upper and Lower Aquifer that are subdivided by the Corcoran Clay layer, a regional aquitard. The Corcoran Clay layer, or E-Clay equivalent, restricts flow between the upper semi-confined aquifer and lower confined aquifer. The presence of a tile drain network along the Grassland Drainage Area and the Subbasin's eastern boundary affects the lateral and vertical water movement in the shallow groundwater zone (LSCE, 2016).

The Delta-Mendota Subbasin has a general flow direction to the east in the Upper Aquifer, where it loses groundwater to the San Joaquin River and its neighboring subbasins. Most recharge throughout the Subbasin is attributed to applied irrigation water, where other sources of recharge include local streams, canal seepage, and infiltration along the western margin of the Subbasin from the Coast Range. The figures that follow were developed for inclusion in the Western San Joaquin River Watershed Groundwater Quality Assessment Report (LSCE, 2015) and the Grassland Drainage Area Groundwater Quality Assessment Report (LSCE, 2016) and are included herein with the intent of demonstrating general trends in groundwater elevations around the Delta-Mendota Subbasin. These figures are not to scale.

Please see the individual GSPs for more specific information relating to similar trends in those respective GSP Plan areas. Additionally, it is important to note that groundwater trends, such as these, are dependent on climatic conditions and are not necessarily representative of the historic and current water budgets for those respective GSP Plan areas.

Upper Aquifer

For the Upper Aquifer, **Figure CC-42** presents select hydrographs illustrating temporal groundwater level trends in the Upper Aquifer wells within the Subbasin. Hydrographs shown on **Figure CC-42** are displayed with different ranges of elevation values on the vertical axes. Wells in the Upper Aquifer exhibit decreasing trends to somewhat stable water levels until the mid-1980s, and increasing or stable water levels thereafter.

Similarly, **Figure CC-43** presents select hydrographs illustrating temporal groundwater level trends in the areas covered by the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSAs in the Northern & Central Delta-Mendota Region GSP Group at various depths. The three select hydrographs representing wells in the Upper Aquifer each show less than 10 years of available data with two wells showing slight declines of about 10 feet or less from about 2003 through 2013, and one well showing a more drastic elevation change, ranging from 100 feet above mean sea level (ft msl) to -20 ft msl over a 5-year period from 2010 to 2016.

Lower Aquifer

Figure CC-44 presents select hydrographs illustrating temporal groundwater level trends in Lower Aquifer wells within the Subbasin. Note, hydrographs shown on **Figure CC-44** displayed different ranges of elevation on the vertical axes. In the Lower Aquifer, piezometric head typically increased or remained relatively stable during the period from the 1980s through the early 2000s.

Again, similarly, **Figure CC-43** presents select hydrographs illustrating temporal groundwater level trends in the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSA areas of the Northern & Central Delta-Mendota Region GSP Group at various depths. The two select hydrographs representing wells in the Lower Aquifer each show similar elevation patterns post-2010 with a total elevation change of 50 ft msl or more. USGS1000489 shows stable and increasing groundwater elevation trends from the late 1950s through the mid-1980s with a data gap from the mid-1980s through 2010, whereafter 2010 groundwater levels have a steep decline through 2016.

Vertical Gradients

Throughout most of the Delta-Mendota Subbasin, the Corcoran Clay layer acts as a regional aquitard, limiting the vertical migration of groundwater. In areas outside the Corcoran Clay layer (along the western margin of the Subbasin), localized interfingered clays minimize the downward migration of groundwater; although in areas where the clay layers are not competent or non-existent, groundwater migrates from shallower to deeper groundwater zones. Similarly, in areas where the Corcoran Clay has been compromised (due to well construction across the clay), groundwater generally flows from the Upper Aquifer to the Lower Aquifer, especially in areas where the Lower Aquifer is actively used as a water supply (lowering the potentiometric head in that zone).

Groundwater Contours

The Subbasin-wide groundwater contours reflected in **Figure CC-45** and **Figure CC-46** evaluate the seasonal high (Spring 2013) and seasonal low (Fall 2013) conditions of the current year (defined as WY2013 for the GSP analyses) for the Upper Aquifer. Spring is defined as groundwater surface elevation measurements collected between January 1 and April 8; where Fall is defined as groundwater surface elevation measurements collected between September 1 and October 31. For wells where multiple Spring 2013 or Fall 2013 measurements were available, the highest elevation for each season was used for contouring. Gaps in data and contours can be attributed to a lack of wells present, level measurements, or requirements to report level readings groundwater level data. Consistent with traditional contouring efforts, the quality of outlier water level data was investigated. In instances of poor quality data, the associated data was eliminated for the groundwater contouring effort. Furthermore, implementation of the CASGEM program in 2014 has reduced temporal and spatial gaps in groundwater level datasets, and implementation of the Delta-Mendota Subbasin GSPs' monitoring programs will add to the improved data quantity and quality.

In the Upper Aquifer, during Spring 2013, the general flow of groundwater in the Delta-Mendota Subbasin was from the Coast Range along the western boundary of the Subbasin toward the San Joaquin River along the eastern boundary. Groundwater elevations tend to increase moving south throughout the Subbasin. Within Stanislaus County, groundwater elevations are the lowest, ranging between 40 and 80 feet above msl, becoming increasingly higher in Madera County, ranging between 80 and 100 feet above msl, and in Merced and Fresno counties, ranging between 80 and 140 feet above msl (**Figure CC-45**). Similar flow directions (west to east and northeast) are observed in the Fall 2013. Within Stanislaus County, groundwater elevations are the lowest ranging between 40 and 80 feet above msl, showing little difference compared to Spring 2013; become increasingly higher in Madera County ranging between 60 and 100 feet above msl; in Merced County ranging between 60 and 140 feet above msl; and in Fresno County ranging from 60 and 120 feet above msl (**Figure CC-46**). Both maps indicate a prevailing southwest to northeast flow gradient above the Corcoran Clay. In general, little variation is apparent in groundwater elevation between seasonal high and low periods in 2013.

Due to insufficient data, groundwater elevation contour maps for the Lower Aquifer for the seasonal high and low (Spring 2013 and Fall 2013, respectively) could not be accurately prepared. **Figure CC-47** and

Figure CC-48 show the available groundwater elevation measurements for Spring 2013 and Fall 2013. Available Spring 2013 measurements range from -127 to 12 feet above msl in Stanislaus County, -65 to 124 feet above msl in Merced County, and -5 to 88 feet above msl in Fresno County (**Figure CC-47**), where no measurements are available for this time period in Madera County. Available Fall 2013 measurements range from -138 to 156 feet above msl in Stanislaus County, -94 to 19 feet above msl in Merced County, and -72 to -4 feet above msl in Fresno County (**Figure CC-48**), where no measurements are available for this time period in Madera County. The Lower Aquifer exhibits less seasonal difference in groundwater elevations than the Upper Aquifer. Throughout most of the Subbasin, the Lower Aquifer shows lower piezometric heads than the Upper Aquifer suggesting that potential exists for downward vertical gradient.

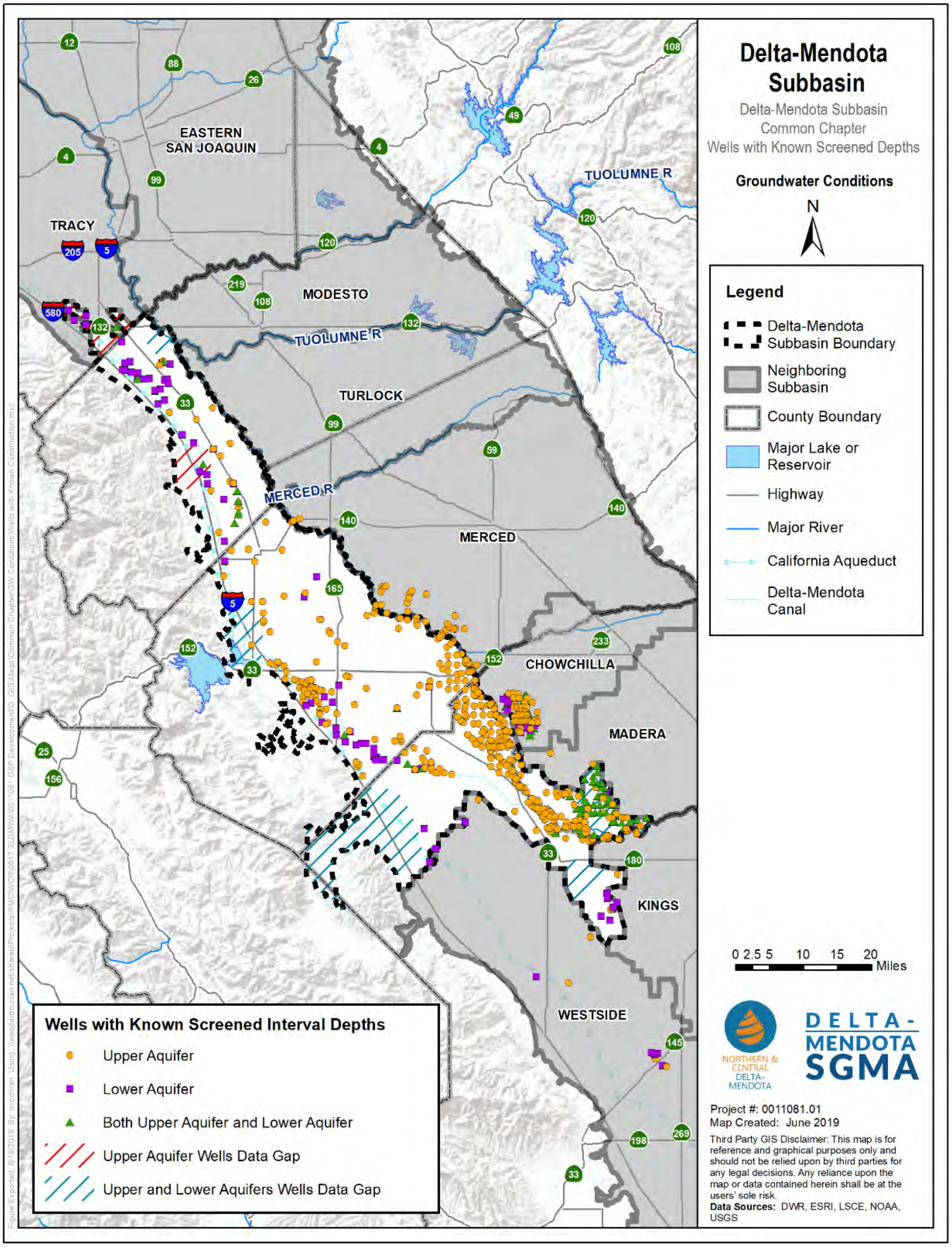
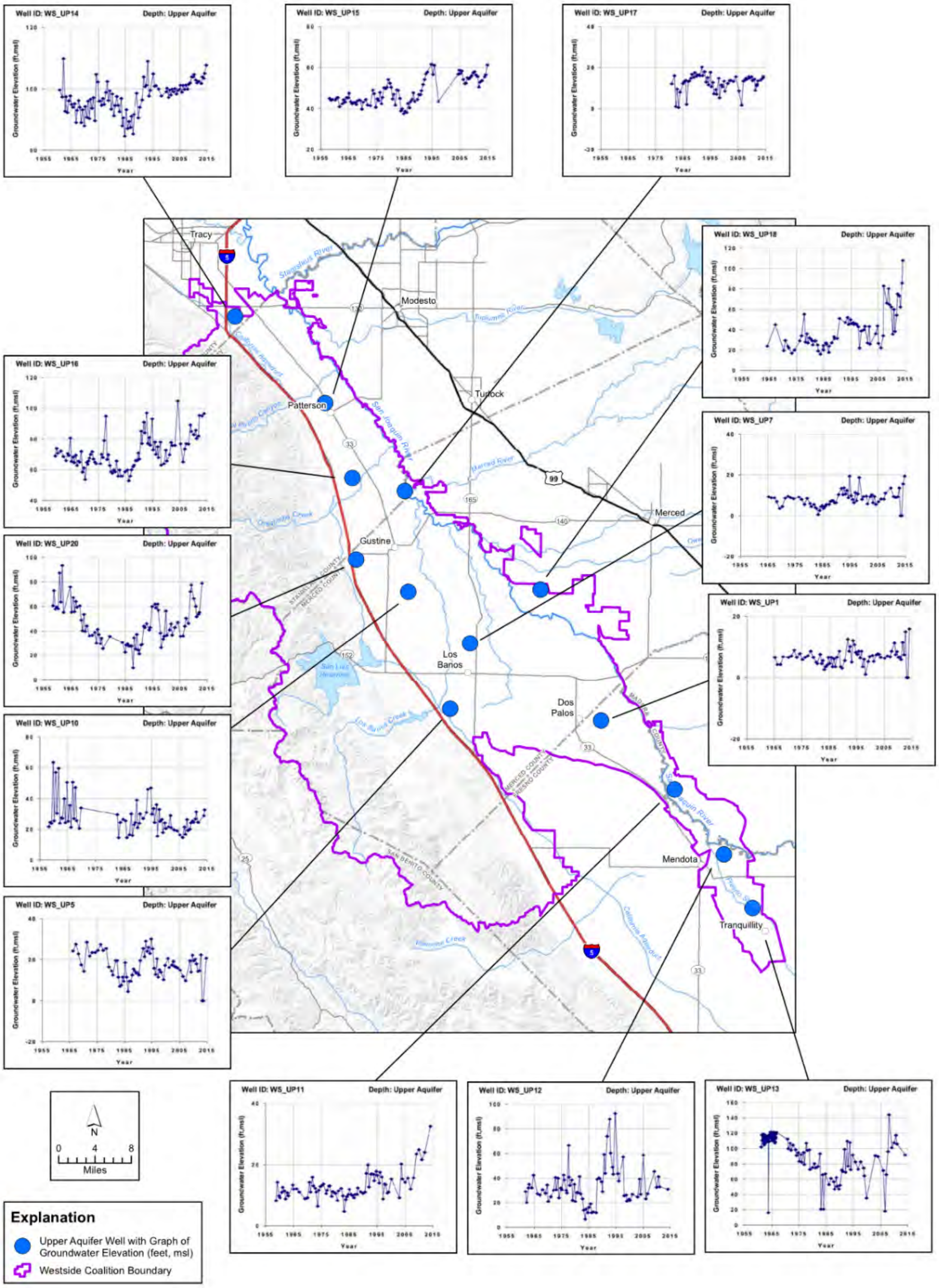
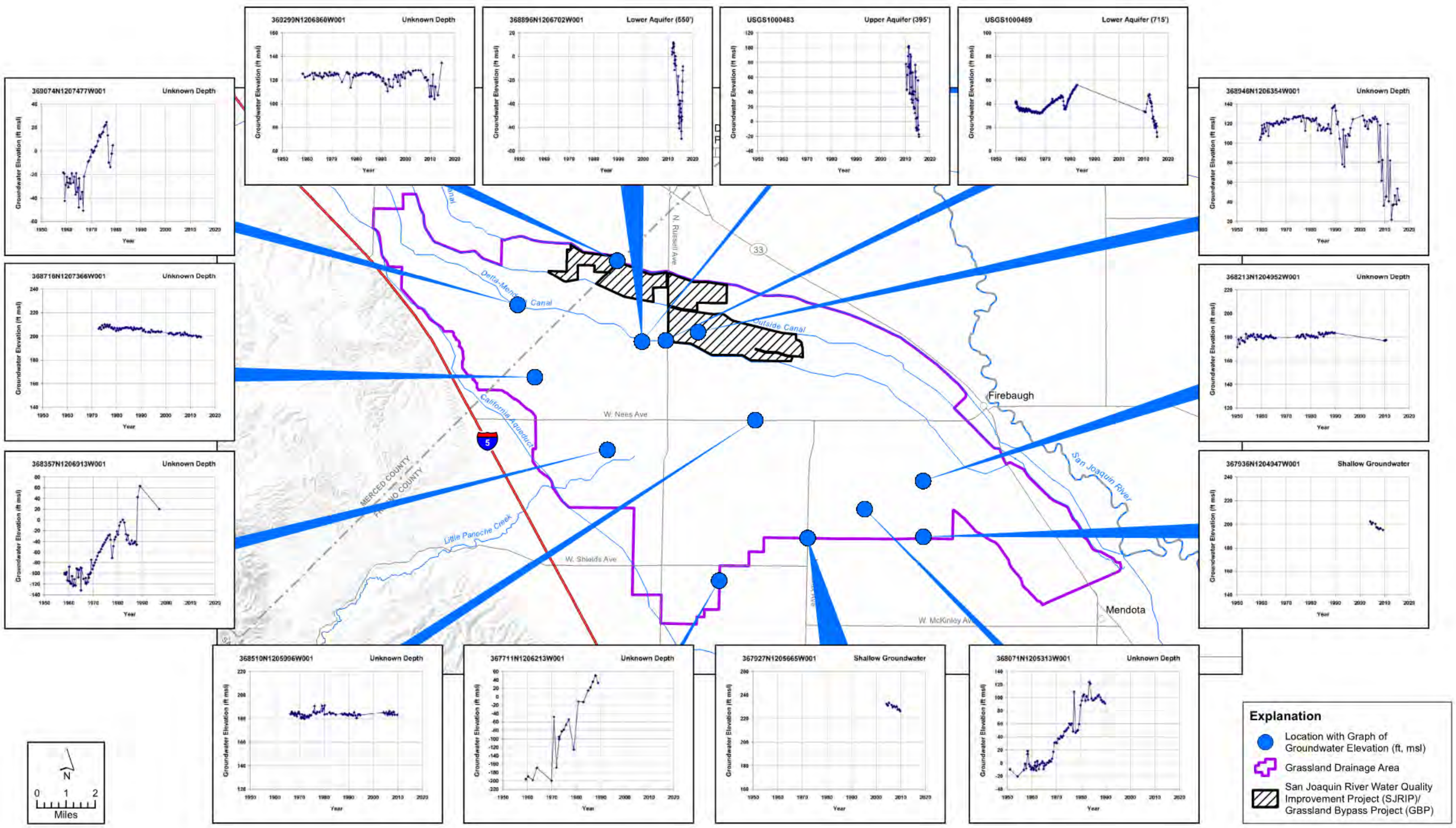


Figure CC-41: Wells with Known Screened Interval Depths



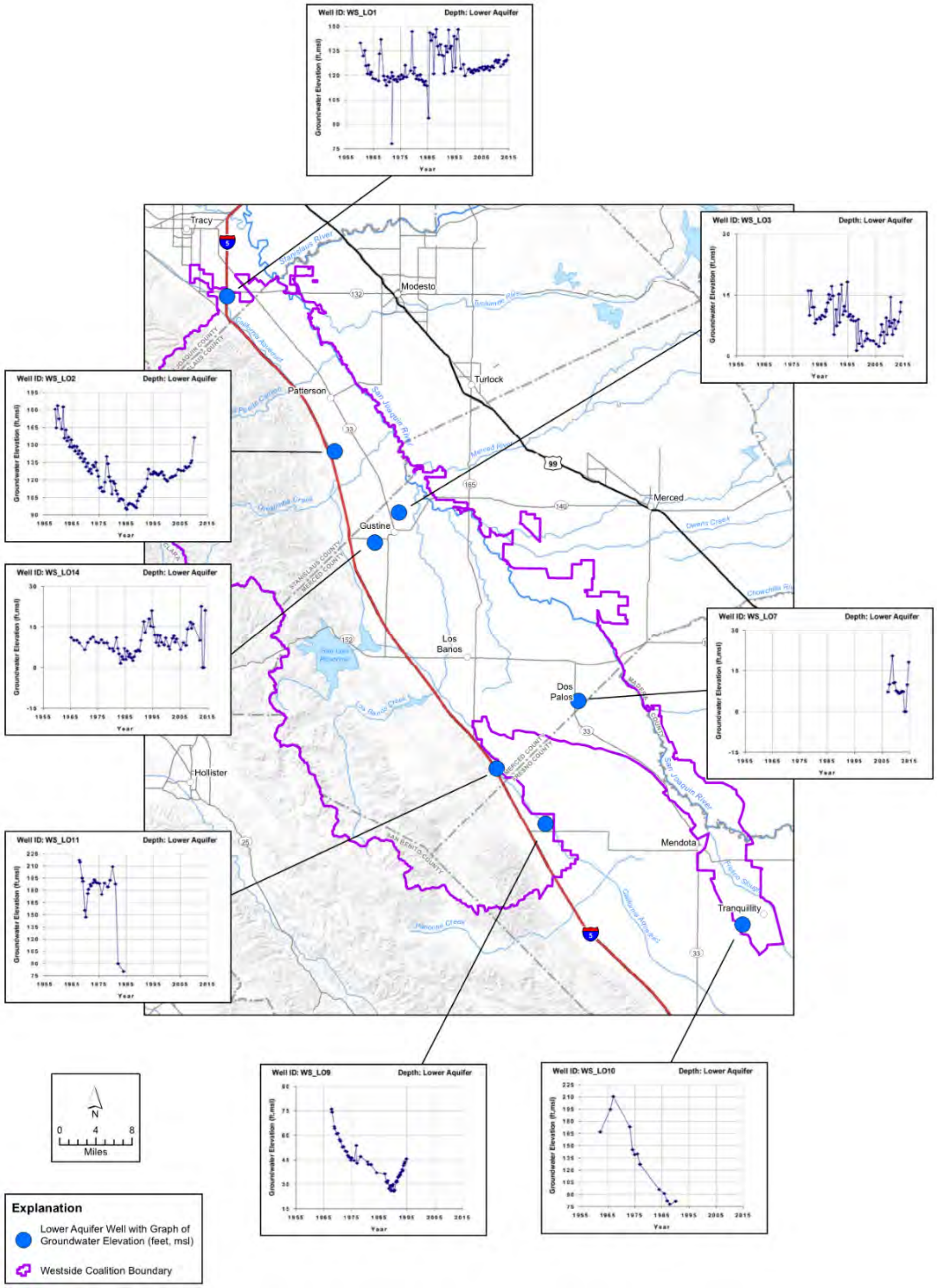
Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016

Figure CC-42: Select Graphs of Groundwater Elevations, Upper Aquifer



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-43: Select Graphs of Groundwater Elevations, Various Depths



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-44: Select Graphs of Groundwater Elevations, Lower Aquifer

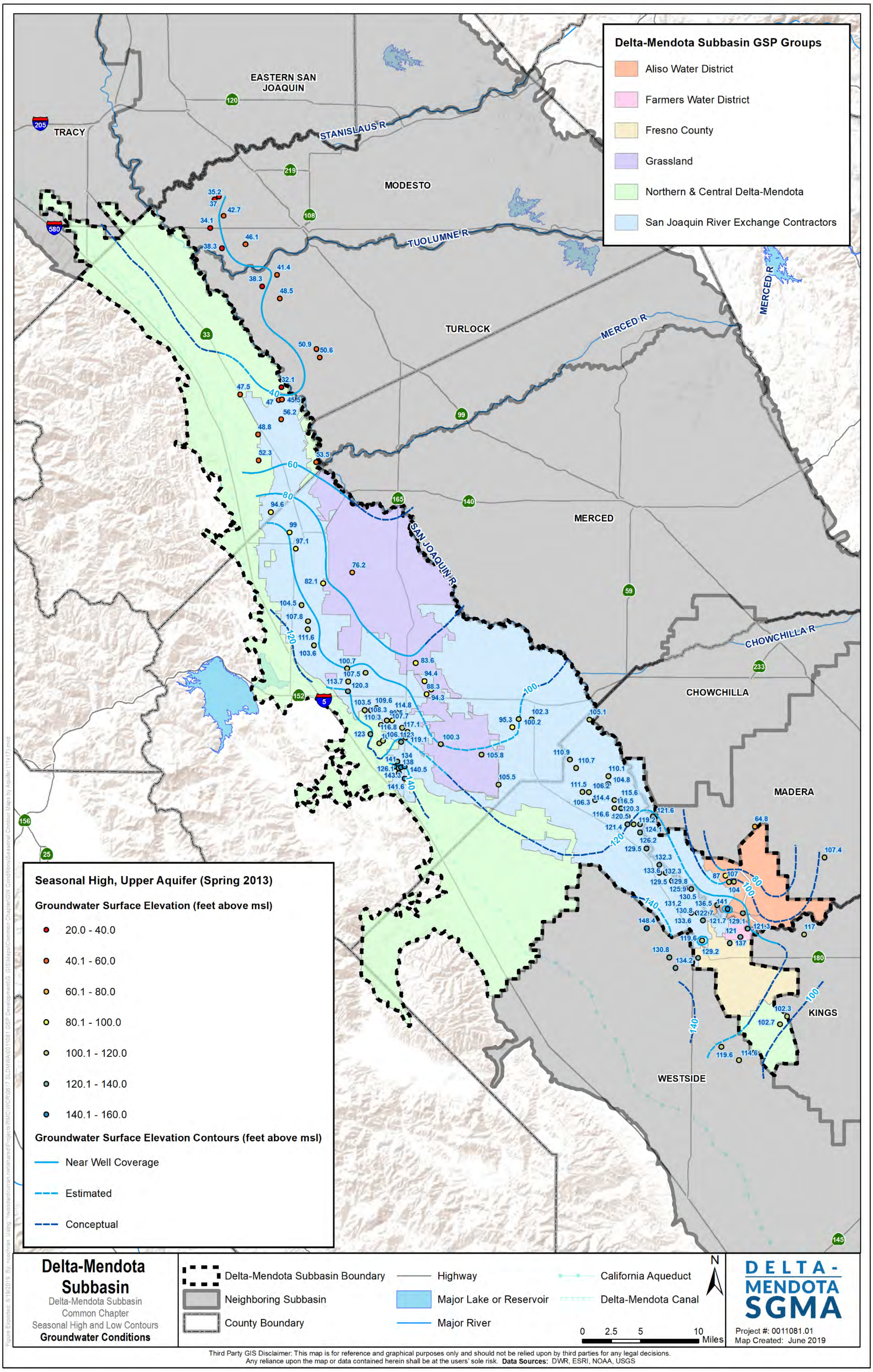


Figure CC-45: Spring 2013 Upper Aquifer Groundwater Contour Map

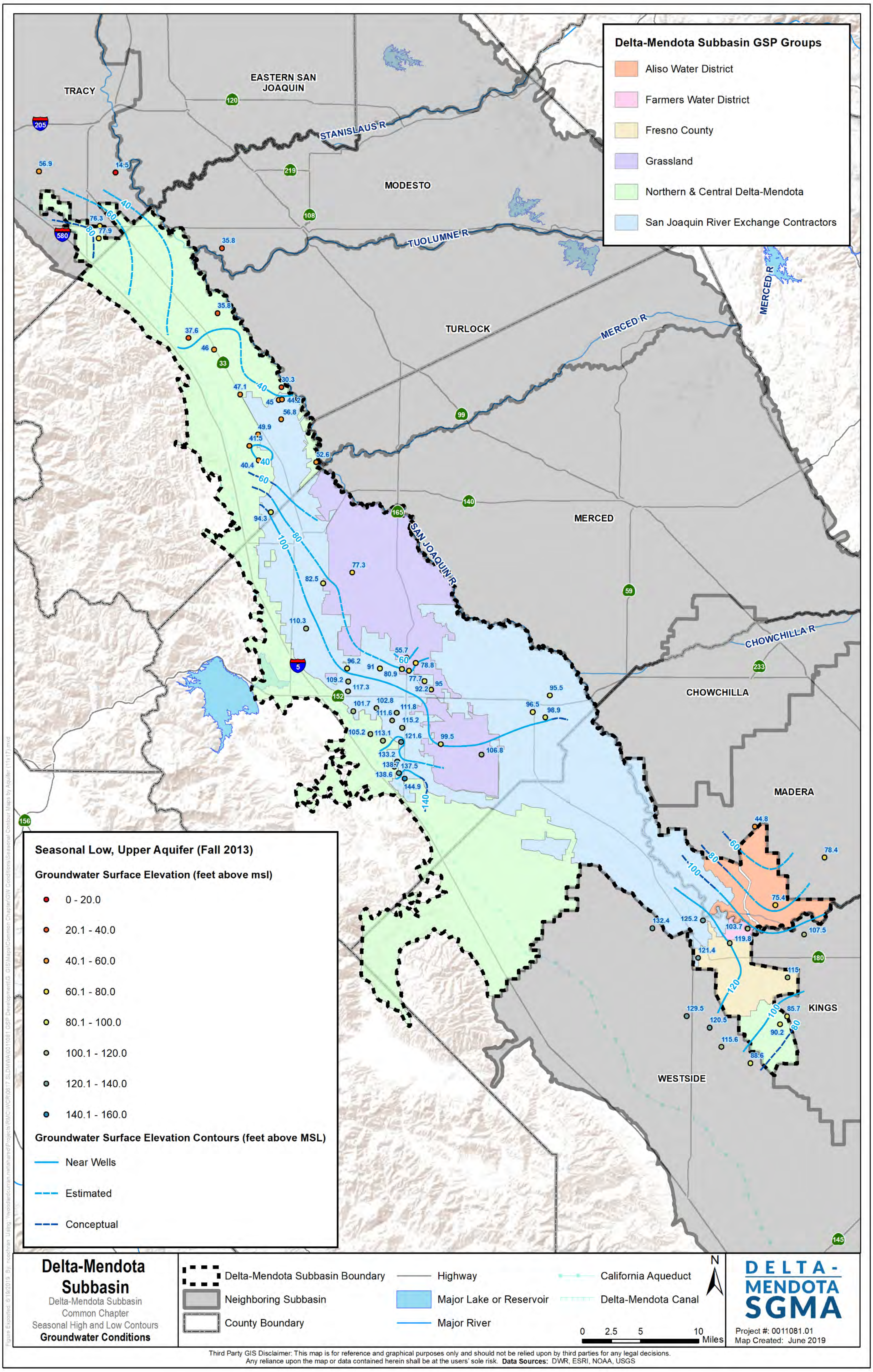


Figure CC-46: Fall 2013 Upper Aquifer Groundwater Contour Map

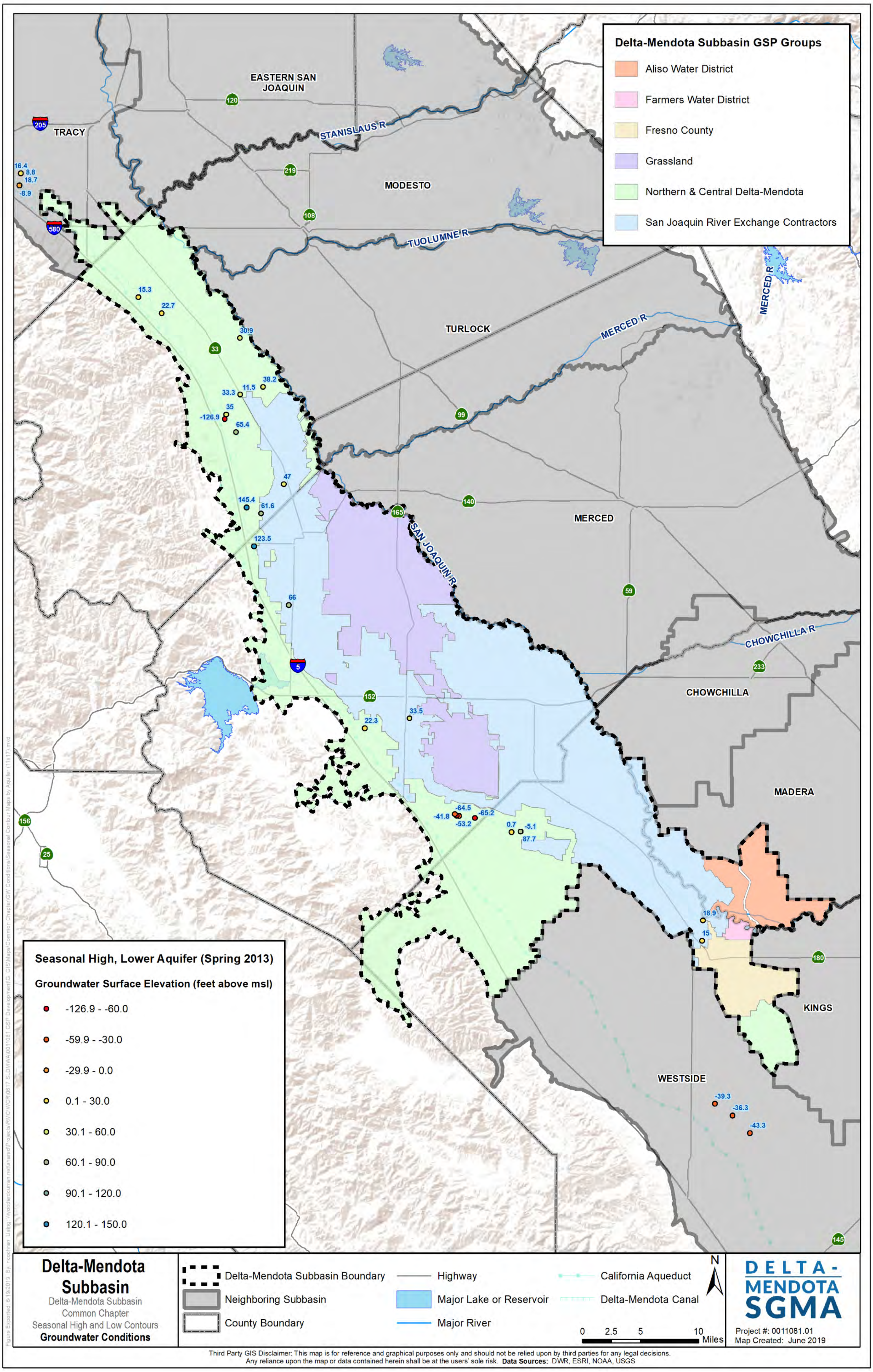


Figure CC-47: Spring 2013 Lower Aquifer Groundwater Elevation Measurements

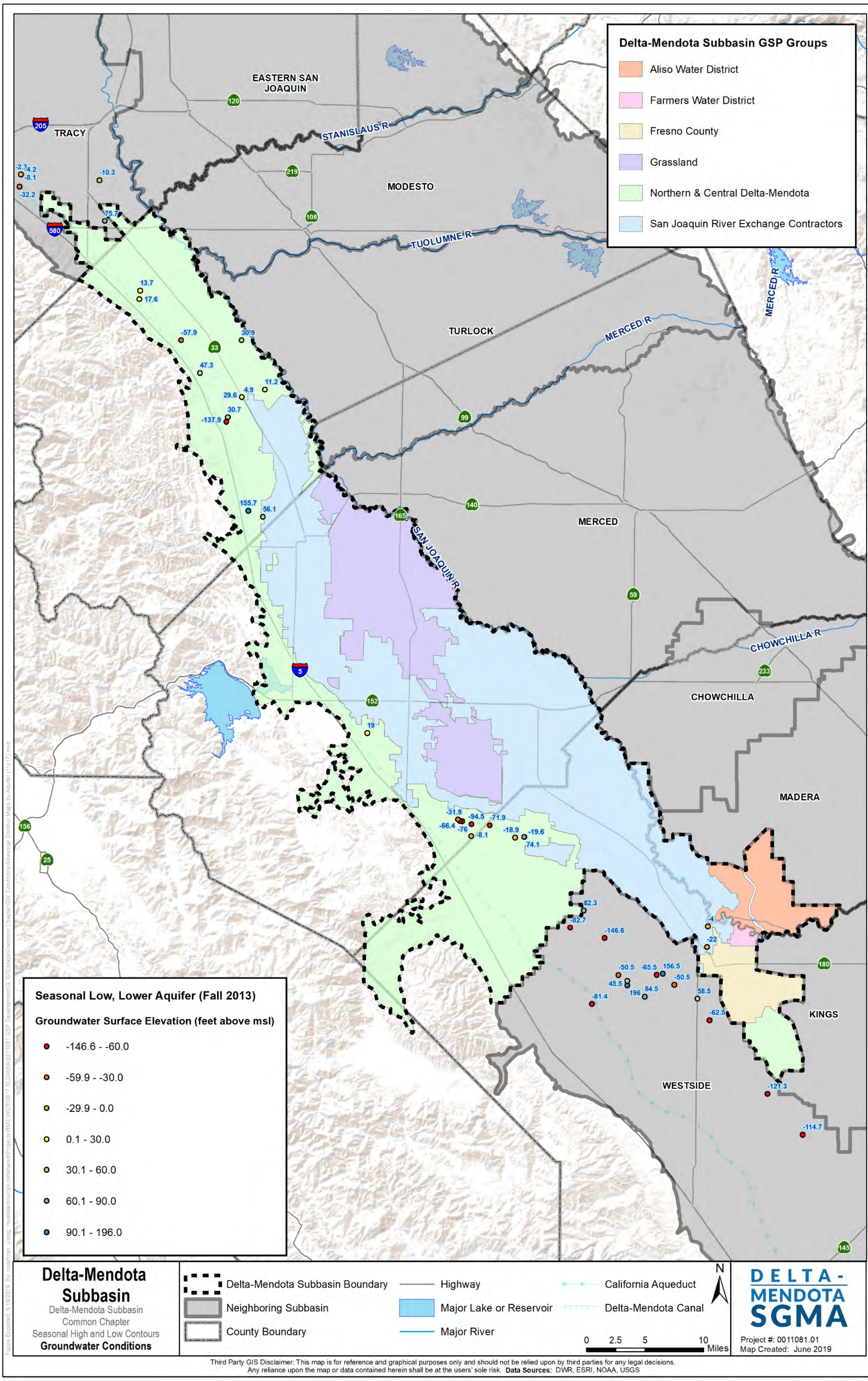


Figure CC-48: Fall 2013 Lower Aquifer Groundwater Elevation Measurements

4.2.3 Groundwater Storage

Annual changes in groundwater storage for both the Upper and Lower Aquifers in the Delta-Mendota Subbasin were estimated as part of the development of the Historic (WY2003-2012), Current (WY2013) and Projected Water Budgets (WY2014-2070). For information on how change in storage was calculated, refer to Section 4.3.2 – Water Budgets of this Common Chapter. **Figure CC-49** and **Figure CC-50** show annual change in storage, cumulative change in storage, and water year type for the Upper Aquifer and Lower Aquifer, respectively, from WY 2003 through 2013 for the Delta-Mendota Subbasin. For the purposes of the water budget four water year types were utilized, wet, average (corresponding to above and below normal water years), dry (corresponding to dry and critical water years) and Shasta critical.

Change in storage is negative for 6 out of the 11-year historic and current water budget period for the Upper Aquifer, and 9 out of 11 years for the Lower Aquifer. Despite periods of wet conditions with recharge outpacing extractions, an overall declining trend in groundwater storage can be observed in both the Upper Aquifer and Lower Aquifer. Cumulative change in storage declined more rapidly in the Upper Aquifer compared to the Lower Aquifer, declining by about 1,300,0000 AF in the Upper Aquifer and 678,000 AF in the Lower Aquifer between WY2003 to 2013.

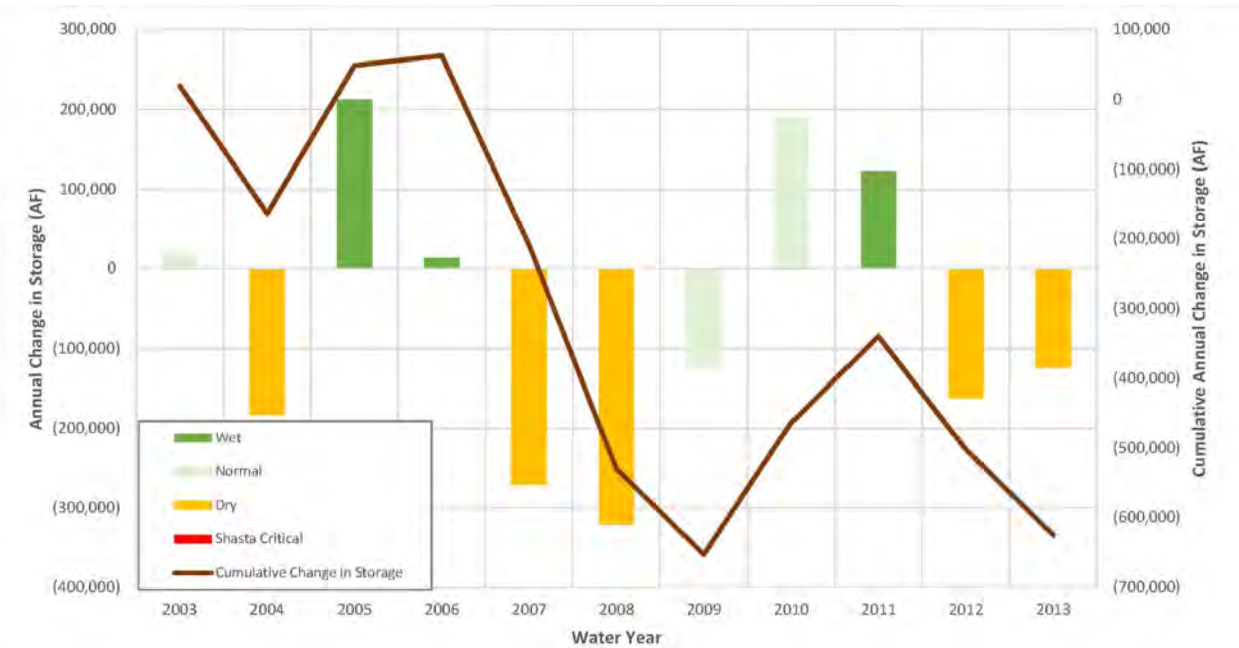


Figure CC-49: Calculated Upper Aquifer Change in Storage, Annual and Cumulative

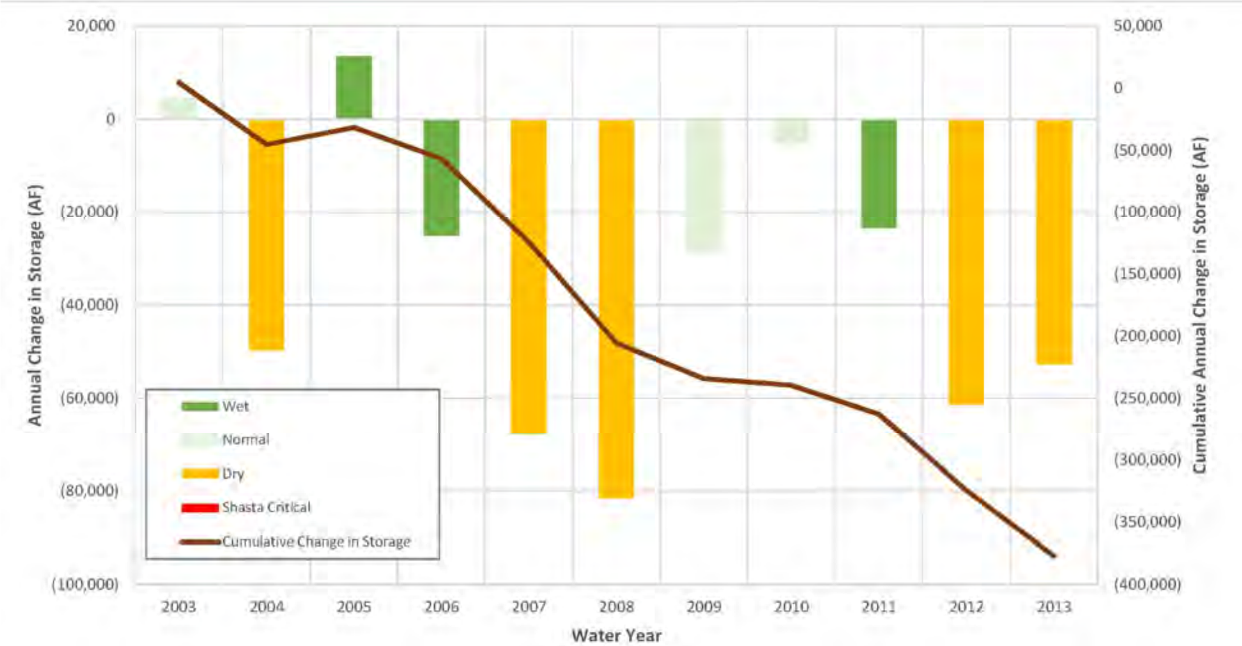


Figure CC-50: Calculated Lower Aquifer Change in Storage, Annual and Cumulative

4.2.4 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator for the Delta-Mendota Subbasin. The Subbasin is located inland from the Pacific Ocean; thus, groundwater conditions related to seawater intrusion are not applicable to the Delta-Mendota Subbasin.

4.2.5 Groundwater Quality

Groundwater quality varies considerably from west to east and north to south throughout the Delta-Mendota Subbasin. In general, Upper Aquifer water quality has historically been impacted by overlying land uses with some areas showing increasing concentrations of nitrate and TDS. Areas of elevated salt concentrations can be found in the Subbasin, generally along the southern portion of the San Joaquin River and in the southern portion of the Subbasin. Lower Aquifer groundwater has, and remains in most cases, to be of generally good quality. For more information about historic and current conditions relative to groundwater quality in each GSP Group area, refer to the individual GSPs.

4.2.6 Land Subsidence

Long-term groundwater level declines can result in a one-time release of “water of compaction” from compacting silt and clay layers (aquitards) resulting in inelastic land subsidence (Galloway et al., 1999). There are several other types of subsidence in the San Joaquin Valley, including subsidence related to hydrocompaction of moisture-deficient deposits above the water table, subsidence related to fluid withdrawal from oil and gas fields, subsidence caused by deep-seated tectonic movements, and subsidence caused by oxidation of peat soils that is a major factor in the Sacramento-San Joaquin Delta (Sneed et al., 2013). However, aquifer-system compaction caused by groundwater pumping causes the largest magnitude and areal extent of land subsidence in the San Joaquin Valley (Poland et al., 1975; Ireland et al., 1984; Farrar and Bertoldi, 1988; Bertoldi et al., 1991; Galloway and Riley, 1999).

Land subsidence is a prevalent issue in the Delta-Mendota Subbasin as it has impacted prominent infrastructure of statewide importance, namely the DMC and the California Aqueduct, as well as local canals, causing serious operational, maintenance, and construction-design issues (Sneed et al., 2013). Reduced freeboard and flow capacity for the DMC and California Aqueduct have rippling effects on imported water availability throughout the State. Even small amounts of subsidence in critical locations, especially where canal gradients are small, can impact canal operations (Sneed and Brandt, 2015). While some subsidence is reversible (referred to as elastic subsidence), inelastic or irreversible subsidence is caused mainly by pumping groundwater from below the Corcoran Clay, thus causing compaction and reducing storage in the fine-grained materials in the lower confined aquifer as well as damaging well infrastructure. As a result, important and extensive damages and repairs have resulted in the loss of conveyance capacity in canals that deliver water or remove floodwaters, the realignment of canals as their constant gradient becomes variable, the raising of infrastructure such as canal check stations, and the releveling of furrowed fields.

Available Data

There are six UNAVCO Continuous GPS (CGPS) locations that monitor subsidence within the Delta-Mendota Subbasin (**Figure CC-51**). Changes in land surface elevation have also been measured at DMC Check Structures. **Figure CC-52** through **Figure CC-57** show the vertical change in land surface elevation from a given time point (specified on charts) for the UNAVCO CGPS stations within the Delta-Mendota Subbasin, along with annual CVP allocations. **Table CC-5** summarizes the greatest monthly land subsidence rate and corresponding year(s) of that change at each UNAVCO CGPS station. Overall, the greatest monthly subsidence rates occurring after January 1, 2015 occurred during the Spring of 2016 to the Spring of 2017. Land subsidence rates (in feet per year), as measured by USBR from December 2011 to December 2014, are shown in **Figure CC-58**. Based on these data, within the majority of the Delta-Mendota Subbasin, annual subsidence rates were between -0.15 and -0.3 feet/year during this period (or between -0.45 and -0.9 feet of total subsidence over this three-year period).

Table CC-5: Subsidence Monitoring Trends
UNAVCO CGPS Stations

Station ID	Greatest Monthly Land Subsidence Rate as of January 1, 2015 (feet)	Year(s) of Greatest Monthly Subsidence Rate
P255	-0.0292	Spring 2016 to 2017
P259	-0.0183	Spring 2016 to 2017
P252	-0.033	Spring 2016 to 2017
P303	-0.2190	Spring 2016 to 2017
P301	-0.0029	Spring 2016 to 2017
P304	-0.0003	Spring 2013 to 2017

Historic Conditions

Along the DMC, in the northern portion of the San Joaquin Valley, extensive groundwater extraction from unconsolidated deposits caused subsidence exceeding 8.5 meters (or about 28 feet) between 1926 and 1970 (Poland et al., 1975), reaching 9 meters (or about 30 feet) in 1980 (Ireland, 1986). Land subsidence from groundwater pumping began in the San Joaquin Valley in the mid-1920s (Poland et al., 1975; Bertoldi et al., 1991; Galloway and Riley, 1999), and by 1970, about half of the San Joaquin Valley had land subsidence of more than 0.3 meters (or about 1 foot) (Poland et al., 1975). When groundwater pumping decreased in the Delta-Mendota Subbasin following imported water deliveries from the CVP via the DMC in the early 1950s, compaction rates were reduced in certain areas and water levels recovered. Notable droughts of 1976-1977 and 1987-1992 saw renewed compaction during these periods, with increased groundwater pumping as imported supplies were reduced or unavailable. However, following these droughts, compaction virtually ceased and groundwater levels rose to near pre-drought levels quite rapidly (Swanson, 1998; Galloway et al., 1999).

Subsidence contours for 1926-1970 (Poland et al., 1975) show the area of maximum active subsidence was southwest of the community of Mendota. Historical subsidence rates in the Mendota area exceeded 500 millimeters/year (or about 20 inches/year) during the mid-1950s and early 1960s (Ireland et al., 1984). The area southwest of Mendota has experienced some of the highest levels of subsidence in California, where from 1925 to 1977, this area sustained over 29 feet of subsidence (USGS, 2017). Historical subsidence rates along Highway 152 calculated from leveling-survey data from 1972, 1988, and 2004 show that for the two 16-year periods (1972-1988 and 1988-2004), maximum subsidence rates of about 50 millimeters/year (or about 2 inches/year) were found just south of El Nido (Sneed et al., 2013). Geodetic surveys completed along the DMC in 1935, 1953, 1957, 1984, and annually from 1996-2001 indicated that subsidence rates were greatest between 1953 and 1957 surveys, and that the maximum subsidence along the DMC (about 3 meters, or about 10 feet) was just east of DMC Check Structure Number 18.

After 1974, land subsidence was demonstrated to have slowed or largely stopped (DWR, June 2017); however, land subsidence remained poised to resume under certain conditions. Such an example includes the severe droughts that occurred between 1976 and 1977 and between 1987 and 1991. Those droughts, along with other corroborating factors, led to diminished deliveries of imported water which prompted some water agencies and farmers (especially in the western Valley) to refurbish old pumps, drill new water wells, and begin pumping groundwater to make up for cutbacks in the imported water supply. The decisions to renew groundwater pumping were encouraged by the fact that groundwater levels had recovered to near-predevelopment levels. CGPS data collected between 2007 to 2014 show seasonally variable subsidence and compaction rates, including uplift as elastic rebound occurs during the fall and winter (Sneed and Brandt, 2015). Vertical displacement at P303, near Los Banos, indicates subsidence at fairly consistent rates during and between drought periods (Sneed and Brandt, 2015). Vertical displacement at P304, near Mendota, indicates that most subsidence occurred during drought periods with very little occurring between drought periods. Finally, data from extensometers 12S/12E-16H2, located on the DMC west of Los Banos, and 14S/13E-11D6, located between the DMC and California Aqueduct west of Mendota, showed subsidence rate increases during 2014, the third year of the most recent drought (Sneed and Brandt, 2015).

Subsidence impacts to the California Aqueduct, which runs parallel and in close proximity to the Delta-Mendota Canal across the Subbasin, is of statewide importance. During the construction of the California Aqueduct, it was thought that subsidence within the San Joaquin Valley would cease with the delivery of water from the Central Valley Project, though additional freeboard was incorporated into the design and construction of the Aqueduct in an attempt to mitigate for future subsidence (DWR, June 2017). After water deliveries from the Aqueduct began, subsidence rates decreased to an average of less than 0.1 inches/year during normal to wet hydrologic years. During dry to critical hydrologic years, subsidence increased to an average of 1.1 inches per year. The 2012-2015 drought produced subsidence similar to those seen before the Aqueduct began delivering water, with some areas experiencing nearly 1.25 inches of sinking per month (based on NASA UAVSAR flight measurements). Dry and critically dry water years since Aqueduct deliveries began have resulted in extensive groundwater withdrawals, causing some areas near the Aqueduct to subside nearly 6 feet.

Current Conditions

Based on subsidence rates observed over the last decade, it is anticipated that without mitigation, subsidence will continue to impact operations of the DMC and California Aqueduct. For example, recently, Reach 4A of the San Joaquin River near Dos Palos experienced between 0.38 and 0.42 feet/year in subsidence between 2008 and 2016. As a result of subsidence, freeboard in Reach 4A is projected to be reduced by 0.5 foot by 2026 as compared to 2016, resulting in a 50 percent reduction in designed flow capacity (DWR, May 2018). Reduced flow capacities in the California Aqueduct will impact deliveries and transfers throughout the State and result in the need to pump more groundwater, thus contributing to further subsidence.

More recent subsidence measuring indicates subsidence hot spots within the Subbasin include the area east of Los Banos and the Tranquillity Irrigation District (TRID) area. USGS began periodic measurements of the land surface in parts of the San Joaquin Valley over the last decade. Between December 2011 and December 2014, total subsidence in the area east of Los Banos, located within the Merced Subbasin (also referred to as the El Nido-Red Top area), over the three-year period ranged from 0.15 to 0.75 feet, or 1.8 to 9 inches respectively (KDSA, 2015). The Jet Propulsion Laboratory (JPL) at the California Institute of Technology has also been monitoring subsidence in California using interferometric synthetic aperture radar (or InSAR), and a recent progress report documenting data for the period from May of 2015 to September of 2016 indicates that the two previously-identified primary subsidence areas near the community of Corcoran and centered on El Nido was joined by a third area of significant subsidence near TRID. For the study period (as shown in **Figure CC-59**), maximum total subsidence of 22 inches was measured near Corcoran, while the El Nido area subsided 15 inches and the TRID area subsided around 20 inches. Analyses at two particular stations near El Nido show interesting trends. At Station P303, between 2007 and 2014, 50 mm (or nearly 2 inches) of subsidence occurred at this location. Vertical displacement at P303 (**Figure CC-55**) show subsidence at fairly consistent rates during and between drought periods, indicating that these areas continued to pump groundwater despite climatic variations (possibly due to a lack of surface water availability) (Sneed and Brandt, 2015). Residual compaction may also be a factor. Vertical displacement at Station P304 indicated that most subsidence in this particular area occurred during drought periods and very little occurred between drought periods (**Figure CC-57**). This suggests that this area received other sources of water (most likely surface water available between drought periods) and that residual compaction was not very important in this area. These two areas demonstrate a close link between the availability of surface water, groundwater pumping, and inelastic land subsidence.

Total land subsidence from April 2015 to April 2016 in the San Joaquin Valley is shown in

Figure CC-60: Vertical Displacement, April 2015 to April 2016 . Subsidence monitoring in the Delta-Mendota Subbasin, and in the San Joaquin Valley as a whole, demonstrated significant inelastic land subsidence as a result of the last drought, with effects continuing to the present time (as evidenced by continued subsidence between 2016 and 2018 through surveys of the DMC). While the impacts appeared to have slowed, the temporal and spatial impacts of continued subsidence have not yet been evaluated.

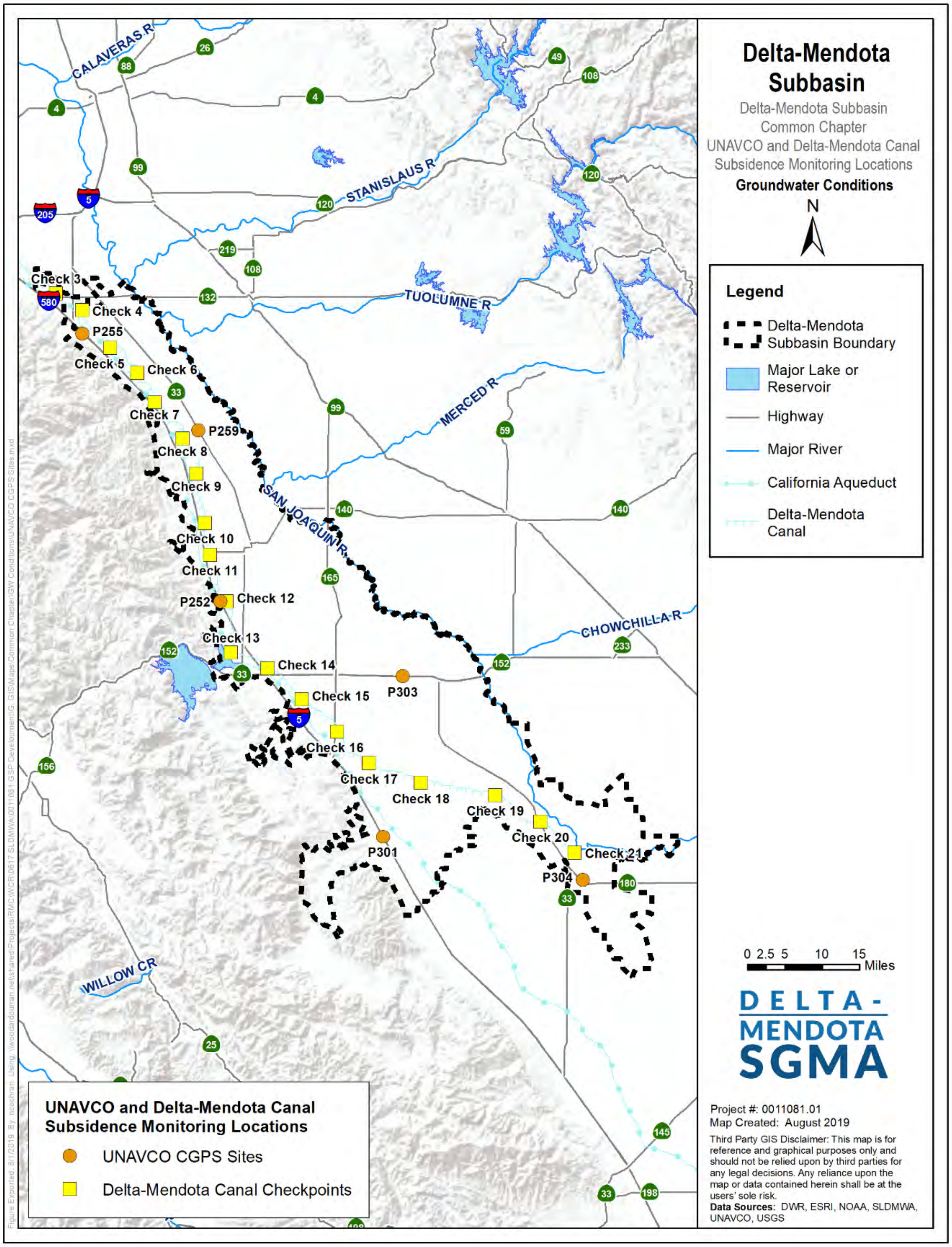


Figure CC-51: UNAVCO and Delta-Mendota Canal Subsidence Monitoring Locations

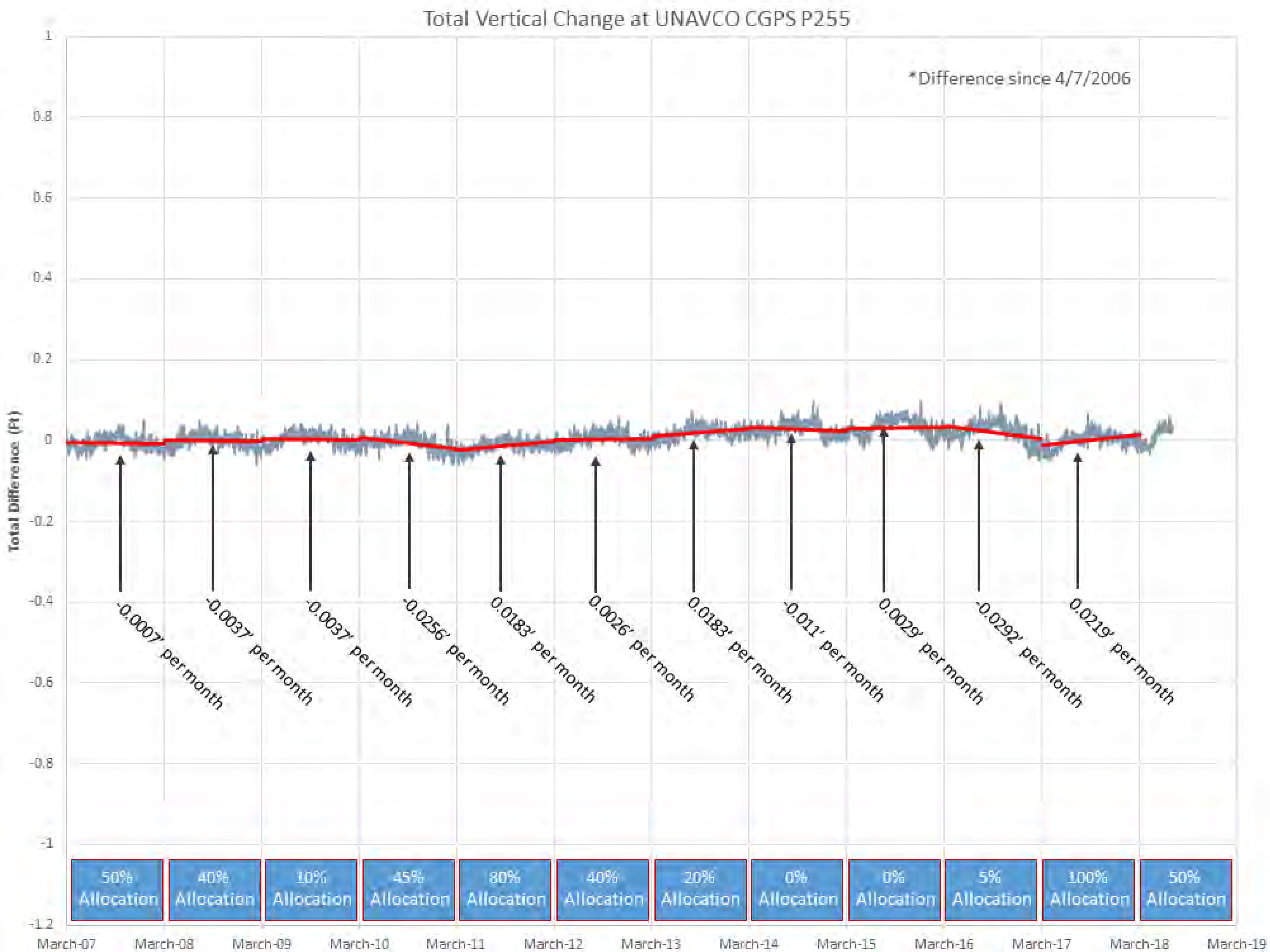


Figure CC-52: Vertical Elevation Change at UNAVCO CGPS P255, Spring 2007 to 2018

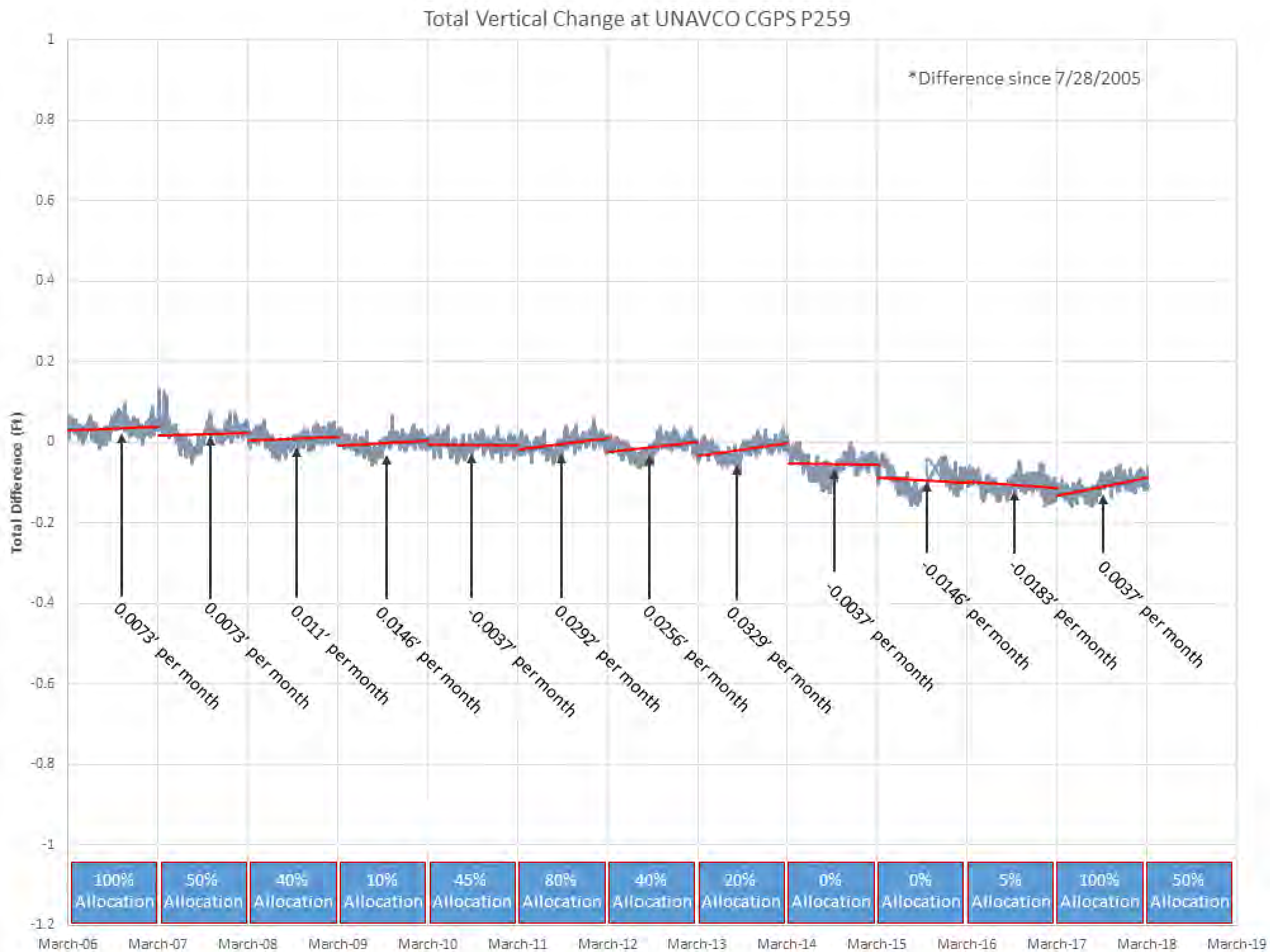


Figure CC-53: Vertical Elevation Change at UNAVCO CGPS P259, Spring 2006 to 2018

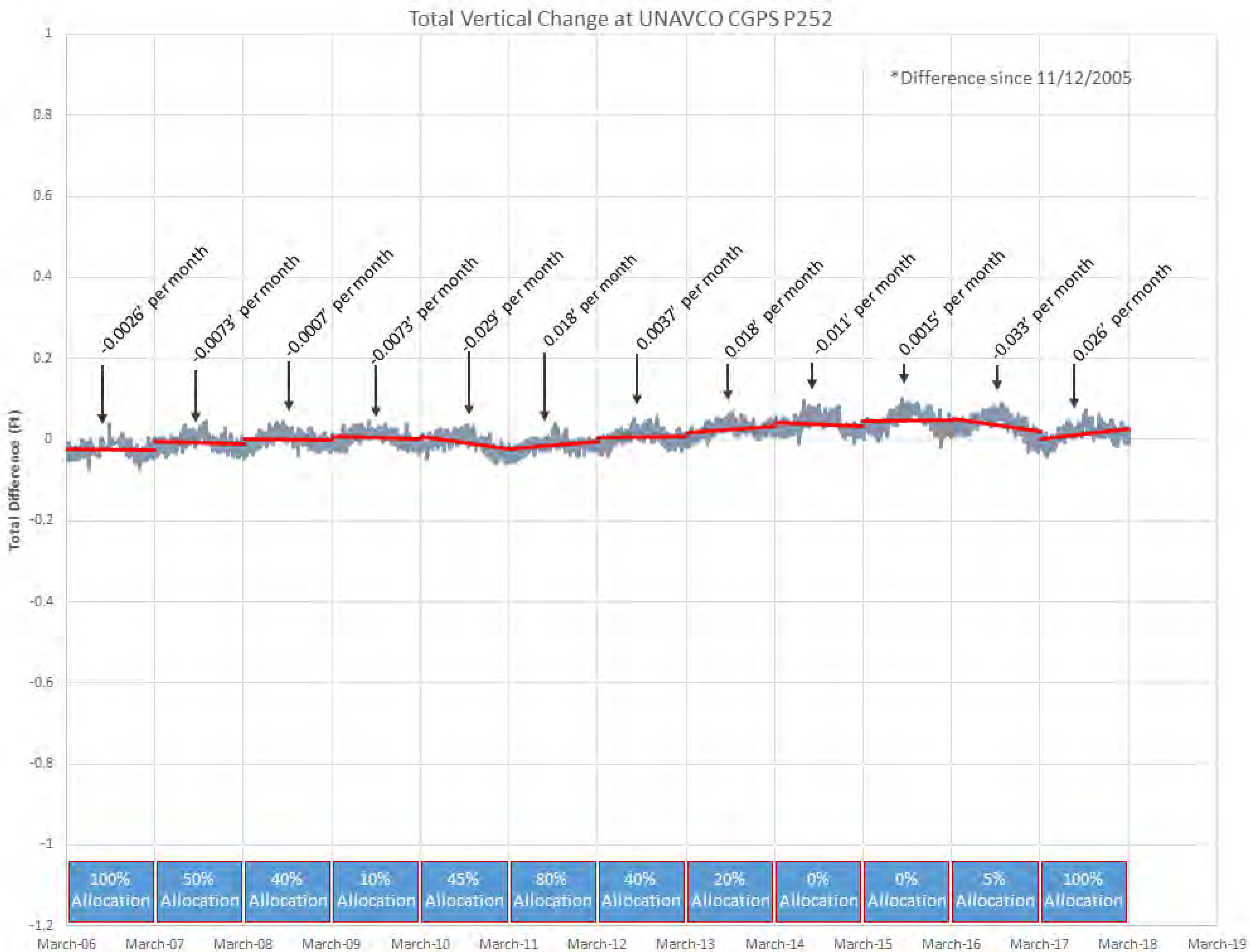


Figure CC-54: Vertical Elevation Change at UNAVCO CGPS P252, Spring 2006 to 2018

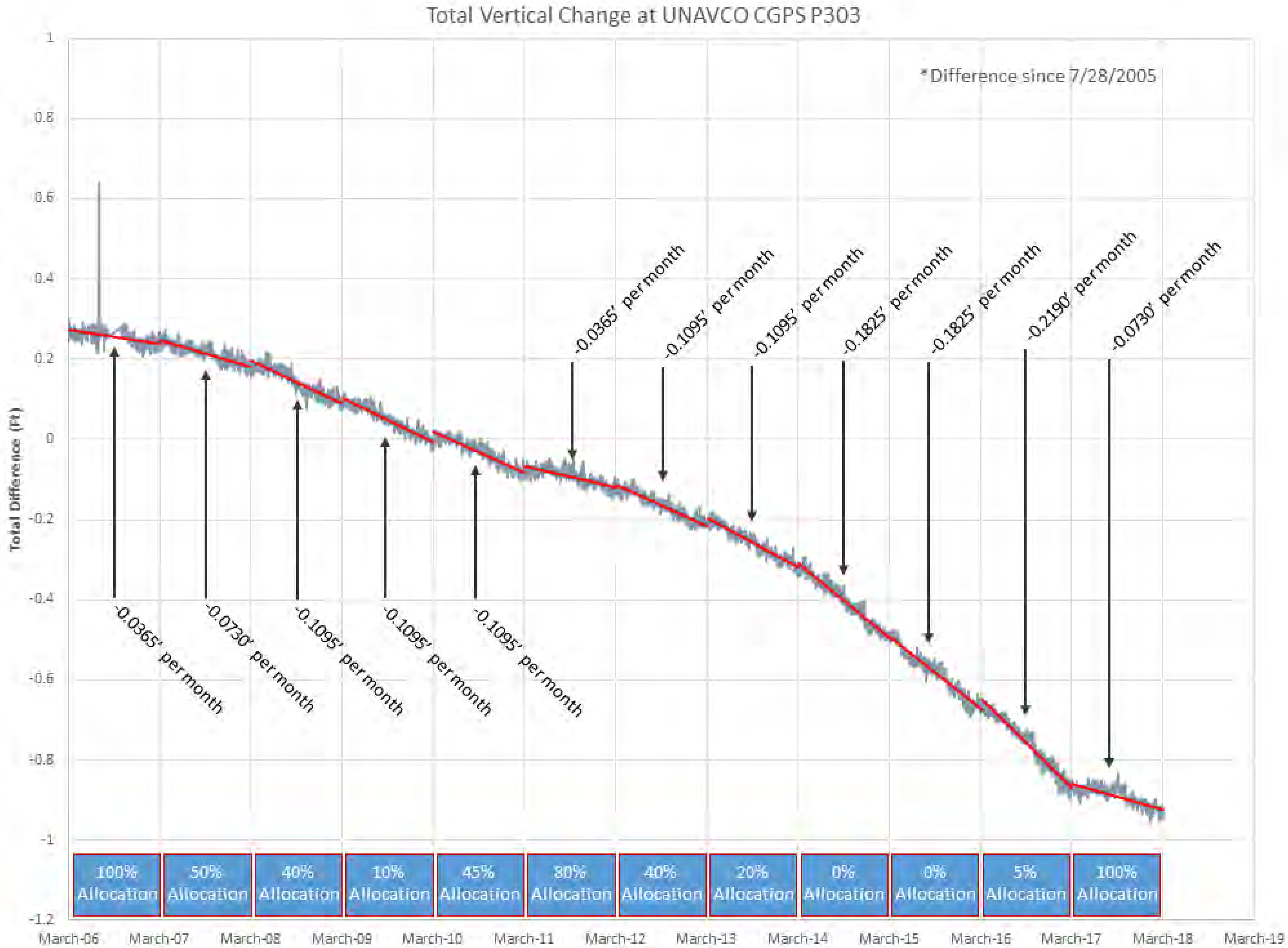


Figure CC-55: Vertical Elevation Change at UNAVCO CGPS P303, Spring 2006 to 2018

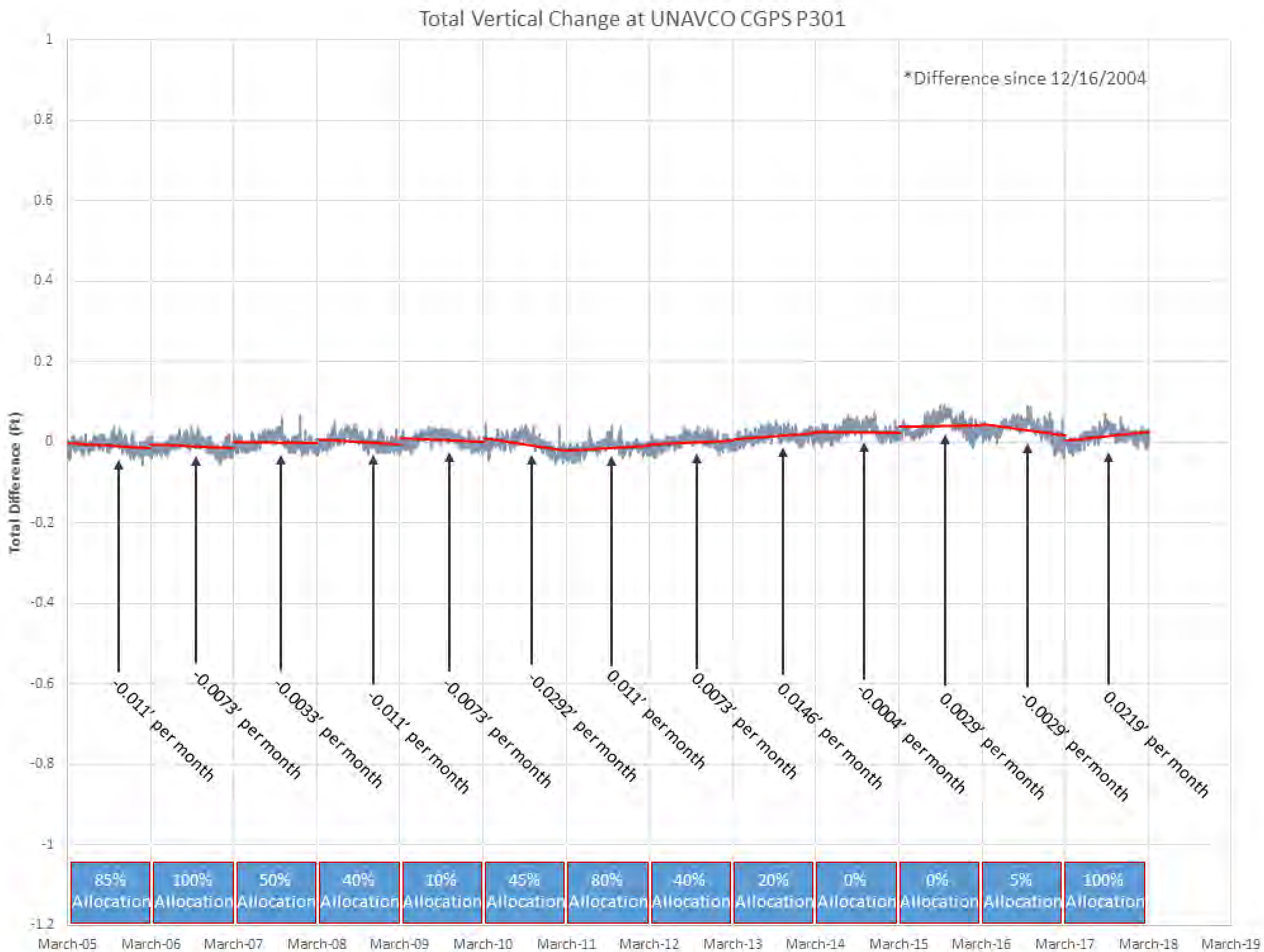


Figure CC-56: Vertical Elevation Change at UNAVCO CGPS P301, Spring 2005 to 2018

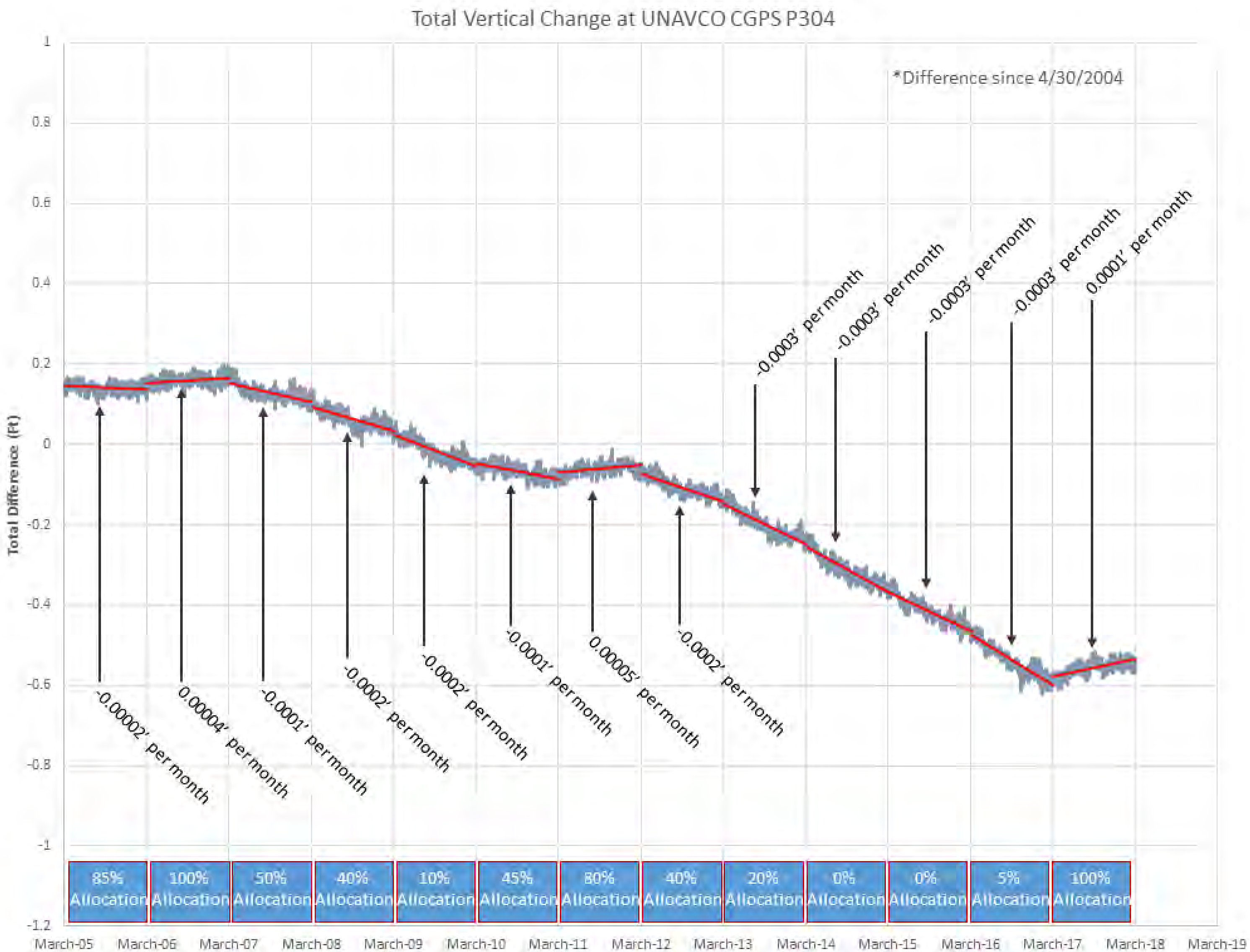


Figure CC-57: Vertical Elevation Change at UNAVCO CGPS P304, Spring 2005 to 2018

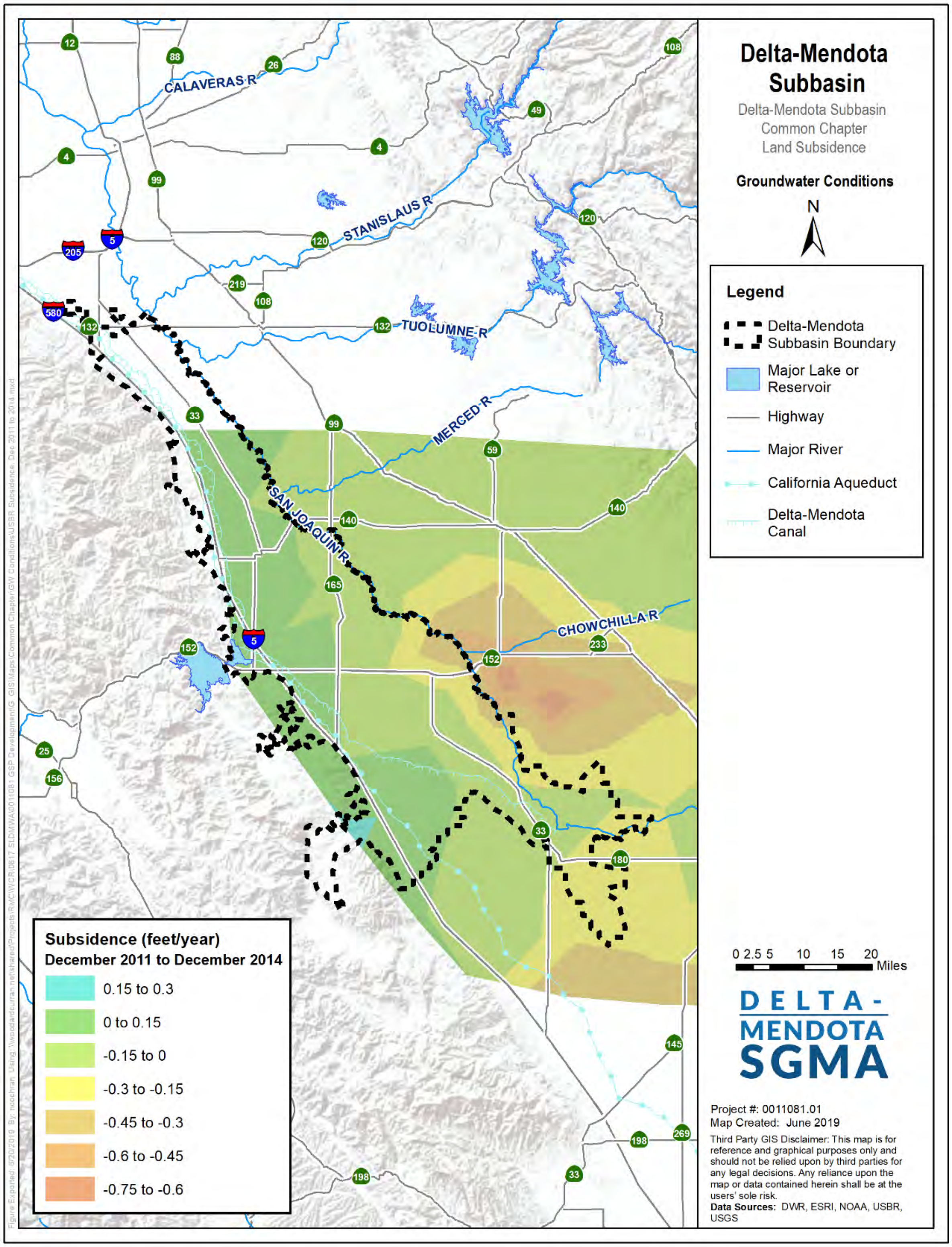


Figure CC-58: Land Subsidence, December 2011 to December 2014

Source: Progress Report: Subsidence in California, March 2015 – September 2016, Farr et. Al. JPL, 2017

Figure CC-59: Recent Land Subsidence at Key San Joaquin Valley Locations

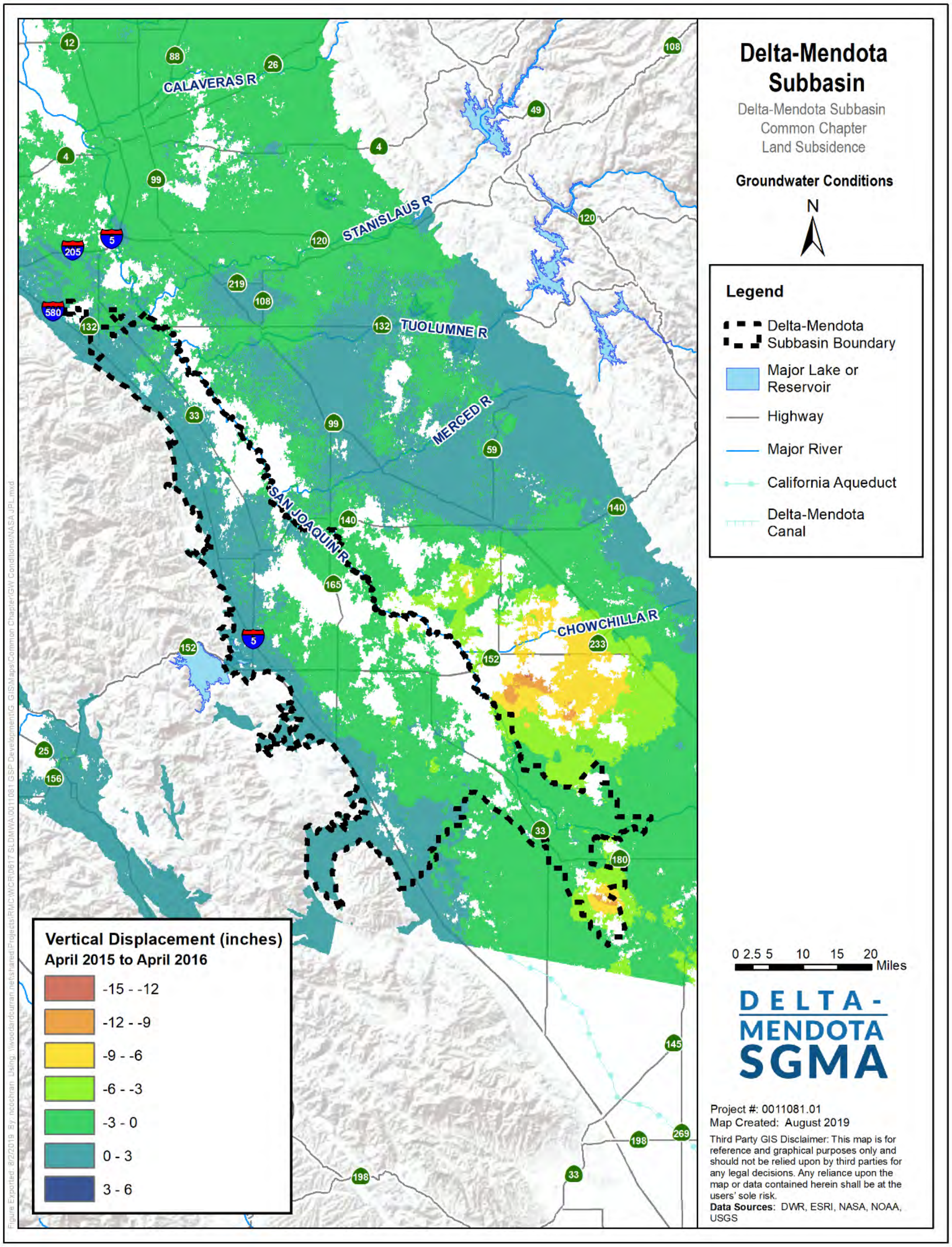


Figure CC-60: Vertical Displacement, April 2015 to April 2016

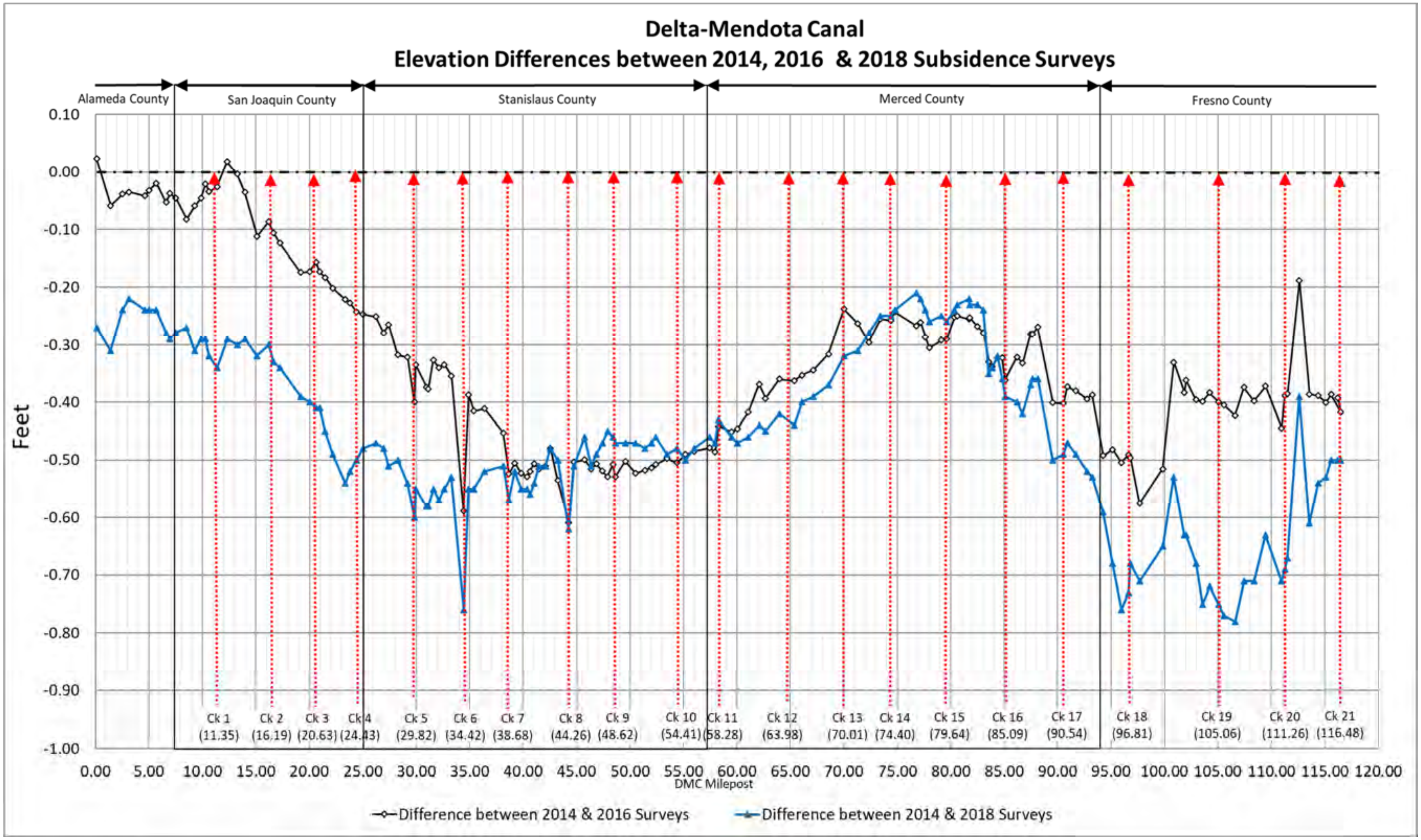


Figure CC-61: Elevation Change along the Delta-Mendota Canal, 2014 through 2018

4.2.7 Interconnected Surface Water Systems

Understanding the location, timing and magnitude of groundwater pumping impacts on interconnected surface water systems is important for the proper management of groundwater resources in order to minimize impacts on interconnected surface waters and the biological communities and permitted surface water diverters that rely on those resources. Historically, throughout the San Joaquin Valley, many interconnected stream reaches have transitioned from net-gaining to net-losing streams (TNC, 2014). Gaining streams occur when streamflows increase as a result of groundwater contribution and losing streams occur when streamflows decrease due to infiltration into the bed of the stream (McBain & Trush, Inc., 2002). Increased groundwater pumping has the ability to contribute to the depletion of interconnected waters with the nature, rate, and location of increased pumping being a function of distance to the river, as well as depth, timing, and rate of groundwater pumping.

Available Data

Two communities in the Delta-Mendota Subbasin are likely most vulnerable to the loss of interconnected surface water as a result of groundwater pumping: San Joaquin River surface water diverters and groundwater dependent ecosystems (GDEs). These communities represent the primary beneficial users of interconnected surface water and groundwater. Streams stemming from the west side of the Delta-Mendota Subbasin are ephemeral in nature, and only two of these creeks reach the San Joaquin River (Del Puerto Creek and Orestimba Creek). These creeks lose their flows to the underlying vadose zone (net-losing streams) and therefore do not represent areas of potential GDEs.

Groundwater dependent ecosystems are defined under Article 2 Definitions, § 351 Definitions of the GSP Emergency Regulations as “ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.” The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018) provided by DWR in conjunction with The Nature Conservancy (TNC) was initially used to identify GDEs within the Delta-Mendota Subbasin, following the associated guidance document provided by TNC (Rohde et al., 2018). Local verification efforts were conducted in the Delta-Mendota Subbasin by different GSA representatives to ground-truth GDEs based on local knowledge. Specifically, areas where natural communities have been urbanized or otherwise modified prior to 2015 were eliminated from the data set used to identify GDEs.

Identification of Interconnected Surface Water Systems

The San Joaquin River and Fresno Slough are the primary surface water bodies interconnected with Delta-Mendota Subbasin groundwater. For information about the sources used to determine the interconnected segments of the San Joaquin River and Fresno Slough within the Delta-Mendota Subbasin, refer to the individual GSPs.

Historic Conditions

The San Joaquin River and its tributaries drain approximately 13,500 mi^2 (measured at the USGS gaging station at Vernalis) along the western flank of the Sierra Nevada and eastern flank of the Coast Range, and flows northward into the Sacramento-San Joaquin Delta where it is joined by the Calaveras and Mokelumne Rivers before combining with the Sacramento River. Typical of Mediterranean climate catchments, river flows vary widely seasonally and from year to year. Three major tributaries join the San Joaquin from the east: the Merced, Tuolumne, and Stanislaus Rivers. Smaller tributaries include the Fresno River, Chowchilla River, Bear Creek, and Fresno Slough (from the Kings River). Precipitation is predominantly snow above about 5,500 to 6,000 feet in the Sierra Nevada, with rain in the middle and lower elevations of the Sierra foothills and in the Coast Range. As a result, the natural hydrology historically reflected a mixed runoff regime dominated by winter-spring rainfall runoff and spring-summer snowmelt runoff. Most flow is derived from snowmelt from the Sierra Nevada, with relatively little runoff contributed from the western side of the drainage basin in the rain shadow of the Coast Range. The unimpaired average annual water yield (WY1906-2002) of the San Joaquin River, as measured immediately above Millerton Reservoir, is 1,801,000 acre-feet (USBR, 2002); the post-Friant Dam average annual water yield (WY 1950-2000) to the lower San Joaquin River is 695,500 acre-feet (USGS, 2000). As average precipitation decreases from north to south, the San Joaquin River basin (including the Stanislaus, Tuolumne, and Merced Rivers) contributes about 22% of the total runoff to the Delta (DWR, 1998).

Current Conditions

Historically, most of the San Joaquin River, which forms the great majority of the Delta-Mendota Subbasin's eastern border, was a gaining reach. Snowmelt runoff during the spring and early summer resulted in these conditions through a good portion of the year. However, significant decreases in groundwater elevations due to a myriad of factors, including pumping, tile drains, the channelizing of flood flows, and upstream diversions on the river, have reversed this condition so most reaches are now losing reaches. Some localized gaining reaches still remain on the lower river, such as between the Stanislaus and Merced Rivers; however, many reaches along these rivers (and along localized streams) may transition from gaining to losing depending on hydrology.

Estimates of Timing and Quantity of Depletions

Using available data and where feasible, each Delta-Mendota Subbasin GSP Group quantified the gains and/or losses from the groundwater at each interconnected reach of the San Joaquin River adjoining the Delta-Mendota Subbasin. **Table CC-6** summarizes these estimates. For more information about the sources or methods used to estimate the timing and quantity of depletions, refer to the individual GSPs.

DELTA-MENDOTA SGMA

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Table CC-6: Estimated Quantity of Gains/Depletions for Interconnected Stream Reaches, San Joaquin River

	Landmark	River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
REACH 1		*267.5 to 229.0*	Located outside the Delta-Mendota Subbasin				
A	Friant Dam	267.5					
	North Fork Road Bridge	266.8					
	Cobb Island Bridge	259.0					
	State Route 41 (Lanes Bridge)	255.2					
	Scout Island Bend	250.0					
	ATSF Railroad Bridge	245.0					
B	State Route 99	243.2					
	Southern Pacific Railroad	243.2					
	State Route 145 Bridge (Skaggs Bridge)	234.1					
	Gravelly Ford	229.0					
REACH 2		*229.0 to 204.8*					
A	Gravelly Ford	229.0		Yes	Losing when flowing		
	Upstream Limit of Right Bank Levee	227.0					
	Upstream Limit of Left Bank Levee	225.0					
B	Chowchilla Bypass Control Structure	216.1	Farmers Water District	Yes	Losing when flowing	-4	2003 to 2013 average. High in 2010 (-8 cfs), low in 2004 and 2009 (-1 cfs)
	Mendota Dam	204.8					
	Mendota Pool			Yes	Losing	-40	-29,000 AFY
REACH 3		*204.8 to 182.0*		Yes	Losing	-25	-18.000 AFY
	Mendota Dam	204.8					
	Avenue 7.5 Bridge (Firebaugh)	195.2					
	Sack Dam	182.0					
REACH 4		*182.0 to 135.8*				-50 - 0	Losses when wet; gaining in some areas (but unquantifiable)
A	Sack Dam	182.0		Yes - first 2 miles No - next 1.5 miles Yes - remaining miles	Losing		
	State Route 152 Bridge	173.9		Yes	Gaining		
B	Sand Slough Control Structure	168.5					
	Mariposa Slough Control Structure	168.4					
	Turner Island Road Bridge	157.2					
	Mariposa Bypass confluence	147.2					
	Bear Creek/Eastside Bypass confluence	135.8					

DELTA-MENDOTA SGMA

WOODARD & CURRAN

Landmark	River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
REACH 5	*135.8 to 118.0*		Yes	Gaining	unquantifiable	Likely gaining from ag/refuge draining but unquantifiable
Bear Creek/Eastside Bypass confluence	135.8					
State Route 165 Bridge (Lander Avenue)	132.9					
Salt Slough con fluence	127.7					
State Route 140 Bridge (Fremont Ford)	125.1					
Mud Slough confluence	121.2					
Merced River confluence (Hills Ferry Bridge)	118.0					
Newman to Crows Landing		Northern & Central Delta-Mendota	Yes	Gaining	50	50
Crows Landing to Patterson		Northern & Central Delta-Mendota Region	Yes	Gaining	-50 to 200	-50 to 200
Patterson to Vernalis		Northern & Central Delta-Mendota Region	Yes	Gaining	190	6.1 cfs/mi for 30.8 miles. Based on Cooley, W. 2001. *Groundwater flow net analysis for lower San Joaquin River Basin.* Memo to CRWQCB, August 8, 2001

Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is defined under the GSP Emergency Regulations as referring "to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (§351(m)). Under §354.16(g) of the GSP Emergency Regulations, each Plan is required to identify GDEs within the subbasin utilizing data provided by DWR or the best available information. The following section describes the process for verifying GDEs within the Delta-Mendota Subbasin and the location of verified and potential GDEs.

The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018c) provided by DWR was used in conjunction with information provided by The Nature Conservancy (TNC) to identify GDEs within the Delta-Mendota Subbasin. To further screen available information regarding GDEs, each GSP Group developed individualized criteria. Additional details regarding the screening process implemented by each GSP can be found in the individual GSPs.

Based on the screening process implemented by each individual GSP Group, GDE polygons determined not to be GDEs were removed from the mapping. **Figure CC-62** and **Figure CC-63** summarize the results of the GDE analysis for the Subbasin. Results are compiled into two habitat classes: wetlands (**Figure CC-62**) and vegetation (**Figure CC-63**). Wetland features are commonly associated with surface expression of groundwater under natural, unmodified conditions. Vegetation feature types are commonly associated with the sub-surface presence of groundwater (phreatophytes – deep rooted plants). Confirmed GDEs have been grouped into larger polygons based on proximity and aquifer connection.

In general, identified Possible GDEs are primarily located along the San Joaquin River corridor, within the northern portion of the Northern & Central Delta-Mendota Region GSP, the SJREC GSP, the Grassland GSP, and the Fresno GSP Plan Areas, where some possible GDEs have been identified along ephemeral streams that originate from the Coast Range. Table CC-7 includes all freshwater species within the Delta-Mendota Subbasin as identified by TNC (2018). Per TNC data, these species (listed in Table CC-7) have either been observed or have the potential to exist within the Delta-Mendota Subbasin; however, the actual presence of these species have not been verified. As a result of the identification of Possible GDEs for the purpose of SGMA, no land use protections for GDEs are conveyed unless otherwise required. Additionally, the Delta Mendota Subbasin recognizes the opportunity to present further-refined GDE delineations in the subsequent GSP Updates.

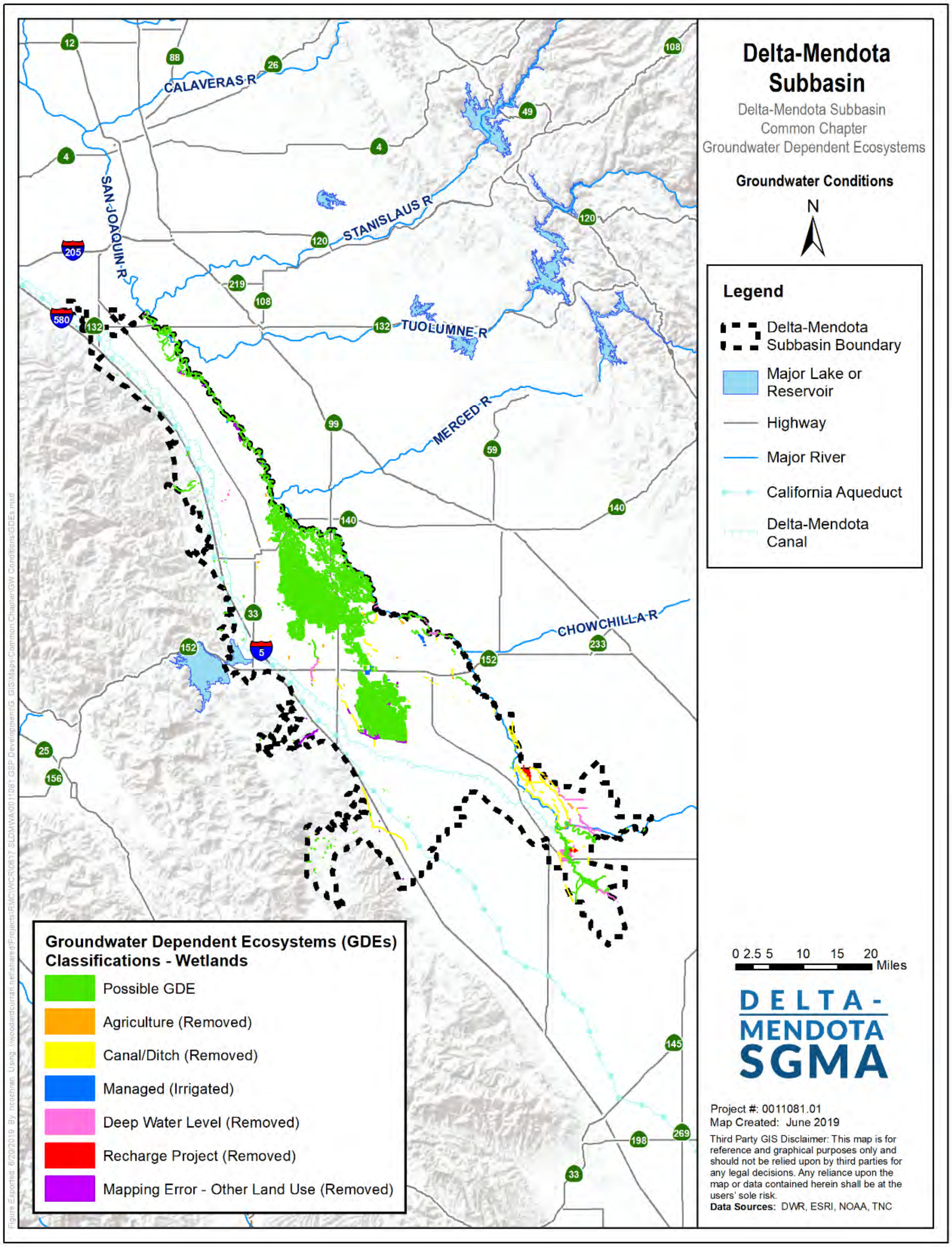

Figure CC-62: Groundwater Dependent Ecosystems, Wetlands

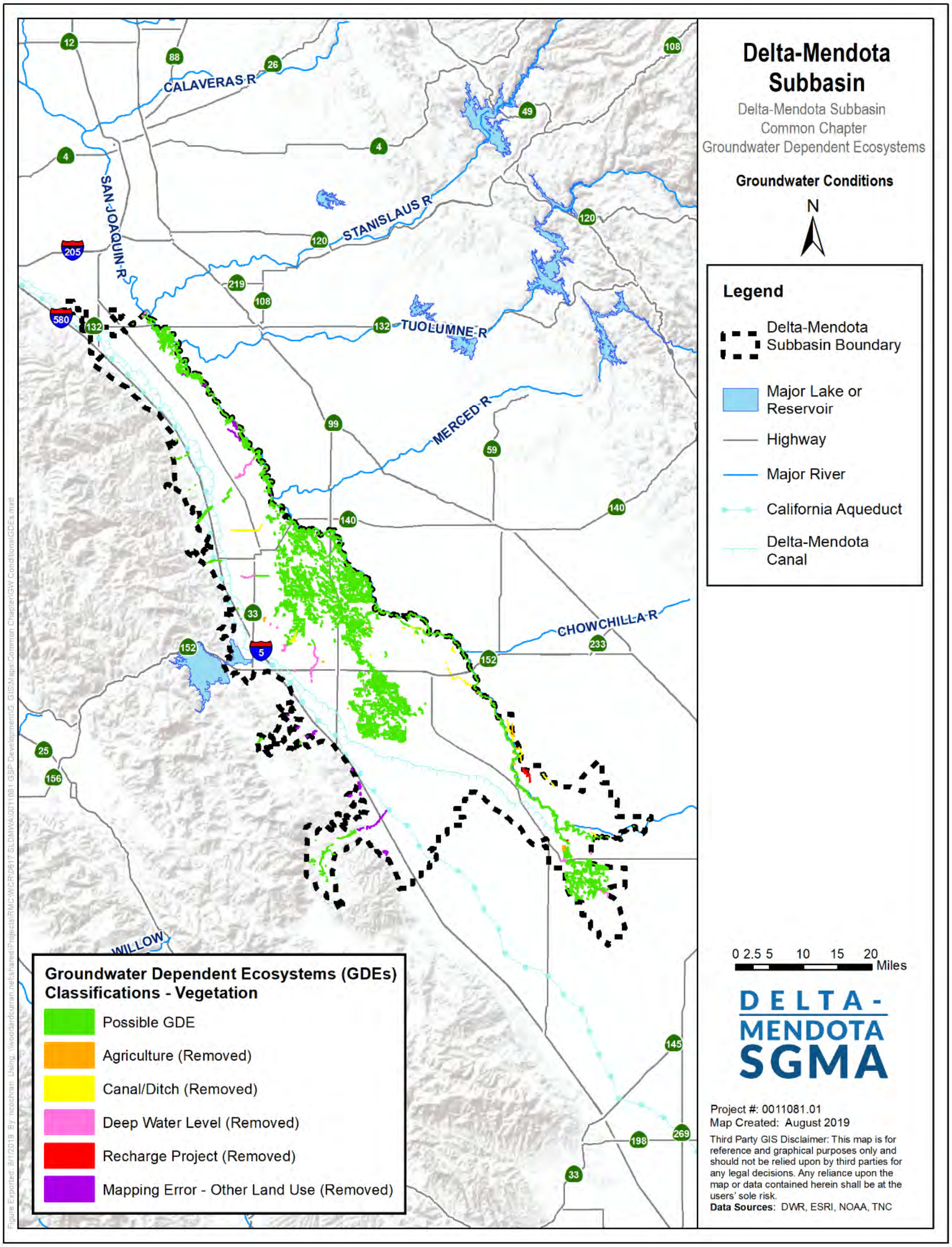

Figure CC-63: Groundwater Dependent Ecosystems, Vegetation

Table CC-7: List of Potential Freshwater Species

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Actitis macularius	Spotted Sandpiper	Birds		
Aechmophorus clarkii	Clark's Grebe	Birds		
Aechmophorus occidentalis	Western Grebe	Birds		
Agelaius tricolor	Tricolored Blackbird	Birds	Bird of Conservation Concern	Special Concern
Aix sponsa	Wood Duck	Birds		
Anas acuta	Northern Pintail	Birds		
Anas americana	American Wigeon	Birds		
Anas clypeata	Northern Shoveler	Birds		
Anas crecca	Green-winged Teal	Birds		
Anas cyanoptera	Cinnamon Teal	Birds		
Anas discors	Blue-winged Teal	Birds		
Anas platyrhynchos	Mallard	Birds		
Anas strepera	Gadwall	Birds		
Anser albifrons	Greater White-fronted Goose	Birds		
Ardea alba	Great Egret	Birds		
Ardea herodias	Great Blue Heron	Birds		
Aythya affinis	Lesser Scaup	Birds		
Aythya americana	Redhead	Birds		Special Concern
Aythya collaris	Ring-necked Duck	Birds		
Aythya marila	Greater Scaup	Birds		
Aythya valisineria	Canvasback	Birds		Special
Botaurus lentiginosus	American Bittern	Birds		
Bucephala albeola	Bufflehead	Birds		
Bucephala clangula	Common Goldeneye	Birds		
Butorides virescens	Green Heron	Birds		
Calidris alpina	Dunlin	Birds		
Calidris mauri	Western Sandpiper	Birds		
Calidris minutilla	Least Sandpiper	Birds		
Chen caerulescens	Snow Goose	Birds		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Chen rossii	Ross's Goose	Birds		
Chlidonias niger	Black Tern	Birds		Special Concern
Chroicocephalus philadelphia	Bonaparte's Gull	Birds		
Cistothorus palustris	Marsh Wren	Birds		
Cygnus columbianus	Tundra Swan	Birds		
Cypseloides niger	Black Swift	Birds	Bird of Conservation Concern	Special Concern
Dendrocygna bicolor	Fulvous Whistling-Duck	Birds		Special Concern
Egretta thula	Snowy Egret	Birds		
Empidonax traillii	Willow Flycatcher	Birds	Bird of Conservation Concern	Endangered
Fulica americana	American Coot	Birds		
Gallinago delicata	Wilson's Snipe	Birds		
Gallinula chloropus	Common Moorhen	Birds		
Geothlypis trichas	Common Yellowthroat	Birds		
Grus canadensis	Sandhill Crane	Birds		
Haliaeetus leucocephalus	Bald Eagle	Birds	Bird of Conservation Concern	Endangered
Himantopus mexicanus	Black-necked Stilt	Birds		
Icteria virens	Yellow-breasted Chat	Birds		Special Concern
Limnodromus scolopaceus	Long-billed Dowitcher	Birds		
Lophodytes cucullatus	Hooded Merganser	Birds		
Megaceryle alcyon	Belted Kingfisher	Birds		
Mergus merganser	Common Merganser	Birds		
Mergus serrator	Red-breasted Merganser	Birds		
Numenius americanus	Long-billed Curlew	Birds		
Numenius phaeopus	Whimbrel	Birds		
Nycticorax nycticorax	Black-crowned Night-Heron	Birds		
Oxyura jamaicensis	Ruddy Duck	Birds		
Pandion haliaetus	Osprey	Birds		Watch list
Pelecanus erythrorhynchos	American White Pelican	Birds		Special Concern

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Phalacrocorax auritus	Double-crested Cormorant	Birds		
Phalaropus tricolor	Wilson's Phalarope	Birds		
Plegadis chihi	White-faced Ibis	Birds		Watch list
Pluvialis squatarola	Black-bellied Plover	Birds		
Podiceps nigricollis	Eared Grebe	Birds		
Podilymbus podiceps	Pied-billed Grebe	Birds		
Porzana carolina	Sora	Birds		
Rallus limicola	Virginia Rail	Birds		
Recurvirostra americana	American Avocet	Birds		
Riparia riparia	Bank Swallow	Birds		Threatened
Setophaga petechia	Yellow Warbler	Birds		
Tachycineta bicolor	Tree Swallow	Birds		
Tringa melanoleuca	Greater Yellowlegs	Birds		
Tringa semipalmata	Willet	Birds		
Tringa solitaria	Solitary Sandpiper	Birds		
Vireo bellii	Bell's Vireo	Birds		
Vireo bellii pusillus	Least Bell's Vireo	Birds	Endangered	Endangered
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	Birds		Special Concern
Artemia franciscana	San Francisco Brine Shrimp	Crustaceans		
Branchinecta conservatio	Conservancy Fairy Shrimp	Crustaceans	Endangered	Special
Branchinecta lindahli	Versatile Fairy Shrimp	Crustaceans		
Branchinecta longiantenna	Longhorn Fairy Shrimp	Crustaceans	Endangered	Special
Branchinecta lynchi	Vernal Pool Fairy Shrimp	Crustaceans	Threatened	Special
Lepidurus packardi	Vernal Pool Tadpole Shrimp	Crustaceans	Endangered	Special
Linderiella occidentalis	California Fairy Shrimp	Crustaceans		Special
Oncorhynchus mykiss - CV	Central Valley steelhead	Fishes	Threatened	Special
Oncorhynchus mykiss irideus	Coastal rainbow trout	Fishes		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Pogonichthys macrolepidotus	Sacramento splittail	Fishes		Special Concern
Actinemys marmorata	Western Pond Turtle	Herps		Special Concern
Ambystoma californiense	California Tiger Salamander	Herps	Threatened	Threatened
Anaxyrus boreas	Boreal Toad	Herps		
Pseudacris regilla	Northern Pacific Chorus Frog	Herps		
Rana boylii	Foothill Yellow-legged Frog	Herps	Under Review in the Candidate or Petition Process	Special Concern
Rana draytonii	California Red-legged Frog	Herps	Threatened	Special Concern
Spea hammondii	Western Spadefoot	Herps	Under Review in the Candidate or Petition Process	Special Concern
Thamnophis atratus	Santa Cruz Gartersnake	Herps		
Thamnophis elegans	Mountain Gartersnake	Herps		
Thamnophis gigas	Giant Gartersnake	Herps	Threatened	Threatened
Thamnophis hammondii	Two-striped Gartersnake	Herps		Special Concern
Thamnophis sirtalis	Common Gartersnake	Herps		
Aeshnidae fam.	Aeshnidae fam.	Insects & other inverts		
Anax junius	Common Green Darner	Insects & other inverts		
Brillia spp.	Brillia spp.	Insects & other inverts		
Callicorixa spp.	Callicorixa spp.	Insects & other inverts		
Capnia hitchcocki	Arroyo Snowfly	Insects & other inverts		
Chironomus spp.	Chironomus spp.	Insects & other inverts		
Coenagrionidae fam.	Coenagrionidae fam.	Insects & other inverts		
Corisella spp.	Corisella spp.	Insects & other inverts		
Cricotopus spp.	Cricotopus spp.	Insects & other inverts		
Ischnura cervula	Pacific Forktail	Insects & other inverts		
Ischnura denticollis	Black-fronted Forktail	Insects & other inverts		
Mesocapnia bulbosa	Bulbous Snowfly	Insects & other inverts		
Paraleptophlebia associata	A Mayfly	Insects & other inverts		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Paratanytarsus spp.	Paratanytarsus spp.	Insects & other inverts		
Phaenopsectra spp.	Phaenopsectra spp.	Insects & other inverts		
Procladius spp.	Procladius spp.	Insects & other inverts		
Psectrocladius spp.	Psectrocladius spp.	Insects & other inverts		
Tanypus spp.	Tanypus spp.	Insects & other inverts		
Tipulidae fam.	Tipulidae fam.	Insects & other inverts		
Trichocorixa spp.	Trichocorixa spp.	Insects & other inverts		
Castor canadensis	American Beaver	Mammals		
Lontra canadensis	North American River Otter	Mammals		
Neovison vison	American Mink	Mammals		
Ondatra zibethicus	Common Muskrat	Mammals		
Anodonta californiensis	California Floater	Mollusks		Special
Margaritifera falcata	Western Pearlshell	Mollusks		Special
Pyrgulopsis diablensis	Diablo Range Pyrg	Mollusks		Special
Alopecurus saccatus	Pacific Foxtail	Plants		
Ammannia coccinea	Scarlet Ammannia	Plants		
Anemopsis californica	Yerba Mansa	Plants		
Arundo donax	NA	Plants		
Azolla filiculoides	NA	Plants		
Azolla microphylla	Mexican mosquito fern	Plants		Special
Baccharis salicina		Plants		
Bacopa eisenii	Gila River Water-hyssop	Plants		
Bidens laevis	Smooth Bur-marigold	Plants		
Bolboschoenus glaucus	NA	Plants		
Bolboschoenus maritimus paludosus	NA	Plants		
Callitriche marginata	Winged Water-starwort	Plants		
Ceratophyllum demersum	Common Hornwort	Plants		
Chloropyron molle hispidum		Plants		Special
Chloropyron palmatum	NA	Plants	Endangered	Special
Cotula coronopifolia	NA	Plants		
Crassula aquatica	Water Pygmyweed	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Crypsis vaginiflora	NA	Plants		
Cyperus erythrorhizos	Red-root Flatsedge	Plants		
Cyperus squarrosus	Awned Cyperus	Plants		
Downingia bella	Hoover's Downingia	Plants		
Downingia pulchella	Flat-face Downingia	Plants		
Echinodorus berteroi	Upright Burhead	Plants		
Elatine brachysperma	Shortseed Waterwort	Plants		
Elatine californica	California Waterwort	Plants		
Eleocharis acicularis	Least Spikerush	Plants		
Eleocharis atropurpurea	Purple Spikerush	Plants		
Eleocharis coloradoensis		Plants		
Eleocharis macrostachya	Creeping Spikerush	Plants		
Eleocharis montevidensis	Sand Spikerush	Plants		
Eleocharis quadrangulata	NA	Plants		
Elodea canadensis	Broad Waterweed	Plants		
Epilobium cleistogamum	Cleistogamous Spike-primrose	Plants		
Eragrostis hypnoides	Teal Lovegrass	Plants		
Eryngium castrense	Great Valley Eryngo	Plants		
Eryngium racemosum	Delta Coyote-thistle	Plants		Endangered
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle	Plants		Special
Eryngium vaseyi vallicola		Plants		
Eryngium vaseyi	Vasey's Coyote-thistle	Plants		
Euthamia occidentalis	Western Fragrant Goldenrod	Plants		
Hydrocotyle verticillata	Whorled Marsh-pennywort	Plants		
Juncus acuminatus	Sharp-fruit Rush	Plants		
Juncus xiphioides	Iris-leaf Rush	Plants		
Lasthenia ferrisiae	Ferris' Goldfields	Plants		Special
Lasthenia fremontii	Fremont's Goldfields	Plants		
Lemna aequinoctialis	Lesser Duckweed	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Lemna gibba	Inflated Duckweed	Plants		
Lemna minor	Lesser Duckweed	Plants		
Lepidium jaredii	Jared's Pepper-grass	Plants		Special
Lepidium oxycarpum	Sharp-pod Pepper-grass	Plants		
Limnanthes douglasii	Douglas' Meadowfoam	Plants		
Limosella acaulis	Southern Mudwort	Plants		
Lipocarpha micrantha	Dwarf Bulrush	Plants		
Ludwigia peploides	NA	Plants		
Ludwigia repens	Creeping Seedbox	Plants		
Lythrum californicum	California Loosestrife	Plants		
Marsilea vestita	NA	Plants		
Mimulus cardinalis	Scarlet Monkeyflower	Plants		
Mimulus guttatus	Common Large Monkeyflower	Plants		
Montia fontana	Fountain Miner's-lettuce	Plants		
Myosurus minimus	NA	Plants		
Myosurus sessilis	Sessile Mousetail	Plants		
Myriophyllum aquaticum	NA	Plants		
Najas guadalupensis	Southern Naiad	Plants		
Navarretia heterandra	Tehama Navarretia	Plants		
Navarretia leucocephala	White-flower Navarretia	Plants		
Navarretia prostrata	Prostrate Navarretia	Plants		Special
Neostapfia colusana	Colusa Grass	Plants	Threatened	Endangered
Panicum dichotomiflorum	NA	Plants		
Paspalum distichum	Joint Paspalum	Plants		
Persicaria hydropiperoides		Plants		
Persicaria lapathifolia		Plants		
Persicaria maculosa	NA	Plants		
Persicaria pensylvanica	NA	Plants		
Phacelia distans	NA	Plants		
Phyla lanceolata	Fog-fruit	Plants		
Phyla nodiflora	Common Frog-fruit	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Pilularia americana	NA	Plants		
Plagiobothrys acanthocarpus	Adobe Popcorn-flower	Plants		
Plagiobothrys greenei	Greene's Popcorn-flower	Plants		
Plagiobothrys humistratus	Dwarf Popcorn-flower	Plants		
Plagiobothrys leptocladus	Alkali Popcorn-flower	Plants		
Plantago elongata	Slender Plantain	Plants		
Pluchea odorata	Scented Conyza	Plants		
Pogogyne douglasii	NA	Plants		
Pogogyne zizyphoroides		Plants		
Potamogeton diversifolius	Water-thread Pondweed	Plants		
Potamogeton foliosus	Leafy Pondweed	Plants		
Potamogeton nodosus	Longleaf Pondweed	Plants		
Potamogeton pusillus	Slender Pondweed	Plants		
Psilocarphus brevissimus	Dwarf Woolly-heads	Plants		
Psilocarphus oregonus	Oregon Woolly-heads	Plants		
Psilocarphus tenellus	NA	Plants		
Puccinellia simplex	Little Alkali Grass	Plants		
Ranunculus sceleratus	NA	Plants		
Rorippa curvisiliqua	Curve-pod Yellowcress	Plants		
Rorippa palustris	Bog Yellowcress	Plants		
Rotala ramosior	Toothcup	Plants		
Ruppia cirrhosa	Widgeon-grass	Plants		
Ruppia maritima	Ditch-grass	Plants		
Sagittaria longiloba	Longbarb Arrowhead	Plants		
Sagittaria montevidensis calycina		Plants		
Salix exigua	Narrowleaf Willow	Plants		
Salix gooddingii	Goodding's Willow	Plants		
Schoenoplectus acutus occidentalis	Hardstem Bulrush	Plants		
Schoenoplectus americanus	Three-square Bulrush	Plants		
Sinapis alba	NA	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Sparganium eurycarpum		Plants		
Stuckenia pectinata		Plants		
Typha domingensis	Southern Cattail	Plants		
Typha latifolia	Broadleaf Cattail	Plants		
Veronica americana	American Speedwell	Plants		
Wolffiella lingulata	Tongue Bogmat	Plants		
Zannichellia palustris	Horned Pondweed	Plants		

Source: The Nature Conservancy (TNC). 2018. Identifying Environmental Surface Water Users - Freshwater Species List for Each Groundwater Basin dataset. https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

4.2.8 Data Gaps

The Delta-Mendota Subbasin is an extensive subbasin covering a large area extending along the northwestern end of the San Joaquin Valley. While there is a significant amount of data available regarding various groundwater-related aspects of the Subbasin, much is still not known in multiple locations around the Subbasin To this end, the following data gaps have been identified and will be addressed as part of the interim period between adoption of this GSP and its first 5-year update.

- Information regarding subsidence varies in extent around the region. While there is a large amount of land elevation survey data available in association with the DMC and the San Joaquin River Restoration Program, other areas in the Delta-Mendota Subbasin require additional data collection to both further establish and monitor future land subsidence rates.
- Only three shallow groundwater wells exist proximate to the northern end of the San Joaquin River (outside of the area being addressed by the San Joaquin River Restoration Program). Additional nested or clustered monitoring wells are required adjacent to the river on the northern end of the Subbasin to evaluate horizontal and vertical groundwater gradients, and in connection with river stage monitoring, to assess the interconnection between the San Joaquin River and the northeastern end of the Delta-Mendota Subbasin.
- There are a large number of wells in the Delta-Mendota Subbasin where no well construction information exists or is readily available. Video surveys and other surveys should be conducted on selected wells that may potentially be added to the Subbasin monitoring network to (1) identify where the wells are screened, and (2) determine if the well(s) are appropriate as additions to the GSP Groups' groundwater monitoring programs.
- Mapping of GDEs in the Delta-Mendota Subbasin, as contained in this Common Chapter, is an initial assessment of their location. This mapping may be refined using most recent groundwater elevation/depth to water contour mapping.
- Monitoring networks contained herein are preliminary and were formulated based on existing well information. As additional wells are installed in the Subbasin and additional well construction information is obtained for existing wells, these networks may need to be refined to improve on the spatial (areal and vertical) distribution of monitoring points and the data collected for evaluation of conditions of the groundwater basin.
- The sustainable yield estimates and water budgets contained in this Common Chapter for both the Upper and Lower Aquifers were developed using limited data. As additional data are collected over the first five years, improved sustainable yield estimates and estimates of water in storage in both principle aquifers should be prepared utilizing the new data.

In addition to these Subbasin-level data gaps, additional data gaps have been identified for each GSP Plan Area. Please see the individual GSPs for additional identified data gaps.

4.3 Delta-Mendota Subbasin Water Budgets

This section describes the common coordinated assumptions agreed upon and utilized by each GSP Group in the Delta-Mendota Subbasin in developing the historical, current, and projected water budgets for their respective GSP Plan Areas. These coordinated historical, current, and projected water budgets were then compiled to prepare the subbasin-level water budgets required under the GSP Regulations § 357.4(b)(3)(B), presented below. The sustainable yield for the Upper Aquifer and Lower Aquifer developed at the Subbasin-level and agreed upon by all GSP Groups in the Delta-Mendota Subbasin is also presented along with a description as to how the sustainable yield for each primary aquifer was calculated.

4.3.1 Coordinated Assumptions

All common coordinated assumptions agreed upon and utilized by each GSP Group in preparing their respective historical, current, and projected water budgets are presented in Technical Memoranda 3 (*Assumptions for the Historical, Current, and Projected Water Budgets of the Delta-Mendota Subbasin*), which is included in **Appendix B** of this Common Chapter.

4.3.2 GSP-Level Water Budgets

Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.

All historical, current, and projected water budgets developed within the Delta-Mendota Subbasin are consistent with GSP Regulations § 354.18 Water Budget, and DWR's *Best Management Practices for the Sustainable Management of Groundwater Water Budget BMP* (2016c) document was used when and where applicable at the discretion of each GSP Group.

4.3.3 Coordinated Water Budgets

The land surface budget, groundwater budget, and annual change in storage for the historical water budget, current water budget, and projected water budget with climate change factors (CCFs) and projects and management actions for the Delta-Mendota Subbasin were developed by compiling the water budgets prepared by each of GSP Group. The land surface budget is an accounting of water flows into and out of the land surface above an aquifer within with Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins, the atmosphere, and the groundwater aquifer below. The groundwater budget is an accounting of groundwater flows into and out of the two principal groundwater aquifers (Upper Aquifer and Lower Aquifer) within the Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins as well as the above land surface.

The land surface budget and groundwater budget are presented respectively for the historical water budget in **Table CC-8** and **Table CC-9,** for the current water budget in **Table CC-10** and **Table CC-11**, and for the projected water budget with climate change factors and projects and management actions in **Table CC-12** and **Table CC-13**. All categories presented in the land surface budget and groundwater budget tables were agreed upon by all Delta-Mendota GSP Groups, with representatives from each GSP group tasked with filling out these budget tables as appropriate to account for the unique hydrology, land use, and water use within their respective GSP regions. The tables below are simply compilations of the individual GSP water budget data as provided by their respective plan preparers. **Figure CC-64** shows the average annual and cumulative change in storage in both principal aquifers under the Subbasin projected water budget (including application of climate change factors and the addition of projects and management actions).

Individual GSAs and agencies in the Delta-Mendota Subbasin understand that the historical, current and projected water budgets were completed using best available science and data. Where data gaps exist, the individual GSAs and agencies intend to conduct the work necessary to substantiate or improve the estimates and assumptions developed for determining their water budgets. Nothing in this part, or in any groundwater sustainability plan adopted pursuant to this part, determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

Table CC-8: Delta-Mendota Subbasin Historical Water Budget, Land Surface Budget

Land Surface Budget												
Water Year	Water Year Type	Inflows						Outflows				
		Precipitation	Surface Water Inflows	Applied Water - Groundwater	Applied Water - Imported Surface Water	Other Direct Recharge	**Total Inflows**	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	**Total Outflows**
2003	Normal	451,000	31,000	382,000	1,485,000	15,000	**2,364,000**	310,000	1,771,000	31,000	291,000	**2,403,000**
2004	Dry	412,000	31,000	398,000	1,486,000	14,000	**2,341,000**	263,000	1,764,000	31,000	304,000	**2,362,000**
2005	Wet	739,000	41,000	285,000	1,483,000	19,000	**2,567,000**	357,000	1,811,000	35,000	338,000	**2,541,000**
2006	Wet	572,000	41,000	270,000	1,499,000	17,000	**2,399,000**	318,000	1,795,000	34,000	289,000	**2,436,000**
2007	Dry	259,000	31,000	471,000	1,499,000	15,000	**2,275,000**	240,000	1,724,000	31,000	307,000	**2,302,000**
2008	Dry	329,000	31,000	529,000	1,382,000	17,000	**2,288,000**	224,000	1,797,000	30,000	327,000	**2,378,000**
2009	Normal	304,000	31,000	517,000	1,360,000	15,000	**2,227,000**	191,000	1,843,000	30,000	321,000	**2,385,000**
2010	Normal	538,000	31,000	371,000	1,392,000	22,000	**2,354,000**	283,000	1,669,000	30,000	394,000	**2,376,000**
2011	Wet	626,000	41,000	259,000	1,556,000	36,000	**2,518,000**	321,000	1,794,000	34,000	402,000	**2,551,000**
2012	Dry	276,000	31,000	471,000	1,505,000	20,000	**2,303,000**	223,000	1,709,000	30,000	353,000	**2,315,000**

Table CC-9: Delta-Mendota Subbasin Historical Water Budget, Groundwater Budget

Groundwater Budget																			
Water Year	Water Year Type	Inflows								Outflows					Change in Storage				
		Deep Percolation			Subsurface Groundwater Inflows		Seepage through Corcoran Clay	Other Direct Recharge	**Total Inflows**	Groundwater Extraction from Upper Aquifer	Groundwater Extraction from Lower Aquifer	Subsurface Groundwater Outflows		**Total Outflows**	Estimated Annual Change in Groundwater Storage				
		Precipitation Infiltration	*Surface Water Infiltration*	*Applied Water Infiltration*	*Upper Aquifer*	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*		Inflows	Outflows	Change in Storage - Upper Aquifer	Change in Storage - Lower Aquifer	Change in Storage - Total
2003	Normal	51,000	66,000	174,000	206,000	68,000	45,000	32,000	**642,000**	350,000	49,000	210,000	105,000	**759,000**	641,000	759,000	20,000	5,000	24,000
2004	Dry	36,000	65,000	204,000	184,000	64,000	45,000	30,000	**628,000**	365,000	49,000	233,000	131,000	**823,000**	628,000	822,000	(183,000)	(50,000)	(232,000)
2005	Wet	78,000	79,000	181,000	229,000	78,000	45,000	72,000	**762,000**	252,000	47,000	223,000	78,000	**645,000**	762,000	645,000	212,000	14,000	225,000
2006	Wet	59,000	78,000	152,000	208,000	70,000	45,000	98,000	**710,000**	238,000	46,000	221,000	78,000	**628,000**	710,000	628,000	14,000	(25,000)	(11,000)
2007	Dry	23,000	66,000	218,000	171,000	50,000	45,000	48,000	**621,000**	431,000	57,000	217,000	127,000	**877,000**	621,000	876,000	(272,000)	(68,000)	(339,000)
2008	Dry	26,000	69,000	233,000	186,000	57,000	45,000	40,000	**656,000**	475,000	70,000	234,000	131,000	**955,000**	655,000	954,000	(321,000)	(81,000)	(403,000)
2009	Normal	21,000	66,000	235,000	207,000	62,000	45,000	33,000	**669,000**	469,000	66,000	210,000	104,000	**894,000**	669,000	893,000	(123,000)	(28,000)	(151,000)
2010	Normal	53,000	73,000	267,000	230,000	74,000	45,000	65,000	**807,000**	335,000	52,000	215,000	112,000	**759,000**	808,000	759,000	190,000	(5,000)	184,000
2011	Wet	67,000	96,000	239,000	217,000	74,000	45,000	101,000	**839,000**	234,000	40,000	229,000	86,000	**634,000**	840,000	633,000	124,000	(23,000)	100,000
2012	Dry	26,000	71,000	257,000	180,000	57,000	45,000	62,000	**698,000**	432,000	56,000	230,000	136,000	**899,000**	698,000	898,000	(162,000)	(61,000)	(224,000)

Table CC-10: Delta-Mendota Subbasin Current Water Budget, Land Surface Budget

Land Surface Budget													
Water Year	Water Year Type	Inflows						Outflows					
		Precipitation	Surface Water Inflows	Applied Water - Groundwater	Applied Water - Imported Surface Water	Other Direct Recharge	**Total Inflows**	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	**Total Outflows**
2013	Dry	318,000	31,000	514,000	1,428,000	17,000	**2,308,000**	228,000	1,685,000	30,000	385,000	**2,328,000**

Table CC-11: Delta-Mendota Subbasin Current Water Budget, Groundwater System

Groundwater Budget																			
Water Year	Water Year Type	Inflows								Outflows					Change in Storage				
		Deep Percolation			Subsurface Groundwater Inflows		Seepage through Corcoran Clay	Other Direct Recharge	**Total Inflows**	Groundwater Extraction from Upper Aquifer	Groundwater Extraction from Lower Aquifer	Subsurface Groundwater Outflows		**Total Outflows**	**Estimated Annual Change in Groundwater Storage**				
		Precipitation Infiltration	*Surface Water Infiltration*	*Applied Water Infiltration*	*Upper Aquifer*	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*		Inflows	Outflows	Change in Storage - Upper Aquifer	Change in Storage - Lower Aquifer	Change in Storage - Total
2013	Dry	28,000	68,000	289,000	177,000	67,000	45,000	65,000	**739,000**	447,000	65,000	220,000	140,000	**917,000**	738,000	917,000	(123,000)	(53,000)	(176,000)

Table CC-12: Delta-Mendota Subbasin Projected Water Budget, Land Surface Budget (containing climate change factors and projects and management actions)

Land Surface Budget														
Water Year	Water Year Type	Inflows							Outflows					
		Precipitation	Surface Water Inflows	Applied Water - Groundwater	Applied Water - Imported Surface Water	Project Effects	Other Direct Recharge	**Total Inflows**	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	Project Effects	**Total Outflows**
2014	Shasta Critical	283,000	26,000	556,000	1,025,000	0	7,000	**1,897,000**	189,000	1,605,000	5,000	200,000	0	**1,999,000**
2015	Shasta Critical	363,000	26,000	607,000	907,000	0	8,000	**1,911,000**	169,000	1,519,000	4,000	261,000	0	**1,953,000**
2016	Dry	712,000	39,000	355,000	1,219,000	0	9,000	**2,334,000**	280,000	1,598,000	32,000	367,000	0	**2,277,000**
2017	Wet	686,000	53,000	282,000	1,442,000	16,000	8,000	**2,487,000**	330,000	1,755,000	39,000	405,000	0	**2,529,000**
2018	Normal	527,000	39,000	356,000	1,376,000	0	6,000	**2,304,000**	279,000	1,625,000	33,000	363,000	(1,000)	**2,300,000**
2019	Wet	712,000	53,000	234,000	1,501,000	11,000	8,000	**2,519,000**	331,000	1,780,000	39,000	338,000	(1,000)	**2,488,000**
2020	Dry	434,000	39,000	353,000	1,463,000	9,000	7,000	**2,305,000**	236,000	1,693,000	32,000	314,000	3,000	**2,275,000**
2021	Wet	808,000	53,000	227,000	1,499,000	6,000	8,000	**2,601,000**	383,000	1,787,000	39,000	352,000	10,000	**2,561,000**
2022	Wet	1,021,000	53,000	216,000	1,502,000	16,000	8,000	**2,816,000**	440,000	1,803,000	39,000	412,000	10,000	**2,694,000**
2023	Normal	580,000	39,000	355,000	1,443,000	4,000	6,000	**2,427,000**	257,000	1,683,000	33,000	371,000	2,000	**2,344,000**
2024	Dry	573,000	39,000	344,000	1,466,000	8,000	7,000	**2,437,000**	260,000	1,695,000	32,000	347,000	3,000	**2,334,000**
2025	Wet	884,000	53,000	227,000	1,501,000	16,000	8,000	**2,689,000**	355,000	1,815,000	39,000	384,000	10,000	**2,593,000**
2026	Dry	575,000	39,000	440,000	1,423,000	15,000	8,000	**2,500,000**	248,000	1,751,000	32,000	377,000	7,000	**2,408,000**
2027	Dry	653,000	39,000	438,000	1,423,000	14,000	8,000	**2,575,000**	280,000	1,732,000	32,000	380,000	9,000	**2,424,000**
2028	Dry	534,000	39,000	442,000	1,424,000	14,000	8,000	**2,461,000**	275,000	1,758,000	32,000	312,000	9,000	**2,377,000**
2029	Dry	462,000	39,000	441,000	1,422,000	15,000	8,000	**2,387,000**	257,000	1,709,000	32,000	312,000	10,000	**2,310,000**
2030	Shasta Critical	417,000	26,000	531,000	1,136,000	3,000	8,000	**2,121,000**	209,000	1,591,000	5,000	318,000	9,000	**2,123,000**
2031	Shasta Critical	492,000	26,000	531,000	1,136,000	3,000	8,000	**2,196,000**	211,000	1,606,000	5,000	360,000	9,000	**2,182,000**
2032	Wet	832,000	53,000	234,000	1,503,000	21,000	8,000	**2,651,000**	335,000	1,802,000	39,000	420,000	23,000	**2,596,000**
2033	Dry	466,000	26,000	445,000	1,350,000	20,000	8,000	**2,315,000**	245,000	1,706,000	5,000	316,000	11,000	**2,272,000**
2034	Wet	851,000	53,000	215,000	1,500,000	34,000	8,000	**2,661,000**	365,000	1,756,000	39,000	405,000	23,000	**2,565,000**
2035	Wet	731,000	53,000	243,000	1,502,000	22,000	8,000	**2,559,000**	324,000	1,815,000	39,000	356,000	23,000	**2,534,000**
2036	Wet	774,000	53,000	278,000	1,508,000	35,000	8,000	**2,656,000**	301,000	1,842,000	39,000	441,000	23,000	**2,623,000**
2037	Wet	1,194,000	53,000	211,000	1,497,000	37,000	8,000	**3,000,000**	494,000	1,741,000	39,000	554,000	24,000	**2,828,000**
2038	Normal	448,000	39,000	390,000	1,440,000	12,000	6,000	**2,335,000**	273,000	1,626,000	33,000	335,000	15,000	**2,267,000**
2039	Normal	488,000	39,000	404,000	1,439,000	11,000	6,000	**2,387,000**	265,000	1,664,000	33,000	362,000	15,000	**2,324,000**
2040	Dry	534,000	39,000	373,000	1,466,000	26,000	7,000	**2,445,000**	263,000	1,675,000	32,000	376,000	11,000	**2,346,000**
2041	Dry	384,000	39,000	388,000	1,468,000	16,000	7,000	**2,302,000**	214,000	1,671,000	32,000	335,000	10,000	**2,252,000**
2042	Normal	530,000	39,000	427,000	1,484,000	12,000	6,000	**2,498,000**	282,000	1,759,000	34,000	344,000	15,000	**2,419,000**
2043	Dry	488,000	39,000	386,000	1,449,000	26,000	7,000	**2,395,000**	238,000	1,766,000	33,000	285,000	11,000	**2,322,000**
2044	Wet	875,000	53,000	244,000	1,483,000	50,000	7,000	**2,712,000**	400,000	1,799,000	40,000	380,000	24,000	**2,619,000**
2045	Wet	622,000	53,000	270,000	1,512,000	42,000	6,000	**2,505,000**	328,000	1,809,000	39,000	318,000	23,000	**2,494,000**
2046	Dry	268,000	39,000	516,000	1,477,000	17,000	7,000	**2,324,000**	225,000	1,765,000	33,000	301,000	11,000	**2,324,000**

Land Surface Budget															
Water Year	Water Year Type	Inflows							Outflows						
		Precipitation	Surface Water Inflows	Applied Water - Groundwater	Applied Water - Imported Surface Water	Project Effects	Other Direct Recharge	Total Inflows	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	Project Effects	Total Outflows
2047	Dry	402,000	39,000	522,000	1,427,000	15,000	8,000	2,413,000	202,000	1,795,000	32,000	333,000	10,000	2,362,000
2048	Normal	331,000	39,000	548,000	1,455,000	6,000	5,000	2,384,000	212,000	1,858,000	33,000	298,000	14,000	2,401,000
2049	Normal	658,000	39,000	359,000	1,438,000	39,000	6,000	2,539,000	280,000	1,667,000	33,000	409,000	18,000	2,389,000
2050	Wet	708,000	53,000	267,000	1,505,000	48,000	7,000	2,588,000	343,000	1,840,000	39,000	336,000	23,000	2,558,000
2051	Dry	350,000	39,000	390,000	1,465,000	24,000	7,000	2,275,000	222,000	1,704,000	32,000	254,000	11,000	2,212,000
2052	Dry	390,000	39,000	496,000	1,421,000	28,000	8,000	2,382,000	210,000	1,693,000	32,000	363,000	11,000	2,298,000
2053	Shasta Critical	306,000	26,000	576,000	1,109,000	3,000	7,000	2,027,000	180,000	1,661,000	5,000	250,000	9,000	2,096,000
2054	Shasta Critical	340,000	26,000	575,000	1,045,000	5,000	8,000	1,999,000	154,000	1,627,000	4,000	300,000	8,000	2,085,000
2055	Dry	630,000	39,000	394,000	1,205,000	16,000	9,000	2,293,000	253,000	1,701,000	32,000	317,000	10,000	2,303,000
2056	Wet	745,000	53,000	300,000	1,432,000	35,000	8,000	2,573,000	311,000	1,857,000	39,000	395,000	22,000	2,602,000
2057	Wet	693,000	53,000	261,000	1,505,000	28,000	8,000	2,548,000	302,000	1,855,000	39,000	322,000	24,000	2,518,000
2058	Normal	478,000	39,000	494,000	1,459,000	11,000	5,000	2,486,000	208,000	1,836,000	33,000	380,000	15,000	2,457,000
2059	Wet	739,000	53,000	252,000	1,501,000	55,000	8,000	2,608,000	306,000	1,844,000	39,000	372,000	24,000	2,561,000
2060	Dry	405,000	39,000	377,000	1,466,000	23,000	7,000	2,317,000	200,000	1,743,000	32,000	305,000	11,000	2,280,000
2061	Wet	910,000	53,000	244,000	1,502,000	56,000	8,000	2,773,000	348,000	1,851,000	39,000	459,000	24,000	2,697,000
2062	Normal	466,000	39,000	400,000	1,441,000	14,000	6,000	2,366,000	230,000	1,716,000	33,000	352,000	15,000	2,331,000
2063	Normal	477,000	39,000	483,000	1,453,000	11,000	5,000	2,468,000	236,000	1,816,000	33,000	332,000	15,000	2,417,000
2064	Dry	338,000	39,000	379,000	1,469,000	26,000	7,000	2,258,000	168,000	1,739,000	32,000	287,000	11,000	2,226,000
2065	Normal	725,000	39,000	382,000	1,438,000	17,000	6,000	2,607,000	249,000	1,693,000	33,000	499,000	16,000	2,474,000
2066	Wet	668,000	53,000	261,000	1,503,000	28,000	8,000	2,521,000	293,000	1,853,000	39,000	300,000	24,000	2,485,000
2067	Wet	690,000	53,000	257,000	1,502,000	28,000	8,000	2,538,000	296,000	1,851,000	39,000	313,000	24,000	2,499,000
2068	Dry	448,000	26,000	484,000	1,188,000	17,000	8,000	2,171,000	222,000	1,650,000	5,000	267,000	11,000	2,144,000
2069	Dry	382,000	26,000	490,000	1,191,000	15,000	8,000	2,112,000	186,000	1,652,000	5,000	262,000	11,000	2,105,000
2070	Wet	962,000	53,000	236,000	1,498,000	55,000	8,000	2,812,000	360,000	1,838,000	39,000	490,000	24,000	2,727,000

Table CC-13: Delta-Mendota Subbasin Projected Water Budget, Groundwater Budget (containing climate change factors and projects and management actions)

Groundwater Budget																				
Water Year	Water Year Type	Inflows									Outflows					Change in Storage				
		Deep Percolation			Subsurface Groundwater Inflows		Seepage through Corcoran Clay	Other Direct Recharge	Project Effects	Total Inflows	Groundwater Extraction from Upper Aquifer	Groundwater Extraction from Lower Aquifer	Subsurface Groundwater Outflows		Total Outflows	Estimated Annual Change in Groundwater Storage				
		Precipitation Infiltration	*Surface Water Infiltration*	*Applied Water Infiltration*	*Upper Aquifer*	*Lower Aquifer*							*Upper Aquifer*	*Lower Aquifer*		Inflows	Outflows	Change in Storage - Upper Aquifer	Change in Storage - Lower Aquifer	Change in Storage - Total
2014	Shasta Critical	51,000	58,000	96,000	162,000	70,000	45,000	58,000	0	**540,000**	500,000	97,000	281,000	186,000	**1,109,000**	540,000	1,110,000	(433,000)	(123,000)	(556,000)
2015	Shasta Critical	39,000	57,000	167,000	157,000	68,000	45,000	60,000	0	**593,000**	546,000	98,000	282,000	197,000	**1,168,000**	593,000	1,168,000	(405,000)	(132,000)	(537,000)
2016	Dry	98,000	75,000	235,000	154,000	67,000	45,000	70,000	0	**744,000**	338,000	57,000	280,000	151,000	**871,000**	743,000	871,000	(92,000)	(49,000)	(141,000)
2017	Wet	93,000	93,000	212,000	198,000	82,000	45,000	109,000	16,000	**848,000**	245,000	50,000	260,000	87,000	**687,000**	843,000	688,000	142,000	(14,000)	128,000
2018	Normal	70,000	84,000	228,000	190,000	70,000	45,000	77,000	5,000	**769,000**	328,000	57,000	233,000	100,000	**763,000**	763,000	762,000	105,000	18,000	122,000
2019	Wet	106,000	92,000	145,000	215,000	79,000	45,000	105,000	15,000	**802,000**	226,000	37,000	233,000	73,000	**614,000**	798,000	614,000	116,000	13,000	128,000
2020	Dry	58,000	78,000	179,000	152,000	62,000	45,000	68,000	9,000	**651,000**	336,000	52,000	266,000	134,000	**833,000**	645,000	833,000	(184,000)	(43,000)	(227,000)
2021	Wet	108,000	93,000	166,000	218,000	80,000	45,000	85,000	16,000	**811,000**	219,000	37,000	235,000	71,000	**607,000**	805,000	608,000	128,000	15,000	144,000
2022	Wet	126,000	88,000	221,000	216,000	80,000	45,000	107,000	26,000	**909,000**	209,000	35,000	231,000	75,000	**595,000**	904,000	596,000	246,000	21,000	267,000
2023	Normal	81,000	78,000	212,000	188,000	72,000	45,000	75,000	9,000	**760,000**	329,000	52,000	234,000	108,000	**768,000**	753,000	768,000	91,000	28,000	119,000
2024	Dry	75,000	74,000	194,000	153,000	62,000	45,000	70,000	9,000	**682,000**	331,000	51,000	270,000	132,000	**829,000**	676,000	829,000	(152,000)	(13,000)	(164,000)
2025	Wet	111,000	91,000	173,000	214,000	81,000	45,000	107,000	26,000	**848,000**	220,000	36,000	234,000	71,000	**606,000**	841,000	606,000	170,000	27,000	197,000
2026	Dry	75,000	76,000	223,000	153,000	62,000	45,000	70,000	13,000	**717,000**	391,000	46,000	269,000	135,000	**886,000**	711,000	885,000	(165,000)	(7,000)	(172,000)
2027	Dry	82,000	80,000	233,000	153,000	60,000	45,000	68,000	15,000	**736,000**	390,000	47,000	270,000	128,000	**880,000**	731,000	879,000	(144,000)	0	(144,000)
2028	Dry	72,000	81,000	161,000	156,000	59,000	45,000	68,000	15,000	**657,000**	391,000	47,000	269,000	127,000	**879,000**	651,000	879,000	(216,000)	(5,000)	(222,000)
2029	Dry	60,000	84,000	175,000	155,000	58,000	45,000	68,000	16,000	**661,000**	387,000	46,000	269,000	127,000	**874,000**	654,000	875,000	(208,000)	(13,000)	(221,000)
2030	Shasta Critical	59,000	65,000	204,000	162,000	57,000	40,000	65,000	9,000	**661,000**	440,000	78,000	277,000	125,000	**960,000**	660,000	960,000	(225,000)	(33,000)	(257,000)
2031	Shasta Critical	66,000	66,000	240,000	162,000	57,000	40,000	65,000	9,000	**705,000**	439,000	77,000	276,000	116,000	**948,000**	703,000	947,000	(180,000)	(22,000)	(201,000)
2032	Wet	112,000	97,000	236,000	222,000	75,000	40,000	86,000	29,000	**897,000**	205,000	32,000	240,000	68,000	**585,000**	891,000	584,000	253,000	17,000	271,000
2033	Dry	61,000	69,000	195,000	161,000	57,000	40,000	65,000	17,000	**665,000**	386,000	45,000	273,000	130,000	**874,000**	659,000	874,000	(195,000)	(18,000)	(213,000)
2034	Wet	114,000	96,000	214,000	219,000	77,000	40,000	107,000	39,000	**906,000**	194,000	26,000	233,000	69,000	**562,000**	901,000	562,000	269,000	15,000	285,000
2035	Wet	100,000	93,000	165,000	220,000	78,000	40,000	86,000	29,000	**811,000**	215,000	30,000	237,000	74,000	**596,000**	806,000	596,000	157,000	14,000	171,000
2036	Wet	105,000	89,000	236,000	219,000	78,000	40,000	105,000	39,000	**911,000**	234,000	48,000	236,000	74,000	**632,000**	905,000	633,000	266,000	19,000	285,000
2037	Wet	149,000	86,000	359,000	214,000	83,000	40,000	107,000	40,000	**1,078,000**	192,000	27,000	230,000	77,000	**566,000**	1,072,000	566,000	431,000	14,000	445,000
2038	Normal	80,000	75,000	175,000	187,000	74,000	40,000	75,000	21,000	**727,000**	323,000	54,000	232,000	107,000	**756,000**	722,000	756,000	95,000	20,000	115,000
2039	Normal	72,000	75,000	219,000	195,000	76,000	40,000	77,000	21,000	**775,000**	332,000	60,000	236,000	105,000	**773,000**	769,000	773,000	143,000	20,000	163,000
2040	Dry	76,000	70,000	232,000	154,000	63,000	40,000	70,000	18,000	**723,000**	324,000	46,000	271,000	133,000	**814,000**	717,000	814,000	(75,000)	(11,000)	(87,000)
2041	Dry	61,000	75,000	197,000	153,000	60,000	40,000	68,000	16,000	**670,000**	328,000	49,000	269,000	128,000	**814,000**	665,000	814,000	(115,000)	(12,000)	(127,000)
2042	Normal	80,000	82,000	198,000	197,000	72,000	40,000	75,000	21,000	**765,000**	357,000	58,000	238,000	99,000	**792,000**	758,000	791,000	98,000	27,000	125,000
2043	Dry	72,000	77,000	136,000	152,000	60,000	40,000	70,000	18,000	**625,000**	329,000	49,000	271,000	106,000	**795,000**	617,000	796,000	(171,000)	(10,000)	(180,000)

Water Year	Water Year Type	Inflows: Deep Percolation: *Precipitation Infiltration*	Inflows: Deep Percolation: *Surface Water Infiltration*	Inflows: Deep Percolation: *Applied Water Infiltration*	Inflows: Subsurface Groundwater Inflows: *Upper Aquifer*	Inflows: Subsurface Groundwater Inflows: *Lower Aquifer*	Inflows: Seepage through Corcoran Clay	Inflows: Other Direct Recharge	Inflows: Project Effects	**Total Inflows**	Outflows: Groundwater Extraction from Upper Aquifer	Outflows: Groundwater Extraction from Lower Aquifer	Outflows: Subsurface Groundwater Outflows: *Upper Aquifer*	Outflows: Subsurface Groundwater Outflows: *Lower Aquifer*	**Total Outflows**	Change in Storage: Estimated Annual Change in Groundwater Storage: Inflows	Outflows	Change in Storage - Upper Aquifer	Change in Storage - Lower Aquifer	Change in Storage - Total
2044	Wet	117,000	91,000	172,000	209,000	80,000	40,000	107,000	57,000	**873,000**	203,000	35,000	242,000	70,000	**590,000**	867,000	590,000	230,000	17,000	247,000
2045	Wet	89,000	87,000	113,000	215,000	81,000	40,000	107,000	56,000	**788,000**	217,000	40,000	230,000	75,000	**602,000**	782,000	603,000	143,000	9,000	151,000
2046	Dry	44,000	75,000	179,000	154,000	61,000	40,000	68,000	17,000	**638,000**	439,000	62,000	268,000	109,000	**918,000**	632,000	919,000	(259,000)	(19,000)	(278,000)
2047	Dry	52,000	80,000	206,000	152,000	59,000	40,000	68,000	16,000	**673,000**	440,000	65,000	270,000	103,000	**918,000**	667,000	919,000	(210,000)	(10,000)	(220,000)
2048	Normal	52,000	84,000	168,000	188,000	68,000	40,000	75,000	20,000	**695,000**	446,000	85,000	237,000	98,000	**906,000**	690,000	907,000	(26,000)	19,000	(7,000)
2049	Normal	94,000	84,000	271,000	188,000	70,000	40,000	77,000	24,000	**848,000**	312,000	51,000	238,000	101,000	**742,000**	842,000	742,000	210,000	24,000	234,000
2050	Wet	87,000	90,000	133,000	216,000	80,000	40,000	107,000	57,000	**810,000**	219,000	41,000	235,000	72,000	**607,000**	803,000	608,000	172,000	11,000	183,000
2051	Dry	48,000	76,000	134,000	152,000	61,000	40,000	68,000	17,000	**596,000**	329,000	51,000	269,000	133,000	**822,000**	591,000	822,000	(192,000)	(20,000)	(212,000)
2052	Dry	49,000	81,000	249,000	154,000	58,000	40,000	68,000	17,000	**716,000**	430,000	60,000	268,000	103,000	**901,000**	711,000	901,000	(175,000)	(14,000)	(189,000)
2053	Shasta Critical	49,000	63,000	148,000	160,000	57,000	40,000	63,000	9,000	**589,000**	474,000	91,000	276,000	101,000	**982,000**	588,000	982,000	(316,000)	(14,000)	(330,000)
2054	Shasta Critical	37,000	65,000	208,000	161,000	55,000	40,000	63,000	8,000	**637,000**	488,000	91,000	277,000	101,000	**997,000**	638,000	996,000	(262,000)	(18,000)	(280,000)
2055	Dry	85,000	86,000	152,000	156,000	55,000	40,000	70,000	16,000	**660,000**	340,000	54,000	268,000	100,000	**802,000**	654,000	801,000	(139,000)	(6,000)	(145,000)
2056	Wet	95,000	97,000	185,000	220,000	75,000	40,000	107,000	55,000	**874,000**	237,000	52,000	238,000	66,000	**633,000**	869,000	633,000	236,000	17,000	253,000
2057	Wet	97,000	95,000	133,000	223,000	76,000	40,000	85,000	30,000	**779,000**	228,000	34,000	240,000	72,000	**614,000**	772,000	613,000	105,000	14,000	119,000
2058	Normal	66,000	82,000	236,000	205,000	68,000	40,000	75,000	21,000	**793,000**	416,000	61,000	239,000	103,000	**859,000**	786,000	860,000	65,000	20,000	85,000
2059	Wet	101,000	92,000	152,000	222,000	79,000	40,000	107,000	58,000	**851,000**	222,000	33,000	235,000	72,000	**602,000**	845,000	602,000	187,000	18,000	205,000
2060	Dry	59,000	76,000	168,000	151,000	61,000	40,000	70,000	17,000	**642,000**	325,000	42,000	265,000	133,000	**805,000**	635,000	805,000	(155,000)	(13,000)	(167,000)
2061	Wet	108,000	91,000	243,000	217,000	80,000	40,000	107,000	58,000	**944,000**	214,000	33,000	235,000	70,000	**592,000**	938,000	592,000	289,000	20,000	309,000
2062	Normal	73,000	79,000	199,000	199,000	73,000	40,000	77,000	22,000	**762,000**	330,000	53,000	236,000	106,000	**765,000**	756,000	765,000	119,000	21,000	140,000
2063	Normal	71,000	77,000	183,000	201,000	73,000	40,000	75,000	21,000	**741,000**	408,000	61,000	237,000	104,000	**850,000**	735,000	850,000	20,000	25,000	45,000
2064	Dry	50,000	74,000	159,000	153,000	61,000	40,000	68,000	18,000	**623,000**	328,000	42,000	271,000	131,000	**812,000**	616,000	813,000	(180,000)	(9,000)	(190,000)
2065	Normal	81,000	82,000	388,000	187,000	71,000	40,000	77,000	22,000	**948,000**	315,000	53,000	238,000	100,000	**746,000**	941,000	745,000	323,000	26,000	349,000
2066	Wet	94,000	90,000	114,000	219,000	80,000	40,000	85,000	30,000	**752,000**	229,000	34,000	240,000	72,000	**615,000**	745,000	615,000	74,000	17,000	91,000
2067	Wet	97,000	89,000	126,000	216,000	80,000	40,000	85,000	30,000	**763,000**	227,000	33,000	236,000	75,000	**611,000**	756,000	611,000	92,000	16,000	108,000
2068	Dry	65,000	58,000	146,000	157,000	62,000	40,000	63,000	11,000	**602,000**	415,000	53,000	274,000	110,000	**892,000**	603,000	892,000	(284,000)	(12,000)	(296,000)
2069	Dry	57,000	64,000	150,000	156,000	58,000	40,000	63,000	11,000	**599,000**	421,000	53,000	274,000	103,000	**891,000**	598,000	890,000	(290,000)	(8,000)	(298,000)
2070	Wet	119,000	100,000	274,000	211,000	77,000	40,000	107,000	57,000	**985,000**	204,000	33,000	227,000	69,000	**573,000**	980,000	573,000	350,000	19,000	369,000

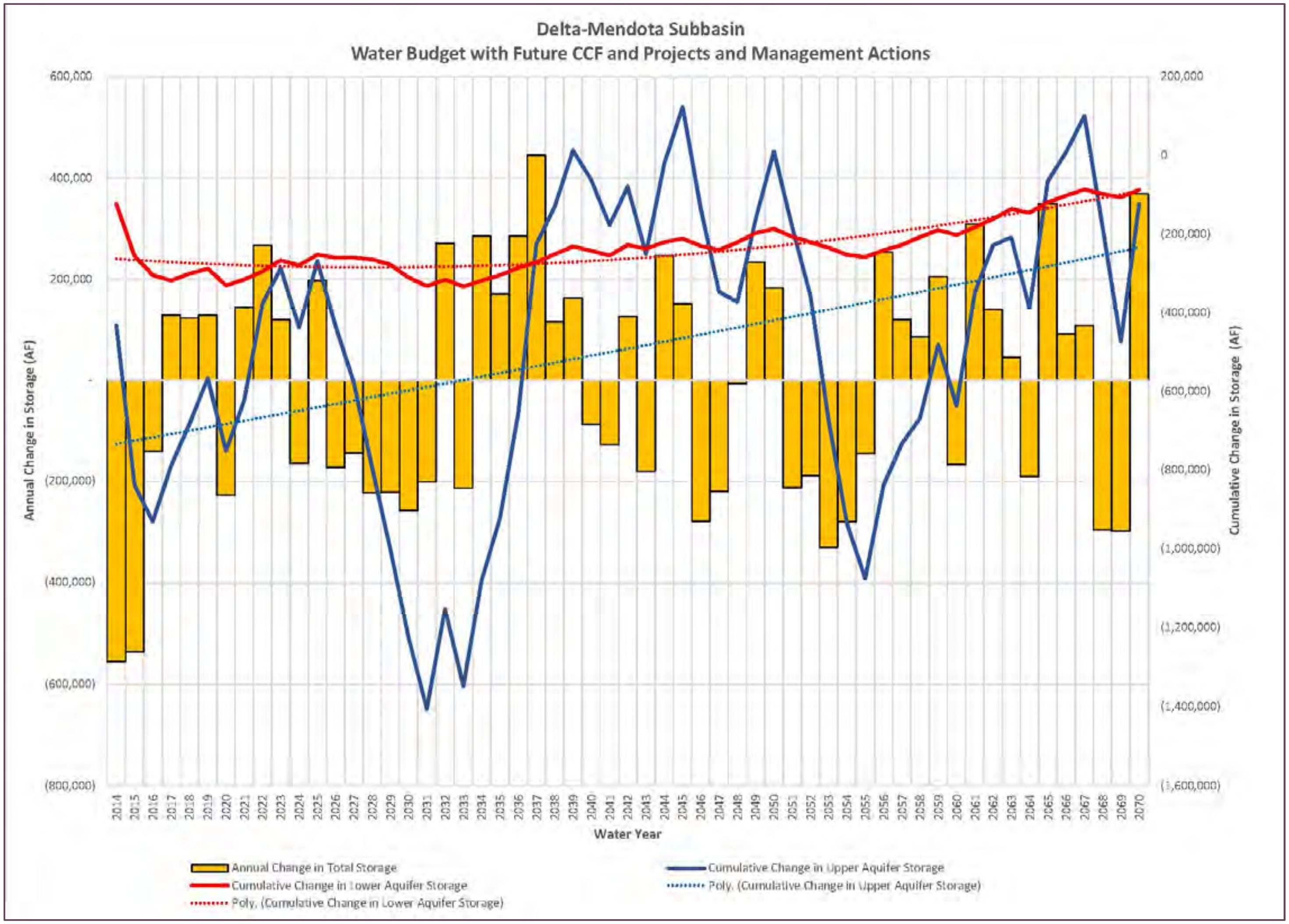

Figure CC-64: Change in Storage, Delta-Mendota Subbasin Projected Water Budget

4.3.4 Sustainable Yield

Under SGMA, sustainable yield is defined 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)). Sustainable yield estimates for the Upper Aquifer and Lower Aquifer have been developed in a coordinated fashion for the Delta-Mendota Subbasin by the Delta-Mendota Technical Working Group and approved by the Delta-Mendota Coordination Committee.

Upper Aquifer Sustainable Yield Estimate

Methodologies for calculating Upper Aquifer sustainable yield were discussed by both the Delta-Mendota Coordination Committee and an ad-hoc Technical Working Group of the Coordination Committee. During a workshop dedicated to this effort, several basic concepts and principles were discussed to calculate the Upper Aquifer sustainable yield estimate. Consideration was given to several potential options with increasing detail, including a combination of the following: total Subbasin Upper Aquifer pumping volumes, total Subbasin Upper Aquifer change in storage, and Subbasin Upper Aquifer subsurface inflows and outflows. Inflow from certain neighboring subbasins, based on groundwater flow direction, as well as subsurface inflow from the Coast Range at existing gradients (as part of the inflow to the Northern & Central Delta-Mendota Region GSP area) was considered. Outflow to neighboring subbasins at existing gradients was also considered in certain applicable areas along the Delta-Mendota Subbasin boundary based on groundwater flow characteristics.

Based on these considerations, the following formula was selected for estimating Upper Aquifer sustainable yield:

Upper Aquifer Sustainable Yield = (Pumping + Change in Storage) + (Outflow – Inflow)

Given existing Subbasin data gaps and uncertainties associated with the data used to develop the water budgets and this estimate, it was also decided that a +/- 10% factor should be applied to determine a range for the Upper Aquifer sustainable yield value. The +/- 10% factor is applied based on the percentage difference between the values from change in storage Subbasin contour mapping for the historic water budget period and the reported changes in storage from the Subbasin consolidated historic water budgets (WY2003-2012) for the Upper Aquifer.

The formula for determining Upper Aquifer sustainable yield was applied to the following compiled Delta-Mendota Subbasin projected water budgets (WY2014-2070):

Projected Baseline values with Climate Change Factors

Projected Baseline values with Climate Change Factors and Projects and Management Actions

This analysis resulted in an Upper Aquifer Sustainable Yield estimate ranging from 325,000 acre-feet to 480,000 acre-feet, demonstrating the Subbasin's Upper Aquifer sustainable yield estimated without implementing any projects and management actions (low end of range) and how the Subbasin's Upper Aquifer sustainable yield will be impacted by implementing planned projects and management actions (high end of range).

The Upper Aquifer sustainable yield values, derived from calculations using the best available but limited data, are considered to be preliminary estimations only and will be updated to an anticipated higher level of accuracy in future GSP updates. The intention of the Delta-Mendota Subbasin GSAs, following GSP submission in 2020, is to increase subbasin-wide data collection efforts. Improved data, modeling results, and understanding of subsurface flows will allow the GSAs and each GSP Group to improve estimated sustainable yield values for future GSP updates. The GSP Groups are in the process of developing GSP implementation guidelines that will address future data collection efforts and other GSP implementation activities.

The Upper Aquifer sustainable yield calculated range reflects the principle that the GSAs within the Delta-Mendota Subbasin reserve the right to claim or retain some portion of subbasin outflow generated by the lowering of groundwater levels from neighboring subbasins and the equitable portion of sources of recharge shared between two subbasins, by physical or non-physical means, in the future if the Delta-Mendota Subbasin GSAs determine that doing so will improve Subbasin sustainability or will prevent undesirable results due to chronic lowering of groundwater levels. Furthermore, intrabasin coordination during GSP development, followed by continuing interbasin coordination discussions and data collection after GSP adoption, will allow the GSAs to further refine these determinations.

Lower Aquifer Sustainable Yield Estimate

Currently, within the Delta-Mendota Subbasin, the distribution of known Lower Aquifer water level data and extraction volume data are not sufficient to allow for an accurate calculation of Lower Aquifer sustainable yield utilizing the same methodology as for the Upper Aquifer. Following discussions by both the Coordination Committee and the ad-hoc Technical Working Group of the Coordination Committee, a consensus was reached to establish a Lower Aquifer sustainable yield estimate for the Subbasin by evaluating studies previously conducted in adjoining subbasins.

The Westlands Water District GSA recently conducted a study using groundwater modeling, in conjunction with the Westside GSP development, to estimate sustainable yield for the Westside Subbasin. Based on an analysis of available data and an initial assumption of Lower Aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, Groundwater Management Strategy Concepts presentation to the WWD Board on October 16, 2018), the GSA estimates a sustainable yield of 230,000 to 250,000 acre-feet, with historic conditions suggesting a range from 250,000 to 300,000 acre-feet (Westlands Water District GSA, Westside Subbasin's Groundwater Model Forecast and Augmentation Strategies presentation to the WWD Board on April 3, 2019). Using Westlands Water District GSA's analysis, the Delta-Mendota Coordination Committee recommended a slightly more conservative sustainable yield value of one-third (0.33) an acre-foot per acre for the Delta-Mendota Subbasin. Using this more conservative value, the estimated Lower Aquifer sustainable yield is approximately 250,000 acre-feet per year over the approximately 750,000-acre subbasin. It should be noted that sustainable management of the Lower Aquifer is governed by significant and unreasonable subsidence rather than sustainable yield. The distribution of sustainable yield is not uniform throughout the Subbasin, and it will be the responsibility of each GSA in the Subbasin to manage Lower Aquifer pumping to prevent significant and unreasonable subsidence.

Since DWR classified the Delta-Mendota Subbasin as a critically-overdraft subbasin due to subsidence issues, the more conservative acre-foot per acre value for a Lower Aquifer sustainable yield estimation is considered valid as a starting point for the Subbasin. Lower Aquifer groundwater extractions may be managed to a stricter criterion in some areas in order to reduce or eliminate the potential for future inelastic land subsidence on critical infrastructure.

The Lower Aquifer sustainable yield estimate will be refined in the future based on data collected and compiled for the Subbasin. This current sustainable yield approximation highlights the importance of an accepted Subbasin-level subsidence monitoring program concurrent with improved estimates of sub-Corcoran Clay groundwater extractions.

5. SUSTAINABLE MANAGEMENT CRITERIA

As required by Subarticle 3. Sustainable Management Criteria of the GSP regulations, the GSPs must include a sustainability goal and definitions of undesirable results, in addition to defining what is considered to be significant and unreasonable and establishing minimum thresholds, measurable objectives and 5-year interim goals. Given the variability of conditions within the Delta-Mendota Subbasin, a subbasin-wide sustainability goal and definitions of undesirable results were developed at the subbasin-level, while the definitions of significant and unreasonable, minimum thresholds, measurable objectives and 5-year interim goals were established at the GSP Plan area-level.

This section describes the coordinated sustainability goal and definition of undesirable results at a subbasin-level and the sustainable management criteria at a GSP-level. Sustainable management criteria developed by each GSP Group were further compared and coordinated between neighboring GSP Groups to avoid conflicts, particularly in setting numeric minimum thresholds, measurable objectives, and interim milestones at boundary locations. The sustainable management criteria for each GSP Group for each applicable sustainability indicator are presented herein.

5.1 Coordinated Assumptions and Data

All common coordinated assumptions and data agreed upon and implemented by each GSP Group in developing their respective sustainable management criteria for each applicable sustainability indicator are presented in Technical Memoranda 4 (*Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Indicators, and GSP Documentation*), which is included in **Appendix B** of this Common Chapter.

Once each GSP Group drafted their respective sustainable management criteria for each applicable sustainability indicator, the Delta-Mendota Subbasin Technical Working Group requested that all GSP Groups meet with their neighboring GSP Groups to coordinate minimum thresholds and measurable objectives to avoid conflicts and ensure each GSP Group would not negatively impact their neighboring GSP Groups from achieving sustainability. These coordination meetings took place between April and August of 2019.

5.2 Coordinated Sustainability Goal and Undesirable Results

The sustainability goal for the Delta-Mendota Subbasin was established to succinctly state the objectives and desired conditions of the Subbasin that culminates in the absence of undesirable results by 2040. The sustainability goal for the Delta-Mendota Subbasin is as follows and was approved by the Delta-Mendota Subbasin Coordination Committee during the June 10, 2019 meeting:

> *The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversion and conveyance and delivery capabilities. This goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.*

The following definitions of "undesirable results" were agreed upon for the following applicable sustainability indicators:

- **Chronic lowering of groundwater levels** - Significant and unreasonable chronic change in in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.

- **Reduction in groundwater storage** - Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.

- **Degraded water quality** - Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities.

- **Land subsidence** - Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conveyance capacity, damage to personal property, impacts to natural resources or create conditions that threaten public health and safety.

- **Depletions of interconnected surface water** - Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water.

5.3 GSP-Level Sustainable Management Criteria

For more information on the development of the sustainable management criteria and information used to support the established sustainable management criteria for the individual GSP Groups, refer to the individual GSPs. Each GSP Group defined what is considered significant and unreasonable in their Plan Area for each applicable sustainability indicators, in addition to establishing minimum thresholds, measurable objectives and 5-year interim goals for their Plan Area.

Each GSP Group developed their sustainable management criteria consistent with GSP Regulations Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria (§ 354.2 through 354.30). DWR's *Draft Best Management Practices for the Sustainable Management of Groundwater Sustainable Management Criteria BMP* (2017) document was also used when and where applicable at the discretion of each GSP Group.

5.4 Delta-Mendota Subbasin Sustainable Management Criteria

The sustainable management criteria for each sustainability indicator contains the following components: the subbasin-wide definition of an undesirable result, GSP-level definition of significant and unreasonable, sustainability goals, 5-year interim goals, minimum threshold, and measurable objective. Separate tables show the sustainable management criteria for chronic lowering of groundwater levels (**Table CC-14**), reduction in groundwater storage (**Table CC-15)**, degraded water quality (**Table CC-16)**, land subsidence (**Table CC-17**), and depletions of interconnected surface water (**Table CC-18**) with details corresponding to the individual GSP Groups. The established sustainable management criteria were developed through detailed analysis and consideration of conditions unique to each GSP Group, where more detail may be necessary to support the decisions made by each GSP Group. For greater detail regarding the development of the sustainable management criteria for each GSP Group, refer to the sustainable management criteria section or chapter contained in each individual GSP.

Table CC-14: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable chronic change in in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions					
Definition of Significant and Unreasonable	Aliso is not currently experiencing significant and unreasonable effects of reduction in water levels or aquifer storage in the Upper Aquifer. Significant and unreasonable effects would be accelerated rates of subsidence as productive layers in the Upper Aquifer above the Corcoran Clay are depleted, especially in areas with deep or composite wells. Accelerated rates of subsidence may occur If 30% of the wells in the monitoring zone exceed the minimum threshold value on a 4-year consecutive average under normal or average year conditions.	Groundwater elevations dropping below historic lows (2015-2016)	Groundwater elevations dropping below historic lows (2015-2016)	Lowering of groundwater levels would lead to increased costs associated with higher total lift, lowering pumps, need to drill deeper wells or costs securing alternative water sources. Impacts to habitat would require mitigation, including alternative water supplies and habitat restoration.	Groundwater elevations dropping below the Minimum Threshold criteria at 40% of representative monitoring locations concurrently over a given water year resulting in shallow domestic wells going dry in the same subregion as the representative monitoring points in violation, higher pumping costs, and/or the need to modify wells to obtain groundwater.	The San Joaquin River Exchange Contractors (SJREC) GSP Group has a positive impact on the aquifer and is unlikely to cause Significant and/or Unreasonable lowering of groundwater levels. Triggers have been established to recover aquifer water levels before nearing an Undesirable Result. Currently, an approximation of 25% below historic low for each management area is used to indicate an Undesirable Result which will be refined based on annual updates and integration with other GSP Groups.
Sustainability Goal for Sustainability Criterion	To maintain the historic hydrological cycle and expand access to surface water during flood years for replenishment of the Upper Aquifer.	Maintain seasonal highs and lows. Prevent trend of decreasing groundwater levels.	Maintain seasonal highs and lows. Prevent trend of decreasing groundwater levels.	Maintain water levels and storage sufficient to meet operational storage in each the Upper Aquifer and Lower Aquifer.	Maintain water levels sufficient to meet operational storage as well as 3-year drought buffer storage.	Maintain historic water levels to meet demand of the beneficial users.
5-Year Interim Goals	**Year 5:** Maintain groundwater elevations comparable to historic hydrologic highs and lows **Year 10:** Maintain groundwater elevations comparable to historic hydrologic highs and lows **Year 15:** Maintain groundwater elevations comparable to historic hydrologic highs and lows	**Year 5:** < Minimum Threshold **Year 10**: < Minimum Threshold **Year 15:** < Minimum Threshold	**Year 5:** < Minimum Threshold **Year 10:** < Minimum Threshold **Year 15:** < Minimum Threshold	**Year 5:** WSE > Measurable Objective **Year 10:** WSE > Measurable Objective **Year 15:** WSE > Measurable Objective	**Year 5:** Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows **Year 10:** Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows **Year 15:** Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows	**Year 5**: Maintain current water levels, SJREC GSP Group is sustainable. **Year 10:** Maintain current water levels, SJREC GSP Group is sustainable. **Year 15:** Maintain current water levels, SJREC GSP Group is sustainable.
Minimum Threshold	The minimum threshold is to provide a 100-foot of buffer from the top of the Corcoran Clay to the top of the water table	**Upper Aquifer** Season Low > 126 feet below ground surface (ft bgs) Season High > 57 ft bgs **Lower Aquifer** Season Low >213 ft bgs Season High > 185 ft bgs	**Upper Aquifer** Season Low > 63 feet below ground surface (ft bgs) Season High > 55 ft bgs **Lower Aquifer** Season Low >213 ft bgs Season High > 185 ft bgs	**Upper Aquifer:** 20% lowered water elevation from recent historic low (set at each monitoring site). **Lower Aquifer:** Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	**Upper Aquifer:** Hydrologic low **Lower Aquifer:** 95% of historic low	The SJREC GSP Group is sustainable. The SJREC GSP Group is unlikely to cause groundwater overdraft. As a result of this and historical groundwater management, trigger levels have been established for a representative site in each management area. If water levels drop below the established trigger level, no transfers of groundwater outside the area are allowed. This management has been in place for parts of the Subbasin for years and has proven effective to preserve a healthy aquifer.

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Measurable Objective	The measurable objective is site specific and tied to water levels in long term hydrographs. The average rate in decline in each well was projected out until 2040 when water levels should begin to stabilize over the long term.	Maintain seasonal highs and lows above minimum thresholds.	Maintain seasonal highs and lows above minimum thresholds.	**Upper Aquifer:** Recent historic low (set at each monitoring site **Lower Aquifer:** Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	**Both Aquifers:** Seasonal historic high average, Spring 2012 or Spring 2017, whichever elevation is lowest or where data exists.	Operate groundwater levels between the effective root zone and the Minimum Threshold.

Table CC-15: Delta-Mendota Subbasin SMC for Reduction in Groundwater Storage

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions					
Definition of Significant and Unreasonable	Aliso is not currently experiencing significant and unreasonable effects of reduction in water levels or aquifer storage in the Upper Aquifer. Significant and unreasonable effects would be accelerated rates of subsidence as productive layers in the Upper Aquifer above the Corcoran Clay are depleted, especially in areas with deep or composite wells. Accelerated rates of subsidence may occur if 30% of the wells in the monitoring zone exceed the minimum threshold value on a 4-year consecutive average under normal or average year conditions.	Depletion of storage greater than the 2012-2016 period.	Depletion of storage greater than the 2012-2016.	Insufficient water storage to develop necessary water to maintain critical habitat. Reduction in storage would lead to increased costs associated with higher total lift, lowering pumps, need to drill deeper wells or costs securing alternative water sources. Impacts to habitat would require mitigation, including alternative water supplies and habitat restoration.	If water levels are managed to meet the Minimum Thresholds, the Northern & Central Delta-Mendota Region GSP Group does not anticipate long-term reductions in storage. And, through coordination with other GSP Groups in the Subbasin, additional projects and/or management actions will be implemented to prevent the long-term decline in storage.	The San Joaquin River Exchange Contractors (SJREC) GSP Group has a positive impact on the aquifer and is unlikely to cause Significant and/or Unreasonable reduction of groundwater storage. Triggers have been established to recover aquifer water levels before nearing an Undesirable Result. Currently, an approximation of 25% below historic low water levels for each management area coupled with a determined storage coefficient, is used to indicate an Undesirable Result which will be refined based on annual updates and integration with other GSP Groups.
Sustainability Goal for Sustainability Criterion	To expand access to surface water during flood years for replenishment of the Upper Aquifer by working with neighbors in both Delta-Mendota and Madera subbasins where overdraft is occurring.	Minimize storage change during extended dry periods.	Minimize storage change during extended dry periods.	Maintain water levels and storage sufficient to meet operational demand.	Maintain water levels sufficient to meet operational storage as well as 3-year drought buffer storage.	Maintain historic water storage to meet demand of the beneficial users.
5-Year Interim Goals	**Year 5:** Maintain groundwater elevations comparable to historic hydrologic highs and lows **Year 10:** Maintain groundwater elevations comparable to historic hydrologic highs and lows **Year 15:** Maintain groundwater elevations comparable to historic hydrologic highs and lows	**Year 5:** < Minimum Threshold **Year 10:** < Minimum Threshold **Year 15:** < Minimum Threshold	**Year 5:** < Minimum Threshold **Year 10:** < Minimum Threshold **Year 15:** < Minimum Threshold	**Year 5:** WSE > Measurable Objective **Year 10:** WSE > Measurable Objective **Year 15:** WSE > Measurable Objective	**Year 5:** Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows **Year 10:** Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows **Year 15:** Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows	**Year 5:** Maintain current water levels, SJREC GSP Group is sustainable **Year 10:** Maintain current water levels, SJREC GSP Group is sustainable **Year 15:** Maintain current water levels, SJREC GSP Group is sustainable
Minimum Threshold	The minimum threshold is to provide a 100-foot of buffer from the top of the Corcoran Clay to the top of the water table.	**Upper Aquifer** Storage Loss of >12,000 acre-feet (AF) from over extended dry period **Lower Aquifer** Storage Loss of >4600 AF over extended dry period	**Upper Aquifer** Storage Loss of >90,000 acre-feet (AF) over extended dry period **Lower Aquifer** Storage Loss of >55,000 AF over extended dry period	**Upper Aquifer:** 20% lowered water elevation from recent historic low (set at each monitoring site). **Lower Aquifer:** Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	**Upper Aquifer:** Hydrologic low **Lower Aquifer:** 95% of historic low	The SJREC GSP Group is sustainable. The SJREC GSP Group is unlikely to cause groundwater overdraft. As a result of this and historical groundwater management, trigger levels have been established for a representative site in each management area. If water levels drop below the established trigger level, no transfers of groundwater outside the area are allowed. This management has been in place for parts of the Subbasin for years and has proven effective to preserve a healthy aquifer.

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Measurable Objective	The measurable objective is site specific and tied to water levels in long term hydrographs. The average rate in decline in each well was projected out until 2040 when water levels should begin to stabilize over the long term.	Long term average change of 0 AF/year	Long term average change of 0 AF/year	**Upper Aquifer:** Recent historic low (set at each monitoring site). **Lower Aquifer:** Four lower aquifer representative monitoring sites have been identified at a multi-completion well. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	**Both Aquifers:** Seasonal historic high average, Spring 2012 or Spring 2017, whichever elevation is lowest or where data exists.	Operate groundwater levels between the effective root zone and the Minimum Threshold which will maintain groundwater storage.

Table CC-16: Delta-Mendota Subbasin SMC for Degraded Water Quality

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities					
Definition of Significant and Unreasonable	Aliso is not experiencing any significant and unreasonable impacts of water quality. Significant and unreasonable is defined as a reduction in crop production due to water quality issues and if 30% of the wells exceed the minimum threshold value on a 4-year consecutive average without treatment.	(1) Continued migration of the Steffens plume (elevated Total dissolved solids [TDS]) in Upper Aquifer both within Management Area A and towards Farmers Water District. (2) Unreasonable rates of migration of groundwater in the Upper Aquifer with naturally-occurring elevated concentrations of total dissolved solids in Management Area B. (3) Potential effects on the beneficial uses of groundwater include agricultural and domestic uses. (4) Degraded water quality in the Fresno Slough effect beneficial users of surface water	(1) Impairment of groundwater quality from the migration of the Steffens Plume from Fresno County's Management Area A. Impacts from the Steffens plume impacts Farmers Water District's ability to utilize groundwater for adjacent use and discharge into the Mendota Pool. (2) Potential effects on the beneficial users of groundwater include water quality levels that impact crops and drinking water standards for domestic uses. (3) Degraded water quality in the Fresno Slough effecting beneficial users of surface water.	Degradation of groundwater quality resulting in reduced ability to develop and manage groundwater for habitat productivity.	(1) Exceedance of maximum contaminant levels (MCLs) or water quality objectives (WQOs) for irrigation in public water systems for three (3) consecutive sampling events in non-drought years or the additional degradation of current groundwater quality where current groundwater quality exceeds the MCLs or WQOs for irrigation. (2) Water quality degradation due to recharge projects that exceeds 20% of the aquifer's assimilative capacity for one or more constituents without justification of a greater public benefit achieved	Migration of contamination plume that makes the water unusable for beneficial use
Sustainability Goal for Sustainability Criterion	Maintain Current Water Quality	Contain the Spreckels Plume and maintain historical rates of saline front migration	Prevent further degradation of groundwater quality from the Steffens Plume migrating from Fresno County Management Area A	Maintain groundwater quality suitable for habitat	Maintain existing water quality in all aquifers	Monitor existing groundwater contamination sites and engage to ensure cleanup and abatement orders are consistent with the San Joaquin River Exchange Contractors (SJREC) GSP Group. Work with upslope drainage area to reduce the migration of saline water into the SJREC GSP Group
5-Year Interim Goals	**Year 5:** Maintain groundwater elevations comparable to historic hydrologic highs and lows **Year 10:** Maintain groundwater elevations comparable to historic hydrologic highs and lows **Year 15:** Maintain groundwater elevations comparable to historic hydrologic highs and lows	**Year 5:** Average annual rate of degradation of 30 milligrams per liter (mg/L) TDS for saline front **Year 10:** Average annual rate of degradation of 30 mg/L TDS for saline front **Year 15:** Average annual rate of degradation of 30 mg/L TDS for saline front Spreckels Steffens plume dependent on Central Valley Regional Water Quality Control Board (CV-RWQCB) Cleanup and Abatement Order (CAO) actions.	**Year 5:** 1000 milligrams per liter (mg/L) total dissolved solids (TDS) **Year 10:** 800 mg/L TDS **Year 15:** 700 mg/L TDS	**Year 5:** < Measurable Objective **Year 10:** < Measurable Objective **Year 15:** < Measurable Objective	**Year 5:** Maintain 2003-2017 groundwater quality range **Year 10:** Maintain 2003-2017 groundwater quality range **Year 15:** Maintain 2003-2017 groundwater quality range	Continue mitigation efforts on the migration of saline water from upslope drainage.
Minimum Threshold	Electrical Conductivity (EC) - 4.5 deciSiemens per meter (dS/m)* Chlorine (Cl) - 13.3 milliequivalents per liter (meq/L)* NO_3-N - 30 milligrams per liter (mg/L)**	Average annual rate of degradation of 60 mg/L TDS for saline front. Threshold for Steffens plume determined by CV-RWQCB.	TDS concentration of 1100 mg/L	Production Wellhead thresholds: Total dissolved solids (TDS) 2,500 milligrams per liter (mg/L) in both aquifers	NO3 – 10 mg/L as N (Primary MCL) TDS – 1,000 mg/L (Secondary MCL) Boron – 0.7 mg/L (WQO for irrigation) or current groundwater quality where it exceeds MCLs or WQOs for irrigation as of December 2018	The minimum threshold is defined as the amount of poor-quality groundwater that is greater than what can be successfully managed through the management actions

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Measurable Objective	EC - 0.75-1.0 dS/m, based on JM Lord and FAO 100% yield for grapes and almonds. Cl - 3.0 meq/L, based on JM Lord minimum recommendations NO_3-N - >5 mg/L, based on FAO Section 5.1, sensitive crop tolerance	Average annual rate of degradation of 20 mg/L TDS for saline front. Measurable objective for Steffens plume will be determined by CV-RWQCB as part of a CAO.	TDS concentration equivalent to background concentrations (approximately 500 mg/L, depending on Cleanup and Abatement Order [CAO] from Central Valley Regional Water Quality Control Board [CV-RWQCB] for Steffens Plume).	Upper Aquifer: Production Wellhead thresholds: 20% increase from max historic electrical conductivity (EC) concentration Lower Aquifer: Lower aquifer representative water quality monitoring sites have been identified; however, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals and measurable objectives in future GSP Updates.	2003-2017 groundwater quality range conditions by GSP sub-region	Mitigate impacts of the migration of saline groundwater from lands upslope of the SJREC GSP

* Based on Food and Agriculture Organization (FAO) 50% yield for grapes
** Based on FAO Section 5.1 typical crop tolerance

Table CC-17: Delta-Mendota Subbasin SMC for Land Subsidence

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota: West Stanislaus Irrigation District-Patterson Irrigation District Management Area	Northern & Central Delta-Mendota: Tranquillity Irrigation District Management Area	Northern & Central Delta-Mendota: Remaining Plan Area	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conveyance capacity, damage to personal property, impacts to natural resources or create conditions that threaten public health and safety							
Definition of Significant and Unreasonable	Aliso is not currently experiencing any significant and unreasonable effects of subsidence. Significant and unreasonable impacts are assumed to occur when the levees within the District have subsided to an elevation causing impacts to the water carrying capacity of the San Joaquin River and Chowchilla Bypass beyond their design flow rates, causing significant and unreasonable flooding or crop damage.	Damage to infrastructure and loss of conveyance capacity in neighboring Groundwater Sustainability Agencies (GSAs).	Damage to infrastructure, loss of conveyance capacity, and potential inability to flood or drain by gravity and associated habitat impacts.	Damage to infrastructure, permanent loss of conveyance capacity beyond mitigation, and potential inability to flood or drain by gravity and associated habitat impacts.	Impacts to laterals from differential settlement that reduces the ability to deliver surface water supplies.	Inadequate freeboard on levee system in wet years as a result of significant additional land subsidence resulting from groundwater extractions.	Increases in 2014-2016 subsidence rates due to groundwater pumping in two or more subregions that results in 50% loss of standup capacity and/or 75% overtopping of lining in the Delta-Mendota Canal as a result of inelastic land subsidence.	Reduction in the conveyance capacity for water distribution and/or damage to critical infrastructure
Sustainability Goal for Sustainability Criterion	Expand access to surface water during flood years for replenishment of the Upper Aquifer by working with neighbors in both the Delta-Mendota and Madera subbasins where subsidence is occurring.	No contribution to lower aquifer compaction.	No contribution to lower aquifer compaction.	No permanent reduction in conveyance and ability to manage habitat.	No additional subsidence as a result of future groundwater extraction	No additional subsidence as a result of future groundwater extraction.	Minimal additional subsidence (0.005 ft/yr) as a result of future groundwater extraction in the Delta-Mendota Subbasin beyond December 2019 surface elevations	The San Joaquin River Exchange Contractors (SJREC) are experiencing subsidence originating outside of the SJREC GSP Group area. The SJREC GSP Group will work with neighbors to mitigate subsidence impacts on SJREC's facilities.
5-Year Interim Goals	Interim goals established at 0.5-feet of additional subsidence per 5-year interim goal period.	**Year 5:** -0.0088 ft **Year 10:** -0.0065 ft **Year 15:** -0.0043 ft	**Year 5:** at Fordel-Ext: -0.015 ft P304-PBO: -0.084 ft **Year 10:** at Fordel-Ext: -0.013 ft P304-PBO: -0.068 ft **Year 15:** at Fordel-Ext: -0.011 ft P304-PBO: -0.0065 ft	The Grassland Plan area is not causing subsidence and will work with neighbors to achieve Subbasin-wide sustainability. **Year 5:** > Measurable Objective **Year 10:** > Measurable Objective **Year 15:** > Measurable Objective	**Year 5:** Establish Minimum Threshold and Measurable Objective for this parameter **Year 10:** To be determined (TBD) in 2025 GSP update based on additional data analysis **Year 15:** TBD in 2025 GSP update based on additional data analysis	**Year 5:** -0.15 ft/yr **Year 10:** -0.11 ft/yr **Year 15:** -0.08 ft/yr	**Year 5:** - North: -0.12 ft/yr - North-Central: -0.18 ft/yr - Central: -0.15 ft/yr - South-Central: -0.10 ft/yr - South: -0.15 ft/yr **Year 10:** - North: -0.12 ft/yr - North-Central: -0.09 ft/yr - Central: -0.09 ft/yr - South-Central: -0.06 ft/yr - South: -0.11 ft/yr **Year 15:** - North: -0.11 ft/yr - North-Central: -0.01 ft/yr - Central: -0.03 ft/yr - South-Central: -0.01 ft/yr - South: -0.08 ft/yr	N/A – SJREC is not causing subsidence and will work with neighbors to achieve the subbasin-wide sustainability goal by 2040.

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota: West Stanislaus Irrigation District-Patterson Irrigation District Management Area	Northern & Central Delta-Mendota: Tranquillity Irrigation District Management Area	Northern & Central Delta-Mendota: Remaining Plan Area	San Joaquin River Exchange Contractors
Minimum Threshold	The minimum threshold is set to not exceed the current rate of subsidence of 0.2 feet/year or 4.0 feet total by 2040	-0.011 ft	Target additional subsidence at two subsidence monitoring points: - Fordel-Ext: -0.017 ft - P304-PBO: -0.1 ft	The minimum threshold is not to exceed, on average, the historic annual average rate of subsidence from December 2011 to December 2015 as defined at each representative subsidence monitoring site: - Point 108: -0.11 ft/yr - Point 152: -0.15 ft/yr - Point 137: -0.13 ft/yr	Acceptable loss in distribution capacity as a result of subsidence resulting from groundwater pumping as based on a future capacity study *Numerical value for this criterion to be determined based on data collection between 2020 and 2025	4 feet of additional subsidence (compared to 2019 levee elevation)	Target rate/goal by sub-region (average 2014-2016 elevation change from Delta-Mendota Canal survey): - North: -0.13 ft/yr - North-Central: -0.26 ft/yr - Central: -0.21 ft/yr - South-Central: -0.15 ft/yr - South: -0.18 ft/yr	SJREC has lost capacity in several conveyance facilities and is spending millions of dollars rehabilitating some of those facilities. The Minimum Threshold is that which doesn't reduce SJREC's conveyance capacity without appropriate mitigation. In other words, zero subsidence without mitigation.
Measurable Objective	The Measurable Objective is set to be the more restrictive of the two Significant and Unreasonable scenarios. It is assumed that significant impacts will cause flooding and crop damage will be 1/2 of the current design minimum freeboard of 4 feet (therefore 2 feet).	-0.002 ft	Target additional subsidence at two subsidence monitoring points: - Fordel-Ext: -0.0086 ft - P304-PBO: -0.036 ft	The measurable objective is not to exceed, on average, the historic annual average rate of subsidence from December 2011 to December 2018, defined at each respective site: - Point 108: -0.08 ft/yr - Point 152: -0.1 ft/yr - Point 137: -0.11 ft/yr	No loss in distribution capacity as a result of subsidence resulting from groundwater pumping *Numerical value for this criterion to be determined based on data collection between 2020 and 2025	2 feet of additional subsidence (compared to 2019 levee)	Target rate/goal by subregion (average 2016-2018 elevation change from Delta-Mendota Canal survey): - North: -0.11 ft/yr - North-Central: -0.01 ft/yr - Central: -0.03 ft/yr - South-Central: -0.01 ft/yr - South: -0.08 ft/yr	The measurable objective for land subsidence is to significantly reduce inelastic land subsidence to less than 0.005 ft/year

Table CC-18: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water					
Definition of Significant and Unreasonable	Aliso Water District groundwater pumping does not influence surface water depletion. Landowners within the District are limited by the Herminghaus Agreement and similar pumping restrictions along the San Joaquin River that prevent pumping from above the A-Clay. Additionally, the primary aquifer, where groundwater pumping occurs, is disconnected from surface water source. A significant and unreasonable result would be a reduction in water availability to downstream beneficial users beyond what was experienced in similar water years in recent history as a result of groundwater extractions.	(1) San Joaquin River Restoration Project (SJRRP) operations and groundwater extractions from the Upper Aquifer that will influence stream depletion along San Joaquin River (2) Water level measurements along the San Joaquin River in the shallow zone of the Upper Aquifer to determine degree of vertical gradient (3) Potential degradation to groundwater dependent ecosystems (GDEs) along San Joaquin River primarily dependent on SJRRP operations of San Joaquin River flows since groundwater pumping expected to remain stable and consistent with historical (pre-SJRRP) levels	Decrease in surface water stage in Mendota Pool from Bureau of Reclamation and Central California Irrigation District (CCID) operations that impact groundwater dependent ecosystems (GDEs) and operations in Mendota Wildlife Area.	The Grassland Plan Area groundwater pumping does not influence surface water depletion. Reduction of interconnected surface water bodies and associated groundwater dependent ecosystems (GDEs), requiring reduction in groundwater pumping (no management activities have depleted interconnected surface water in the Grassland Plan Area within the Historic Period). A significant and unreasonable undesirable result would regard impaired habitat directly associated with interconnected surface waters.	Where interconnected stretches of surface water are identified, an X%* increase in depletions of surface water as a result of groundwater pumping. *The percent increase in depletions is to be determined from monitoring data collected between 2020 and 2025 and associated analyses of these data.	When groundwater extraction directly decreases streamflow in losing stretch of the San Joaquin River.
Sustainability Goal for Sustainability Criterion	Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Minimize downward gradient in the San Joaquin River	Maintain stage in Mendota Pool between 12.75 and 13 feet.	No reduction in interconnected surface water bodies or associated GDEs due to GGSA pumping.	No loss of productive agriculture due to an inability to pump groundwater.	Mitigate observed reductions of interconnected surface and groundwater due to pumping in the San Joaquin River Exchange Contractors (SJREC) GSP Group area.
5-Year Interim Goals	Not Applicable	**Year 5:** gradient of -1.1 **Year 10:** gradient of -0.99 **Year 15:** gradient of -0.83 All gradients measured at monitoring site SJRRP-09-55, 55b	**Year 5:** Mendota Pool staff gage reading of 7.4 ft **Year 10:** Mendota Pool staff gage reading of 9.1 ft **Year 15:** Mendota Pool staff gage reading of 11.3 ft	**Year 5:** WSE > Measurable Objective (Upper Aquifer) **Year 10:** WSE > Measurable Objective (Upper Aquifer) **Year 15:** WSE > Measurable Objective (Upper Aquifer)	**Year 5:** Establish Minimum Threshold and Measurable Objective for this parameter **Year 10:** To be determined (TBD) in 2025 GSP update based on additional data analysis **Year 15:** TBD in 2025 GSP update based on additional data analysis	**Year 5:** Mitigate depleted interconnected surface water in the San Joaquin River **Year 10:** Mitigate depleted interconnected surface water in the San Joaquin River **Year 15:** Mitigate depleted interconnected surface water in the San Joaquin River
Minimum Threshold	Not Applicable Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Gradient of -1.3 at monitoring site SJRRP-09-55, 55b	Mendota Pool staff gage reading of 5.4 ft	20% lowered water elevation from recent historic low (set at each monitoring site).	An X%* increase in surface water depletions along interconnected stretches of surface water as a result of groundwater pumping. *The percent increase in depletions is to be determined from monitoring data collected between 2020 and 2025 and associated analyses of these data.	Observed increase in seepage from the San Joaquin River due to groundwater extractions in the SJREC GSP Group area. The SJREC plan to work with the counties to restrict perforating wells above the first encountered restrictive clay layer (near the San Joaquin River) to prevent induced seepage similar to the established operations defined in the Herminghaus Agreement on Reach 2 of the San Joaquin River.

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Measurable Objective	Not Applicable. Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Gradient of -0.67 at monitoring site SJRRP-09-55, 55b	Mendota Pool staff gage reading of 13.5 ft	Recent historic low (set at each monitoring site).	No increased depletions of surface water as a result of groundwater pumping.	Same as Minimum Threshold

6. SUBBASIN MONITORING PROGRAM

As required by Subarticle 4. Monitoring Networks of the GSP regulations, the GSPs must include a monitoring network for each sustainability indicator, in addition to describing the monitoring protocols and data management to be followed in implementing the GSP monitoring program. Given the variability of conditions within the Delta-Mendota Subbasin, each GSP Group developed their individual monitoring networks, in coordination with their neighboring GSP Groups, such that the subbasin-wide monitoring program is simply a compilation of those coordinated individual monitoring networks. Please see the individual GSPs for further discussion as to how the monitoring networks were developed.

The subbasin-wide monitoring networks presented herein are the representative monitoring networks for each of the applicable sustainability indicators, as defined according to the GSP Regulations § 354.36, *Representative Monitoring*. It is at the representative monitoring sites where each GSP Group has defined minimum thresholds, measurable objectives, and interim milestones to evaluate progress in achieving the Subbasin's sustainability goal by 2040. Data collected at the representative monitoring locations may be augmented with additional data, as available and appropriate, from other locations and/or publicly-available datasets, in evaluating Subbasin conditions on an annual basis.

6.1.1 Coordinated Assumptions and Data

As previously noted, the required monitoring networks were developed at the GSP-level in order to appropriately capture the variability of hydrogeologic and water quality conditions in the Delta-Mendota Subbasin. All common coordinated assumptions agreed upon and implemented by each GSP Group in developing their respective monitoring networks are presented in Technical Memorandum 5 (*Assumptions for Delta-Mendota Subbasin Monitoring Network*) which is included in **Appendix B** of this Common Chapter.

6.1.2 Coordinated Monitoring Activities

All Delta-Mendota Subbasin GSP Groups have agreed to utilize the following monitoring protocols, data management, and roles and responsibilities for implementing and reporting from their respective monitoring plans under SGMA to ensure consistency in data collection, analysis and management allowing for subbasin-wide evaluation of groundwater conditions relative to the Subbasin sustainability goal, as defined and agreed upon by all GSP Groups.

Monitoring Protocols

Each GSP Group will utilize agreed-upon protocols, which may be the same as, or equal to, data collection protocols (i.e. industry standards and best management practices) to ensure the collection of comparable data using comparable methods. Additionally, the following minimum monitoring frequency for each applicable sustainability indicator was agreed upon by each GSP Group during the joint Delta-Mendota Subbasin Coordination Committee and Technical Working Group meeting on June 18, 2019:

- **Chronic lowering of groundwater levels/reduction in groundwater storage** - Twice per year, with seasonal high groundwater elevation data collected between February and April, and seasonal low groundwater elevation data collected between September and October
- **Degraded water quality** – Once per year during irrigation season, typically between May and July

- **Depletions of interconnected surface water** – Twice per year in conjunction with groundwater level monitoring
- **Subsidence** – Publicly available subsidence data will be used along with locally-collected data. At a minimum, three data points will be collected within the first five years of GSP implementation, with a baseline value from 2019 or a date prior to that.

For non-monitored data to be reported as part of the annual reports (e.g. groundwater extractions, surface water deliveries), actual metered data will be used where such data exists, and when direct data do not exist, estimated quantities will be calculated based on existing indirect data (e.g. electrical usage, crop demand, ET) and/or other industry best practices.

Data Management

Each GSP Group will be responsible for conducting quality control reviews of data collected from the monitoring networks. As described in the Coordination Agreement, each GSP Group will exchange and share collected data in order to facilitate analysis and reporting at the Subbasin level. The Coordinated Data Management System (DMS) will be the primary vehicle by which data are shared amongst the GSP Groups, and it will be the responsibility of each GSP Group to conduct a quality control review of data entered into the DMS.

Roles and Responsibilities

It will be the responsibility of each GSP Group, and the GSAs included in that group, to conduct the monitoring program as agreed upon at the Subbasin level, for reviewing the data collected, and for ensuring that these data are available at the Subbasin level. **Figure CC-65** shows the general flow of data collected from the Delta-Mendota monitoring programs.

Figure CC-66 shows the roles and responsibilities of each GSA and GSP Group in the collecting, processing and reporting of data from the GSP monitoring networks. Additionally, it is the responsibility of each GSP Group, including their respective GSAs, to maintain the monitoring network and, as appropriate, revise and/or expand the monitoring networks to fill identified data gaps. Please see the individual GSPs for further information regarding data gaps and the GSAs plans for addressing those gaps.

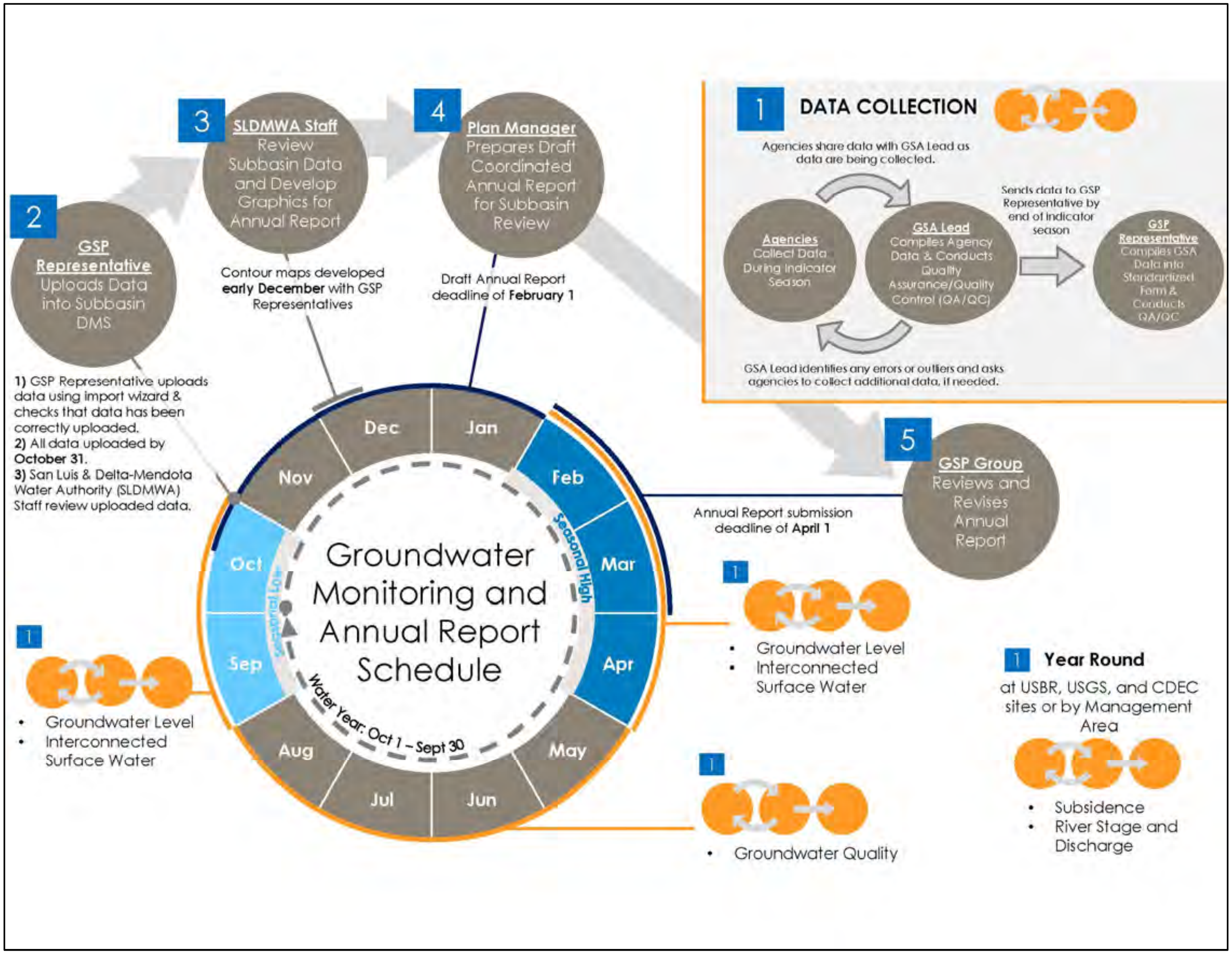

Figure CC-65: Data Flow in Delta-Mendota Subbasin

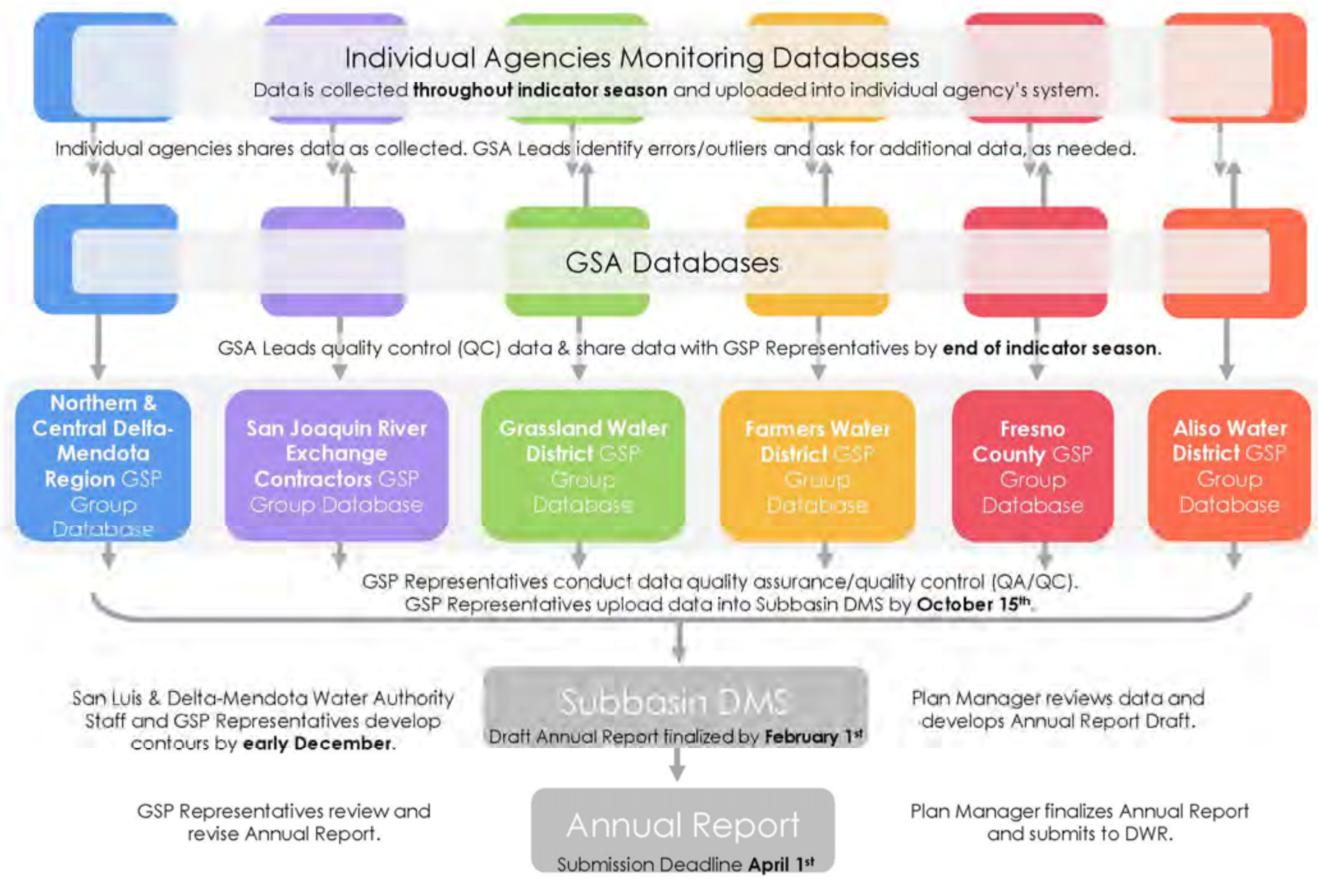

Figure CC-66: Delta-Mendota Monitoring and Data Management Roles and Responsibilities

6.1.3 GSP-Level Monitoring Networks

For more information on the individual GSP monitoring networks for each applicable sustainability indicator, including how the networks were developed, please refer to the individual GSPs. The monitoring networks for each applicable sustainability indicator for each GSP Group were developed in accordance with the GSP Regulations Article 5. Plan Contents, Subarticle 4. Monitoring Networks (§ 354.21 – 354.40). DWR's Best Management Practices for the *Sustainable Management of Groundwater Monitoring Protocols, Standards, and Sites BMP* (2016b) and *Monitoring Networks and Identification of Data Gaps BMP* (2016a) documents were used when and where applicable at the discretion of each GSP group in developing monitoring networks and monitoring protocols.

6.1.4 Delta-Mendota Subbasin Monitoring Networks

The subbasin-level monitoring networks are a compilation of the representative monitoring networks developed by each individual GSP Group. The monitoring network for the chronic lowering of groundwater sustainability indicator is comprised of two parts, the Upper Aquifer (**Figure CC-67**) and Lower Aquifer (**Figure CC-68**). The monitoring networks for the reduction in groundwater storage for the Upper Aquifer and Lower Aquifer are the same as those utilized for the chronic lowering of groundwater levels. The monitoring network for the degraded water quality sustainability indicator is also comprised of two parts, the Upper Aquifer (**Figure CC-69**) and Lower Aquifer (**Figure CC-70**). Data gaps (areas without wells of known construction) are shown for the Upper Aquifer and Lower Aquifer for the chronic lowering of groundwater and degraded water quality sustainability indicator. The interconnected surface water monitoring network for the Delta-Mendota Subbasin is shown in **Figure CC-71**, and the monitoring network for land subsidence for the Delta-Mendota Subbasin is shown in **Figure CC-72**.

The Delta-Mendota Subbasin representative monitoring networks will be periodically reviewed and revised, as appropriate, by the GSP Groups responsible for maintaining them and coordinated at the Subbasin level. Revised monitoring networks will be included in the five-year updates to the GSPs.

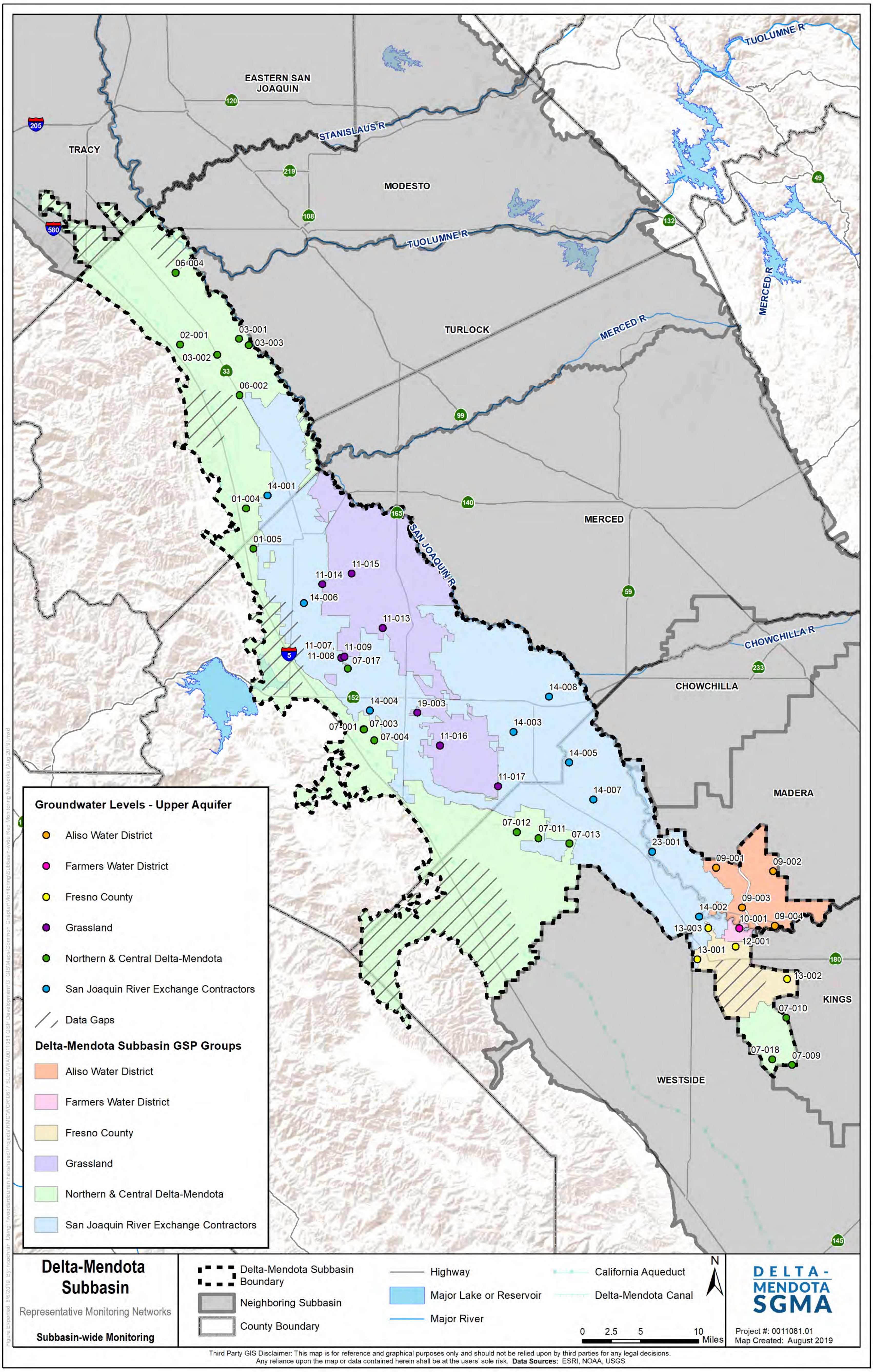

Figure CC-67: Upper Aquifer Groundwater Level Monitoring Network

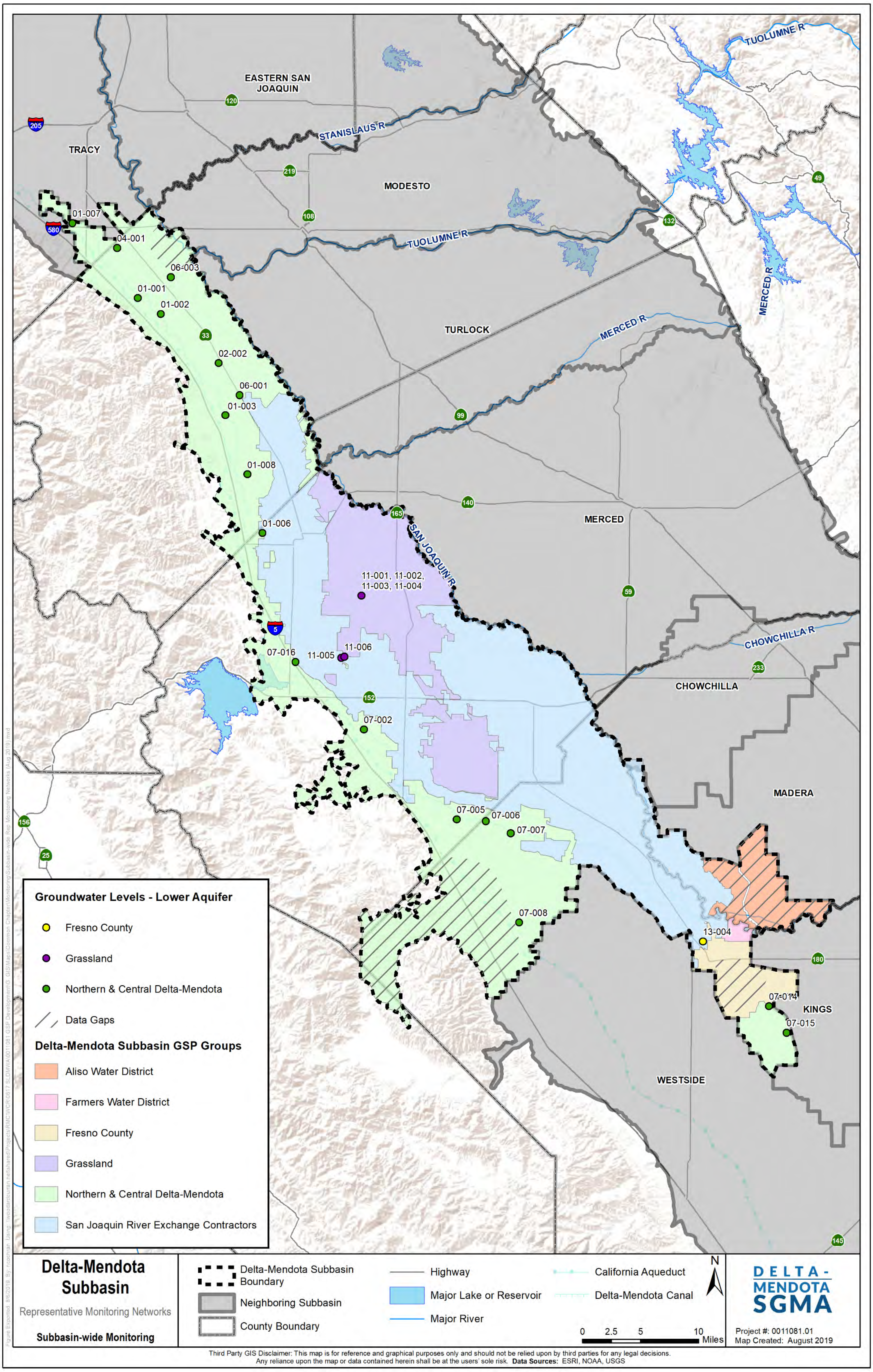

Figure CC-68: Lower Aquifer Groundwater Level Monitoring Network

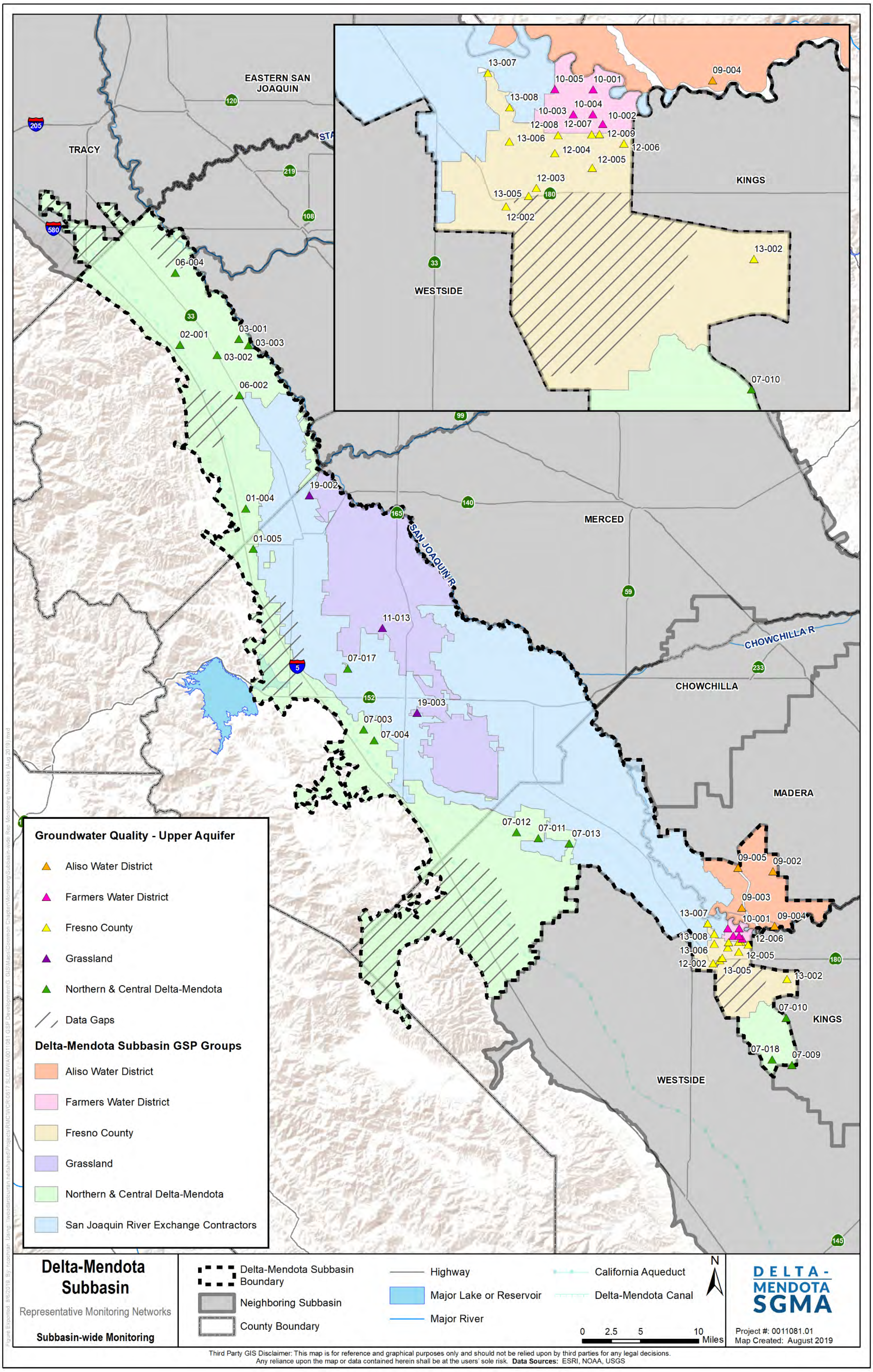

Figure CC-69: Upper Aquifer Groundwater Quality Monitoring Network

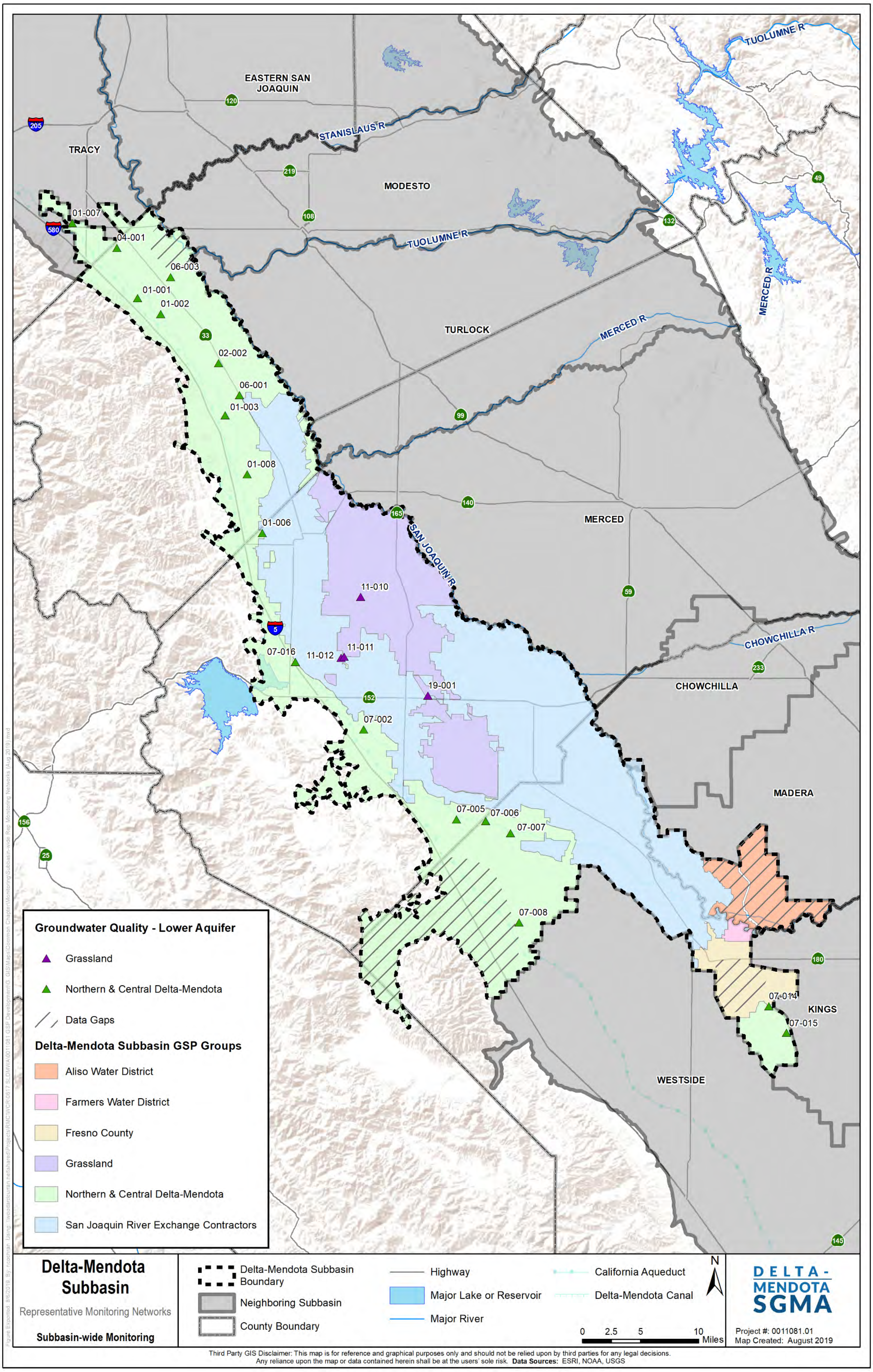

Figure CC-70: Lower Aquifer Groundwater Quality Monitoring Network

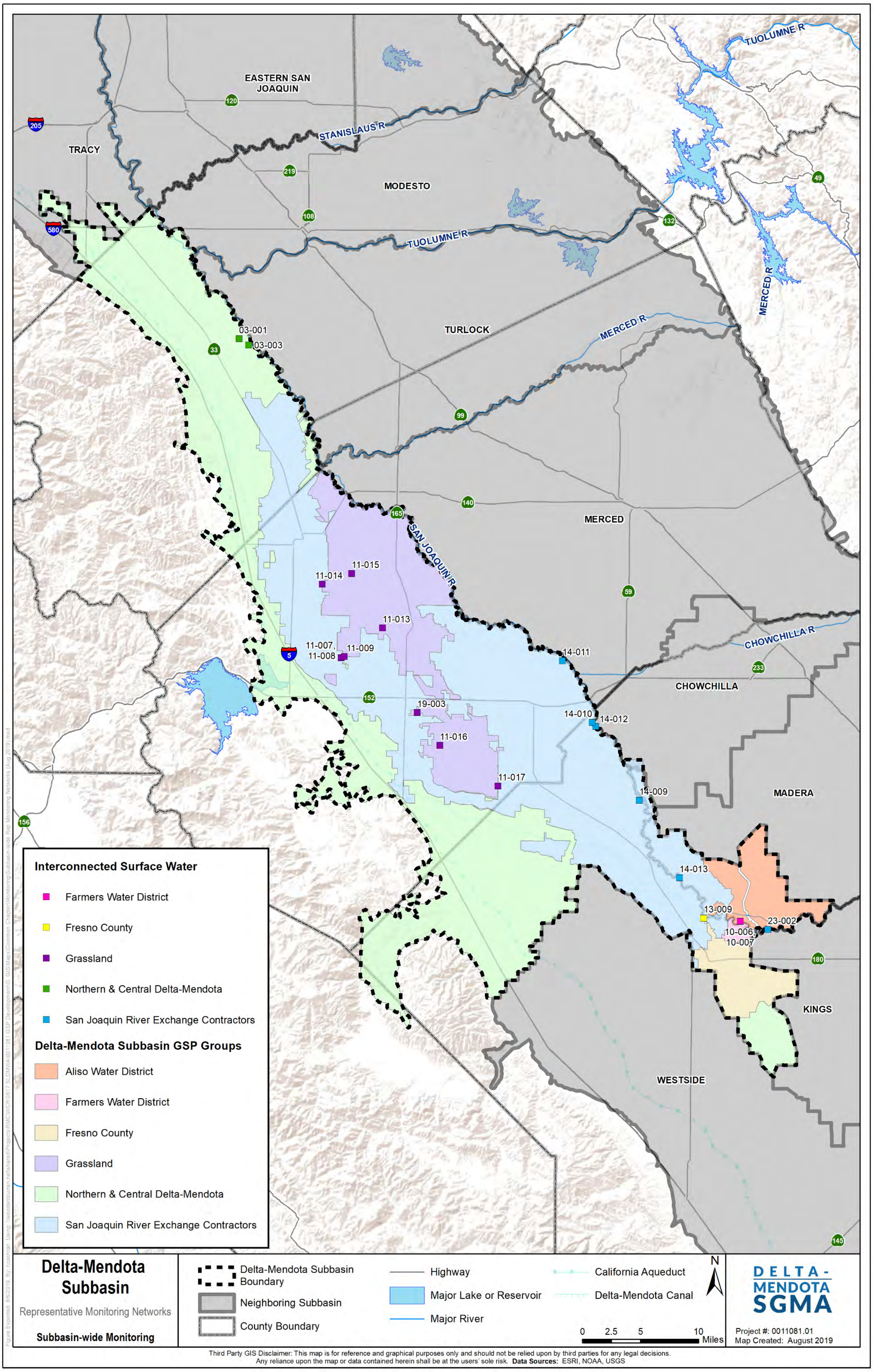

Figure CC-71: Interconnected Surface Water Monitoring Network

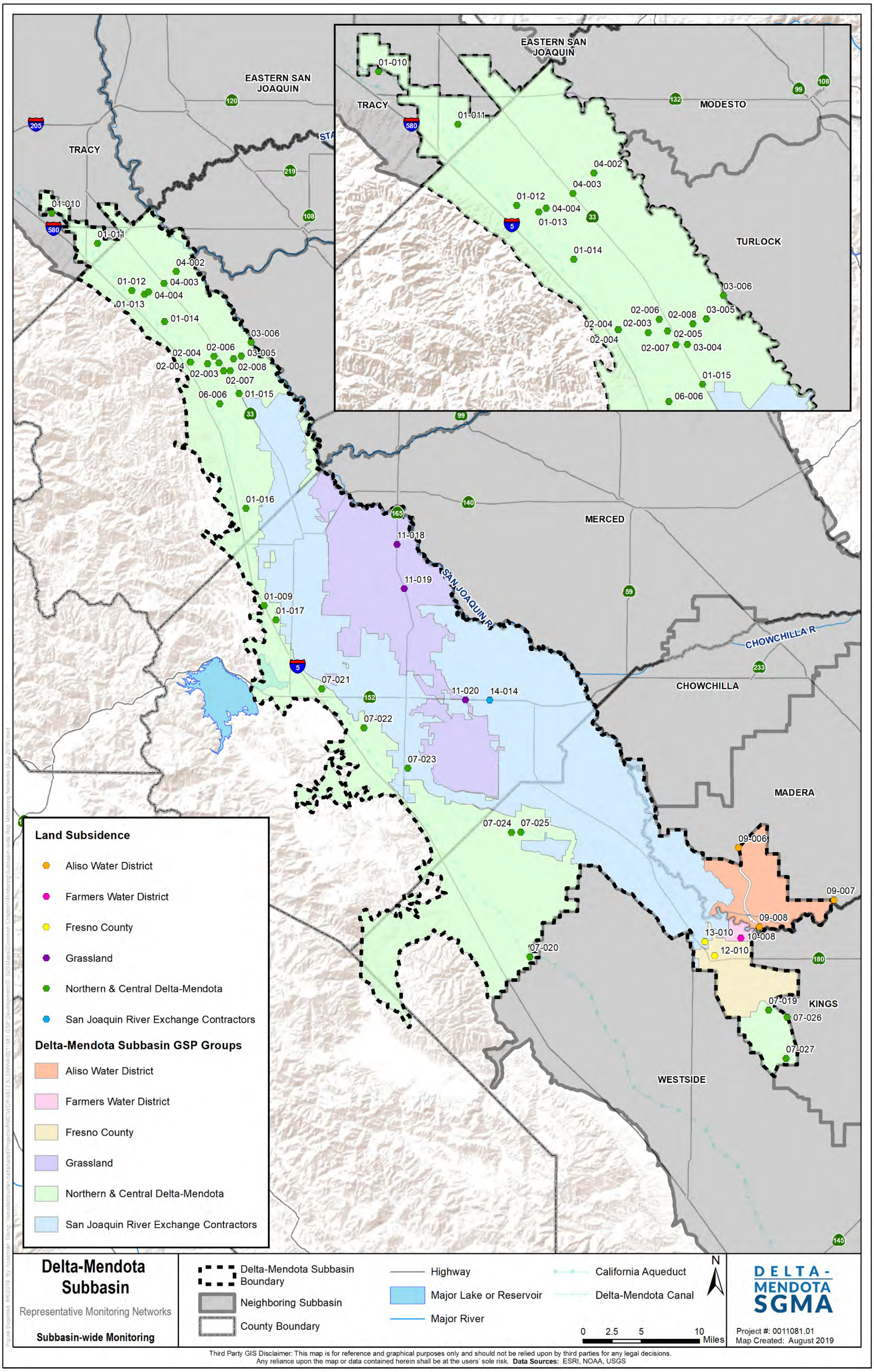

Figure CC-72: Land Surface Elevation Monitoring Network

7. SUBBASIN DATA COLLECTION AND MANAGEMENT

As required in §352.6, Data Management System of the GSP regulations, each GSA is required to develop and maintain a data management system (DMS) that is capable of storing and reporting information relevant to the development or implementation of the GSP(s). Additionally, per §354.4, Reporting Monitoring Data to the Department, all monitoring data is to be stored in a DMS with copies of the monitoring data included in the annual report and submitted electronically on forms provided by DWR. Recognizing that GSP implementation, including annual reporting, will require some efforts at the subbasin level, the 23 GSAs overlying the Delta-Mendota Subbasin have chosen to develop a coordinated DMS that can be utilized by each GSP Group for management of their data but which will allow for the required compendium of data sets for preparation of Subbasin annual reports. The coordinated DMS will also provide a generic framework that can be used by any GSP Group or GSA in the Subbasin for individual data management while allowing for consistent formatting and the simplified uploading of compiled datasets into the Subbasin-wide coordinated DMS.

The individual GSP Groups have also developed and will maintain separate data storage processes or DMSs. Each separate DMS developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the respective GSA and/or GSP Group, and ultimately to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Subbasin Plan Manager and Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

The DMS constructed for the Delta-Mendota Subbasin is a secured web-based application hosted on Amazon Web Services (AWS). The DMS focuses on five core business requirements including: centralized data warehouse, security of data, permissioned based access, data visualization and reporting. Other goals of the DMS focus around improving data collection/aggregation processes, creating data standards, gaining efficiencies in reporting and improving data sharing with stakeholders. The DMS is designed to aggregate data through import processes by GSP to support data visualization and annual report generation.

Underlying the web application is a relationship database used to store the information aggregated from GSPs across primary data types identified to support monitoring and Annual Report development. Those data types include groundwater extractions, surface water deliveries, groundwater storage, groundwater elevations, groundwater quality, interconnected surface water and land subsidence. The web application functionality includes an embedded GIS viewer, screens to view tables of time series data, and charting capabilities for hydrographs. The embedded GIS viewer contains functionality to store map layers such as reference data, GSA/GSP boundaries and derived information such as water level contours.

Section 6.1.2 describes the process by which monitoring data are collected by each GSP Group and processed for inclusion in the Coordinated DMS. In order to be able to track data by location in the Subbasin, each monitoring locations in the Delta-Mendota Subbasin is assigned a unique identifier in the DMS. The number system is in a format of ##-####, where the first two digits indicates which GSA the monitoring location is associated with, the subsequent four digits indicate which specific monitoring location in that GSA area. As shown in **Figure CC-66**, the general methodology agreed upon for data import and management is as follows:

- Each GSA collects their respective data per agreed-upon monitoring protocols and transmits it to the GSA Representative.
- Each GSA Representative then compiles the data and conducts a quality control check.
- The GSA Representative then transmits the compiled data set to the GSP Lead or Representative, who then aggregates the data from all GSAs and conducts a second quality control check.
- The GSP Lead or Representative then uploads the data set into the DMS using import wizards designed specifically for this process.
- The Subbasin Plan Manager then uses the data in the DMS to compile information as required for the annual report.

Compiled data sets from the DMS are then augmented with required maps generated externally to produce the required annual report. Mapping prepared outside the DMS are subsequently imported into the DMS as GIS files to ensure all data are kept in one place and to allow for access by GSAs and other Subbasin stakeholders.

The DMS will be maintained by the San Luis & Delta-Mendota Water Authority, while acting as the Plan Manager, with a contract with the software vendor for hosting, maintenance and future maintenance. Each GSP will pay a maintenance fee for the continued hosting and support of the Subbasin coordinated DMS.

The Coordinated DMS as described herein may be supplemented by additional DMS developed and maintained by each GSP Group in the Subbasin. The reader is referred to each of the six Subbasin GSPs for specific information relative to data collection and management in each GSP Plan area.

8. STAKEHOLDER OUTREACH

California Code of Regulations, Title 23, §354.10 identifies the requirements for notice and communication information presented in a GSP, which includes:

- A summary of information relating to notification and communication by the GSAs with other agencies and interested parties;
- 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;
- A list of public meetings at which the GSP was discussed or considered by the GSAs;
- Comments regarding the GSP received by the GSAs and a summary of any responses by the GSAs;
- A communication section of the GSP that includes an explanation of the GSAs' decision-making process, identification of opportunities for public engagement, a discussion of how public input and response was used, a description of how the GSAs encouraged the active involvement of diverse social, cultural and economic elements of the population within the basin, and the methods used by the GSAs to inform the public about progress implementing the GSP, including the status of projects and actions.

In meeting these requirements, outreach and educational activities were conducted at the Subbasin, GSP and GSA level throughout the GSP development process. This section describes the noticing and outreach conducted at the Delta-Mendota Subbasin level for GSP development. Please refer to each individual Subbasin GSP for specific details regarding noticing and communication, and descriptions of the beneficial uses and users of groundwater at the GSP and GSA level. Information regarding Subbasin coordination and committees can be found in Section 2, Delta-Mendota Subbasin Governance, of this document.

8.1 Situation Assessment and Communications Plan

To assist in GSA formation and GSP development, agencies in the Delta-Mendota Subbasin sought and received Facilitation Support Services funding from DWR in August 2016. Under this funding, a neutral, third-party facilitation team conducted a situation assessment on behalf of the Subbasin GSAs. The purpose of the assessment was to understand how stakeholders perceived the status of the Subbasin's groundwater resources and identify potential barriers to the successful development of the GSPs.

The facilitation team, with input from local agencies, identified 30 stakeholders representing diverse interests and beneficial users in the Subbasin, together with disadvantaged communities, agricultural well owners, government and land use agencies, and environmental and ecosystem interests. From February 2017 to May 2017, the facilitators conducted over 30 phone and in-person interviews with stakeholders. The facilitators recorded the interview responses and summarized the results in a presentation made to the GSA representatives.

The assessment results were used to inform the development of the Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan (Communications Plan), which is provided with this document as **Appendix E**. The Communications Plan identifies near- and long-term outreach and engagement strategies, tactics, and tools for stakeholder engagement in GSP development and implementation. The Subbasin GSAs used the Communications Plan as a framework for conducting the stakeholder outreach and engagement activities described in this document.

The Delta-Mendota Subbasin is home to a large Hispanic or Latino population with many using Spanish as their primary language. As such, public noticing, educational materials and other outreach efforts were developed and presented in both English and Spanish throughout the GSP development process.

8.2 Public Noticing and Information

The Delta-Mendota Subbasin GSAs developed and used several coordinated tools, in addition to their own resources to inform members of the public about GSP development activities and promote opportunities for public engagement. These tools are described below.

- **Website:** The Subbasin website – www.deltamendota.org – is the primary location for information related to SGMA implementation in the Subbasin. Information provided on the website includes: an overview of SGMA, a description of each of the GSP groups, contact information for each of the GSAs, and upcoming workshops and public meetings. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the Delta-Mendota Subbasin Coordination Committee, Technical Working Group, and Communications Working Group (described below), and provides links to the individual GSP websites maintained by each GSP Group.
- **Delta-Mendota Subbasin Newsletter:** The Delta-Mendota Subbasin Newsletter is distributed on a monthly basis and serves as an informational tool to keep interested parties, beneficial users, and members of the general public informed about the development and status of the GSPs. Newsletter topics include Subbasin-wide activities, general announcements, upcoming meetings and workshops, and past and upcoming GSP development activities. Copies of the newsletters are archived on the Subbasin website.
- **Informational Materials**: GSAs in the Subbasin developed a suite of materials in English and Spanish to educate and inform members of the public about SGMA and topics covered in the GSP. These materials include bilingual presentations, fact sheets, handouts, frequently asked questions, and videos. Copies of the materials are available on the Subbasin website. GSA representatives distributed these materials before and during meetings, workshops, and other outreach activities.

8.3 List of Public Meetings Where the GSPs were Discussed

Each GSP Group for the Delta-Mendota Subbasin has conducted individual outreach efforts relative to their own GSP Plan area in addition to those same efforts at the subbasin-level. Please refer to each of the individual GSPs for this information. Below is a list of the coordinated public workshops and meetings where the GSPs were discussed. These include meetings of the Delta-Mendota Subbasin Coordination Committee, the two Subbasin Working Groups and coordinated public workshops. All meetings were publicly noticed and held from June 2017 through July 2019. Meeting agenda, minutes and handouts are available on the Delta-Mendota Subbasin website at www.deltamendota.org.

Delta-Mendota Coordination Committee Meetings

The Delta-Mendota Subbasin Coordination Committee meets on the second Monday of each month at 9:30 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, a special meeting of the Coordination Committee was held on March 8, 2019 to discuss sustainable yield estimation methodologies.

Delta-Mendota Technical Working Group Meetings

The Delta-Mendota Technical Working Group meets on the third Tuesday of each month at 10:00 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, several special meetings of the Technical Working Group were held to discuss specific topics. These additional meetings were as follows:

- August 24, 2018 and September 19, 2018 meetings to discuss Groundwater Dependent Ecosystems
- August 8, 2018, October 30, 2018 and December 19, 2018 meetings to discuss water budgets

Delta-Mendota Communication Working Group Meetings

The Delta-Mendota Communications Working Group meets on the fourth Tuesday of each month at 1:00 pm. These meetings typically conducted via conference call. Meeting information for this working group is available on the Delta-Mendota Subbasin website.

Coordinated Public Workshops

Coordinated public workshops were held for the Delta-Mendota Subbasin shown in the table below. All workshops were advertised and conducted in both English and Spanish.

Table CC-19: Coordinated Public Workshops

Date	Location, Venue	Topic
Spring 2018 Workshops		
May 14, 2018	Los Banos, San Luis & Delta Mendota Water Authority	• Sustainable Groundwater Management Act overview • Delta-Mendota Subbasin overview • Opportunities for engagement
May 16, 2018	Patterson, Hammon Senior Center	
May 17, 2018	Mendota, Mendota Library	
Fall 2018 Workshops		
October 22, 2018	Firebaugh, Firebaugh Middle School	• GSP development and implementation process • Data collection • Hydrogeologic Conceptual Model • Numerical and analytical models • Water budgets
October 24, 2018	Los Banos, College Greens Building	
October 25, 2018	Patterson, Hammon Senior Center	
Winter 2019 Workshops		
February 19, 2019	Los Banos, College Greens Building	

Date	Location, Venue	Topic
February 20, 2019	Patterson, Patterson City Hall	• Historic and current water budgets • Sustainability criteria • Undesirable results • Projects and management actions
March 4, 2019	Santa Nella, Romero Elementary School	
Spring 2019 Workshops		
May 20, 2019	Patterson, Patterson City Hall	• Projected water budgets • Sustainable yield • Groundwater monitoring networks • Projects and management actions
May 21, 2019	Los Banos, College Greens Building	
May 22, 2019	Santa Nella, Romero Elementary School	
May 23, 2019	Mendota, Mendota Library	

Please see **Appendix F** for summaries of the coordinated public workshops, and **Appendix G** for example promotional materials for the public workshops.

8.4 Comments Regarding the GSPs

Key components of the six Subbasin GSPs were presented at the public workshops conducted throughout the GSP development process. **Appendix F** contains summaries of the coordinated public workshops, including comments received from and feedback provided to workshop participants. Additionally, each of the GSP Groups in the Delta-Mendota Subbasin are individually responsible for the public review of their plans and for addressing any public comments received. Please see the individual GSPs for additional information regarding plan review.

8.5 Subbasin Decision Making Process

The Delta-Mendota Subbasin Coordination Agreement outlines the responsibilities of all Subbasin parties, including decision making protocols and voting structure. These are further discussed in Chapter 2 of this document.

During the GSP development process, the Technical Working Group was charged with coordinating implementation of the required technical elements of the GSP (e.g. water budgets, monitoring networks), and to provide recommendations to the Delta-Mendota Subbasin Coordination Committee. Similarly, the Communications Working Group was charged with implementing the Subbasin Communications Plan and with providing recommendations for workshops and other outreach activities to the Coordination Committee. The Coordination Committee took actions and approved recommendations and work products and provided direction to both working groups and other ad hoc committees.

In general, the coordinated decision-making process included developing agendas for each meeting of the Delta-Mendota Subbasin Coordination Committee and for each Working Group meeting. The agendas were developed in concert with the Technical and Communications Working Groups, and the respective representatives of each GSP Group. Agenda items were either educational, informational, or required direction or decision. Meeting agendas, meetings minutes and handouts have been posted on the Delta-Mendota Subbasin website for public access.

8.6 Opportunities for Public Engagement and How Public Input was Used

Community input was encouraged and received at all meetings of the Coordination Committee, Technical Working Group, Communications Working Group meetings and at the public workshops. The Subbasin

GSPs (and therefore, this Common Chapter) was shaped by community input, Working Group input, and Coordination Committee direction and decisions.

8.6.1 Opportunities for Public Engagement

Regular opportunities for public engagement were available throughout GSP development. The Coordination Committee, Technical and Communications Working Groups, and individual GSA staff encouraged public input throughout the development of the GSPs as described below. A list of stakeholder and community organizations contacted as part of the Subbasin coordinated outreach efforts is included in **Appendix H**.

Meetings and Direct Engagement

Open meetings and public workshops were held as described in Section 8.1. In addition, GSA staff made direct contact with community representatives to encourage their participation in the GSP development process. GSA representatives provided their contact information by phone, email, or mail both online (on the Subbasin website) and at workshops for stakeholder questions and comments.

Targeted Stakeholder Engagement

The Subbasin GSAs also conducted targeted outreach and engagement to hard-to-reach communities, interested parties, and stakeholders that were previously underrepresented in other engagement activities. This included outreach to the following stakeholder types:

- **Agricultural Interests:** Agricultural stakeholders in the Subbasin include agricultural well operators, growers, ranchers, farmworkers, and agricultural landowners. Strong agricultural representation exists within the leadership of the GSAs. To augment direct outreach being conducted by individuals GSAs, Subbasin representatives also coordinated closely with local county farm bureaus to disseminate information related to GSP development and public workshops.
- **School Districts:** Schools districts are considered for both beneficial users of groundwater (for drinking water), as well communication channels to disseminate information about SGMA and GSP development. GSA representatives directly contacted local school districts to notify them of the public workshops. Some schools also help distributed informational materials and workshop flyers to their students and parents.
- **Industrial Interests:** There are many industrial interested in the Subbasin, including packaging and processing plants, mining industries, and other similar facilities that use groundwater in some fashion. The GSP Groups have identified these interests within their respective Plan areas and have disseminated information related to GSP development during individual outreach efforts.
- **Environmental/Conservation Interests:** Environmental and conservation interests in the Subbasin have been contacted and communicated with during GSP development. Specific related interest groups contacted during GSP development include The Nature Conservancy, the California Department of Fish and Wildlife, Audubon, and various sportsman clubs and wetland managers.

- **Disadvantaged Communities:** The GSAs followed best practices identified in Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation (Community Water Center, 2015) and other guidance documents to engage disadvantaged and severely disadvantaged communities. This included holding meetings in disadvantaged communities; holding meetings in the evening at known local venues, such as schools, civic centers, and community centers; translating fact sheets, meeting materials, and presentations into other languages; and providing interpreting services at all public workshops.
- **Other Interests:** Other potential groundwater users in the Subbasin (or those with groundwater-related interests) contacted during GSP development included the various counties in which the Delta-Mendota Subbasin lie and/or are adjoining (including San Joaquin County and San Benito County), Caltrans, the DWR State Water Project Division of Operations and Maintenance, the U.S. Bureau of Reclamation, the U.S. Geological Survey and the San Joaquin River Restoration Program.

The Reader should refer to each individual GSP for a more complete description of GSP-specific meetings and direct engagement.

GSP Section Review and Comment Periods

Each GSP Group was responsible for coordinating the individual review of their GSP. Please see each GSP for additional information as to their specific public review process. This Common Chapter to the six Delta-Mendota Subbasin GSPs was posted on the Subbasin's website (www.deltamendota.org) following submittal of the Subbasin GSPs.

8.6.2 How Public Input and Response was Used in the Development of the GSP

Each GSP Group was responsible for coordinating the individual review of their GSP and for determining how to incorporate public input and responses into their respective plans. Public input to the GSPs was solicited through the GSP development process through a number of means, including coordinated public workshops, Board of Directors presentations, City Council presentations, and growers' meetings. Please see the individual GSPs for more information regarding GSP-specific outreach efforts and how stakeholder and public input was received and factored into the GSPs.

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Appendix A - Coordination Agreement

DELTA-MENDOTA SUBBASIN COORDINATION AGREEMENT

THIS DELTA-MENDOTA SUBBASIN COORDINATION AGREEMENT is made effective as of December 12, 2018 by and among the groundwater sustainability agencies within the Delta-Mendota Subbasin (each a "**Party**" and collectively the "**Parties**") and is made with reference to the following facts:

WHEREAS, On September 16, 2014, Governor Jerry Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act ("**SGMA**");

WHEREAS, SGMA requires all groundwater subbasins designated as high or medium priority by the California Department of Water Resources ("**DWR**") to manage groundwater in a sustainable manner;

WHEREAS, the Delta-Mendota Subbasin (Basin Number 5-22.07, DWR Bulletin 118) within the San Joaquin Valley Groundwater Basin ("**Subbasin**"), has been designated as a high-priority basin by DWR;

WHEREAS, the Delta-Mendota Subbasin includes multiple groundwater sustainability agencies that intend to manage the Subbasin through the development and implementation of multiple different groundwater sustainability plans ("**GSP**");

WHEREAS, SGMA allows local agencies to engage in the sustainable management of groundwater, but requires groundwater sustainability agencies in all basins that are managed by more than one groundwater sustainability plan to enter into a coordination agreement to coordinate the multiple groundwater sustainability plans to sustainably manage the Subbasin pursuant to SGMA;

WHEREAS, pursuant to the requirements of SGMA, and the California Code of Regulations, and in recognition of the need to sustainably manage the groundwater within the Delta-Mendota Subbasin, the Parties desire to enter into this Agreement between their individual groundwater sustainability agencies;

WHEREAS, in order to efficiently coordinate among the large number of groundwater sustainability agencies ("**GSA**") in the Subbasin, the Parties intend to organize themselves into "**GSP Groups**" and to be represented by the "**GSP Group Representatives**," on terms to be developed and implemented by separate Agreements between each GSP Group and the Parties within such GSP Group; and

WHEREAS, this Coordination Agreement is being executed before the respective GSPs have been prepared, and the Parties anticipate attaching and incorporating technical reports covering such additional required information before submittal of this Agreement to DWR with the Parties' respective GSPs without separate amendment being required.

THEREFORE, in consideration of the facts recited above and of the covenants, terms and conditions set forth herein, the Parties agree as follows:

SECTION 1 – PURPOSE

1.1 Compliance with SGMA

In subbasins with multiple GSPs, SGMA requires the GSPs to be coordinated through a coordination agreement. The purpose of this Coordination Agreement including the anticipated attachment and incorporation of technical reports to be developed after the initial execution of this Agreement, is to comply with that SGMA requirement and ensure that the multiple GSPs within the Subbasin are developed and implemented utilizing the same methodologies and assumptions, that the elements of the GSPs are appropriately coordinated to support sustainable management, and to ultimately set forth the information necessary to show how the multiple GSPs in the Subbasin will achieve the sustainability goal, as determined for the Subbasin in compliance with SGMA and its associated regulations.

1.2 Description of Criteria & Function

An additional purpose of this Coordination Agreement is to describe the criteria for establishing the responsibilities of each Party for meeting the terms of this Coordination Agreement, the procedure for the exchange of information between the Parties, and procedures for resolving conflicts between the Parties. The goal of the coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies, including but not limited to, groundwater elevation data, groundwater extraction data, surface water supply, total water use, changes in groundwater storage, water budgets, and sustainable yield during their development as required by SGMA and associated regulations. Additionally, this Coordination Agreement sets out the process for identifying a Plan Manager.

SECTION 2 – DEFINITIONS

2.1 "Coordinated Plan Expenses" shall mean any expenses incurred by the Secretary and the Plan Manager for purposes of developing and implementing the Coordination Agreement.

2.2 "**Coordination Agreement**" shall mean this Coordination Agreement.

2.3 "**Coordination Committee**" shall mean the committee of GSP Group Representatives established pursuant to this Coordination Agreement.

2.4 "**Group Contact"** shall mean one Party designated on Exhibit "A" attached hereto and by reference incorporated herein as responsible to supply notices and to circulate information and invoices for its respective Exhibit "A" GSP Group, as said Exhibit may be updated from time to time.

2.5 "**GSA**" shall mean a groundwater sustainability agency established in accordance with SGMA and its associated regulations, and "GSAs" shall mean more than one such groundwater sustainability agency. Each Party is a GSA.

2.6 "**GSP"** shall mean a groundwater sustainability plan as defined by SGMA and its regulations, and "GSPs" shall mean more than one such plan.

2.7 "**GSP Group**" shall mean a grouping of Parties, stakeholders, and interested parties developing an individual GSP within the Subbasin, as shown in Exhibit "A," who are combined for purposes of representation and voting on the Coordination Committee and for purposes of sharing Coordinated Plan Expenses as set forth in this Coordination Agreement.

2.8 "**GSP Group Alternate Representative," "Alternate Representative,"** or **"Alternate"** and their plural forms shall mean an alternate member of the Coordination Committee selected to represent the GSP Groups in accordance with Exhibit "A" and Section 5.1.2-5.1.4 of this Coordination Agreement who shall serve in the absence of the respective GSP Group Representative and shall be entitled to cast the vote for the absent GSP Representative.

2.9 "**GSP Group Representative"** or **"Representative"** and their plural forms as appropriate shall mean a member or members of the Coordination Committee selected to represent the GSP Groups in accordance with Exhibit "A" and Section 5.1.2 – 5.1.4 this Coordination Agreement.

2.10 "**Participation Percentages"** shall mean that percentage of Coordinated Plan Expenses allocated to each GSP Group as described on Exhibit "A" to this Coordination Agreement, which is attached and incorporated by reference herein, as updated from time to time.

2.11 "**Party**" or "**Parties**" shall mean a Groundwater Sustainability Agency or in the plural, two or more Groundwater Sustainability Agencies within the Delta-Mendota Subbasin.

2.12 "**Plan Manager**" shall mean an entity or individual, appointed at the pleasure of the Coordination Committee, or as provided in section 4.1.2 of this Coordination Agreement, to perform the role of the Plan Manager to serve as the point of contact to DWR as set forth in Section 5.2.3 of this Coordination Agreement.

2.13 "**Seasonal High**" shall mean the highest annual static groundwater elevation associated with stable aquifer conditions following a period of lowest annual groundwater demand.

2.14 "**Seasonal Low**" shall mean the lowest annual static groundwater elevation associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

2.15 "**San Luis & Delta-Mendota Water Authority"** or "**SLDMWA"** shall mean the San Luis & Delta-Mendota Water Authority, a California joint powers agency.

2.16 "**SGMA**" shall mean the Sustainable Groundwater Management Act, as amended from time to time, commencing at Water Code section 10720, together with its implementing regulations applicable to Groundwater Sustainability Plans, set forth at California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2.

2.17 "**SGMA Definitions**" shall mean those SGMA-specific definitions provided by statute or regulation and attached in the Appendix to this Coordination Agreement; in the event of any inconsistency between a term defined in this Section and a SGMA-specific definition, the definition contained in this Coordination Agreement shall prevail.

2.18 "**Subbasin**" shall mean the Delta-Mendota Subbasin (Basin Number 5-22.07, DWR Bulletin 118) within the San Joaquin Valley Groundwater Basin.

2.19 "**Technical Memoranda**" shall mean the memoranda prepared by the Coordination Committee that include the data and methodologies for assumptions described in Water Code section 10727.6 to prepare coordinated plans. Individually, the memoranda shall be referred to as a "**Technical Memorandum**."

2.20 "**Water Year**" shall mean the period from October 1 through the following September 30 as defined by SGMA.

2.21 "**Water Year Type**" shall mean the classification provided by DWR to assess the amount of annual precipitation in a basin and as defined by SGMA.

SECTION 3 – GENERAL GUIDELINES

3.1 Responsibilities of the Parties

3.1.1 Obligation to Coordinate

The Parties to this Coordination Agreement agree to work collaboratively to meet the objectives of SGMA and this Coordination Agreement. Each Party to this Coordination Agreement is a GSA and acknowledges that it is bound by the terms of this Coordination Agreement as an individual Party.

3.1.2 Obligations Outside of Coordination Agreement Regarding GSP Groups

a) Representation and Voting. Each Party understands its participation, as more fully set forth in Section 5 of this Coordination Agreement, is based on representation through and by its GSP Group Representative(s). It is the responsibility and obligation of each Party under this Coordination Agreement to develop its own arrangements for how its respective GSP Group Representative and Alternate Representative are selected and how required actions of GSAs within the GSP Group under its respective GSP are identified and implemented.

b) The Coordination Committee and its members shall have no requirement to recognize a voting status or other decisional authority of any Party to this Coordination Agreement other than through the designated GSP Group Representative(s). For purposes of this Coordination Agreement, it is assumed that GSP Group Representatives have been authorized by the Parties in their GSP Groups to participate as described herein.

c) By signing this Coordination Agreement, each Party commits to provide documentation to the Secretary and the Coordination Committee of the authorization of its GSP Group Representative(s). Provided, that the Secretary shall not be obligated to evaluate or provide an opinion on the legal sufficiency of the documentation.

d) It is the responsibility and obligation of each Party under this Coordination Agreement that is included on Exhibit "A" as part of a multi-party GSP Group to provide documentation to the Secretary and to the Coordination Committee establishing that such GSP Group has a binding agreement or mechanism assuring that the GSP Group will pay its Participation Percentage set forth on Exhibit "A," as said Exhibit "A" may be modified from time to time. Provided, that the Secretary shall not be obligated to evaluate or provide an opinion on the legal sufficiency of the documentation.

3.1.3 Non-Entity Status

The Parties acknowledge and agree that this Coordination Agreement does not create a legal entity with power to sue or be sued, to enter into contract, or to enjoy the benefits or accept the obligations of a legal entity.

3.1.4 Implementation of Individual GSPs

This Coordination Agreement does not otherwise affect each Party's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, this Coordination Agreement is the mechanism through which the Parties will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA.

3.2 Adjudicated or Alternate Plans in the Subbasin

As of the date of this Coordination Agreement, there are no portions of the Subbasin that have been adjudicated or approved to submit an alternative plan as defined by SGMA.

SECTION 4 – ROLE OF SAN LUIS & DELTA-MENDOTA WATER AUTHORITY

4.1 Agreement to Serve

By executing this Agreement, and not as a Party, the San Luis & Delta-Mendota Water Authority agrees to carry out the functions described in this Section 4 and its subparts consistent with the terms of this Section and under the direction and supervision of the Coordination Committee, subject to the reimbursement and the termination provisions contained in this Section.

4.1.1 Secretary

The SLDMWA agrees to perform the obligations of the Secretary described in this Coordination Agreement, by delegation to one or more of its employees or to a consultant under contract to the SLDMWA.

4.1.2 Plan Manager

The SLDMWA agrees to perform the obligations of the Plan Manager described in this Coordination Agreement, by delegation to one or more of its employees or to a consultant under contract to the SLDMWA.

4.2 Reimbursement of SLDMWA

The commitment of the SLDMWA to perform the designated functions under this Section is contingent upon the execution and performance of a separate cost sharing agreement between the SLDMWA and the Parties.

4.3 Termination of SLDMWA's Services

Either the Parties acting through the Coordination Committee or the SLDMWA at any time may terminate the services being provided by the SLDMWA under this Coordination Agreement upon thirty (30) days' written notice, if from the SLDMWA, to the Coordination Committee and each GSP Group Representative; and if from the Coordination Committee, to the SLDMWA and each GSP Group Representative.

SECTION 5 – RESPONSIBILITIES FOR KEY FUNCTIONS

5.1 Coordination Committee

5.1.1 The Parties agree to establish a Coordination Committee to provide the forum for the Parties to accomplish the coordination obligation of SGMA pursuant to this Coordination Agreement.

5.1.2 The Coordination Committee will consist of the GSP Group Representatives identified on Exhibit "A" attached hereto and incorporated herein by this reference, as said Exhibit "A" may be modified from time to time pursuant to Section 13 of this Agreement. Each GSP Group Representative shall have one Alternate Representative authorized to vote in the absence of the GSP Group Representative.

5.1.3 Individuals serving as GSP Group Representatives and Alternate Representatives shall be selected by each respective GSP Group in the discretion of the respective GSP Group, and such appointments shall be effective upon providing written notice to the Secretary and to each Group Contact listed on Exhibit "A".

5.1.4 The Coordination Committee will recognize each GSP Group Representative and GSP Group Alternate Representative until such time as the Group Contact provides written notice of removal and replacement to the Secretary and to every other Group Contact designated on Exhibit "A." Each GSP Group or GSP Subgroup shall promptly fill any vacancy created by the removal of such Representative or Alternate Representative so that each GSP

Group shall have the number of validly designated Representatives and Alternate Representatives specified on Exhibit "A".

5.1.5. Minutes of the Coordination Committee will be prepared and maintained as set forth in Section 5.5.4.

5.2 Coordination Committee Officers

The Officers of the Coordination Committee will include a Chairperson, Vice Chairperson, Secretary, and Plan Manager. Except where the Parties have named such Officers pursuant to Section 4 of this Coordination Agreement, Officers shall be selected at the initial meeting of the Committee or as soon thereafter as reasonably can be accomplished.

5.2.1 Chairperson and Vice Chairperson

a) A GSP Group Representative shall serve as Chairperson. The Vice Chairperson, who shall also be a GSP Group Representative, shall serve in the absence of the Chairperson. In the absence of both the Chairperson and Vice Chairperson, a meeting may be led by an Acting Chairperson selected on an ad hoc basis.

b) The positions of Chairperson and Vice Chairperson shall rotate among the GSP Groups on an annual basis according to alphabetical order, with the first rotation beginning on the date the first Chairperson is selected. The schedule for rotation among the GSP Groups will be set at the first meeting after the Chairperson is appointed and reviewed and adjusted annually. A GSP Group Representative may waive designation as Chairperson. In such a case the Chairperson office would rotate to the next designated entity.

5.2.2 Secretary

The Coordination Committee shall select a Secretary to carry out the functions described in this subsection, to serve at the pleasure of the Coordination Committee. The Secretary shall be a public agency who may be, but need not be a Party to this Coordination Agreement. The San Luis & Delta-Mendota Water Authority is hereby designated as the initial Secretary, to serve at the pleasure of the Coordination Committee.

a) The Secretary shall select an appointee to implement the Secretary's responsibilities under this Coordination Agreement, for example, to coordinate meetings; prepare agendas; circulate notices and agendas; provide written notice to all Parties that the Coordination Committee has made a recommendation requiring approval by the Parties; prepare and maintain minutes of meetings of the Coordination Committee; receive notices on behalf of the Coordination Committee and call to the Coordination Committee's attention the need for responding; and provide such other assistance in coordination as may be appropriate.

b) The Secretary shall assume primary responsibility for Brown Act compliance, including without limitation, the responsibility to: prepare an agenda and notice, publicly post, and distribute agendas to all GSP Group or Subgroup Representatives, the Parties, and any other interested persons who requests, in writing, such notices. The Agenda shall be of adequate detail to inform the public and the parties of the meeting and the matters to be transacted or discussed, and shall be posted in a public location and distributed to each of the parties to this Coordination Agreement at least seventy-two (72) hours prior to every regular meeting and at least twenty-four (24) hours prior to every special meeting.

5.2.3 Plan Manager

If the SLDMWA ceases to serve as Plan Manager as agreed under Section 4.1.2 of this coordination Agreement, then the Coordination Committee shall name a successor Plan Manager, who may be a consultant hired by the Secretary pursuant to the Coordination Agreement, the representative of an entity that has been selected as Secretary, or a public agency serving as or participating in a GSA that is a Party to this Coordination Agreement, and who shall serve as the point of contact for DWR as specified by SGMA. The San Luis & Delta-Mendota Water Authority is hereby designated as the initial Plan Manager, to serve at the pleasure of the Coordination Committee.

a) The Plan Manager shall carry out the duties of a "plan manager" as provided in Title 23, division 2, Chapter 1.5, Subchapter 2, California Code of Regulations.

b) The Plan Manager has no authority to make policy decisions or represent the Coordination Committee without the specific direction of the Coordination Committee. The Plan Manager is obligated to disclose all substantive communications he/she transmits and receives in his/her capacity as Plan Manager to the Coordination Committee.

5.3 Coordination Committee Authorized Actions and Limitations

5.3.1 Authorized Actions

The Coordination Committee is authorized to act upon the following enumerated items:

a) The Coordination Committee shall review, and consistent with the requirements of SGMA, approve the Technical Memoranda described in Sections 8-12 of this Coordination Agreement.

b) Once GSP Plans have been submitted to and approved by DWR, the Coordination Committee shall be responsible for ongoing review and updating of the Technical Memoranda as needed; assuring submittal of annual reports; providing five-year assessments and recommending any needed revisions to the Coordination Agreement; and providing review and assistance with coordinated projects and programs.

c) The Coordination Committee shall review and approve work plans, and in accordance with the budgetary requirements of the respective Parties, approve annual estimates of Coordinated Plan Expenses presented by the Secretary and any updates to such estimates; provided, that such estimates or updates with supporting documentation shall be circulated to all Parties for comment at least thirty (30) days in advance of the meeting at which the Coordination Committee will consider approval of the annual estimate.

d) Pursuant to Section 13, the Coordination Committee is authorized to approve changes to Exhibit "A" to this Coordination Agreement and to recommend amendments to terms of this Coordination Agreement.

e) The Coordination Committee shall assign work to subcommittees and workgroups as needed, provide guidance and feedback and ensure that subcommittees and workgroups prepare work products in a timely manner.

f) The Coordination Committee shall direct the Plan Manager in the performance of its duties under SGMA.

g) The Coordination Committee shall provide direction to its Officers concerning other administrative and ministerial issues necessary for the fulfillment of the above-enumerated tasks.

5.3.2 Limitations

When the terms of this Coordination Agreement or applicable law require the approval of a Party, that approval shall be required and evidenced as indicated in Section 6 of this Agreement.

5.4 Subcommittees and Workgroups

The Coordination Committee may appoint subcommittees, workgroups, or otherwise direct staff made available by the Parties. Such subcommittees or workgroups may include qualified individuals possessing the knowledge and expertise to advance the goals of the Coordination

Agreement on the topics being addressed by the subcommittee, whether or not such individuals are GSP Group Representatives or Alternate Representatives.

5.4.1 Work of Subcommittees and Workgroups

Tasks assigned to subcommittees, workgroups, or staff made available by the Parties may include developing technical data, supporting information, and/or recommendations on matters including, but not limited to:

a) Developing a process to update the Coordination Committee on the activities of the respective Parties, including the development, planning, financing, environmental review, permitting, implementation, and long-term monitoring of the multiple GSPs in the Subbasin;

b) Subject to the oversight of the Coordination Committee, scheduling meetings of the subcommittee or workgroup as necessary to coordinate development and implementation of the Technical Memoranda and Coordination Agreement. Attendance at these meetings may be augmented to include staff or consultants of all Parties to ensure that the appropriate expertise is available;

c) Determining common methodologies for GSP development;

d) Developing a Subbasin-wide monitoring network;

e) Preparing a coordinated water budget;

f) Developing a coordinated data management system;

g) Providing an explanation of how the respective GSPs implemented together satisfy the requirements of SGMA and are in substantial compliance with SGMA; and

h) Such other tasks as may be referred by the Coordination Committee from time to time.

5.4.2 Subcommittee Voting

One GSP Group Representative or Alternate Representative shall vote on behalf of the GSP Group at the subcommittee level; if no GSP Group Representative or Alternate Representative is present, one individual working on a subcommittee on behalf of the Parties in a GSP Group shall vote on behalf of the GSP Group. Subcommittees shall report voting results and provide information to the Coordination Committee but shall not be entitled to make determinations or determinations that are binding on the Parties.

5.5 Coordination Committee Meetings

5.5.1 Timing and Notice

The Chairperson of the Coordination Committee, any two GSP Group Representatives, or the Secretary may call meetings of the Coordination Committee as needed to carry out the activities described in this Coordination Agreement. The Coordination Committee may, but is not required to, set a date for regular meetings for the purposes described in this Coordination Agreement. All Coordination Committee Meetings shall be held in compliance with the Ralph M. Brown Act (Government Code Section 54950 *et seq*.).

5.5.2 Quorum

A majority of the GSP Group Representative(s) from every GSP Group listed on Exhibit "A" shall constitute a quorum of the Coordination Committee for purposes of holding a Coordination Committee meeting; provided, that the GSP Group Representative(s) from every GSP Group listed on Exhibit "A" must be present at a meeting for any Coordination Committee vote on a matter described in section 5.3.1 a) through 5.3 d) and 5.3.1 f) to take place. The GSP Group Alternate Representative(s) of each GSP Group shall be counted towards a quorum and as the voting representative(s) in the absence of the GSP Group Representative for which the GSP Group Alternate has been appointed. If less than a quorum is present, the GSP Group Representatives and Alternate Representatives may hear reports and discuss items on the agenda, but no action may be taken.

5.5.3 Open Attendance

Members of the public, stakeholders, and representatives of the Parties who are not appointed as GSP Group Representatives may attend all meetings and shall be provided with an opportunity to comment on matters on the meeting agenda, but shall have no vote.

5.5.4 Minutes

The Secretary's appointee shall keep and prepare minutes of all Coordination Committee meetings. Notes of subcommittee and workgroup meetings shall be kept by the Secretary's appointee or an assistant to the appointee. All minutes and subcommittee and workgroup meeting notes shall be maintained by the Secretary as Coordination Agreement records and shall be available to the Parties and the public upon request.

5.6 Voting by Coordination Committee

5.6.1. Each GSP Group Representative shall be entitled to one vote at the Coordination Committee. It shall be up to the Parties in each GSP Group to determine how the GSP Group vote(s) will be cast.

5.6.2 Except as set forth in Section 5.6.3, the unanimous vote of the GSP Representatives from all GSP Groups is required on all items upon which the Coordination Committee is authorized to act as identified in Section 5.3.1 a) through 5.3.1 d) and 5.3.1 f); the vote of a majority of a quorum shall be required for all other matters on which the Coordination Committee is authorized to act.

5.6.3 Voting Procedures to Address Lack of Unanimity

When it appears likely that the Coordination Committee will not be able to come to unanimous decision on any matter upon for which a unanimous decision is required, upon a majority vote of a quorum of the Coordination Committee, the matter may be subjected to the following additional procedures.

a) Straw Polls

Straw poll votes may be taken for the purpose of refining ideas and providing guidance to the Coordination Committee, subcommittees, or both.

b) Provisional Voting

Provisional votes may occur prior to final votes. This will be done when an initial vote is needed to refine a proposal but the GSP Group Representatives wish to consult with their respective GSP Group(s) before making a final vote.

c) A vote shall be delayed if any GSP Group Representative declares its intention to propose an alternative or modified recommended action, to be proposed at the next meeting, or as soon thereafter as the GSP Group Representative can obtain any further information or clarifying direction from its GSP Group or governing body, or both, as needed to proposed its alternative or modified recommended action.

d) If the process outlined in subsection 5.6.3(c) fails to result in a unanimous vote, any GSP Group Representative not voting in favor of the recommended action may request that the vote be delayed so that the Coordination Committee can obtain further information on the recommended action (for example, by directing a subcommittee established under this

Coordination Agreement), so the GSP Group Representative can obtain clarifying direction from its GSP Group or governing body, or both, as needed.

e) Each of the Parties acknowledges the limited time provided by SGMA to complete the GSP preparation process, and agrees to make its best efforts to cooperate through the Coordinating Committee in coming to require a unanimous vote.

SECTION 6 – APPROVAL BY INDIVIDUAL PARTIES

6.1 Where law or this Coordination Agreement require separate written approval by each of the Parties, such approval shall be evidenced in writing by providing the resolution, Motion, or Minutes of their respective Boards of Directors to the Secretary of the Coordination Committee.

SECTION 7 – EXCHANGE OF DATA AND INFORMATION

7.1 Exchange of Information

The Parties acknowledge and recognize pursuant to this Coordination Agreement that the Parties may need to exchange information amongst and between the Parties.

7.2 Procedure for Exchange of Information

7.2.1 The Parties shall exchange public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. However, to the extent it is necessary to make a written request for information to another Party, each Party shall designate a representative to respond to information requests and provide the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine, or other electronic means to the appropriate representative as named in this Coordination Agreement. The designated representative shall respond in a reasonably timely manner.

7.2.2 Nothing in this Coordination Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Coordination Committee.

7.2.3 The Parties agree that each GSP Group shall provide the data required to develop the Subbasin-wide coordinated water budget but unless required by law, will not be required to provide individual well or parcel-level information in order to preserve confidentiality of individuals to the extent authorized by law, including but not limited to Water Code Section 10730.8, subdivision (b).

7.2.4 To the extent that a court order, subpoena, or the California Public Records Act is applicable to a Party, such Party in responding to a request made pursuant to that Act for release of information exchanged from another Party shall notify each other Party in writing of its proposed release of information in order to provide the other Parties with the opportunity to seek a court order preventing such release of information.

SECTION 8 – METHODOLOGIES AND ASSUMPTIONS

8.1 SGMA Coordination Requirements

Pursuant to SGMA, this Coordination Agreement must ensure that the individual GSPs utilize the same data and methodologies for developing assumptions used to determine: 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield.

8.2 Pre-GSP Coordination

Prior to the individual development of GSPs, the Parties agree to develop agreed-upon methodologies and assumptions for 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield. This development may be facilitated through the Coordination Committee's delegation to a sub-committee or workgroup of the technical staff provided by some or all of the Parties. The basis upon which the methodologies and assumptions will be developed includes existing data/information, best management practices, and/or best modeled or projected data available and may include consultation with the DWR as appropriate.

8.3 Technical Memoranda Required

The data and methodologies for assumptions described in Water Code section 10727.6 and title 23, California Code of Regulations, section 357.4 to prepare coordinated plans shall be set forth in Technical Memoranda prepared by the Coordination Committee for each of the elements discussed in Sections 9, 10, 11, and 12 of this Coordination Agreement. The Technical Memoranda shall be subject to the unanimous approval of the Coordination Committee and once approved, shall be attached to and incorporated by reference into this Coordination Agreement without formal amendment of the Coordination Agreement being required. The Parties agree that they shall not submit this Coordination Agreement to DWR until the Technical Memoranda described herein have been added to the Coordination Agreement. The Technical Memoranda created pursuant to this Agreement shall be utilized by the Parties during the development and implementation of their GSPs in order to assure coordination of the GSPs in compliance with SGMA.

SECTION 9 – MONITORING NETWORK

9.1 In accordance with SGMA, the Parties hereby agree to coordinate the development and maintenance of a monitoring network at a Subbasin level through the coordination of the respective monitoring networks established pursuant to the GSPs in which each of the Parties hereto are participating. The Subbasin monitoring network description shall include monitoring objectives, protocols, and data reporting requirements specific to enumerated sustainability indicators. Each GSP Group's network shall facilitate the collection of data in order to characterize groundwater and related surface water conditions in the Subbasin and evaluate changing conditions that occur from implementation of the individual GSPs. Each Party's GSP will describe the monitoring network's objectives for the Subbasin, including an explanation of network development and implementation to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater.

9.2 Each GSP Group shall provide the Coordination Committee all relevant data and information for their respective representative monitoring sites established in accordance with Title 23, California Code of Regulations, section 354.36, as amended from time to time.

SECTION 10 – COORDINATED WATER BUDGET

10.1 In accordance with SGMA, the Parties hereby agree to prepare a single coordinated water budget for the Subbasin as described in this subsection for use in the respective GSP in which each of the Parties hereto are participating. The water budget will provide an estimate of the total annual volume of groundwater and surface water entering and leaving the Subbasin, including historical, current and projected water budget conditions, and the change in the volume of water stored and the safe yield for differing aquifers.

10.2 To the extent feasible, the Parties will consider the best available information and best available science to quantify the water budget for the Subbasin 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.

SECTION 11 – COORDINATED DATA MANAGEMENT SYSTEM

11.1 The Parties will develop and maintain a coordinated data management system that is capable of storing and reporting information relevant to the reporting requirements and/or implementation of the GSPs and monitoring network of the Subbasin.

11.2 The Parties also will develop and maintain separate data management systems. Each separate data management system developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Coordination Committee will ensure the data is stored and managed in a coordinated manner throughout the Subbasin and reported to DWR annually as required.

SECTION 12 – ADOPTION AND USE OF THE COORDINATION AGREEMENT

12.1 Coordination of GSPs

Each Party is responsible to ensure that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline. The Parties to this Coordination Agreement intend that their individual GSPs be coordinated together in order to satisfy the requirements of SGMA and to be in substantial compliance with the California Code of Regulations. The collective GSPs will satisfy the requirements of sections 10727.2 and 10727.4 of the Water Code by providing a description of the physical setting and characteristics of the separate aquifer systems within the Subbasin, the measurable objectives for each such GSP, interim milestones, and monitoring protocols that together provide a detailed description of how the Basin as a whole will be sustainably managed.

12.2 GSP and Coordination Agreement Submission

The Parties agree to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. Subject to the subsequent attachment of the Technical Memoranda described in Sections 8-12, the Parties intend that this Coordination Agreement fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy the requirements SGMA for the entire Subbasin.

SECTION 13 – MODIFICATION AND TERMINATION OF THE COORDINATION AGREEMENT

13.1 Modification or Amendment of Exhibit "A"

The Parties agree that Exhibit "A," except for the withdrawal or addition of Parties to this Agreement, may be updated by unanimous vote of the Coordination Committee from time to time. Upon such modification, the updated Exhibit "A" shall be attached to this Agreement as a replacement to the previously existing Exhibit "A." Upon such attachment, the updated "Exhibit "A" shall become a part of this Coordination Agreement without further Amendment of the Coordination Agreement being required. The Secretary shall provide notice of such change to all Group Contacts.

13.1.1 Addition of a Party

A Party may be added to this Coordination Agreement only upon its execution of a counterpart of this Agreement and its provision of any additional documentation required by Sections 3.1.2 a) through 3.1.2 d) of this Coordination Agreement. No Party may be added that is not within the Delta-Mendota Subbasin or that fails to execute an agreement to share in Coordinated Plan Expenses, unless such payment is waived by consent of all Parties.

13.2 Modification or Amendment of Coordination Agreement

Except as provided in Sections 13.1 and 13.3, the Parties hereby agree that this Coordination Agreement may be supplemented, amended, or modified only by a writing signed by all Parties.

13.3 Amendment for Compliance with Law

Should any provision of this Coordination Agreement be determined to be not in compliance with legal requirements under circumstances where amendment of the Agreement to include a provision addressing the legal requirement will cure the non-compliance, the Parties agree to promptly prepare and approve such amendment.

SECTION 14 – WITHDRAWAL, TERM, AND TERMINATION

14.1 Withdrawal

Subject to the requirements identified in SGMA and the any coordination guidelines or regulations issued by DWR, a Party may unilaterally withdraw from this Coordination Agreement without causing or requiring termination of this Coordination Agreement, effective upon thirty (30) days written notice to the Secretary and all other Parties. The Plan Coordinator shall report any such withdrawal to DWR within five (5) days of receipt of the written notice.

14.1.1 Any Party who withdraws shall remain obligated for Coordinated Plan Expenses as provided in a separate Cost Sharing Agreement. If no separate Cost Sharing Agreement is then in effect or enforceable against the withdrawing Party, the Party is obligated to pay its share of all debts, liabilities, and obligations the Party incurred or accrued under the Coordination Agreement prior to the effective date of such withdrawal, as established under its separate GSP Group agreement concerning such share of obligations.

14.1.2 Upon withdrawal, a Party agrees that it has a continuing obligation to comply with SGMA and any coordination guidelines or regulations issued by DWR, which require a coordination agreement if there are multiple GSPs in the Subbasin. This obligation shall survive the withdrawal from this Coordination Agreement and is for the express benefit of the remaining Parties.

14.1.3 In the event any GSP Group Representative(s) prevents/prevent a required unanimous vote of the Coordination Committee after following all procedures described in 5.3.1 or Section 15 of this Agreement, the Parties in such GSP Group agree to provide notice that such GSP Group has unilaterally withdrawn from this Agreement in accordance with this Section.

14.2 Term

As modified pursuant to Section 13 and unless terminated in accordance with Section 14.2.3, this Coordination Agreement shall continue for a term that is coterminous with the requirements of SGMA for the existence of a Coordination Agreement.

14.3 Termination

This Coordination Agreement may be terminated or rescinded and the coordinated implementation of GSPs terminated by unanimous written consent of all the Parties. Nothing in this Coordination Agreement shall prevent the Parties from entering into another coordination agreement for coordination with any other subbasin.

SECTION 15 – PROCEDURES FOR RESOLVING CONFLICTS

In the event of any dispute arising from or relating to this Agreement, the disputing Party shall, within thirty (30) calendar days of discovery of the events giving rise to the dispute, notify all Parties to this Agreement in writing of the basis for the dispute. Within thirty (30) calendar days of receipt of said notice, all interested Parties shall meet and confer in a good-faith attempt to informally resolve the dispute. All disputes that are not resolved informally shall be settled by arbitration. Within ten (10) days following the failed informal proceedings, each interested Party shall nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties shall rank their top three among all nominated arbitrators, awarding three points to the top choice, two points to the second choice, one point to the third choice and zero points to all others. Each interested Party shall forward its tally to the Secretary, who shall tabulate the points and notify the interested Parties of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The Secretary may also develop procedures for approval by the Parties, for selection in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines to act. The arbitration shall be administered in accordance with the procedures set forth in the California Code of Civil Procedure, section 1280, et seq., and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring a legal action relating to the controversy.

SECTION 16 – GENERAL PROVISIONS

16.1 Authority of Signers

The individuals executing this Coordination Agreement represent and warrant that they have the authority to enter into this Coordination Agreement and to legally bind the Party for whom they are signing to the terms and conditions of this Coordination Agreement.

16.2 Governing Law

The validity and interpretation of this Coordination Agreement will be governed by the laws of the State of California without giving effect to the principles of conflict of laws, with venue for all purposes to be proper only in the County of Merced, State of California.

16.3 Severability

Except as provided for cure by amendment in Section 13.3, if any term, provision, covenant, or condition of this Coordination Agreement is determined to be unenforceable by a court of competent jurisdiction, it is the Parties' intent that the remaining provisions of this Coordination Agreement will remain in full force and effect and will not be affected, impaired, or invalidated by such a determination.

16.4 Counterparts

This Coordination Agreement may be executed in any number of counterparts, each of which will be an original, but all of which will constitute one and the same agreement.

16.5 Good Faith

The Parties agree to exercise their best efforts and utmost good faith to effectuate all the terms and conditions of this Coordination Agreement and to execute such further instruments and documents as are reasonably necessary, appropriate, expedient, or proper to carry out the intent and purposes of this Coordination Agreement.

SECTION 17 – SIGNATORIES

PARTIES:

<table>
<tr><td colspan="4">PATTERSON IRRIGATION DISTRICT GSA</td></tr>
<tr><td>Patterson Irrigation District</td><td colspan="3">Date: 05/22/2018</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative: Vince Lucchesi</td></tr>
<tr><td colspan="4">WEST STANISLAUS IRRIGATION DISTRICT GSA 1</td></tr>
<tr><td>West Stanislaus Irrigation District</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
<tr><td colspan="4">DM II GSA</td></tr>
<tr><td>Del Puerto Water District</td><td>Date:</td><td>Oak Flat Water District</td><td>Date:</td></tr>
<tr><td colspan="2">Signature</td><td colspan="2">Signature</td></tr>
<tr><td colspan="2">Name of Representative:</td><td colspan="2">Name of Representative:</td></tr>
<tr><td colspan="4">CITY OF PATTERSON GSA</td></tr>
<tr><td>City of Patterson</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
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<tr><td>Patterson Irrigation District</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
<tr><td colspan="4">WEST STANISLAUS IRRIGATION DISTRICT GSA 1</td></tr>
<tr><td>West Stanislaus Irrigation District</td><td colspan="3">Date: 5/16/18</td></tr>
<tr><td colspan="4">Signature Robert Pierce</td></tr>
<tr><td colspan="4">Name of Representative: Robert Pierce, General Manager</td></tr>
<tr><td colspan="4">DM II GSA</td></tr>
<tr><td>Del Puerto Water District</td><td>Date:</td><td>Oak Flat Water District</td><td>Date:</td></tr>
<tr><td colspan="2">Signature</td><td colspan="2">Signature</td></tr>
<tr><td colspan="2">Name of Representative:</td><td colspan="2">Name of Representative:</td></tr>
<tr><td colspan="4">CITY OF PATTERSON GSA</td></tr>
<tr><td>City of Patterson</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
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PARTIES:

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:**	**Twin Oaks Irrigation Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
WEST STANISLAUS IRRIGATION DISTRICT GSA 2			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
DM II GSA			
Del Puerto Water District	**Date:** 8/28/18	**Oak Flat Water District**	**Date:** 8/28/18
Signature Anthea C Hansen		**Signature** Anthea C Hansen	
Name of Representative: Anthea C Hansen		**Name of Representative:** Anthea C Hansen	

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SECTION 17 – SIGNATORIES

PARTIES:

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:**		
Signature			
Name of Representative:			
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
DM II GSA			
Del Puerto Water District	**Date:**	**Oak Flat Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CITY OF PATTERSON GSA			
City of Patterson	**Date:** 9/20/18		
Signature [signature]			
Name of Representative: Ken Irwin			

CITY OF PATTERSON GSA	
City of Patterson	**Date:**
Signature	
Name of Representative:	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:** 7/31/18	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative: Jerald R. O'Banion		**Name of Representative:**	

CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:** 7/31/18	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative: Jerald R. O'Banion		**Name of Representative:**	

ORO LOMA WATER DISTRICT GSA	
Oro Loma Water District	**Date:**
Signature	
Name of Representative:	

WIDREN WATER DISTRICT GSA	
Widren Water District	**Date:**
Signature	
Name of Representative:	

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	

CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:** 10/9/18
Signature		**Signature**	
Name of Representative:		**Jim DeMartini, Chariman:**	
APPROVED AS TO FORM John P. Doering County Counsel Stanislaus County		**BY:** ____ Asst County Counsel	**Date:** 10/3/18
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date: 8/13/18	Panoche Water District	Date:
Signature [signature]		Signature	
Name of Representative: Lon Martin		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature** 07/31/18	
Name of Representative:		**Name of Representative:** John Bennett	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature** 8/2/18	
Name of Representative:		**Name of Representative:** Aaron Barcellos	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:** 7/31/18
Signature		**Signature**	
Name of Representative:		**Name of Representative:** Michael Linneman	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	

CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:** 6/20/18	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative: Jerry Salvador		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:** 8-6-18
Signature		**Signature**	
Name of Representative:		**Name of Representative:** Elizabeth Reeves	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature Randall Miles 6-27-18		**Signature**	
Name of Representative: Randall Miles		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative: Amy Montgomery		**Name of Representative:**	
Santa Nella County Water District	**Date:** 9/14/18	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	

CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date: 8/21/18
Signature		Signature Sal Quintero	
Name of Representative:		Name of Representative: Sal Quintero	

ORO LOMA WATER DISTRICT GSA	
Oro Loma Water District	Date:
Signature	
Name of Representative:	

WIDREN WATER DISTRICT GSA	
Widren Water District	Date:
Signature	
Name of Representative:	

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

ATTEST:
BERNICE E. SEIDEL
Clerk of the Board of Supervisors
County of Fresno, State of California
By ________ Deputy

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative: Steve Sloan			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative: Jean Sagouspe			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

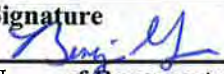
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:** 9-7-2016	**Columbia Canal Company**	**Date:**
Signature [signature]		**Signature**	
Name of Representative: James O'Banion		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature [signature]		**Signature** [signature]	

Mike Stearns   Jim Nickel

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:** Kimberly Brown	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

Name of Representative:	Name of Representative:
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	Date: 8/6/2018
Signature [signature] President	
Name of Representative: DONALD SKINNER, President	
CITY OF MENDOTA GSA	
City of Mendota	Date:
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	Date:
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	Date:
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	Date:
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	Date:
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	Date:
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	Date:
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	Date:
Signature	
Name of Representative:	

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:** 12/12/18
Signature [signature]	
Name of Representative: Cristian Gonzalez	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:** 9-25-18
Signature 	
Name of Representative: Ben Gallegos	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

Name of Representative: | Name of Representative:

TURNER ISLAND WATER DISTRICT -2 GSA

Turner Island Water District | Date:

Signature

Name of Representative:

CITY OF MENDOTA GSA

City of Mendota | Date:

Signature

Name of Representative:

CITY OF FIREBAUGH GSA

City of Firebaugh | Date:

Signature

Name of Representative:

CITY OF LOS BANOS GSA

City of Los Banos | Date: November 14, 2018

Signature

Name of Representative: Alex Terrazas, City Manager

CITY OF DOS PALOS GSA

City of Dos Palos | Date:

Signature

Name of Representative:

CITY OF GUSTINE GSA

City of Gustine | Date:

Signature

Name of Representative:

CITY OF NEWMAN GSA

City of Newman | Date:

Signature

Name of Representative:

COUNTY OF MADERA-3 GSA

County of Madera | Date:

Signature

Name of Representative:

COUNTY OF MERCED DELTA-MENDOTA GSA

County of Merced | Date:

Signature

Name of Representative:

Name of Representative:	Name of Representative:
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	Date:
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	Date:
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	Date:
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	Date:
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	Date:
Signature	7/9/2018
Name of Representative: April Hogue	
CITY OF GUSTINE GSA	
City of Gustine	Date:
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	Date:
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	Date:
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	Date:
Signature	
Name of Representative:	

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:** September 18, 2018
Signature	
Name of Representative: Doug Dunford	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:** 15 AUG 18
Signature	
Name of Representative: Michael E. Holland	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:** 10-02-2018
Signature	
Name of Representative: Tom Wheeler	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

9-11-18

MICHAEL LINDEN, DEP COUNTY COUNSEL

COUNTY OF MERCED DELTA-MENDOTA GSA			
County of Merced	**Date:** 7/31/18		
Signature			
Name of Representative: Jerald R. O'Banion			
GRASSLAND WATER DISTRICT GSA			
Grassland Water District	**Date:**	**Grassland Resource Conservation District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
FARMERS WATER DISTRICT GSA			
Farmers Water District	**Date:**		
Signature			
Name of Representative:			
FRESNO COUNTY GSA			
County of Fresno	**Date:**		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	**Date:**		
Signature			
Name of Representative:			

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	**Date:**
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	Date: 7-10-2018	Grassland Resource Conservation District	Date: 7-10-2018
Signature		Signature	
Name of Representative: Pepper Snyder		Name of Representative: Dennis Campini	
FARMERS WATER DISTRICT GSA			
Farmers Water District	Date:		
Signature			
Name of Representative:			
FRESNO COUNTY MANAGEMENT AREA A and B GSAs			
County of Fresno	Date:		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	Date:		
Signature			
Name of Representative:			

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	Date:
Signature	
Name of Representative:	

<table>
<tr><td colspan="4">GRASSLAND WATER DISTRICT GSA</td></tr>
<tr><td>Grassland Water District</td><td>Date:</td><td>Grassland Resource Conservation District</td><td>Date:</td></tr>
<tr><td colspan="2">Signature</td><td colspan="2">Signature</td></tr>
<tr><td colspan="2">Name of Representative:</td><td colspan="2">Name of Representative:</td></tr>
<tr><td colspan="4">FARMERS WATER DISTRICT GSA</td></tr>
<tr><td>Farmers Water District</td><td colspan="3">Date: 9-14-18</td></tr>
<tr><td colspan="4">Signature [signature]</td></tr>
<tr><td colspan="4">Name of Representative: JIM STILWELL</td></tr>
<tr><td colspan="4">FRESNO COUNTY MANAGEMENT AREA A and B GSAs</td></tr>
<tr><td>County of Fresno</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
<tr><td colspan="4">ALISO WATER DISTRICT GSA</td></tr>
<tr><td>Aliso Water District</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
</table>

EXECUTING NOT AS A PARTY:

<table>
<tr><td colspan="2">SAN LUIS & DELTA-MENDOTA WATER AUTHORITY</td></tr>
<tr><td>San Luis & Delta-Mendota Water Authority</td><td>Date:</td></tr>
<tr><td colspan="2">Signature</td></tr>
<tr><td colspan="2">Name of Representative:</td></tr>
</table>

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	Date:	Grassland Resource Conservation District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	

FARMERS WATER DISTRICT GSA	
Farmers Water District	Date:
Signature	
Name of Representative:	

FRESNO COUNTY MANAGEMENT AREA A and B GSAs	
County of Fresno	Date: August 21, 2018
Signature	
Name of Representative: Sal Quintero	

ATTEST:
BERNICE E. SEIDEL
Clerk of the Board of Supervisors
County of Fresno, State of California

By__________Deputy

ALISO WATER DISTRICT GSA	
Aliso Water District	Date:
Signature	
Name of Representative:	

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	Date:
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	Date:	Grassland Resource Conservation District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	

FARMERS WATER DISTRICT GSA	
Farmers Water District	Date:
Signature	
Name of Representative:	

FRESNO COUNTY GSA	
County of Fresno	Date:
Signature	
Name of Representative:	

ALISO WATER DISTRICT GSA	
Aliso Water District	Date: 10-23-18
Signature Roy Catania	
Name of Representative: ROY CATANIA, BOARD PRESIDENT	

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	Date:
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	**Date:**	**Grassland Resource Conservation District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	

FARMERS WATER DISTRICT GSA	
Farmers Water District	**Date:**
Signature	
Name of Representative:	

FRESNO COUNTY MANAGEMENT AREA A and B GSAs	
County of Fresno	**Date:**
Signature	
Name of Representative:	

ALISO WATER DISTRICT GSA	
Aliso Water District	**Date:**
Signature	
Name of Representative:	

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	**Date:** 8/6/18
Signature Frances C Mizuno	
Name of Representative: Frances Mizuno	

EXHIBIT "A" – Groundwater Sustainability Plan (GSP) Groups

	Groundwater Sustainability Plan Group & Representation on Coordination Committee	Group Contact Agency	Participation Percentage
1	**Northern / Central Delta-Mendota Region – 2 Representatives** Central DM Subgroup – 1 Member representing the following: Central Delta-Mendota Multi-Agency GSA Oro Loma Water District GSA Widren Water District GSA Northern DM Subgroup – 1 Member representing the following: City of Patterson GSA DM-II GSA Northwestern Delta-Mendota GSA Oak Flat Water District GSA Patterson Irrigation District GSA West Stanislaus Irrigation District GSA	West Stanislaus Irrigation District	16.7%
2	**San Joaquin River Exchange Contractors – 2 Representatives** City of Dos Palos GSA City of Firebaugh GSA City of Gustine GSA City of Los Banos GSA City of Mendota GSA City of Newman GSA Madera County GSA Merced County Delta-Mendota GSA San Joaquin River Exchange Contractors GSA Turner Island Water District-2 GSA	San Joaquin River Exchange Contractors	16.7%
3	**Farmers Water District – 1 Representative** Farmers Water District GSA	Farmers Water District	16.7%

4	**Aliso Water District – 1 Representative** Aliso Water District GSA	Aliso Water District	16.7%
5	**Grassland Water District – 1 Representative** Grassland Water District GSA Grassland WD and Grassland Resource Conservation District Merced County Delta-Mendota GSA	Grassland Water District	16.7%
6	**Fresno County Management Area A & B – -1 Representatives** Fresno County Management Area A GSA Fresno County Management Area B GSA	Fresno County	16.7%

APPENDIX – SGMA DEFINITIONS

1. "**Agency**" or "**GSA**" shall mean a groundwater sustainability agency as defined in SGMA.

2. "**Coordination Agreement**" shall mean this Coordination Agreement, unless indicated otherwise.

3. "**Annual Report**" shall mean the report required by Water Code Section 10728 and SGMA Regulations Section 356.2.

4. "**Basin**" shall mean the Delta-Mendota subbasin and defined in Bulletin 118 as Basin 5- 22.07; for purposes of the Coordination Agreement, "Basin" and "Subbasin shall have the same meaning.

5. "**Basin Setting**" shall mean the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to California Code of Regulations, title 23, sections 354.12-354.20.

6. "**CASGEM**" shall mean the California Statewide Groundwater Elevation Monitoring Program developed by the DWR.

7. "**DWR**" shall mean the Department of Water Resources.

8. "**Groundwater**" shall mean the water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.

9. "**Groundwater flow**" shall mean the volume and direction of groundwater movement into, out of, or throughout a basin.

10. "**Interconnected surface water**" shall mean the surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

11. "**Measureable objectives**" shall mean specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted GSP to achieve the sustainability goal for the basin.

12. "**Principal Aquifers**" shall mean aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

13. "**Representative Monitoring**" shall mean a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

14. "**Sustainability Indicator**" shall mean any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results.

15. "**Water Source Type**" shall mean the source from which water is derived to meet the applied beneficial uses, including groundwater, precipitation, recycled water, reused water, and surface water sources.

16. "**Water Use Sector**" shall mean categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

Appendix B - Common Technical Memoranda

TECHNICAL MEMORANDUM #1

RE: Common Datasets and Assumptions used in the Delta-Mendota Subbasin GSPs

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following datasets and assumptions were used in a coordinated fashion by those preparing the six GSP for the Delta-Mendota Subbasin. These data sets and assumptions were agreed upon by the Delta-Mendota Subbasin Technical Working Group and approved by the Delta-Mendota Coordination Committee over the period extending from December 2017 through June 2019.

1. DATASETS

The technical development for the six GSPs in the Subbasin relied on the best available data for their respective Plan areas. The following outlines common datasets and instances of localized data use during the development of the GSPs.

<u>Groundwater Level Data and Contour Mapping</u>

1. Subbasin-wide groundwater level contour maps for the upper aquifer were developed for the selected historic water budget period (Spring 2003 and 2012) and current water budget period (Spring 2013 and Fall 2013). Contours were developed for the upper aquifer for the years identified. Thirty-foot contour intervals were used; individual GSAs compromised on this contour spacing following initial attempts at smaller contours due to variability in data. The lower aquifer's historic water surface elevation (WSE) data inventory was too limited to develop groundwater level contours for the entire Subbasin and is anticipated to be addressed in future GSPs and annual reports as these data gaps are addressed. Water level contour maps were composed from the following data sources:
    - i. California Department of Water Resources (DWR):
        1. California Statewide Groundwater Elevation Monitoring (CASGEM) Program
        2. Water Data Library (WDL)
    - ii. Water level data from local monitoring programs.

2. Subbasin-wide change in storage was evaluated for the upper aquifer using annual groundwater contour maps from Spring 2003 to Spring 2013 developed from the same datasets identified above and compared to each GSP's change in groundwater storage as calculated from historic and current water budgets for consistency. Change in storage for the lower aquifer was evaluated using specific yield and historic land subsidence provided by each GSP Group along with change in groundwater levels and storativity where lower aquifer groundwater level data were available. Datasets used to assess subsidence are discussed below.

<u>Subsidence</u>

3. Each GSP Group determined the historic rate of subsidence in their respective Plan area using the following data sources and period of record. The subsidence rates were combined using a 'sum-of-the-parts' methodology to develop an understanding of subsidence in the Subbasin.
    a. Aliso Water District GSP: United States Bureau of Reclamation (USBR) San Joaquin River Restoration Program (SJRRP) 2011-2017.
    b. Farmers Water District GSP: United States Geological Survey (USGS) and University-NAVSTAR Consortium (UNAVCO) 2004-2017.
    c. Fresno Management Areas A & B GSP: USGS and UNAVCO 2004-2017.
    d. Grassland GSP: USBR 2011-2017 with Ken D. Schmidt & Associates (KDSA) edits.
    e. Northern & Central Delta-Mendota GSP (without Tranquillity Irrigation District): USBR's Delta-Mendota Canal subsidence surveys interpolated from 1984 to 2014 (Pools 3 through 18) as well as the Department of Water Resources 2017 CA Aqueduct Subsidence Study.
    f. Northern & Central Delta-Mendota GSP (Tranquillity Irrigation District): Tranquillity Irrigation District's (TRID) local subsidence data from 2014 to 2018.
    g. San Joaquin River Exchange Contractors GSP: USBR's SJRRP subsidence monitoring network, USBR's Delta-Mendota Canal subsidence survey data, USGS continuous monitoring sites (including extensometers and CPGS sites), and local surveying data for years 2003-2012, 2013, and 2014-2018.

<u>Water Budgets</u>

4. Each GSP group developed Historic, Current, and Projected Water Budgets using the best available local and publicly available data for their respective Plan area. The six individually-developed water budgets were compared and combined for the Delta-Mendota Subbasin water budgets. Instances in which common data sources were used are as follows:
    a. The Historic, Current, and Projected Water Budgets relied on a common data source for water year type; the California Data Exchange Center (CDEC): San Joaquin River Index was used. The San Joaquin River Exchange Contractors water year type behavior is influenced by inflow to Shasta Reservoir, as does the managed wetlands in the Grassland GSP area that have federal contracts for refuge water supplies. Therefore, the Full Natural Flow (FNF) into Shasta Reservoir was considered to refine the water year type to distinguish between a critically dry year under the San Joaquin River Index and a critically dry year with reduced surface water deliveries to the San Joaquin River Exchange Contractors and the refuges due to a critical year under the Exchange Contract and refuge contracts (reduced inflows to Shasta Reservoir).
    b. The six GSP Groups also coordinated the use of DWR's 2030 and 2070 Climate Change Factors (CCF or CCFs) for the Projected Water Budget.

DELTA-MENDOTA SGMA

Groundwater Dependent Ecosystems

5. Groundwater Dependent Ecosystems (GDEs) were evaluated by each GSP Group. The Natural Communities (NC) Dataset Viewer's GDE delineations, produced by The Nature Conservancy (TNC) in partnership with the Department of Fish and Wildlife and DWR, was reviewed and vetted using the following data sources:

a. Aliso Water District GSP, Farmers Water District GSP, Fresno Management Areas A & B GSP, Northern & Central Delta-Mendota Regions GSP, and the San Joaquin River Exchange Contractors GSP used 2015 groundwater contours comprised of local and DWR's WDL depth to water data.

b. Grassland GSP used current Ducks Unlimited Wetland Inventory data for the Wetland GDE map, because the NC Dataset for wetland GDEs in this unique wetland habitat area is not accurate. The Wetland GDE map assumes that all wetlands identified by Ducks Unlimited are possible GDEs, and the Vegetative GDE map assumes that all TNC-delineated Vegetative GDEs are possible GDEs. The GSP Groups reserve the opportunity to gather more local data to refine the GDE maps in future updates.

c. Northern & Central Delta-Mendota Regions GSP used aerial satellite photos and field verification at locations with infrastructure, farms, ditches and canals, etc. to ground-truth the GDE data produced by TNC.

2. ASSUMPTIONS

Coordination and limited data required assumptions to be made to meet GSP requirements. Assumptions that affected the Delta-Mendota Subbasin's coordinated effort are outlined below along with the data and methodologies applied. The basis upon which the methodologies and assumptions were developed includes data and information provided by local agencies, State and federal data, best management practices, and/or best modeled or projected data available.

Mapping

1. Historic WSE Mapping – Assumed accurate and best available locally provided data

a. Upper Aquifer

i. Spring 2003 and Spring 2013 WSE contours were developed for the upper aquifer using datasets identified in item 1.1 above. Spring data was defined as being measured from January 1 through April 8.

ii. The groundwater levels at individual wells were plotted for both Spring 2003 and Spring 2013. Contours were refined by Luhdorff & Scalmanini, Consulting Engineers (LSCE) in the southern portion of the Subbasin and by KDSA for the entire Delta-Mendota Subbasin.

iii. The Spring 2003 and 2013 surfaces were overlaid to produce a change in groundwater level map for the historic period.

iv. The contour maps for the upper aquifer were developed on the following dates:
1. UPPER Change Spring 2003 vs. 2013 – Last edited February 7, 2019
2. UPPER Spring 2003 – Last edited February 6, 2019
3. UPPER Spring 2013 – Last edited February 6, 2019

a. Lower Aquifer

i. All available wells from the inventory identified in the datasets section above that had lower aquifer WSE readings in Spring 2013 and Fall 2013 were used to generate two maps showing lower aquifer 2003 and 2013 water levels (WSE values at individual wells). The spatial coverage was insufficient for contouring due to the distribution aligning linearly along the Delta-Mendota Canal and the limited well count. This effort was ultimately determined to be a data gap by the Technical Working Group on January 15, 2019.

1. Spring 2013: 37 water elevation measurements
2. Fall 2013: 48 water elevation measurements
3. Final maps for depiction of the lack of coverage and to meet GSP regulations were developed on February 6, 2019. Contours were unable to be developed for reasons noted above. Data will be collected in the future allowing for the development of lower aquifer contour maps as required in future annual reports.

2. Current WSE Mapping – Assumed accurate and best available locally provided data

a. Upper Aquifer

i. The upper aquifer Spring 2013 contour map developed on February 6, 2019 was also used to meet the requirements of the Current WSE contour maps. An additional upper aquifer Fall 2013 contour map was developed on March 1, 2019 using similar methodology and data from September 1 to October 31.

b. Lower Aquifer

i. As with the determination for the historic period, the spatial coverage was insufficient, and this effort has been determined to be a data gap by the Technical Working Group on January 15, 2019.

3. Groundwater Extraction Data

Extraction data were estimated or measured by local GSAs for use in the development of individual GSPs. Groundwater extraction volumes used for the Delta-Mendota Subbasin water budgets were compiled from the six individual GSP water budgets.

4. Surface Water Supply

Surface Water Supply allocations, deliveries, imports, and projected supplies were provided or estimated by local GSAs for use in the development of individual GSPs. Applied surface water volumes used for the Delta-Mendota Subbasin water budgets were compiled from the six individual GSP water budgets.

5. Total Water Use

Total Water Use was estimated or measured by local GSAs for use in the development of individual GSPs. Total water use included in the Delta-Mendota Subbasin water budgets was compiled from the individual GSP water budgets.

6. Change in Groundwater Storage

a. Upper Aquifer

i. Upper aquifer change in groundwater storage was evaluated using annual groundwater level contours from Spring 2003 to Spring 2013 developed using the same datasets identified above and applying specific yield (defined as the volume of water released from storage by an unconfined aquifer per unit surface area of aquifer per unit decline of the water table) provided by each individual GSP Group. The Delta-Mendota Subbasin upper aquifer change in groundwater storage assessment considered a 'sum-of-the-parts' methodology, combining the change in groundwater storage for each GSP to determine the overall change in groundwater storage for the Subbasin.

b. Lower Aquifer

i. On January 15, 2019, the Technical Working Group discussed addressing the historic period change in groundwater storage in the lower aquifer. Instead of using scarce data, the change was compared against loss of storage from inelastic land subsidence as calculated using change in land surface elevation multiplied by the area and supplemented by change in groundwater levels and storativity in areas of the Subbasin where those data were available.

7. GDEs

The Natural Communities Dataset Viewer's (NC Dataset Viewer) GDE delineations, produced by The Nature Conservancy (TNC) in partnership with the Department of Fish and Wildlife and DWR, were reviewed and vetted by each GSP Group. The primary reasons for not fully utilizing the NC Dataset Viewer GDE delineations were as follows: (1) A mapping error was identified, noting the land use is incompatible with the presence of GDEs; (2) for wetlands within the Grassland GSP, a more accurate and comprehensive wetland data set was available; and (3) The depth to groundwater exceeds 30 feet. The 30-foot criterion was used with the understanding that the deepest rooting depth of a vegetative GDE identified in NC Dataset Viewer is 30 feet, and further refined using effective rooting depths published by TNC. The GDE determinations and Spring 2015 depth to groundwater contours were compiled into a Wetland GDE map and Vegetative GDE map on May 29, 2019 and approved by the Subbasin Coordination Committee

The methods for GDE determinations are as follows.

a. Aliso Water District GSP:

   i. Spring 2013 and 2015 groundwater contours were assessed in Aliso Water District to evaluate areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs. Aliso WD GSP's GDE determinations remained constant when using either Spring 2013 or Spring 2015 water levels for consideration.

   ii. GDEs identified within a 100-foot buffer from the San Joaquin River remained "Possible GDEs," as consistent with a typical wetland setback standard used by CalTrans. (See the Aliso Water District GSP for detailed references relating to this standard.)

b. Farmers Water District GSP:

   i. Using GIS, Spring 2015 groundwater elevation contours were overlain on the TNC GDE delineations identified in Farmers Water District to evaluate areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs.

   ii. Local understanding of recent land use was also considered when vetting the TNC GDE delineations.

c. Fresno Management Areas A & B GSP:

   i. Spring 2015 groundwater contours were overlain on the TNC GDE delineations used for Fresno Management Areas A & B to evaluate areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs.

   ii. Local understanding of recent land use was also considered when vetting the TNC GDE delineations.

d. Grassland GSP:

   i. The Ducks Unlimited Wetland Inventory data were used in place of TNC GDE delineations for the identification of possible Wetland GDEs, with the understanding that the TNC GDE delineations for wetlands did not cover the full extent of wetlands in the Grassland Plan area. The Ducks Unlimited wetland delineations were more comprehensive and were developed with ground-truthing surveys which improved accuracy. This deviation in the use of a common dataset for the Subbasin was necessary as this GSP Plan area contains extensive acres of heavily vegetated, shallow seasonal wetlands and therefore required a supplemental approach to GDE delineation beyond the TNC GDE delineation.

   ii. All TNC Vegetative GDEs were also considered "Possible GDEs" and the Grassland GSP Group recognizes the opportunity to gather more local data to refine this position in future GSP updates, if applicable.

e. Northern & Central Delta-Mendota Regions GSP:

   i. Spring 2015 groundwater elevation contours were overlain on the TNC GDE delineations to identify areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs.

   ii. GDEs identified within a 100-foot buffer from the San Joaquin River remained "Possible GDEs," as consistent with a typical wetland setback standard in California.[1,2]

   iii. Local understanding of recent land use was also considered when vetting the TNC GDEs.

f. San Joaquin River Exchange Contractors GSP:

   i. Aerial imagery was reviewed for possible mapping errors based on land use and infrastructure. Remaining potential GDE's used Spring 2015 groundwater contours to identify areas in which the groundwater level exceeded the effective rooting depth published by TNC.

8. Subsidence

a. NASA JPL and USBR subsidence maps were provided to the Technical Working Group on October 16th, 2018.

   i. These maps were used for discussion purposes.

b. Subsidence values were produced by each GSP Group, using the most temporally and spatially representative data for their respective GSP on February 7, 2019. The GSP-specific subsidence values are listed in the table below. See the individual GSPs for more detailed information as to how the GSP-specific subsidence values were derived.

GSP Region	Subsidence Rate	Units	Rate	Period of Record	Source	Additional Notes
Aliso	0.15	ft/year	Annual	2011-2017	USBR	Local Surveys and SJRRP monitoring data
Farmers	0.689	ft	Cumulative	2004-2017	USGS and UNAVCO	USGS Fordel-upper aquifer Compaction, Total = 0.031 ft P304-Total Subsidence = 0.72 ft Lower aquifer Compaction, Total = 0.689 ft
Fresno	0.689	ft	Cumulative	2004-2017	USGS and UNAVCO	USGS Fordel-upper aquifer Compaction, Total = 0.031 ft P304-Total Subsidence = 0.72 ft Lower aquifer Compaction, Total = 0.689 ft
Grassland	0.075	ft/year	Annual	2011-2017	USBR and KDSA	The estimated rate of subsidence is based on monitoring points outside of the GSA and therefore has not been verified; Initial data came from USBR, KDSA provided edits to that data.
Northern & Central	Varies by DMC Pool, ranges from 0.7 to -0.88	ft	Cumulative	2003-2013	SLDMWA	Interpolated from 1984 and 2014 Subsidence Surveys for Pools 3-18
Northern & Central	0.53	ft/year	Annual	2014-2018	TRID	Survey data
San Joaquin River Exchange Contractors	0.35	ft	Cumulative	2003-2012	Various datasets	Local surveys, CGPS/CORS/Extensometer data, SJRRP monitoring data, DMC surveys

HCM/Groundwater Conditions

1. Four distinct hydrogeologic layers were initially identified for the Hydrogeological Conceptual Model: shallow layer (0-30 ft), medium layer (30 ft – top of Corcoran Clay), Corcoran Clay, and below Corcoran Clay. However, given that some areas in the Subbasin have more complex hydrogeology than others, these layers were consolidated to three regionally-recognized hydrogeologic features with management areas used further define localized hydrogeologic complexities as needed for SGMA compliance. At the Subbasin level, the three regionally-recognized hydrogeologic features are two principle aquifers – an upper aquifer (unconfined to semi-confined above the Corcoran Clay) and a lower aquifer (confined below the Corcoran Clay), and the intervening regional aquitard known as the Corcoran Clay. This hydrogeologic conceptual model was recommended by the Technical Working Group and approved by the Coordination Committee.
2. SGMA requires a description of the definable bottom of the basin (§354.14 of the GSP Emergency Regulations). The agreed-upon definable bottom of the basin for the Delta-Mendota Subbasin is the base of fresh water consistent with the published definition of the Base of Fresh Water found in R. W. Paige (USGS, Hydrologic Investigations Atlas HA-489, 1973), defined as >3,000 micromhos/cm [µmhos/cm] at 25°C.
3. The current year (2013) seasonal high (spring) ranges from January to April, and seasonal low (fall) ranges from August to October. Data collected during these periods were used for WSE mapping.
4. Data collected during the aforementioned period (as noted in #3, above) were used to prepare water surface contour maps for the upper aquifer. No water surface elevation contour maps were prepared for the lower aquifer for 2013 Fall and Spring (as required by the GSP regulations) due to a lack of aquifer-specific data in most areas of the Subbasin. However, lower aquifer data collected during the aforementioned period were plotted on maps in lieu of the required contour maps. Woodard & Curran / Provost & Pritchard prepared 2013 Fall and Spring WSE contouring for the upper aquifer.

5. Timeframe for upper aquifer WSE mapping defined spring as January 1st to April 8th and fall as September 1st to October 31st.
6. The water year types for water year (WY) 2011 (wet water year), WY2012 (dry water year), and WY2015 (Shasta dry/critical water year) were used to compare WSE maps between GSP Plan areas.
7. Kenneth D. Schmidt & Associate's (KDSA) mapping of interconnected reaches of the San Joaquin River (SJR) based on the SJRRP was used for areas within the SJREC and Grassland GSP Plan areas. A table is included in the Common Chapter showing which SJR reaches are within each GSP Plan area and whether those reaches are gaining or losing. For other GSP Plan areas adjacent to the San Joaquin River, determinations of interconnectedness were provided by those preparing individual GSPs.

Water Budget

1. Historic Water Budget

The historic period was defined as WY2003 through WY2012 by the Technical Working Group on August 8, 2018 and confirmed by the Coordination Committee on August 13, 2018. The historic water budget period was ratified by the Coordination Committee on January 14, 2019 following the Coordination Agreement and Cost Share Agreement being finalized on December 12, 2018.

Each GSP Group determined the surface and groundwater inputs and outputs using the best available public and local data for each respective GSP Plan area. The historic water budget was split into 1) a land interactions water budget and 2) a groundwater budget. The parameters that each GSP Group evaluated were coordinated and summed to develop the Subbasin-wide water budget used to assess the change in storage in the upper aquifer for each GSP Group on February 15, 2019. For details regarding the approach to developing the Subbasin water budgets using numerical and non-numerical tools and the associated discussions with DWR staff, see Technical Memorandum #3 – Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check, and Sustainable Yield.

The change in lower aquifer groundwater storage considered the best available subsidence data per GSP Group and the respective specific yield. The lower aquifer change in storage for the Subbasin total was compiled on February 15, 2019.

2. Current Water Budget

The current Water Budget follows similar methodology to the historic water budgets for both upper and lower aquifer change in groundwater storage. The current period was defined as WY2013 by the Technical Working Group on August 8, 2018 and confirmed by the Coordination Committee on August 13, 2018. The current water budget period was formally ratified by the Coordination Committee on January 14, 2019 following the Coordination Agreement and Cost Share Agreement being finalized on December 12, 2018.

3. Projected Water Budget

Each GSP Group developed their own projected water budgets, using a similar comparison strategy to the historic and coordinated water budgets. The Subbasin-wide projected water budget was presented to the Technical Working Group and Coordination Committees on April 1, 2019. For more details regarding determinations of the projected water budget period and associated representative water years, see Technical Memorandum #3 – Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check, and Sustainable Yield.

The representative period, functioning as surrogate years, for a 50(+)-year historic period (WY2014-2070) was proposed by the Technical Working Group on January 15, 2019. Use of DWR's CCF modeling was also coordinated for changes in precipitation, evapotranspiration and streamflows.

For years 1 through 4 of the projected water budgets (WY2014 through WY2017), actual data were used and no CCF's were applied. Water year types are based on the SJR index except for Shasta Critical years. The following water year types will therefore be used: Shasta Critical, Critical, Dry, Below Normal, Above Normal, and Wet, with all designations based on the San Joaquin River Index except Shasta Critical, which is defined by Shasta indices under the Exchange Contract and refuge water supply contracts. For the projected simulation, four water year types were used for representative water years: Average (above or below normal), Dry (dry or critical), Wet and Shasta Critical.

Climate Change Factors for precipitation and evapotranspiration (ET) were applied considering representative historical water years surrogating for the future year until 2070. Fifty-three years of historical data (1965-2017) were used to model the projected water budget. However, to better match the existing hydrologic cycle, the six GSP Groups decided to begin the projected period with the representative year of 1979 for WY2018 (versus 1965 for WY2018). The coordinated representative year pattern is as follows:

- 1979 data represents WY2018
- 1980 data represents WY2019 (and so on until WY2056)
  and
- 1965 data represents WY2057
- 1966 data represents WY2058 (and so on until WY2070)

For years 38-43 (repeated WY2012-2017), the DWR model did not establish precipitation or ET CCF. The following CCFs for ET and precipitation were used:

- WY 2012 used 2001's 2070 CCF
- WY 2013 used 1992's 2070 CCF
- WY 2014 used 1976's 2070 CCF
- WY 2015 used 1977's 2070 CCF
- WY 2016 used 2002's 2070 CCF
- WY 2017 used 2011's 2070 CCF

For years 30 – 43 (repeated WY 2004-2017), the DWR modeling did not establish streamflow CCFs. For this reason, DWR suggested to use surrogate years' CCFs for the projection. The following CCFs were selected for streamflows:

- WY2004 used 2002's 2030 CCF
- WY2005 used 2002's 2030 CCF
- WY2006 used 1998's 2030 CCF
- WY2007 used 1992's 2070 CCF
- WY2008 used 1992's 2070 CCF
- WY2009 used 2002's 2070 CCF
- WY2010 used 2003's 2070 CCF
- WY2011 used 1997's 2070 CCF
- WY2012 used 1992's 2070 CCF
- WY2013 used 1992's 2070 CCF
- WY2014 used 1976's 2070 CCF
- WY2015 used 1977's 2070 CCF
- WY2016 used 2002's 2070 CCF
- WY2017 used 1998's 2070 CCF

9. Sustainable Yield

Methodologies for calculating upper aquifer sustainable yield were discussed by both the Coordination Committee and the Technical Working Group. After reviewing several options for this calculation, the Coordination Committee requested that the Technical Working Group further discuss potential options and provide a recommendation back to the Coordination Committee for adoption. On April 16, 2019, a joint workshop of the Coordination Committee and the Technical Working Group was held to discuss options for upper aquifer sustainable yield estimation and to identify a recommendation.

During the April workshop, several basic concepts and principles were discussed to calculate the upper aquifer sustainable yield value. Consideration was given to several potential options with increasing detail, including some combination of the following: total Subbasin upper aquifer pumping volumes, total Subbasin upper aquifer change in storage (which includes the effects of precipitation, evapotranspiration, and deep percolation), and Subbasin upper aquifer subsurface inflows and outflows. Inflow from certain neighboring subbasins, based on groundwater flow direction, as well as subsurface inflow from the Coast Range at existing gradients (as part of the inflow to the Northern & Central Delta-Mendota GSP area) was considered. Outflow to neighboring subbasins at existing gradients was also considered in certain applicable areas along the Delta-Mendota Subbasin boundary based on groundwater flow characteristics. Outflow from the Aliso GSP area, which lies east of the San Joaquin River, was not considered as outflow for purposes of developing these principles.

The formula for determining upper aquifer sustainable yield was applied to rolled-up Delta-Mendota Subbasin projected water budgets (WY2014-2070) in two categories:

- *Projected Baseline values with Climate Change Factors*
- *Projected Baseline values with Climate Change Factors and Projects and Management Actions*

If the projected baseline values for the Subbasin are expected to have undesirable results, the GSAs are required to implement projects or management actions that will offset the overdraft and result in a sustainable condition. The Technical Working Group recommended calculation of both a projected baseline for sustainable yield with applied climate change factors and a projected baseline for sustainable yield with climate change factors plus planned projects and management actions. Staff completed preliminary calculations for both baselines using average annual values from the Subbasin projected water budgets and following the formula below:

Upper Aquifer Sustainable Yield = Pumping + Change in Storage + (Outflow– Inflow)

The Technical Working Group determined that a +/- 10% factor should be applied to determine a range for the upper aquifer sustainable yield value. The +/- 10% factor is applied based on the percentage difference between the values from change in storage contour mapping (prepared by Provost & Pritchard) and reported changes in storage from the Subbasin consolidated historic water budgets (WY2003-2012) for the upper aquifer.

In summary, the most detailed range for the upper aquifer sustainable yield is calculated using the above formula for both categories of water budgets: projected baseline with climate change factors and projected baseline with climate change factors plus projects and management actions. The 10% factor is applied to the results for both categories. This range aims to demonstrate the Subbasin's upper aquifer sustainable yield without implementing any projects and management actions (low end of range) and how the Subbasin's upper aquifer sustainable yield will be impacted by implementing planned projects and management actions (high end of range).

Within the Delta-Mendota Subbasin, the distribution of known lower aquifer water level data and extraction volume data are limited and not sufficient to allow for a calculation of lower aquifer sustainable yield. The Technical Working Group therefore look to studies and/or analysis conducted in adjoining subbasins with similar hydrogeologic conditions for consideration in developing a preliminary sustainable yield estimate. A recent study conducted in the adjoining Westside Subbasin was identified and selected for use in developing this preliminary estimate.

The Westlands Water District GSA completed a recent study using groundwater modeling, in conjunction with the Westside Subbasin GSP development, to estimate sustainable yield for that subbasin. An analysis of their data reflected an initial assumption of lower aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, *Groundwater Management Strategy Concepts* presentation to the WWD Board on October 16, 2018). Using this analysis, a slightly lower (and therefore more conservative) sustainable yield value for the lower aquifer was selected (0.33 acre-feet per acre), amounting to approximately 250,000 acre-feet per year over the approximately 750,000-acre Delta-Mendota Subbasin.

The lower criteria for a lower aquifer sustainable yield estimation compared to that considered by Westlands Water District reflects DWR's classification of the Delta-Mendota Subbasin as critically overdrafted due to the subsidence issues and was therefore considered to be more protective against the potential for future inelastic land subsidence. After more data are obtained in future years, the lower aquifer sustainable yield value may undergo revisions.

For both the upper and lower aquifer sustainable yield, the Delta-Mendota Coordination Committee acknowledges that sustainable management criteria will be the primary indicator for managing lower aquifer extractions.

10. Boundary Flows

Boundary flows were evaluated by comparing inflows and outflows assessed by each GSP Group's water budget analyses and associated data, as well as groundwater flow trends from groundwater contours and hydrogeologist input. Each set of neighboring GSP Groups had independent meetings to coordinate and compare their respective contributions to inflows and outflows, and the results were provided and discussed by the Delta-Mendota Subbasin's Technical Working Group and Coordination Committee. More details on the applicable datasets can be found in the water budgets and groundwater contours sections of this Technical Memo.

TECHNICAL MEMORANDUM #2

RE: Assumptions for Hydrogeological Conceptual Model of the Delta-Mendota Subbasin

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions for the Delta-Mendota Hydrogeological Conceptual Model were agreed upon by the Delta-Mendota Subbasin Technical Working Group and approved by the Delta-Mendota Coordination Committee over the period extending from December 2017 through April 2019.

1. Four distinct hydrogeologic layers were initially identified for the Hydrogeological Conceptual Model: shallow layer (0-30 ft), medium layer (30 ft – top of Corcoran Clay), Corcoran Clay, and below Corcoran Clay. However, given that some areas in the Subbasin have more complex hydrogeology than others, these layers were consolidated to three regionally-recognized hydrogeologic features with management areas used further define localized hydrogeologic complexities as needed for SGMA compliance. At the Subbasin level, the three regionally-recognized hydrogeologic features are two principle aquifers – an upper aquifer (unconfined to semi-confined above the Corcoran Clay) and a lower aquifer (confined below the Corcoran Clay), and the intervening regional aquitard known as the Corcoran Clay. This hydrogeologic conceptual model was recommended by the Technical Working Group and approved by the Coordination Committee.
2. SGMA requires a description of the definable bottom of the basin (§354.14 of the GSP Emergency Regulations). The agreed-upon definable bottom of the basin for the Delta-Mendota Subbasin is the base of fresh water consistent with the published definition of the Base of Fresh Water found in R. W. Paige (USGS, Hydrologic Investigations Atlas HA-489, 1973), defined as >3,000 micromhos/cm [µmhos/cm] at 25°C.
3. For the required water surface elevation mapping for the defined current year (WY2013), data from January to April were used for the seasonal high (spring) mapping, and data from August to October were used for the seasonal low (fall) mapping to provide sufficient spatial distribution of data for mapping (recommended by the Technical Working Group during the period from March 2018 through August 2018).
4. Data collected during the aforementioned period (as noted in #3, above) were used to prepare water surface contour maps for the upper aquifer. No water surface elevation contour maps were prepared for the lower aquifer for 2013 Fall and Spring (as required by the GSP regulations) due to a lack of aquifer-specific data in most areas of the Subbasin. However, lower aquifer data collected during the aforementioned period were plotted on maps in lieu of the required contour maps.

5. The Technical Working Group used WY2011 (wet water year), WY2012 (dry water year), and WY2015 (Shasta critical water year) to compare groundwater elevation mapping prepared by the various GSP Groups for their respective GSP Plan areas.
6. Kenneth D. Schmidt & Associates mapping of interconnected reaches of the San Joaquin River based on the San Joaquin River Restoration Program was used for areas within the SJREC and Grassland GSP Plan areas. For other GSP Plan areas adjacent to the San Joaquin River, determinations of interconnectedness were provided by those preparing individual GSPs. A table will be provided showing which San Joaquin River reaches are within each GSP Plan area and whether those reaches are interconnected. If necessary to implement the sustainability goal of the Subbasin, the GSAs will coordinate estimating volumes of gains and losses at these reaches of the San Joaquin River.

TECHNICAL MEMORANDUM #3

RE: Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions were utilized by each GSP Group in the Subbasin in developing the historic and projected water budgets for their respective GSP Plan areas. These GSP-specific water budgets were then compiled (rolled-up) to the Subbasin level for inclusion in the Common Chapter. Also included herein are the assumptions used in developing Subbasin-level sustainable yield estimates for each principal aquifer. These assumptions were recommended by the Delta-Mendota Subbasin Technical Working Group and approved by the Delta-Mendota Coordination Committee.

1. Water Budgets

On September 25, 2017, the Delta-Mendota Subbasin Technical Working Group met with Trevor Joseph (Senior Engineering Geologist) and Mark Nordberg (Senior Engineering Geologist) from the California Department of Water Resources (DWR) to discuss how the development of six GSPs for the Subbasin will be coordinated to implement the best available science while also coordinating to use the same data and methodologies. DWR expressed concerns regarding coordination between those GSPs using a numerical model and those using a non-numerical (spreadsheet) model. Mr. Joseph advised that SGMA requires sustainability for the entire subbasin and was concerned about coordinating a subbasin water budget. The SJREC have experience sustainably managing groundwater using a non-numerical model. A follow-up meeting took place on November 17, 2017 with DWR representatives Trevor Joseph, Tyler Hatch (Senior Engineer) and Amanda Peisch-Derby (Regional SGMA Coordinator) to showcase how this spreadsheet model has been used. It was further discussed that the hydrogeologic principles and equations used for both types of modeling in the Delta-Mendota Subbasin are the same. DWR agreed that coordination amongst the GSP Groups, ensuring use of the same data and methodologies, can be achieved for SGMA modeling purposes in the Subbasin.

Historic Water Budget

The historic period adopted by the Subbasin Coordination Committee was defined as Water Year (WY) 2003 through WY2012. A water year is the period beginning October 1st and ending on September 30th of the subsequent year. The historic water budget period was ratified by the Coordination Committee on January 14, 2019.

Each GSP Group in the Delta-Mendota Subbasin developed land surface water budgets and groundwater budgets for the historic period using the best available public and local data for each respective GSP Plan area. The parameters (specific inputs and outputs) that each GSP Group evaluated were coordinated and summed to develop the Subbasin-wide water budget and to estimate the change in groundwater storage in the upper aquifer in each GSP Plan area. Parameters included pumping/tile drainage, subsurface inflows/outflows, and deep percolation of precipitation and applied surface water. Estimates of changes in groundwater levels in the upper aquifer over the historic water budget period were also utilized to estimate change in groundwater storage. The estimated change in groundwater storage for the upper aquifer from the compiled water budgets was compared to that estimated from changes in groundwater level. For purposes of developing a change in groundwater storage in the upper aquifer over the historic water budget period, the estimates developed from the water budget methodology were used for the Subbasin.

Development of the change in lower aquifer storage value was limited as a result of a lack of available aquifer-specific groundwater level data in most areas of the Subbasin. As a result, a methodology for estimating change in lower aquifer storage from subsidence, along with changes in potentiometric head (where groundwater level data were available), was used. For GSP Plan areas where groundwater level data were not available to support calculations of change in lower aquifer storage, change in land surface elevations was used as a proxy for estimates of change in lower aquifer storage. The best available subsidence data by GSP Group and representative specific yield values (defined as the volume of water released from storage by an unconfined aquifer per unit surface area of aquifer per unit decline of the water table) were used to estimate change in lower aquifer storage from subsidence.

Change in Storage Cross-Check

Groundwater elevation contour maps were developed for the upper aquifer for Spring 2003 and Spring 2013 to assess changes in groundwater storage during the historic and current water budget periods. The contour maps were used to estimate upper aquifer change in storage during the historic and current period by subtracting the Spring 2013 contours from the Spring 2003 contours and multiplying the change in groundwater elevations by GSP Plan area and specific yield of the aquifer. Estimates were made for each GSP Plan area and compared to the overall change in storage estimated in the individual GSP historic and current groundwater budgets. The results of the two methodologies were comparable (within 20%).

Change in land surface elevation is used as a proxy for lower aquifer change in storage using a similar methodology, multiplying the change in land surface elevation between 2003 and 2013 by the area covered by individual GSP Plan areas to estimate the change in lower aquifer storage.

Current Water Budget

The current year for the associated water budget was set as WY2013 by the Delta-Mendota Technical Working Group on August 8, 2018 and confirmed by the Delta-Mendota Coordination Committee on August 13, 2018. The current water budget and associated changes in storage (by principal aquifer) were calculated in the same manner as the historic water budgets. The current water budget period was ratified by the Coordination Committee.

Projected Water Budget

Each GSP Group developed their own GSP-specific projected water budgets using a similar methodology to the historic and current water budgets. GSP-specific water budgets were compiled at the Subbasin level, and the Subbasin projected water budget was recommended and approved at a joint meeting of the Delta-Mendota Technical Working Group and Coordination Committee.

Per SGMA and the GSP regulations, the projected water budget period begins with the year subsequent to the current water budget year and extends for a projection period of at least 50 years to WY2070 for application of the required climate change factors. For the Delta-Mendota Subbasin, the current water budget is WY2013, and the projected water budget period is WY2014 through WY2070.

As future hydrology (e.g. precipitation totals) is not known, historic hydrology is used to simulate projected future hydrology. As a result, each year in the projected water budget is assigned a representative water year from the historic period. For example, WY2018 is assumed to have hydrology similar to that of WY1979; WY2019 is assumed to have hydrology similar to that of WY1980; and so forth. The pattern of historic hydrology used to simulate future hydrology is established based on actual hydrology from WY2014 - WY2017 (known water year types at the start of the projected water budget period). This resulted in the following projected hydrologic pattern.

For the first four years of the projected water budget (WY2014 through WY2017), actual data are used and no climate change factor is applied. For WY2018 through WY2070, the following representative water year sequencing is used:

- WY2018 is equivalent to WY1979.
- Each subsequent projected water year (WY2019 through WY2056) will follow the equivalent subsequent historic water year (e.g. WY2019 is equivalent to WY1980; WY2020 is equivalent to WY1981, and so forth, with WY2056 being equivalent to WY2017).
- WY2057 is equivalent to WY1965 with each subsequent water year (WY2058 through WY2070) equivalent to the subsequent historic water year (with WY2070 being equivalent to WY1978).

Representative water years used the associated historic water year types for assumptions relative to projected hydrology (precipitation, stream flows, and evapotranspiration [ET]). Water year types were based on the San Joaquin River Index except for Shasta Critical Years, which required simulation of the SJREC and wildlife refuge surface water deliveries. Therefore, in summary, the following water year types were assigned to projected water years based on the associated representative water year type: Shasta Critical, Critical, Dry, Below Normal, Above Normal, and Wet, with all designations based on the San Joaquin River Index, except Shasta Critical defined by Shasta index (as recommended by the Technical Working Group). For projected simulations, water year types were 'lumped' into four categories as follows: wet, average (above and below normal), dry (dry and critical) and Shasta critical (as recommended by the Technical Working Group).

As agreed, upon, Climate Change Factors (CCFs) for precipitation and ET were applied considering representative historical year types surrogating for future years through WY2070. For projected years WY2038 through WY2043 (repeated WY2012 through WY2017), DWR did not establish precipitation or ET CCFs. Based on conversations with DWR, the following CCFs for precipitation and ET were used for this intervening period:

- WY 2012 used the 2001 2070 CCF
- WY 2013 used the 1992 2070 CCF
- WY 2014 used the 1976 2070 CCF
- WY 2015 used the 1977 2070 CCF
- WY 2016 used the 2002 2070 CCF
- WY 2017 used the 2011 2070 CCF

For projected years WY2030 - WY2043 (repeated WY2004 - WY2017), DWR did not establish streamflow CCFs. For this reason, DWR suggested to use surrogate years' CCFs for the projected period. The following CCFs were selected for streamflows:

- WY 2004 used the 2002 2030 CCF
- WY 2005 used the 2002 2030 CCF
- WY 2006 used the 1998 2030 CCF
- WY 2007 used the 1992 2070 CCF
- WY 2008 used the 1992 2070 CCF
- WY 2009 used the 2002 2070 CCF
- WY 2010 used the 2003 2070 CCF
- WY 2011 used the 1997 2070 CCF
- WY 2012 used the 1992 2070 CCF
- WY 2013 used the 1992 2070 CCF
- WY 2014 used the 1976 2070 CCF
- WY 2015 used the 1977 2070 CCF
- WY 2016 used the 2002 2070 CCF
- WY 2017 used the 1998 2070 CCF

The projected water budget period and associated representative water years were recommended by the Technical Working Group. Use of DWR's CCFs was also coordinated, and it was agreed that CCFs will only be applied to hydrology.

2. Sustainable Yield

The following methodologies were recommended by the Delta-Mendota Technical Working Group and approved by the Coordination Committee for establishing the required sustainable yield estimate for each principal aquifer:

Upper Aquifer Sustainable Yield

The following formula was agreed upon for the calculation of the sustainable yield of the upper aquifer:

Sustainable Yield = (Pumping + Change in Storage) + (Outflow – Inflow)

Data used in the calculation are from the Delta-Mendota Subbasin compiled projected water budget with Climate Change Factors and Projects/Management Actions, as well as Baseline Projected Water Budget with Climate Change Factors. A ± 10% factor was applied to the resulting sustainable yield estimate; this factor was estimated based on the percent difference in the WY2003-2012 upper aquifer change in storage calculations between the compiled historic water budget and the estimate of change in storage utilizing change in groundwater level contours cross-check analysis (see above). Data incorporated into the equation are the average annual values from the indicated projected water budgets (WY2014 - WY2070) using only upper aquifer values.

Sustainable management criteria (Minimum Thresholds and Measurable Objectives) will be the primary indicator governing upper aquifer extractions. The sustainable yield estimates will be updated as part of the five-year GSP review.

Lower Aquifer Sustainable Yield

Within the Delta-Mendota Subbasin, the distribution of known lower aquifer water level data and extraction volume data are limited and not sufficient to allow for a calculation of lower aquifer sustainable yield. A Northern & Central Delta-Mendota Region Management Committee memo dated April 10, 2019 outlined the alternative method used to estimate sustainable yield method for the lower aquifer and is summarized below.

The Westlands Water District GSA has completed a recent study using groundwater modeling, in conjunction with the Westside Subbasin GSP development, to estimate sustainable yield for that subbasin. Based on an analysis of their data and reflected an initial assumption of lower aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, Groundwater Management Strategy Concepts presentation to the WWD Board on October 16, 2018). Using this analysis, a slightly lower sustainable yield value for the lower aquifer was selected (0.33 acre-feet per acre), amounting to approximately 250,000 acre-feet per year over the approximately 750,000-acre Delta-Mendota Subbasin.

The lower criteria for a lower aquifer sustainable yield estimation compared to that considered by Westlands Water District reflects DWR's classification of the Delta-Mendota Subbasin as critically-overdrafted due to the subsidence issues. After more data are obtained in future years, the lower aquifer sustainable yield value may undergo revisions.

3. Other

The Technical Working Group of the Subbasin Coordination Committee discussed that not-yet implemented plans or programs (e.g. Delta conveyance, Updates to the Bay-Delta Water Quality Control Plan/SED, proposed large storage projects, etc.) would not be incorporated into the current GSPs. However, projects or programs may be qualitatively incorporated or described in individual GSPs, and such programs will be monitored during the next five years and incorporated into the GSPs in future updates as appropriate.

TECHNICAL MEMORANDUM #4

RE: Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions were utilized by each GSP Group in the Subbasin for preparing a subbasin-level description of management areas and sustainable management criteria.

1. Management Areas

The Coordination Committee left management areas and management of their respective GSPs to the six GSP Groups. Management areas were determined individually by each GSP Group with Woodard & Curran preparing a map showing all management areas ('sum of the parts' approach).

2. Sustainable Management Criteria

Per the GSP Regulations, definitions of undesirable results must be provided at the Subbasin level. The Technical Working Group defined these as follows:

- Chronic Lowering of Groundwater Levels: Significant and unreasonable chronic change in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.
- Long-term Reduction of Groundwater Storage: Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.
- Degraded Water Quality: Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities.
- Depletions of Interconnected Surface Water: Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water

- Land Subsidence: Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conveyance capacity, damage to personal property, impacts to natural resources or create conditions that threaten public health and safety.
- Seawater Intrusion: The Coordination Committee recognized that the Subbasin is not in a coastal location and therefore seawater intrusion is unable to occur and therefore a definition of an undesirable result is not necessary.

Each GSP Group individually defined significant and unreasonable for each sustainability indicator, as well as established sustainability goals, interim milestones, minimum thresholds and measurable objectives. This process was discussed during the February 2019 meetings of the Technical Working Group, and ultimately recommended and approved by the Coordination Committee.

TECHNICAL MEMORANDUM #5

RE: Assumptions for Delta-Mendota Subbasin Monitoring Network

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions and approaches were utilized in developing the required Subbasin monitoring network for sustainability indicators:

- The required Subbasin-level monitoring networks will be a compilation of networks developed by each individual GSP Group.
- The compilation of the individual GSP monitoring networks will provide sufficient data in order to develop required water surface elevation contouring for each principal aquifer in the Subbasin, if applicable.
- The GSP groups will use CASGEM monitoring network data for 2018 and 2019 data collection and will supplement with locally collected data where available.
- Each monitoring location or point within the GSP network will be monitored, at a minimum, at the agreed upon frequency for each of the data types.
- Field Collection will follow agreed-upon protocols which may be the same as, or equal to, data collection protocols (i.e. industry standards and best management practices).
- For non-monitored data to be reported as part of the annual reports (e.g. groundwater extractions, surface water deliveries), actual metered data will be used where such data exists, and when direct data do not exist, estimated quantities will be calculated based on existing indirect data (e.g. electrical usage, crop demand, ET) and/or other industry best practices.
- Seasonal high groundwater elevation data will be collected between February and April, and seasonal low groundwater elevation data will be collected between September and October.
- Each GSP Group may use supplemental data in addition to the SGMA-required monitoring network documented in their GSP in order to comply with these requirements and those set forth in the Coordination Agreement.

- Individual data gaps in the monitoring networks and monitoring data identified in the GSPs will progressively be addressed by the applicable GSA or GSP Group during the 20-year GSP implementation timeframe (2020 to 2040).

TECHNICAL MEMORANDUM #6

RE: Coordination of the Delta-Mendota Subbasin Data Management System

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation. This Technical Memorandum describes the development and anticipated use of the coordinated Subbasin Data Management System (DMS) for GSP implementation.

Coordinated Data Management System

As required in Section 352.6, Data Management System, of the GSP regulations, the Delta-Mendota Subbasin GSAs will develop and maintain a data management system that is capable of storing and reporting information relevant to the reporting requirements, implementation of the GSPs, and the monitoring networks of the Subbasin. Additionally, per Section 354.4, Reporting Monitoring Data to the California Department of Water Resources (DWR), all monitoring data are to be stored in a DMS with copies of the monitoring data included in the annual report and submitted electronically on forms provided by DWR. Recognizing that GSP implementation, including annual reporting, will require some efforts at the subbasin level, the 23 GSAs overlying the Delta-Mendota Subbasin have chosen to develop a coordinated DMS that can be utilized by each GSP Group for management of their data but which will allow for the required compilation of data sets for preparation of Subbasin annual reports. The coordinated DMS, once developed, will provide a generic framework that can be used by any GSP Group or GSA in the Subbasin for individual data management while allowing for consistent formatting and the simplified uploading of compiled datasets into the Subbasin-wide coordinated DMS.

The Parties have also developed and will maintain separate data storage processes or Data Management Systems. Each separate DMS developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the respective GSA and/or GSP Group, and ultimately to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Subbasin Plan Manager and Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

Leading up to the development of the DMS, the Subbasin used an *ad hoc* DMS working group and survey to develop a conceptual design for the software requirements. This was followed by the software vendor creating wireframes to communicate the functionality of the DMS. This *ad hoc* working group developed data standards for each data type to make the aggregation feasible at a subbasin level and established weekly calls to develop import wizards, attribute tables, interpretations of reporting requirements, and an annual report format. Data provided by Santa Nella County Water District were used to beta-test the completed DMS prior to release as a generic system for Subbasin-wide use.

The DMS includes permissions and business rules so each GSP can only upload data for their GSP based upon usernames and roles. GSP Groups, or GSAs within a GSP Group, are also not allowed to see other GSP Groups' data until all annual reporting has been completed and accepted by the Plan Manager. DMS development is ongoing, with development concurrent with final GSP development, and has been designed to support the needs of the severely disadvantaged communities, disadvantaged communities, and GSAs within the Subbasin. The DMS is scheduled to be completed for use in developing annual reports by January 2020.

The DMS constructed for the Delta-Mendota Subbasin is a secured web-based application hosted on Amazon Web Services (AWS). The DMS focuses on five core business requirements including: centralized data warehouse, security of data, permissioned based access, data visualization and reporting. Other goals of the DMS focus around improving data collection/aggregation processes, creating data standards, gaining efficiencies in reporting and improving data sharing with stakeholders. The DMS is designed to aggregate data through import processes by GSP to support data visualization and annual report generation.

Underlying the web application is a relationship database used to store the information aggregated from GSPs across primary data types identified to support monitoring and Annual Report development. Those data types include groundwater extractions, surface water deliveries, groundwater storage, groundwater elevations, groundwater quality, interconnected surface water and land subsidence. The web application functionality includes an embedded GIS viewer, screens to view tables of time series data, and charting capabilities for hydrographs. The embedded GIS viewer contains functionality to store map layers such as reference data, GSA/GSP boundaries and derived information such as water level contours.

In order to facilitate data synthesis, the GSP Groups agreed on the following frequencies for monitoring data collection:

- Groundwater elevations – twice a year (seasonal high and seasonal low)
- Interconnected surface water – twice a year (seasonal high and seasonal low)
- Groundwater quality – once a year
- Land subsidence – continuous monitoring sites or by Management Area

These datasets will be augmented with other data collection required for annual report preparation, including estimates of groundwater extractions and surface water diversions.

Additionally, the GSP Groups agreed to utilize the same general monitoring protocols or similar industry standards to ensure that the data were collected in a consistent and coordinated fashion. All monitoring locations in the Delta-Mendota Subbasin were assigned a unique identifier in the DMS. The number system is in a format of ##-####, where the first two digits indicates which GSA the monitoring location is associated with, and the subsequent four digits indicate the specific monitoring location in that GSA area. The general methodology agreed upon for data import and management is as follows:

- Each GSA collects their respective data per agreed-upon protocols and transmits it to the GSA representative.
- Each GSA representative then compiles the data and conducts a quality control check.
- The GSA representative transmits the compiled data set to the GSP Lead or Representative, who then aggregates the data from all GSAs and conducts a second quality control check.
- The GSP Lead or Representative uploads the data set into the DMS using import wizards designed specifically for this process.

- The Subbasin Plan Manager then uses the data in the DMS to compile information as required for the annual report.

Compiled data sets from the DMS will be augmented with required maps generated externally to produce the required annual report. Mapping prepared outside the DMS will be subsequently imported into the DMS as GIS files to ensure all data are kept in one place.

The DMS will be maintained by the San Luis & Delta-Mendota Water Authority, while acting as the Plan Manager, with a contract with the software vendor for hosting, maintenance and future updates. Each GSP will pay a maintenance fee for the continued hosting and support of the Subbasin coordinated DMS.

The Subbasin-level DMS, as described herein, may be supplemented by additional DMSs developed and maintained by each GSP Group or GSA in the Subbasin. The reader is referred to each of the six Subbasin GSPs for specific information relative to data collection and management in each GSP Plan area.

TECHNICAL MEMORANDUM #7

RE: Adoption and Use of the Subbasin Coordination Agreement

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

This Technical Memorandum describes the Delta-Mendota Subbasin governance structure, participating parties, the Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement), and details of this Coordination Agreement. Each GSA in the Subbasin is included in this memorandum. Additional details of the organization, management structure, and legal authority of each GSA and their associated GSPs, and accompanying GSA boundary maps, are described in the Delta-Mendota Subbasin Common Chapter (Common Chapter). Descriptions of intrabasin and interbasin coordination agreements in place for the development and implementation of the GSPs overlying the Subbasin are also referenced.

1. GSP and Coordination Agreement Submission

A Delta-Mendota Subbasin Common Chapter has been developed to “knit” the six Delta-Mendota GSPs together for cohesive implementation. The Common Chapter includes a separate signature page that contains a disclosure statement and professional stamp for the consultant charged with compiling the chapter (Woodard & Curran), as agreed upon by the Technical Working Group on April 17, 2018 and January 15, 2019. Each Subbasin GSP is stamped and signed by the professional overseeing their preparation. The Common Chapter was developed as part of a collaborative process, with input from the various GSAs, technical consultants, and stakeholders. The Coordination Agreement, Common Chapter, and Technical Memoranda collectively serve as the mechanism through which the GSAs and individual GSPs are coordinated during implementation.

The GSAs have agreed to submit their respective GSPs to the California Department of Water Resources (DWR) through the Delta-Mendota Subbasin Coordination Committee (Coordination Committee) and the Plan Manager, along with all developed Common Chapter and Technical Memoranda, by January 31, 2020. When submitted to DWR, the collective documents will be available for public review and comment as part of the 60-day public comment period per SGMA regulations.

2. GSP Groups and GSAs in the Delta-Mendota Subbasin

Below is a summary of the six GSP Groups and twenty-three GSAs (and their respective signatories) to the Coordination Agreement. Some signatories (also referred to as parties) are participating in multiple GSAs and/or GSPs.

DELTA-MENDOTA SGMA

Northern & Central Delta-Mendota Region GSP

- Patterson Irrigation District GSA
  - Patterson Irrigation District, Twin Oaks Irrigation District
- West Stanislaus Irrigation District GSA
  - West Stanislaus Irrigation District
- DM-II GSA
  - Del Puerto Water District, Oak Flat Water District
- City of Patterson GSA
  - City of Patterson
- Northwestern Delta-Mendota GSA
  - Merced County, Stanislaus County
- Central Delta-Mendota GSA
  - San Luis Water District, Santa Nella County Water District, Panoche Water District, Mercy Springs Water District, Tranquillity Irrigation District, Merced County, Fresno Slough Water District, Fresno County, Eagle Field Water District, Pacheco Water District
- Widren Water District GSA
  - Widren Water District
- Oro Loma Water District GSA
  - Oro Loma Water District

San Joaquin River Exchange Contractors (SJREC) GSP

- San Joaquin River Exchange Contractors Water Authority GSA
  - Central California Irrigation District, Columbia Canal Company, Firebaugh Canal Water District, San Luis Canal Company
- Turner Island Water District-2 GSA
  - Turner Island Water District
- City of Mendota GSA
  - City of Mendota
- City of Firebaugh GSA
  - City of Firebaugh
- City of Los Banos GSA
  - City of Los Banos
- City of Dos Palos GSA
  - City of Dos Palos
- City of Gustine GSA
  - City of Gustine
- City of Newman GSA
  - City of Newman
- Madera County GSA
  - Madera County
- Portion of Fresno County Management Area B GSA
  - Fresno County
- Portion of Merced County – Delta-Mendota GSA
  - Merced County

Grassland GSP

- Grassland GSA
  - Grassland Water District, Grassland Resource Conservation District
- Portion of Merced County GSA
  - Merced County

Farmers Water District GSP

- Farmers Water District GSA
  - Farmers Water District

Fresno County GSP

- Fresno County Management Area A GSA
  - Fresno County
- Fresno County Management Area B GSA
  - Fresno County

Aliso Water District GSP

- Aliso Water District GSA
  - Aliso Water District

With respect to the San Benito County portion of the Delta-Mendota Subbasin, this area will be included in the Central Delta-Mendota GSA of the Northern & Central Delta-Mendota Region GSP. In 2017, the San Benito County Water District Groundwater Sustainability Agency indicated its intent to act as the GSA for certain areas within its jurisdiction, but not for the unmanaged *de minimis* area in the most southwest portion of the Delta-Mendota Subbasin. For purposes of assuring that all land within the Subbasin is part of a GSP as required by DWR regulations, the Central Delta-Mendota GSA entered into a Memorandum of Understanding with San Benito County to include the unmanaged *de minimis* area in the Northern & Central Delta-Mendota Region GSP.

3. Delta-Mendota Subbasin Intrabasin Coordination Agreement

The aforementioned GSAs are coordinating development and implementation of the six GSPs under the Delta-Mendota Subbasin Coordination Agreement. All GSAs within the Subbasin agree to work collaboratively to meet the objectives of SGMA and the Coordination Agreement. Each GSA acknowledges that it is bound by the terms of this Coordination Agreement.

The Coordination Agreement for the Delta-Mendota Subbasin covers the following topics:

1. Purpose of the Agreement, including:
   a. Compliance with SGMA and
   b. Description of Criteria and Function;
2. Definitions
3. General Guidelines, including:
   a. Responsibilities of the Parties and
   b. Adjudicated or Alternative Plans in the Subbasin;
4. Role of San Luis & Delta-Mendota Water Authority (SLDMWA), including:
   a. Agreement to Serve,
   b. Reimbursement of SLDMWA, and
   c. Termination of SLDMWA's Services;

5. Responsibilities for Key Functions, including:
    a. Coordination Committee,
    b. Coordination Committee Officers,
    c. Coordination Committee Authorized Action and Limitations,
    d. Subcommittees and Workgroups,
    e. Coordination Committee Meetings, and
    f. Voting by Coordination Committee;
6. Approval by Individual Parties;
7. Exchange of Data and Information, including:
    a. Exchange of Information and
    b. Procedure for Exchange of Information;
8. Methodologies and Assumptions, including:
    a. SGMA Coordination Agreements,
    b. Pre-GSP Coordination, and
    c. Technical Memoranda Required;
9. Monitoring Network
10. Coordinated Water Budget
11. Coordinated Data Management System
12. Adoption and Use of the Coordination Agreement, including:
    a. Coordination of GSPs and
    b. GSP and Coordination Agreement Submission;
13. Modification and Termination of the Coordination Agreement, including:
    a. Modification or Amendment of Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages),
    b. Modification or Amendment of Coordination Agreement, and
    c. Amendment for Compliance with Law;
14. Withdrawal, Term, and Termination;
15. Procedures for Resolving Conflicts;
16. General Provisions, including:
    a. Authority of Signers,
    b. Governing Law,
    c. Severability,
    d. Counterparts, and
    e. Good Faith; and
17. Signatories of all Parties

The Coordination Agreement, effective as of December 12, 2018, has been signed by all thirty-six parties in the Delta-Mendota Subbasin. These signatories to the Coordination Agreement have formed a total of 23 GSAs in the Subbasin. A key goal of basin-wide coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies during their plan development and that the elements of the Plans necessary to achieve the sustainability goal for the Subbasin are based upon consistent interpretations of the basin setting, as required by SGMA and associated regulations. It is the intent that the Coordination Agreement become part of each individual GSP within the Delta-Mendota Subbasin.

Delta-Mendota Subbasin Coordination Committee

The Delta-Mendota Subbasin Coordination Agreement establishes the Delta-Mendota Subbasin Coordination Committee (Coordination Committee), which provides representation from each of the six GSP groups. The Coordination Committee complies with requirements of the Brown Act. The Coordination Agreement describes the Coordination Committee's requirements for meeting noticing, attendance, voting, data sharing, governance of subcommittees and working groups, and approval of Subbasin documents.

The Coordination Agreement allows for development of individual subcommittees or working groups to support the development of the Technical Memorandums and to coordinated data, methodologies, and assumptions. For this purpose, the Coordination Committee recommended formation of an ad hoc Technical Working Group, Communications Working Group, and Data Management System Working Group.

The Coordination Committee provides specific direction to the Plan Manager. The initial Plan Manager for the six coordinated GSPs is Andrew Garcia, Senior Civil Engineer for San Luis & Delta-Mendota Water Authority (SLDMWA); however, the Coordination Committee and Coordination Agreement allow for a consultant of the SLDMWA to act as Plan Manager, if necessary. If the SLDMWA ceases to serve as Plan Manager, the Coordination Committee can name a successor per the Coordination Agreement. In the meantime, Mr. Garcia's contact information is included below:

Mr. Andrew Garcia, Plan Manager
San Luis & Delta-Mendota Water Authority
842 6th Street
Los Banos, CA 93635
Phone: (209)-832-6200 / Fax (209)-833-1034
andrew.garcia@sldmwa.org

Contact information for each GSP plan administrator is included in the respective GSPs.

Technical Memoranda

The Coordination Agreement describes the development of Technical Memoranda. These memoranda collectively explain the data, methodologies, and assumptions approved and used by the six GSP Groups within the Subbasin. The Coordination Agreement specifically referenced four Technical Memoranda; the Technical Working Group of the Coordination Committee subsequently recommended development of additional Technical Memoranda during the GSP development efforts. The Technical Memoranda are subject to the Coordination Committee's review and unanimous approval and will be submitted along with the Coordination Agreement to DWR. The Technical Memoranda will be used throughout GSP implementation to ensure continued coordination and compliance with SGMA.

The Technical Memoranda include:

1. Common Datasets Used in the Delta-Mendota Subbasin GSPs
2. Assumptions for Hydrogeological Conceptual Model of the Delta-Mendota Subbasin
3. Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield
4. Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria
5. Assumptions for Delta-Mendota Subbasin Monitoring Network
6. Coordination of the Delta-Mendota Subbasin Data Management System
7. Adoption and Use of the Subbasin Coordination Agreement
8. Coordinated Noticing, Communication, and Outreach Activities in the Delta-Mendota Subbasin

Interbasin Coordination

The Delta-Mendota Subbasin adjoins nine neighboring subbasins. These subbasins range in basin condition as determined by DWR, so some subbasins are also on the January 31, 2020 GSP submission deadline, while others have a 2022 deadline. With this multitude of neighbors and variety of timelines, the Delta-Mendota Subbasin has initiated interbasin coordination efforts with all of the adjoining subbasins. The SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, executed an interbasin data sharing agreement with Westlands Water District, the coordinating agency for the Westside Subbasin. The agreement establishes common assumptions for groundwater conditions as well as a process for continued data sharing for data located within five miles of the boundary between Westside Subbasin and the Delta-Mendota Subbasin.

Additional interbasin coordination efforts have been initiated with other adjoining subbasins. No other agreements have been formalized at the time of the Delta-Mendota Subbasin's GSP submissions, but may be developed later. The Delta-Mendota Subbasin intends to coordinate with neighboring subbasins to develop shared understandings of data and technical approaches.

TECHNICAL MEMORANDUM #8

RE: Coordinated Noticing, Communication, and Outreach Activities in the Delta-Mendota Subbasin

PREPARED BY: Stantec

DATE: July 25, 2019

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1. Introduction

The Sustainable Groundwater Management Act of 2014 (SGMA) and subsequent Emergency Regulations developed by the California Department of Water Resources (DWR) in May 2016 identified a number of requirements for public notice and communication related to Groundwater Sustainability Agency (GSA) formation and Groundwater Sustainability Plan (GSP) development. California Code of Regulations §354.10 identifies the requirements for notice and communication information in a GSP:

> "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:
>
> (a) 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.
>
> (b) A list of public meetings at which the Plan was discussed or considered by the Agency.
>
> (c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.
>
> (d) A communication section of the Plan that includes the following:
>
> (1) An explanation of the Agency's decision-making process.
>
> (2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.
>
> (3) A description of how the Agency encourages the active involvement of diverse social, cultural and economic elements of the population within the basin.
>
> (4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions."

Pursuant to these requirements, GSAs in the Delta-Mendota Subbasin (Subbasin) conducted a number of activities to engage beneficial users of groundwater, interested parties, and the general public in the development of the six Subbasin GSPs. Each GSA was responsible for conducting outreach and engagement related to SGMA within its service area; however, recognizing efficiencies in pooling resources and the importance of consistent messaging, the GSAs also conducted a series of coordinated activities aimed at engaging stakeholders across the Subbasin. This document describes the coordinated tools, methods, and activities the GSAs used to inform and engage stakeholders in development of the Subbasin GSPs.

2. Situation Assessment and Communications Plan

To assist in GSA formation and GSP development, agencies in the Subbasin sought and received Facilitation Support Services funding from DWR in August 2016. Under this funding, a neutral, third-party facilitation team conducted a situation assessment on behalf of the Subbasin GSAs. The purpose of the assessment was to understand how stakeholders perceived the status of the Subbasin's groundwater resources and identify potential barriers to the successful development of the GSPs.

The facilitation team, with input from local agencies, identified 30 stakeholders representing diverse interests and beneficial users in the Subbasin, together with disadvantaged communities, agricultural well owners, government and land use agencies, and environmental and ecosystem interests. From February 2017 to May 2017, the facilitators conducted over 30 phone and in-person interviews with stakeholders. The facilitators recorded the interview responses and summarized the results in a presentation made to the GSA representatives.

The assessment results were used to inform the development of the Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan (Communications Plan), which is provided with this document as **Attachment A**. The Communications Plan identifies near- and long-term outreach and engagement strategies, tactics, and tools for stakeholder engagement in GSP development and implementation. The Subbasin GSAs used the Communications Plan as a framework for conducting the stakeholder outreach and engagement activities described in this document.

3. Public Noticing and Information

Legal Requirements:

> **§354.10 (d):** A communication section of the Plan that includes the following:
> (3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of population within the basin.

The Subbasin GSAs developed and used several tools to inform members of the public about GSP development activities and promote opportunities for public engagement. These tools are described below.

- Website: The Subbasin website – www.deltamendota.org – is the primary location for information related to SGMA implementation in the Subbasin. Information provided on the website includes: an overview of SGMA, a description of each of the GSP groups, contact information for each of the GSAs, and upcoming workshops and public meetings. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the Delta-Mendota Subbasin Coordination Committee, Technical Working Group, and Communications Working Group (described below).

- Delta-Mendota Subbasin Newsletter: The Delta-Mendota Subbasin Newsletter is distributed on a monthly basis and serves as an informational tool to keep interested parties, beneficial users, and members of the general public informed about the development and status of the GSPs. Newsletter topics include Subbasin-wide activities, general announcements, upcoming meetings and workshops, and past and upcoming GSP development activities. Copies of the newsletters are archived on the Subbasin website.

- Informational Materials: GSAs in the Subbasin developed a suite of materials in English and Spanish to educate and inform members of the public about SGMA and topics covered in the GSP. These materials include bilingual presentations, fact sheets, handouts, frequently asked questions, and videos. Copies of the materials are available on the Subbasin website. GSA representatives distributed these materials during meetings, workshops, and other outreach activities.

4. Public Engagement in GSP Development

Legal Requirements:

§354.10(b): A list of public meetings at which the Plan was discussed or considered by the Agency;

§354.10 (d): A communication section of the Plan that includes the following:
(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.
(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of population within the basin.

This section describes outreach activities coordinated among the Subbasin GSAs to inform, engage, and consult stakeholders in GSP development. Coordinated outreach activities fell into two main categories: general public outreach and targeted outreach. General public outreach activities primarily consisted of committee and working group meetings, and coordinated workshops aimed at informing and receiving public input on the content of the GSPs. The GSAs also conducted outreach activities targeted at hard-to-reach communities and beneficial users, including agricultural interests, school districts, and disadvantaged communities.

General Public Engagement Activities

There were two primary opportunities for members of the public to engage in development of the Subbasin GSPs: Coordination Committee and working group meetings and coordinated public workshops. These activities are further described below. In addition, the GSAs also informed and engaged members of the public by posting information on the Subbasin and member-agency websites, distributing the monthly newsletter, disseminating bilingual informational materials, and tabling at public events.

Committee Meetings

Comprised of members representing the entities preparing the Subbasin GSPs, the Coordination Committee was formed to provide overall guidance and resolve conflicts among the GSAs to ensure that the GSPs were coordinated as required by SGMA. The Technical Working Group and Communications Working Group were formed under the Coordination Committee to specifically coordinate technical and communication activities, respectively. Public meetings of the Coordination Committee and working groups served as key opportunities for stakeholders to engage and consult in development of the GSPs. Public comments were recorded in the meeting minutes, posted on the Subbasin website, and considered during development of the GSPs.

Coordinated Public Workshops

The Subbasin GSAs planned and held a series of public workshops from May 2018 – May 2019 aimed at educating and soliciting input from the public about topics covered in the GSPs. Table 1 identifies the workshop dates, locations, and topics. At these workshops, GSA representatives and their technical consultants presented information on each GSP development phase. Presentations were followed by an open house period to allow participants to talk directly with their GSA representatives. Bilingual interpreters were present at all workshops to provide interpretation services. All workshop materials, in both English and Spanish, are available on the Subbasin website.

Questions, comments, and input from workshop participants were recorded by facilitation staff and summarized the workshop summaries, provided with this document as **Attachment B**. All public comments were taken in consideration by GSAs and technical consultants during development of the GSPs.

The GSAs used a variety of methods to promote the workshops. These methods included distribution of bilingual flyers and utility bill inserts, email notifications, social media posts, website posts, newspaper notices, and press releases. **Attachment C** includes example workshop promotion activities. GSA representatives also directly contacted local organizations throughout the Subbasin. A list of organizations contacted is provided with this document as **Attachment D**.

Table 1. Coordinated Public Workshops

Date	Location, Venue	Topic
Spring 2018 Workshop		
May 14, 2018	Los Baños, San Luis & Delta-Mendota Water Authority	• Sustainable Groundwater Management Act overview • Delta-Mendota Subbasin overview • Opportunities for engagement
May 16, 2018	Patterson, Hammon Senior Center	
May 17, 2018	Mendota, Mendota Library	
Fall 2018 Workshops		
October 22, 2018	Firebaugh, Firebaugh Middle School	• GSP development and implementation process • Data collection • Hydrogeologic Conceptual Model • Numerical & Analytical Models • Water budgets
October 24, 2018	Los Baños, College Greens Building	
October 25, 2018	Patterson, Patterson Senior Center	
Winter 2019 Workshops		
February 19, 2019	Los Baños, College Greens Building	• Historic and current water budgets • Sustainability criteria • Undesirable results • Projects and management actions
February 20, 2019	Patterson, Patterson City Hall	
March 4, 2019	Santa Nella, Romero Elementary School	
Spring 2019 Workshops		
May 20, 2019	Patterson, Patterson City Hall	• Projected water budgets • Sustainable yield • Groundwater monitoring networks • Projects and management actions
May 21, 2019	Los Baños, College Greens Building	
May 22, 2019	Santa Nella, Romero Elementary School	
May 23, 2019	Mendota, Mendota Library	

Targeted Stakeholder Engagement

The Subbasin GSAs also conducted targeted outreach and engagement to hard-to-reach communities, interested parties, and stakeholders that were previously underrepresented in other engagement activities. This included outreach to the following stakeholder types:

- *Agricultural Interests:* Agricultural stakeholders in the Subbasin include agricultural well operators, growers, ranchers, farmworkers, and agricultural landowners. Strong agricultural representation exists within the leadership of the GSAs. To augment direct outreach being conducted by individuals GSAs, Subbasin representatives also coordinated closely with local county farm bureaus to disseminate information related to GSP development and public workshops.

- *School Districts:* Schools districts are considered for both beneficial users of groundwater (for drinking water), as well communication channels to disseminate information about SGMA and GSP development. GSA representatives directly contacted local school districts to notify them of the public workshops. Some schools also help distributed informational materials and workshop flyers to their students and parents.

- *Disadvantaged Communities:* The GSAs followed best practices identified in Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation (Community Water Center, 2015) and other guidance documents to engage disadvantaged and severely disadvantaged communities. This included holding meetings in disadvantaged communities; holding meetings in the evening at known local venues, such as schools, civic centers, and community centers; translating fact sheets, meeting materials, and presentations into other languages; and providing interpreting services at all public workshops.

5. GSP Implementation

Legal Requirements:

> **§ 354.10(b)(4): The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.**

Each GSA will utilize its own methods to inform the public about progress implementing its GSP and the status of any projects and management actions. The Subbasin website will continue to be the main source of information for Subbasin- wide announcements, public meetings, workshops, and informational materials. In addition, the GSAs will continue to coordinate public outreach and stakeholder engagement activities related to GSP implementation as-needed.

Attachments: Attachment A - Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan Attachment B – Coordinated Public Workshop Summaries
Attachment C – Example Public Workshop Promotion Materials
Attachment D – Stakeholder and Community Organizations Contacted Regarding Coordinated SGMA Workshops

ATTACHMENT A. DELTA-MENDOTA SUBBASIN SUSTAINABLE GROUNDWATER MANAGEMENT ACT COMMUNICATIONS PLAN

Delta Mendota Subbasin Groundwater Management

Sustainable Groundwater Management Act Communications Plan

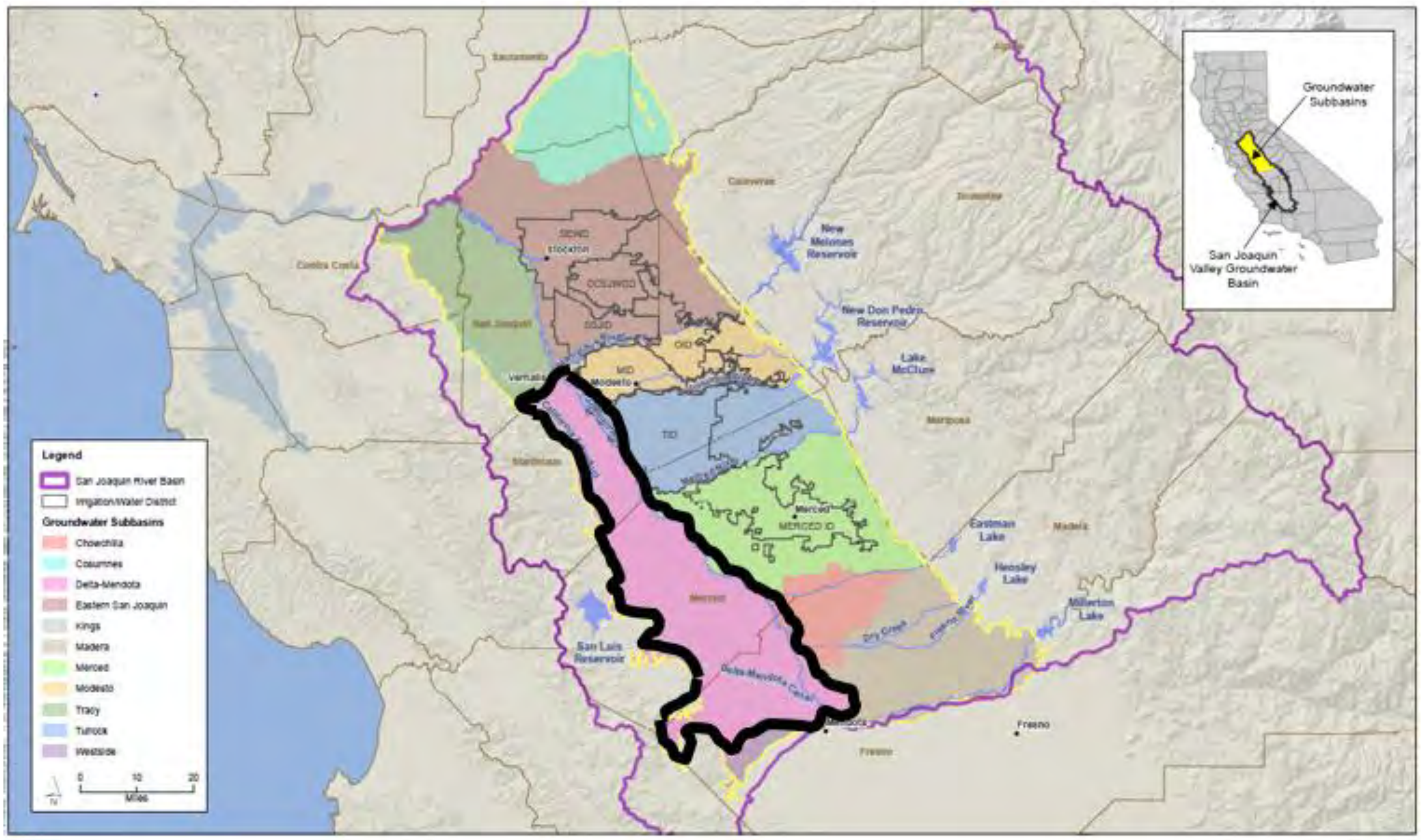

Figure 9-1
Vicinity Map of Groundwater Subbasins

Prepared by:
Lisa Beutler, MWH/Stantec,
Via CA Dept. of Water Resources,
Facilitation Services Technical Assistance

June 2017

MWH Stantec

Forward: How to use this Plan

This Communication Plan provides a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. Its purpose is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. It is presented as a working public draft, and should be considered a living document that is continuously refined and updated as circumstances suggest.

Chapter 1*:* *Introduction and Background* provides text and information about SGMA and the Delta Mendota Subbasin that can be repurposed directly into websites or printed materials by agencies and/or entities with an interest in SGMA and how it will affect the subbasin. This section also describes the communications activities mandated by SGMA.

Chapter 2: *Communications Plan Overview* provides communications planning goals and objectives as well as the scope. This section can be used in support of project management activities.

Chapter 3: *Situation Assessment* provides some of the context for communications activities. This section can be used in developing required assessments of stakeholder issues and interests. It also informs project management activities.

Chapter 4: *Audiences and Messages* identifies key subbasin audiences and message points for specific audience segments. The goal of this chapter is to provide information that can be used by the subbasin GSAs in preparing to work with key stakeholders.

Chapter 5: *Risk Management* is the summary of a communications risk assessment that considers subbasin communications strengths and weakness and proposes on-going adjustments based on best communication management practices. This section informs project management activities and provides a context for some of the recommended communications tactics.

Chapter 6: *Tactical Approaches* offers a communications to do list with specific communications activities relevant for project phases and subbasin audiences.

Chapter 7: *Measurements and Evaluation* outlines methods to determine the effectiveness of outreach and engagement.

Chapter 8: *Roles and Responsibilities* provides a sample list of tasks and illustrates the types of communications roles and responsibilities which might be assigned. This section should be incorporated into project management plans.

Subbasin GSAs should feel free to repurpose any or all parts of the document that will assist them in meeting SGMA requirements.

This document was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program and completed by the Communication and Engagement Group of MWH/Stantec.

Delta Mendota Subbasin
Sustainable Groundwater Management Act
Communications Plan
Working Draft

Contents

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List of Acronyms and Abbreviations

Item	Description
Basin	Groundwater Basin or Subbasin
Coms Plan	Delta Mendota Subbasin, Sustainable Groundwater Management Act, Working Draft Communications Plan
CSD	Community Service District(s):
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
DAC	Disadvantaged Communities
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
IRWMP	Integrated Resource Water Management Plan
PDF	Portable Document Format
RCD	Resource Conservation District(s)
SGMA	Sustainable Groundwater Management Act
SLDMWA	San Luis Delta- Mendota Water Authority
State Board	State Water Resources Control Board

Item	Description
SA	Situation Assessment
USGS	United States Geological Survey

Revision History

Table 1. Revision History

Revision History			
Revision/Dock Title #	Date of Release	Author	Summary of Changes

INTRODUCTION AND BACKGROUND

The purpose of this Communication Plan is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. Its chapters identify key stakeholders and provide a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. The plan was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program.

1.1. SGMA Basics[1]

After decades of debate, in 2014 California lawmakers adopted SGMA. This far-reaching law seeks to bring the State's critically important groundwater basins into a sustainable regime of pumping and recharge. The change in water management laws has created new obligations for residents and water managers in the Delta-Mendota Groundwater Subbasin. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members in implementation of this law.

SGMA requires, **by June 30, 2017**, the formation of locally-controlled GSAs in many of the State's groundwater basins and subbasins (basins). A GSA is responsible for developing and implementing a **groundwater sustainability plan** (GSP). These plans assist the basins in meeting sustainability goals. The primary goal is to maintain sustainable yields without causing undesirable results.

1.1.1. GSAs & GSPs

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. A single local agency can decide to become a GSA, or a combination of local agencies can decide to form a GSA by using either a Joint Power Authority (JPA), a memorandum of agreement (MOA), or other legal agreement. If no agency assumes this role the GSA responsibility defaults to the County; however, the County may decline.

A GSP may be any of the following *(Water Code § 10727(b)):*

- A single plan covering the entire basin developed and implemented by one GSA.
- A single plan covering the entire basin developed and implemented by multiple GSAs.

[1] Sections on SGMA are largely drawn, in whole or in part, from publicly available materials from the Department of Water Resources. For more see: http://www.water.ca.gov/groundwater/sgm

- Subject to Water Code Section 10727.6, multiple plans implemented by multiple GSAs and coordinated pursuant to a single coordination agreement that covers the entire basin.

If local agencies are unable to form an approved GSA and/or prepare an approved GSP in the required timeframe, then the basin or subbasin would be considered unmanaged. Unmanaged groundwater basins and subbasins are subject to State Water Resources Control Board (State Board) oversight. This is true even if the vast majority of the subbasin is covered by a plan. Should intervention occur, the State Board is authorized to recover its costs from the GSAs.

1.2. SGMA Communications and Engagement Requirements

SGMA includes specific requirements for communications and engagement by each planning phase. **Figure 1** (next page) illustrates the requirements and provides water code references. The GSP submittal guidelines also describe the outreach and engagement documentation to be submitted with the plan. **Table 2** describes the submittal requirements. A full list of codes and requirements is also provided in **Appendix 1**.

Table 2. GSP Submittal Requirements[2]

GSP Regulations Section	Requirement	Description
Article 5. Plan Contents, Sub-article 1. Administrative Information		
354.10	Notice and Communication	• Description of beneficial uses and users • List of public meetings with dates • GSP comments and responses • Decision-making process • Public engagement process • Method(s) to encouraging active involvement • Steps to inform the public on GSP implementation progress

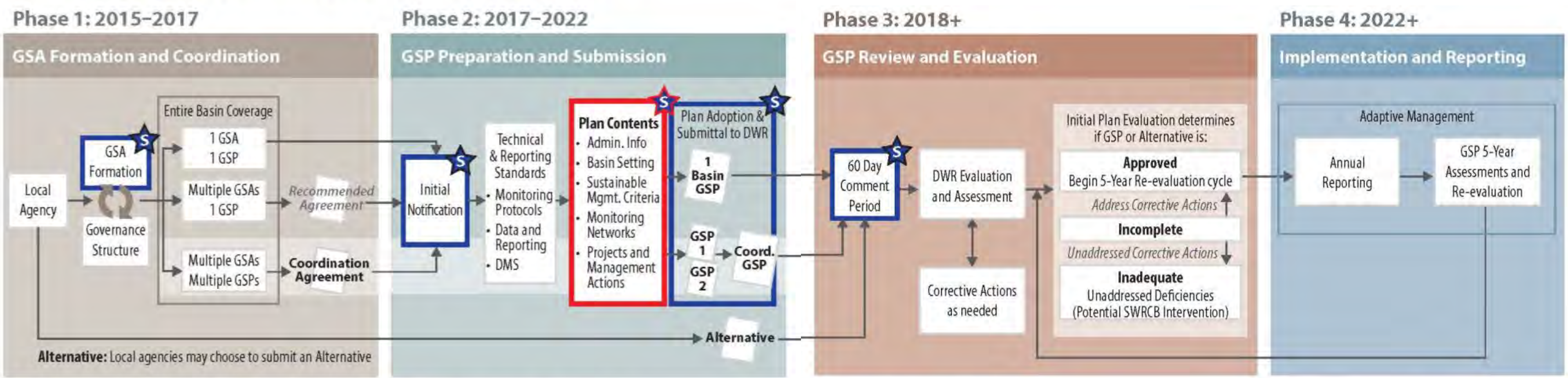
1.3. Planning Approach

While the SLDMWA is assisting with the coordination of GSP(s) development, this Communications Plan (Coms Plan) is offered for the voluntary use of all of the GSAs of the Delta-Mendota Subbasin. A full Coms Plan schedule should be developed in conjunction with the overall GSP(s) development schedule. One additional option is for the Coordination Committee of GSAs to provide overall communications guidance. This could potentially be included in a section of the Coordination Agreement.

[2] Guidance Document for the Sustainable Management of Groundwater, Preparation Checklist for GSP Submittal, Department of Water Resources, December 2016

Figure 1. Stakeholder Engagement Requirements

Stakeholder Engagement Requirements by Phase



Phase 1 Engagement Requirements

- **Establish and Maintain List of Interested Parties** §10723.4
- **GSA Formation Public Notice** §10723(b)
- **GSA Formation Public Hearing** §10723(b)
- **GSA Formation (due 6/30/17)** §10723(b)
  Notify DWR:
  - Include list of interested parties
  - Explain how parties' interests will be considered
- **Pre-GSP Development** §10727.8
  Provide a written statement describing how interested parties may participate to:
  - DWR
  - Cities within the GSA boundary
  - Counties within the GSA boundary

Phase 2 Engagement Requirements

- **GSP Initial Notification** §353.6*
- **GSP Preparation** §10727.8 and §10723.2
  - Encourage active involvement
  - Consider beneficial uses and users of groundwater when describing *Undesirable Results, Minimum Thresholds, and Projects & Actions*
- **GSP Communications Section** §354.10*
  - GSA decision-making process
  - Opportunities for engagement and how public input is used
  - How GSA encourages active involvement
  - Method of informing the public
- **Public Notice of Proposed Adoption** §10728.4
- **GSP Adoption Public Hearing** §10728.4
- **GSP Submittal** §354.10*
  - Include a summary of communications: description of beneficial uses/users, list of public meetings, comments received/responses

Phase 3 Engagement Requirements

- **60 Day Comment Period** §353.8*
  - Any person may provide comments to DWR regarding a proposed or adopted GSP via the SGMA Portal at http://sgma.water.ca.gov/portal/
  - Comments will be posted to DWR's website

Phase 4 Engagement Requirements

- **Public Notices and Meetings** §10730
  - Before amending a GSP
  - Prior to imposing or increasing a fee
- **Encourage Active Involvement** §10727.8

Engagement Requirements Applicable to ALL PHASES

- **Beneficial Uses and Users** §10723.2
  Consider interests of all beneficial uses and users of groundwater
- **Advisory Committee** §10727.8
  GSA may appoint and consult with an advisory committee
- **Public Notices and Meetings** §10730
  - Before electing to be a GSA
  - Before adopting or amending a GSP
  - Prior to imposing or increasing a fee
- **Encourage Active Involvement** §10727.8
  Encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin
- **Native American Tribes** §10720.3
  - May voluntarily agree to participate
  - See Engagement with Tribal Government Guidance Document
- **Federal Government** §10720.3
  - May voluntarily agree to participate

Stakeholder Input — *Stakeholders should be informed throughout the development of Plan Content*

Code References: §(#) = SGMA, §(#)* = GSP Regulations

Source: Guidance Document for Groundwater Sustainability Plan Stakeholder Communication and Engagement Department of Water Resources, June 2017

An important additional step will be establishing, in conjunction with the multiple GSAs, the roles and responsibilities for implementing the Coms Plan.

1.4. SGMA and the Delta Mendota Subbasin[3]

The Delta-Mendota Subbasin of the San Joaquin Valley Groundwater Basin is a long, relatively narrow groundwater basin that covers portions of five counties, from north to south, San Joaquin, Stanislaus, Merced, Madera and Fresno Counties (see **Figure 2**). The Delta-Mendota sub-basin is bounded on the west by the Tertiary and older marine sediments of the Coast Ranges. The northern boundary (from west to east) begins on the west by following the Stanislaus/San Joaquin County line, then deviates to the north to encapsulate all of the Del Puerto Water District before returning back to the Stanislaus/San Joaquin County line. The boundary continues east then deviates north again to encapsulate all of the West Stanislaus Irrigation District before returning back to the Stanislaus/San Joaquin County line. The boundary continues to follow the Stanislaus/San Joaquin County line east until it intersects with the San Joaquin River.

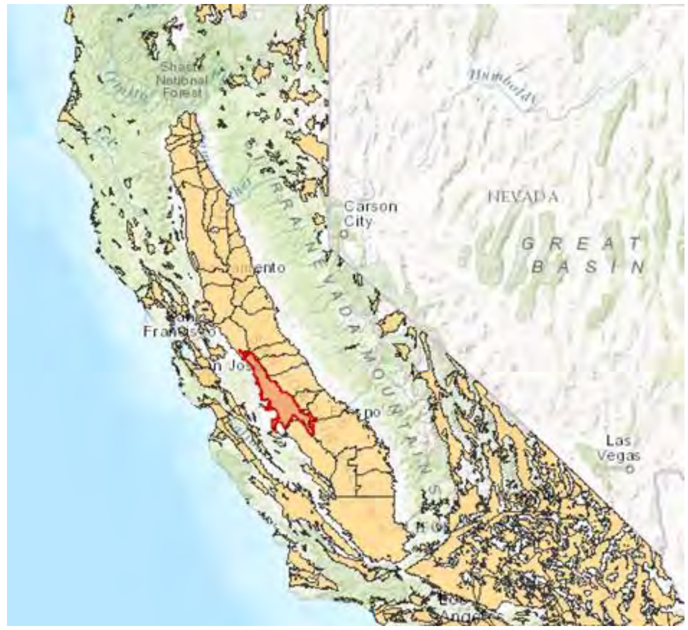


Figure 2. Delta Mendota Subbasin

The eastern boundary (from north to south) follows the San Joaquin River to within Township 11S, where it jogs eastward along the northern boundary of Columbia Canal Company and then follows the eastern boundary of Columbia Canal company until intersecting the northern boundary of the Aliso Water District. The boundary then heads east following the northern and then eastern boundary of the Aliso Water District until intersecting the Madera/Fresno County line. The boundary then heads westerly following the Madera/Fresno County line to the eastern boundary of the Farmers Water District. The boundary then heads southerly along the eastern boundary of the Farmers Water District, and continues southerly along the section line to the intersection with the northern right-of-way of the railroad. The boundary then heads east along the northern right-of-way of the railroad until intersecting with the western boundary of the Mid-Valley Water District. The boundary then heads south along the western boundary of the Mid-Valley Water District to the intersection with the northern boundary of Reclamation District 1606. The boundary then heads west and then south following the boundary of Reclamation District 1606 and James Irrigation District until its intersection with the Westlands Water District boundary.

The southern boundary (from east to west) matches the northerly boundaries of Westlands Water District legal jurisdictional boundary last revised in 2006. The boundary then

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[3] Information related to the Delta Mendota subbasin is drawn directly from http://sgma.water.ca.gov/basinmod/basinrequest/preview/23.

proceeds west along the southernmost boundary of the San Luis Water District. The boundary then projects westward from this alignment until intersecting the Delta-Mendota sub-basin Western boundary described above.

1.5. Delta-Mendota Subbasin GSP Planning

The GSAs of the Delta-Mendota Subbasin intend to work together to meet Sustainable Groundwater Management Act (SGMA) requirements and prepare a Groundwater Sustainability Plan (GSP) or coordinated Sustainability Plans by June 31, 2020. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members and non-members in planning and implementation of this law and has been directly assisting a subset of the local GSA eligible agencies in organizing to accomplish required SGMA tasks. The SLDMWA has also hosted informal, information meetings with all of the subbasin GSAs.

While SLDMWA coordinated GSAs are confident in their ability to prepare a GSP for the areas under their jurisdiction, SGMA requires that an approved GSP or multiple coordinated GSPs are in place to provide sustainable management for the entire subbasin. The identified GSAs have been asked to determine how they wish to proceed in individual GSP development or a coordinated single GSP by July 2017 and whether or not they wish to participate in the Prop 1 Sustainable Groundwater Planning Grant as a joint request.

1.6. Delta Mendota Subbasin GSAs

Following are the DWR identified agencies (as of June 15, 2017).[4]

1. Aliso Water District
2. Central Delta-Mendota Region Multi-Agency GSA
3. City of Dos Palos
4. City of Firebaugh
5. City of Gustine
6. City of Los Baños
7. City of Mendota
8. City of Newman
9. City of Patterson
10. County of Madera—3
11. DM-II
12. Farmers Water District
13. Fresno County—Management Area ‘A’
14. Fresno County—Management Area ‘B’
15. Grasslands Groundwater Sustainability Agency
16. Merced County—Delta-Mendota

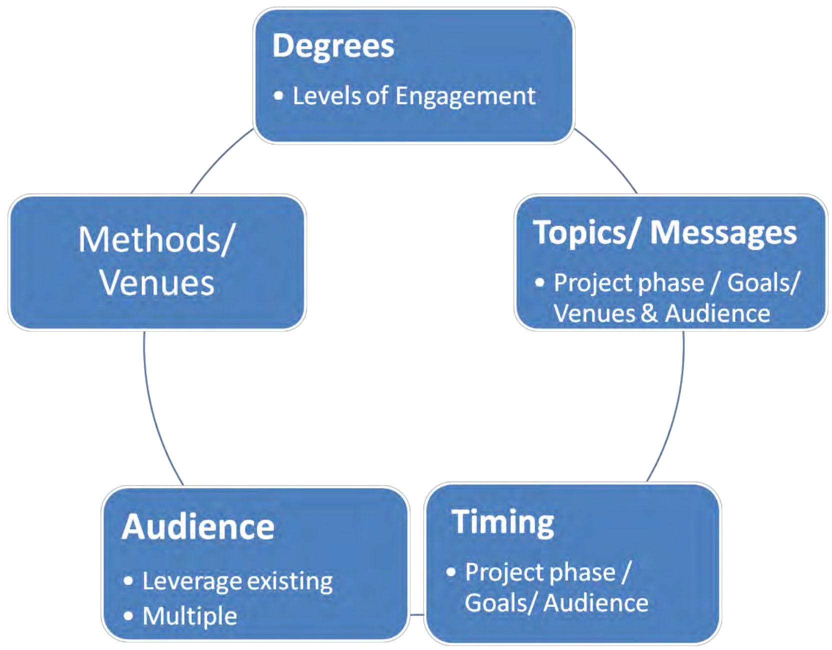
[4] See: http://sgma.water.ca.gov/portal/

17. Northwestern Delta-Mendota GSA
18. Ora Loma Water District
19. Patterson Irrigation District
20. San Joaquin River Exchange Contractors Water Authority
21. Turner Island Water District-2
22. West Stanislaus Irrigation District GSA
23. Widren Water District GSA

COMMUNICATIONS PLAN OVERVIEW

Communication is the process of transmitting ideas and information. According to the Project Management Institute, 75%-90% of a project manager's time is spent communicating. A Coms Plan provides the purpose, method, messages, timing, intensity, and audience of the communication, then describes who will do the communicating, and the frequency of the communication (see **Figure 3**.)

Figure 3. Elements of a Communications Plan



2.1. Purpose

The purpose of the Delta-Mendota Subbasin, Sustainable Groundwater Management Act, Coms Plan is to outline the information and communications needs of the project stakeholders and provide a roadmap to meet them. The Coms Plan then identifies how communications activities, processes, and procedures will be managed throughout the project life cycle.

2.2. Importance

While communications are important in every project, a well-executed communications strategy will be essential to the success of the GSP(s) development and adoption process. The financial and regulatory stakes are high and communication missteps can create project risks. Further, development of a viable GSP(s) will require an on-going collaboration among all the stakeholders, both organizational and external. The plan will be comprehensive and consider multiple variables, a range of system elements and project costs and benefits. Stakeholder input will be needed to refine GSP requirements and fully

define the water management system, and potential impacts, costs and benefits that may result in managing for sustainability.

2.3. Scope

The plan focuses on formal communication elements. Other communication channels exist on informal levels and enhance those discussed within this plan. This plan is not intended to limit, but to enhance communication practices. Open, ongoing communication between stakeholders is critical to the success of the project.

2.4. Communications Goal

Development, adoption and implementation of the GSP(s) will require basin external stakeholders, other agencies, staff, managers, and the multiple GSA Boards to evaluate choices, make decisions and commit resources.

The core communications goal is to plan for and efficiently deliver clear and succinct information:

- At the right time
- To the right people
- With a resonating message

This is done to facilitate quality decision making and build accompanying public support

2.5. Communications Objectives

The Coms Plan Objectives are to present strategies and actions that are:

- Realistic and action-oriented
- Specific and measurable
- Minimal in number (a few well delivered are better than many mediocre efforts)
- Audience relevant

2.6. Strategic Approach

Three primary communications strategies have been identified for the GSP(s) development.

1) Fully leverage the activities of existing groups. This practical approach is cost effective and respectful of the limited time that stakeholders have to participate in collaborative processes.
2) Provide targeted, communications and outreach to opinion leaders in key stakeholder segments.
3) Provide user friendly information and intermittent opportunities through existing communication channels and open houses or workshops to allow interested stakeholders (internal and external) to engage commensurate with their degree of interest.

2.7. Communications Governance, Communications Team

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[5], some form of communications governance is recommended. Several governance options for consideration are offered in Appendix 2. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. For the purpose of this document, an assumption is made that some form of governance will be identified and a communications team (which may be an individual or multiple individuals, and/or include the project consultants) is designated.

A driving consideration for this recommendation is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance is efficient and effective.

2.8. Constraints

All projects are subject to limitations and constraints as they must be within scope and adhere to budget, scheduling, and resource requirements. These constraints can be even more challenging in projects with multiple agencies as will be the case with the development and coordination of multiple GSPs.

There are also legislative, regulatory, technology, and other organizational policy requirements which must be followed as part of communications management. These limitations must be clearly understood and communicated where appropriate. While communications management is arguably one of the most important aspects of project management, it must be done in an effective and strategic manner recognizing and balancing the multiple constraints.

All project communication activities should occur within the project's approved budget, schedule, and resource allocations. The GSP(s) project managers and the leadership of the participating GSAs should have identified roles in ensuring that communication activities are performed.

To the extent possible, to support collaboration and reduce costs, GSP(s) partners should utilize standardized formats and templates as well as project file management and collaboration tools.

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[5] See Appendix 1

SITUATION ASSESSMENT

3.1. *Introduction*

The challenges of asking a community to make changes in how things are done, or forging an agreement among multiple parties are often large. Prior to preparing a Coms Plan, a neutral, 3rd party facilitator conducted a stakeholder Situation Assessment (SA).

The facilitator's role was to provide an independent evaluation of potential stakeholder's interest in coordination and governance for GSA formation and GSP development and identify any barriers or concerns that would need to be addressed for the GSA formation process and GSP(s) development to be successful.

3.2. *Situation Assessments*

An SA is an information-gathering process that informs outreach, engagement and collaboration. As part of preparing the basin communication's process, it was important to know more about:

- Stakeholder Categories
- Opinion leaders
- Regulatory and political context
- Advocates and detractors
- Attitudes and knowledge
- Other elements useful to the crafting of decisions

An assessment is also a low risk approach to education and signaling a future relationship. It facilitates the community's appraisal of its needs, wants and values. A well-crafted assessment sets the stage for the parties to better understand and interpret their situation so that they can make informed decisions for actions, in the short term and for the future.

The Delta-Mendota subbasin SA included background research and interviews. Interviews were usually with individuals but in a few cases a very small group was convened. To encourage candor, the results of the input process were bundled so those interviewed were not individually identified unless they explicitly indicated they wished to share their individual response.

3.3. *Background Research*

The facilitator worked closely with the SLDMWA and DWR to identify useful documents, plans and activities that might inform the overall communications planning process.

3.4. *Interviews and Consultations*

Using information gathered during the background research and similar GSA formation efforts throughout the state, the facilitator worked with the SLDMWA to craft interview questions. The facilitator also provided some selection criteria to the SLDWMA to help identify a representative group of interview candidates. Once selected, the SLDMWA staff and facilitation team invited the interviewees to participate. In addition to full interviews,

additional calls and in person communications were conducted to acquire amplifying information. **Figure 4** provides a quick overview.

Figure 4. Interview and Consultation Quick Facts

Number of Contacts: 30

Dates of Calls and Interviews Conducted:
February to May 2017

Average Length: 1 hr.
(Shortest = 20 mins., Longest = 1.5 hrs)

Selected participants were all engaged or otherwise stakeholders in some aspect of the basin GSA development process.

A project background sheet was provided in advance of each formal interview and used again during the interviewee discussions with the facilitator. Each interview followed the same format and included 16-18 questions (depending on whether or not a follow-up question was needed).

The questions covered the following topics pertaining to the GSA formations and GSP(s) development:

1. Overarching perspectives from each key stakeholder on general groundwater conditions, GSA governance; subbasin management and associated SGMA compliance
2. Preferred methods to achieve groundwater sustainability consistent with SGMA requirements
3. The level of agreement/conflict around groundwater governance across the range of stakeholder perspectives
4. Experience with facilitated processes, outreach and engagement, and the goals for such support
5. Potential configurations of governance and formations of GSAs and GSP development

3.5. *Summary of key findings*

Interview results indicate an overall positive environment for the project and project communications; however, the effort will require interactions of a large number of parties and planning for an extremely complex system. Following are the reflections, ideas and suggestions of those contacted.

3.5.1. <u>Related to Groundwater Sources and Trends</u>

- *Significant observed impacts associated with Weather, Water Project Deliveries and Cropping Patterns* – Participants observed a declining

groundwater situation and were able to attribute it to drought and weather (particularly timing of seasonal rainfall and periods of prolonged, higher temperatures), conversion to permanent crops, and significant changes in access to surface water.

- *Surface & Groundwater Nexus* – As noted in comments related to access to surface water, there was a clear understanding of the surface/groundwater nexus. Many believed that any realistic solution would have to include a full assessment of the region's surface water future.

- *Extremely Complex Systems* – Many of those interviewed reported that parts of the subbasin were doing fine and could, with good management, be sustainable. They described problems as being primarily in pockets of the subbasin. They also characterized some parts of the subbasin as not being managed sustainably and indicated that they believe this would have continued had SGMA not passed. While it was generally agreed that it would have been better if SGMA was not driving the change, they felt change would not occur without something like SGMA. Several of the participants were able to describe specific locations and situations that illustrated this.

  Issues related to operations of the Bureau of Reclamation, the Delta-Mendota Canal (DMC), the Mendota Pool and restoration activities are of keen interest to all the stakeholders. Everyone was familiar with issues of subsidence and with the facts and figures represented in graphics like those in **Figure 5**, prepared by the United States Geological Survey (USGS).[6]

  Many perceived that groundwater supplies for municipal uses in some parts of the basin were at risk.

- *Historic Rights and Arrangements* – Access to surface water is based on numerous historic rights and agreements as well as more contemporary agreements. As such there is no **single** description of the status of surface water availability among the many subbasin GSAs,[7] although there is a strong understanding of the rights and arrangements that do exist.[8]

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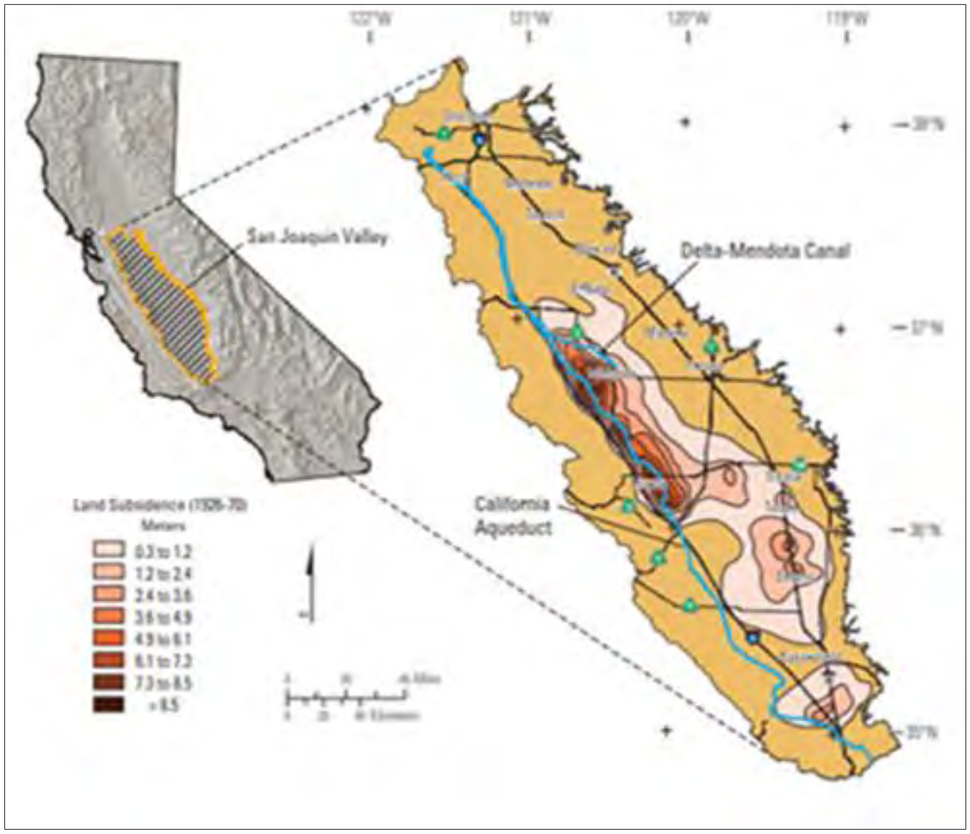
[6] U.S. Department of the Interior | U.S. Geological Survey: https://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html, Page Last Modified: Monday, 20-Mar-2017 22:39:47 EDT

[7] A full inventory of water rights and arrangements for the subbasin GSAs is recommended to be prepared as part of the GSP planning process.

[8] In 2010 there were 1,403 water rights claimed in the San Joaquin Delta watershed, the largest number of any watershed in the State. [Source: Associated Press: Original data source is State Water Resources Control Board eWRIMS, Database

Figure 5. USGS Illustration of the DMC and Subsidence



The hierarchy of water rights as well as laws related to groundwater rights will be a significant factor in GSP negotiations.

Another historical factor related to sustainability is the character of land ownership. There was a perceived difference in the values placed on sustainability by multi-generational family farms versus investor driven agriculture and/or water development.

3.5.2. Related to GSA Governance; Subbasin Management and SGMA Compliance

- *Numbers* - The subbasin includes numerous Water Agencies (35) and other potential GSA eligible agencies including Cities and Counties (such as Dos Palos, Firebaugh, Gustine, Los Baños, Mendota, Newman, Patterson, Fresno, Madera, Merced, San Joaquin, and Stanislaus) and Community Service Districts (CSDs) including among others Grayson, Westley, and Volta, as well as multiple Resource Conservation Districts (RCDs) that for the most part were within the general boundaries of other GSA eligible authorities (Panoche, Poso and Grasslands as an example).

By the June 30, 2017 filing deadline, 23 eligible entities had formally filed GSA formations and met SGMA requirements for subbasin coverage.

Even with this large number of GSA entities, during the SA interviews and in a follow-up survey, most agencies indicated a preference for a reduced number of GSPs and potentially just one or two.

At the time of this assessment there was not a full understanding of all of the potential requirements of being a GSA and ultimately what might be required to prepare a compliant GSP.

Table 3. Number of Subbasin Public Water Agencies

Number of Public Water Agencies

- Merced County
- Fresno County
- Broadview WD
- Centinella WD
- Central California ID,
- Davis WD
- Del Puerto WD
- Eagle Field WD
- El Solyo WD
- Farmers WD
- Firebaugh Canal WD
- Foothill WD
- Fresno Slough WD
- Grasslands WD
- Hospital WD
- Kern Canon WD
- Laguna WD
- Mercy Springs WD
- Mustang WD
- Oak Flat WD
- Orestimba WD
- Oro Loma WD
- Pacheco WD
- Panoche WD
- Patterson WD
- Romero WD
- Salado WD
- San Luis Canal Company
- San Luis WD
- Santa Nella C.WD
- Sunflower WD
- Tranquility ID
- West Stanislaus ID
- Widren WD
- Quinto WD

At the time of this assessment participants did not fully recognize the potential number of stakeholders and/or the requirements to conduct outreach.

- *Subbasin Governance Structures* – Many individuals and entities within the subbasin have experience working in cooperative governance and related structures. For example, the SLDMWA provides leadership for an Integrated Resource Water Management Plan (IRWMP) illustrated in **Figure 6**[9] on the following page. Many of the stakeholders are also involved with Irrigated Lands Coalitions (see **Figure 7**).[10]

  Likewise, many are also involved in efforts related to the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) initiative (see **Figure 8**).

[9] Source : San Luis & Delta-Mendota Water Authority, Westside-San Joaquin Integrated Water Resources Plan, July 2014

[10] Source: Central Valley Regional Water Resources Control Board

Existing Cooperative / Collaborative Governance Structures with Delta Mendota Subbasin Stakeholders

Figure 6. Integrated Regional Water Management Groups

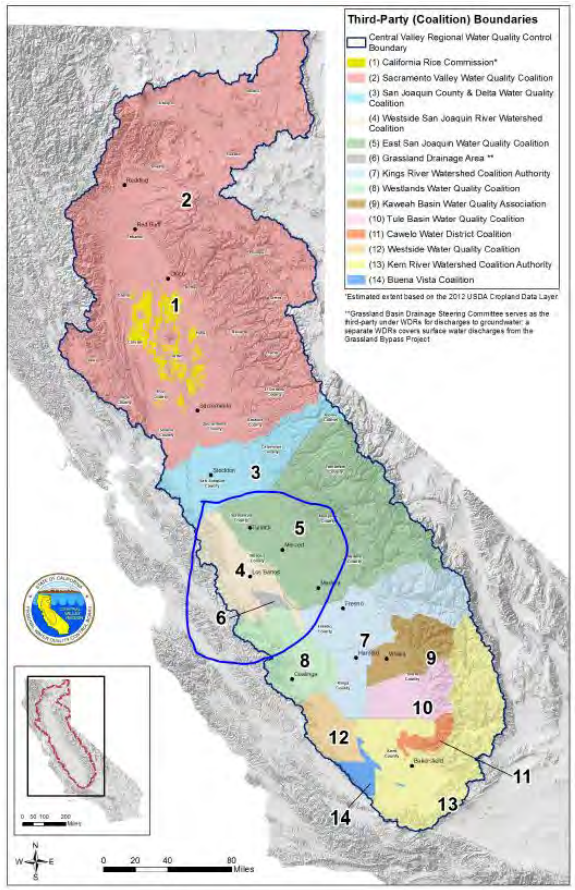


Figure 7. Irrigated Lands Coalitions

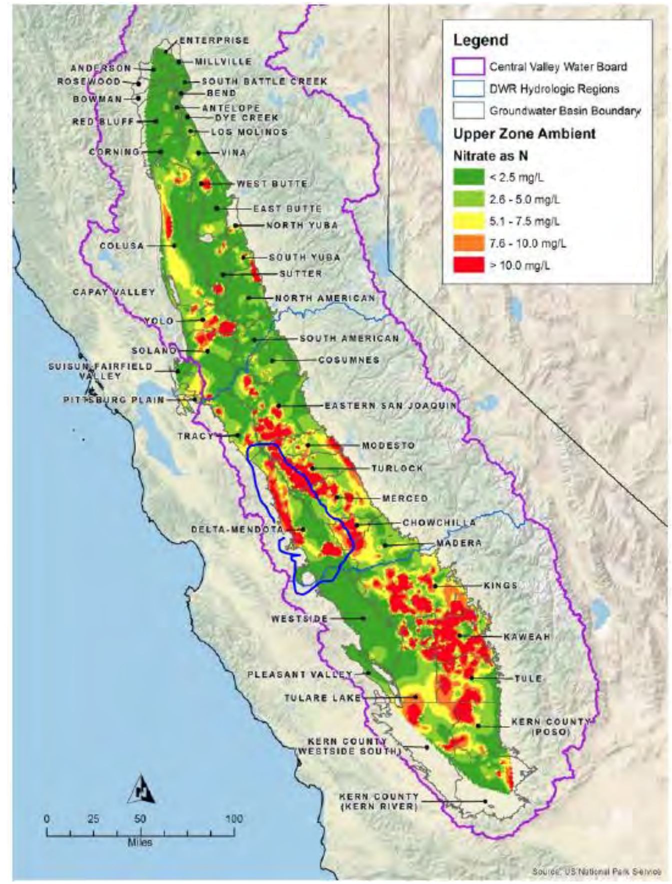


Figure 8. CV-Salts Initiative

CV-Salts was launched to develop sustainable salinity and nitrate management planning for the Central Valley. (See **Figure 8**.[11])

Finally, there are multiple arrangements in place related to surface water transfers and other previous groundwater management planning efforts.

Experience with these programs has created a capacity for collaborative planning that will be essential for GSP development. It also creates opportunities to access and leverage existing stakeholder meetings and events rather than needing to convene multiple new stakeholder processes.

3.5.3. Issues to be Addressed in Creating a Sustainability Plan

Some of the participants indicated they had an extremely good understanding of their section of the subbasin, with exact and extensive records to support their perspective. They found that making projections using historical data had been more reliable than some of the groundwater models that were in use.

In thinking about development of a GSP they felt there could be some difficulty in developing water balances due to lack of quality data for some locations. Another mild concern was the potential for disagreements about the selection of a groundwater model(s) or reconciling differences among methods.

Still another concern was the capacity of the GSAs and/or GSA members to fully participate. Some of these agencies are very lightly staffed and have varying levels of knowledge related to groundwater management. All of the participants had significant other duties prior to the passage of SGMA.

One concern, expressed after completion of the assessment, was the potential for some agencies to simply opt out of participating in the development of a GSP but still receive the benefits of the region having an approved plan without having contributed to the larger good of the subbasin.

3.5.4. Representation

The State Board lists the following as Required Interested Parties for the purpose of SGMA outreach:

- All Groundwater Users
- Holders of Overlying Rights (agriculture and domestic)
- Municipal Well Operators and Public Water Systems
- Tribes
- Counties
- Planning Departments /Land Use
- Local Landowners
- Disadvantaged communities
- Business

[11] Ibid

- Federal Government
- Environmental Uses
- Surface Water Users (if connection between surface and ground water)

All of these stakeholder categories were contacted in the interview process excepting tribes. In the case of tribes, there are no classified tribal lands in the Delta-Mendota subbasin, therefore no planning, outreach or communication needs are currently anticipated for tribes.

Due to subbasin characteristics, a primary focus of the assessment was on agricultural, disadvantaged communities (DACs) and municipal groundwater users.

- *Related to Agricultural Representation* - most respondents believed that the elected leadership of the GSA agencies would do a good job in representing agriculture and noted that many of them were growers themselves. It was also noted that farmers were busy and would be far more interested in any specifics of a GSP that would impact operations or the degree of certainty about water availability than the particulars of GSA governance.

- *Regarding DACs* - Much of the subbasin and its counties (San Joaquin, Stanislaus, Merced, and Fresno) have communities that meet the DAC definition and the region is generally considered disadvantaged. The ability of DACs to participate in GSP development was considered limited and it was thought that there would be a need for specific and direct outreach to DACs through elected leadership and via use of trusted community advocates. As part of the SA, several of those interviewed identified themselves as being able to represent a DAC perspective and one in particular was particularly concerned about the availability of Spanish language materials. As a result, Spanish language materials were included in the meeting materials of the public GSA adoption meetings and the SLDMWA provided a fluent Spanish speaker to assist with meetings.

In the past, to promote DAC identification and involvement, the Westside-San Joaquin IRWM previously conducted an extensive survey of private and public community representatives to educate and encourage understanding of the IRWM process, to help understand the issues confronted by DACs, and to

better address the needs of minority and/or low-income communities. This effort resulted in identification of DACs in the Region and an initial list of 22 projects that would benefit DACs and low-income communities. Given known constraints on this community it is recommended that more focused DAC outreach should be coordinated with the IRWM. This effort is now in progress.

- *Regarding Municipals* - The SA outreach also included interviewing Municipal Stakeholders. A significant number of the Cities are fully dependent on wells for water supply and issues related groundwater management are of grave concern. These representatives all felt that even while it would be difficult to make time to participate in GSAs and GSP development, that they must make the time. Many had also determined that they wished to form their own GSA to reflect their specific interests in any kind of broader GSP negotiation.

- *Regarding Environmental Interests* - There appeared to be a less defined stakeholder segment representing traditional, environmentally focused issues. Outreach was made to subbasin government agencies that often serve as a surrogate for these interests and an informal consultation occurred with a representative of the Planning and Conservation League to identify any known, active stakeholders. However, no specific entity or individual was identified by those contacted. A general perception was that this community would desire engagement and would designate representatives if the GSP development was thought to potentially impact existing restoration or other environmental concerns but the formation of GSAs per-se, was of less interest. The next phase of communications should include outreach to organizations such as Audubon, the Nature Conservancy and Ducks Unlimited just to ensure due diligence. These connections will be important going forward, particularly if environmental issues are identified.

- *Regarding Industrial Users* – The region includes some industrial water users. This sector has a relatively lower percent of water use compared to other subbasins users; however, representatives of the sector pointed out how essential access to water was to their industry. The interviewees also emphasized how important these industries were to the local economies. There was a stated concern about representation since there didn't appear to be a direct way to engage, particularly with multiple GSAs being formed.

- *Regarding Counties & Planning Agencies* – All of the subbasin counties have designated representatives and all are assisting with GSA coverage for areas not otherwise covered by a GSA. All of the city and county representatives had direct engagement with the planning arms of their jurisdictions, or were staff to the planning departments. These representatives, like the municipal representatives, viewed this as critical issue even as it creates new workload for the already busy entities.

3.5.5. Communications and Facilitation Preferences

Participants were asked to describe their communications preferences. Several offered specific suggestions on written materials. Most did not believe there would be a need for a high frequency of communications directly with non-GSA stakeholders.

Several suggested using regularly scheduled activities of existing groups and gatherings to share information rather than creating stand-alone events. They listed annual meetings of the water agencies as one good venue as well as meetings related to the IRWM and Irrigated Lands. Several also thought that it would be good to go to places like Farmers Markets, particularly for the disadvantaged communities, and County Fairs.

Farm Bureau representatives also indicated a willingness to support outreach efforts. The Merced Farm Bureau, in particular, has already helped to advertise public meetings related to GSA formations.

Related to facilitation there was not a broad exposure to professional facilitators among many of the stakeholders. Even so, participants consistently listed qualities such as fairness and transparency, a good understanding of the issues, and confidence as helpful facilitator strengths. There was a sense that the GSAs would not need hand holding but that facilitation could be useful for helping the stakeholders forge decisions and making what many believed would need to be compromises.

3.5.6. Success Factors, Barriers to Success

The participants were asked to describe their view on the odds for success as well as any barriers that would prevent successful completion of a GSP.

Overall, most participants expressed a medium to high likelihood for success. They noted that the carrot (grants and technical support) and stick (significant regulatory intervention) by the State creates a dynamic that is supportive to success.

Participants stated barriers related to the capacity of the GSAs to participate and ultimately agree to, and implement changes. The much diffused governance structure of multiple GSAs amplifies this dilemma as do actions beyond the control of the subbasin entities (such as climate and water deliveries).

In addition to perceived barriers, participants outlined their thoughts on opportunities and success strategies.

- *Drought* – While the drought was unwelcome it increased awareness of the need for changes. Many felt it would be easier to move forward while the topic is prominent in everyone's minds.
- *Short and Long Game* – Several suggested it will be important to have a plan that includes long and short term strategies and activities.
- *Integrated Planning* – Many of the participants emphasized the importance of integrated planning.

3.5.7. Other Comments and Advice

Many participants expressed appreciation for being contacted and invited the facilitator to contact them again if there were questions.

3.6. *Promising messages and methods*

Three primary communications strategies have already been identified for the GSP(s) development:

- Leveraging the activities of existing groups
- Providing targeted, communications and outreach to opinion leaders in key stakeholder segments
- Providing user friendly information and intermittent opportunities for a broader range of stakeholders

The same strategies aligned with the recommendations of the SA participants. These methods will allow stakeholders to engage commensurate with their degree of interest while providing sufficient information to ensure long-term success for plan development and implementation.

AUDIENCES AND MESSAGES

GSA formation and GSP(s) development**,** like most large planning efforts, consists of a broad range of stakeholders with differing interests and influence.

4.1. Two Core Audience Segments

This Coms Plan Anticipates two core audience segments. First is the subbasin GSA Boards and the communications among and between themselves. This audience segment is significant in size given that 23 GSAs will be working to develop a GSP(s) and each GSA has its own Board and audiences.

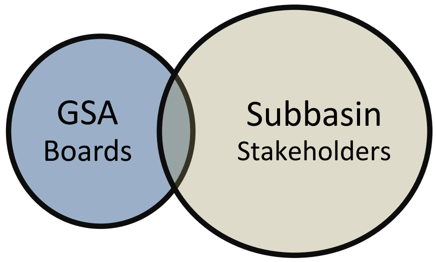


Figure 9. Two Core Audience Segments

The second audience is the subbasin stakeholders as identified in SGMA. This audience is also large. Many of the stakeholders are shared by the GSA Boards and some of the larger stakeholder segments are also represented on the GSA Boards (see **Figure 9**).

Nearly all of the communications strategies apply to both segments; however, some strategies apply to one or the other specifically and are so identified.

4.2. Communications and Change Management

The process of adopting and implementing a GSP will require significant change management. Communications planning should encompass basic change management approaches. Messages should also evolve over time and be tied to the planning process and key decision points. Then, for each audience and each major planning step, communications must do the following:

1. Describe what the actual proposed plan (change) is
2. Articulate how the change will directly impact the category of stakeholder involved
3. Outline the methods that will be used to implement the plan (change)
4. Define the costs and benefits of changing and not changing, and what future conditions will be if change does not occur
5. Consider unintended consequences and others that may also be impacted by the same change then develop a strategy to engage them
6. Offer opportunities for input and for stakeholders and others to improve the approach

The communications requirements for large changes are often underestimated. Some experts indicate that messages may need to be delivered up to 8 different times to be fully absorbed. Communications needs will also evolve as the GSP planning progresses. **Table 4** provides a sample of early communications that focus on SGMA and groundwater basics.

Table 4. Sample – Early Phase Message Elements for Subbasin Stakeholders

Element	What the Change Is	How it will affect the Stakeholder	How the change will be Implemented	Why it is a good idea
Early Phase GSP Development	• Locally governed GSAs will work together to sustainably manage ground water. • The Subbasin /Basin is required to ensure Sustainable Groundwater Management by submitting a sustainability plan by 2020. • The plan must be implemented and found to result in sustainable management by 2040.	(Unique to audience type) • Changes in the current methods of acquiring and utilizing groundwater may occur. • May affect future decisions related to crop types and decisions related to conjunctively using surface water. • May provide additional project resources to the DAC communities.	A collaborative approach is being undertaken to prepare the plan with multiple GSAs coordinating with the SLDMWA as the planning organizer.	• Sustainable and wise use of groundwater allows for the success of future generations and creates greater certainty for today's beneficial users. • Failure to act may result in negative regulatory consequences.

As part of the GSP planning process, the next phase of communications will also need to communicate the requirements for sustainability and how they are achieved in the context of the Delta-Mendota subbasin. Then, communications related to GSP specifics and adoption will require additional outreach, targeted to specific audiences.

4.3. Tied to Decision Making

Communications should also be tightly linked to decision making. For each anticipated decision, stakeholders for that decision should be identified and the following addressed.

1. Who (Is the stakeholder)
    a. An impacted party?
    b. A potential planning partner?
    c. A potential provider of services or resources?
    d. A regulator of the activity?
    (Note: Maybe more than one category.)

2. What (What is the interest of the stakeholder? How will the stakeholder be affected? What are the stakeholders' needs?)
3. Who (Who is the right messenger for the information)
4. How (How should the information be delivered? What are the best methods?)
5. When (What is the appropriate timing for the messages?)
6. Engagement and Knowledge Transfer (How do we create two-way communications?))

Table 5 illustrates some of these ideas.

Table 5. Communications Planning Questions

Who	Interest	Messenger	Delivery	Timing	Knowledge Transfer
• Impacted • Partner • Provider • Regulator	• How will decision affect? • What will stakeholder need?	• Who is a trusted information Source? • How do we ID and Partner	• What are the best delivery methods?	• When should we conduct outreach?	• What do the stakeholders know that we need to know?

4.4. GSA Boards

Due to the multiple subbasin GSAs, specific focus is needed on communications to keep them informed, provide consistent updates and information that the Boards can use in their own outreach, and support their decision making. Primary objectives for communications with the subbasin GSA Boards are to ensure:

- Consistent understanding of the requirements for a GSP and/or GSP coordination
- On-going access to current information
- Timely notice of any significant developments or decision points that may require changes to policies and/or require some other board action
- Confidence that the GSP(s) will be accepted by the GSA's stakeholders

Key communications activities involving the Board include;

1. Providing short and digestible pieces of information to ensure each Board member can quickly articulate to his/her constituents on key matters and remain sufficiently informed so that no decision points are surprises.
2. Provide user-friendly informational materials to be used with public audiences, and will support the Board with their own constituent outreach.
3. Utilize regular Board communications for routine updates and reserve specific Board agenda items for highly significant discussion items.

4.5. Primary Audiences

There are several core stakeholder groups that will require ongoing communications and tailored messaging throughout the planning process. They are:

- Agriculture
- Disadvantaged Communities
- Municipals

Other stakeholders requiring special consideration include:

- Industrial Users/ Business
- Regulators (State and Federal)
- Potential Partners
- Environmental Organizations
- Federal Agencies

While all of the stakeholder types are important to engage for development of a GSP, the first three will be most affected by any changes that might be proposed as a result of the *GSP(s)*.

The following provides an outline of key messages and activities in support of each of the audience types.

4.2.1. Agricultural

Messages about the GSP(s) development should feature the overall desirability of a sustainable management approach how the plan will contribute to management certainty and protect against regulatory oversight.

In thinking about irrigation users it is also important to remember that one size does not fit all.

4.2.2. Disadvantaged Communities

Messages developed for this sector should be tailored and specific to the community. This type of outreach is often best served by use of surrogates and trusted messengers. As identified in the SA, these messages should be aligned with activities of the IRWM, especially given the high, current dependence of many on unsustainable water sources. Messages about ways to access the increased availability of resources due to grant incentives should also be considered.

A specific outreach method to consider relates to the predominance of cells phones within the communities. According to the Pew Research Center, "over 50 percent of low-income households own a smartphone. Smartphone penetration in this demographic creates substantial opportunities for utilities to reach disadvantaged communities with software solutions like customer self-service platforms and targeted digital communications."[12]

4.2.3. Municipals

[12] Secondary Source: Water Smart. https://www.watersmart.com/rethinking-disadvantaged-community-engagement/ (accessed June 1, 2017)

Some care will be needed to address tensions related to the relative percentages of use by Municipal agencies and what constitutes highest and best beneficial uses within an agricultural region. A promising interaction with this community would involve collaboration on messaging to achieve mutually beneficial goals.

Some thought it might be possible for the municipal agencies to provide in-kind support to the GSP development process through support for project websites and mailing lists, production of meeting notices, assistance to the planning process from in-house public information professionals and offering access to physical meeting spaces.

Municipals may need assistance in making the case for the need to think at a Basin scale rather than more local terms.

4.2.4. Business and Industry Interests

Business and industry interests seek assurances about the availability of water for operations and the viability of the farming industry in the region. Messages for these audiences should focus on how the GSP(s) development will contribute to sustainability and how these audiences can participate in discussion specific to their interests.

4.2.5. Regional/Statewide Interests and Regulators

Some degree of uncertainty remains in the overall legal, legislative and regulatory environment as it relates to SGMA implementation.

It is in the interest of the subbasin stakeholders to engage state and federal agencies and regulators throughout the process. These parties may have resources to assist the subbasin and a cooperative attitude will build good will in the event that adjustments are needed to achieve SGMA compliance.

4.2.6. Potential Agency Partners

A variety of collaborations to achieve GSP(s) development goals may be possible. The GSAs should consider the potential for collaboration with non-GSA members and inter-basin (adjacent subbasin) partners, as part of plan deliberations.

4.2.7. GSP Coordinators Planning Forum

A planning forum for subbasin GSP coordinators should be established to further inform a coordination strategy. This forum would include agency representatives as well as the consultant teams and be used for the sole purpose of coordination and mutual support. It is anticipated that this body might meet on a quarterly or as needed basis. This forum would also provide a central point of contact for adjacent subbasin coordinators.

4.2.8. Environmental Community

As noted in the SA, this community will be interested in a GSP features. The focus of messaging for this group being on how the GSP(s) development will contribute to a sustainable regional water portfolio. Special effort should be made to identify specific

topics of interest. For example, as part of GSP development, a list of groundwater dependent species may be created, or impacts to wetlands may be identified. These types of lists would highlight where input from the environmental community might be needed.

4.2.9. Federal Government

Federal representatives interviewed for the assessment asked to be kept informed of subbasin SGMA activities. These agencies have a direct interest in surface water integration as well as SGMA activities that could impact wetlands restoration efforts or groundwater dependent ecosystems and species.

RISK MANAGEMENT

Risk management is the identification, assessment, and prioritization of risks (defined as *the effect of uncertainty on achieving objectives*) followed by coordinated, efficient and economical strategies and actions to minimize, monitor, and control the probability and/or impact of negative events. Strategies and actions may also be used to avert risk by leveraging strengths and opportunities.

Risks can come from uncertainty in economic factors, threats from project failures (at any phase), regulatory and legal uncertainties, natural causes and disasters (drought, flood, etc.), as well as dissention from adversaries, or events of uncertain or unpredictable circumstances. Several risk management standards have been developed. This analysis utilizes those from the Project Management Institute.

Table 6 outlines standardized risk categories and translates them to outreach risks.

Table 6. Risk Factors

RISK CATEGORY	Outreach RISK FACTORS
Technical, quality, or performance	• Realistic performance goals, scope and objectives
Project management	• Quality of outreach design • Outreach deployment and change management • Appropriate allocation of time and resources • Adequate support for Outreach in project management plans
Organizational / Internal	• Executive Sponsorship • Proper prioritization of efforts • Conflicts with other functions • Distribution of workload between organizational and consultant teams
Historical	• Past experiences with similar projects • Organizational relations with stakeholders • Policy and data adequacy • Media and stakeholder fatigue*
External	• Legal and regulatory environment • Changing priorities • Risks related to political dynamics

5.1. Technical, quality, or performance

The subbasin is fortunate to have a high level of water knowledge and skilled personnel available to assist with GSP planning. In general, stakeholder expectations for outreach and performance goals, scope and objectives are attainable. The larger concern in this category is properly communicating the scope of the GSP(s) development and the need for extensive coordination and outreach among a number of parties. Communication of SGMA

requirements for outreach as a planning requirement should be an ongoing consideration and appears to be underestimated in emphasis.

5.2. Project management

A number of positive project management factors are present for the GSP(s) development outreach. Project managers view outreach as an important planning element. The outreach design is based on best management practices and industry standards. It is not overly complicated and with technical services support from DWR and other sources, sufficient resources should be available to properly execute it. Procedures and practices are already in place that can be leveraged to achieve communication goals.

The primary concern in this category relates to GSP coordination. This type of outreach will require additional assessment as the individual GSAs will determine their own protocols for representation.

5.3. Organizational / Internal

Conflicts with other GSA member functions and/or conflicts with outreach activities by efforts that include the same stakeholders (e.g. Irrigated Lands, IRWM, and CV-Salts) should be monitored.

One additional consideration will be the distribution of workload between GSA, organizational and consultant teams. Clear roles and responsibilities must be defined and continuous interaction in place to ensure successful execution.

The GSP(s) development process will also need identified, high level spokespersons or champions. These individuals should be able to discuss subbasin planning with the media, in discussions with regulators and potentially at professional conferences.

5.4. External

The legal and regulatory environment of the GSP(s) development process is complex and evolving. Ongoing issues with surface water deliveries and changing agricultural market conditions are outside of the control of the parties. It will be important for mechanisms to be in place that allow for relatively rapid responses to changing conditions.

5.5. Historical

The primary stakeholders in this process generally view interactions and meetings as productive. There is a history of cooperation and a willingness to work together to save costs and achieve better outcomes.

TACTICAL APPROACHES

Following are specific tactical approaches that may be utilized to deliver the activities, messages, and recommendations of the previous chapters. These approaches are based on best communication practices and grounded in the public participation philosophy of the International Association for Public Participation, Public Participation Spectrum as illustrated in **Table 7**.

The Spectrum represents a philosophy that outreach should match the desired level of input from both the stakeholder and the organizational entity.

Table 7. IAP2 Public Participation Spectrum

IAP2 Public Participation Spectrum

Developed by the International Association for Public Participation

INCREASING LEVEL OF PUBLIC IMPACT

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public Participation Goal:	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public issues and concerns are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the Public:	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**
We will keep You informed.	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and issues are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example Tools:	**Example Tools:**	**Example Tools:**	**Example Tools:**	**Example Tools:**
• Fact sheets • Web Sites • Open houses	• Public comment • Focus groups • Surveys • Public meetings	• Workshops • Deliberate polling	• Citizen Advisory Committees • Consensus-building • Participatory decision-making	• Citizen juries • Ballots • Delegated decisions

Based on the assessment findings for the GSP(s) development, most stakeholders would simply like to be INFORMED unless there is a potential for significant changes that may include that stakeholder. Tactics for this group will include fact sheets, websites, open houses, briefings, and informational items placed in publications they already read.

The next largest group of stakeholders, primarily groundwater pumpers and disadvantaged communities, wish to be CONSULTED. This group will have access to all the materials

prepared as part of the informational phase. In addition they should be invited to provide comments on written materials and planning concepts and participate in focused workshops and/or briefings. They should also be invited to attend larger public meetings.

The development of some GSP features may require a higher degree of INVOLVEMENT. This would focus on engagement of a subset of stakeholders that may experience significant impacts associated with SGMA.

COLLABORATION opportunities have also been identified; however, they are of a different character than defined in the Spectrum. Collaboration in this GSP(s) development process will focus on working with partners that have mutual goals to achieve those goals together. This will more resemble a partnership than a public engagement activity.

6.1. Communications Coordination.

Each GSA is required to perform legally mandated outreach activities and the GSP submission guidelines require a minimum level of engagement.

The subbasin GSAs should coordinate outreach activities even if there is a decision to move forward with multiple GSPs. In addition to efficiency and cost savings (the GSAs can share resources) this strategy will allow for consistency in messaging and reduce confusion for stakeholders that may not know what GSA jurisdiction they are in, and/or are in multiple GSA jurisdictions. Following are suggested options for communications coordination.

1. Website
2. Meeting calendar
3. Branded informational Flyers, Templates, PowerPoint Presentations, etc.
4. Periodic newsletter
5. GSP related mailing lists
6. Descriptions of interested parties
7. Issues and interest statements for legally mandatory interested parties
8. Public workshops
9. Message calendar
10. Press releases and guest editorials
11. Speakers Bureau
12. Existing group venues
13. Outreach documentation

6.2. Tactics

6.2.1. Website

As part of the communications plan development, a list of website concepts and draft website content was prepared. The following describes the proposed approach:

a. Centralized – Establish a centralized website for the entire subbasin.

b. Individual GSAs – Posting of material to a website is part of the SGMA requirements. Those GSAs with their own webpages can link to and from the centralized site if they wish to provide their own customized information. For those GSAs without their own website, courtesy pages would be provided as an added feature of the main site. The courtesy pages would all use a single template with the same information to facilitate easy management and updates. Individual GSAs choosing to take advantage of the courtesy pages would be responsible for ensuring that information is current. The page should include a "Last Updated" box to indicate the timeliness of the information.

c. **Basic features** – A basic website framework has already been developed along with introductory information that has prepopulated each page. **Figure 10** illustrates the basic content of the site and includes:
   1. Background information
   2. Information about getting involved, including meeting information
   3. A separate link for Spanish Language materials
   4. Frequently asked questions
   5. Links to GSAs
   6. Contact information

Should a GSA decide to not participate in the Central website, a similar structure could be utilized.

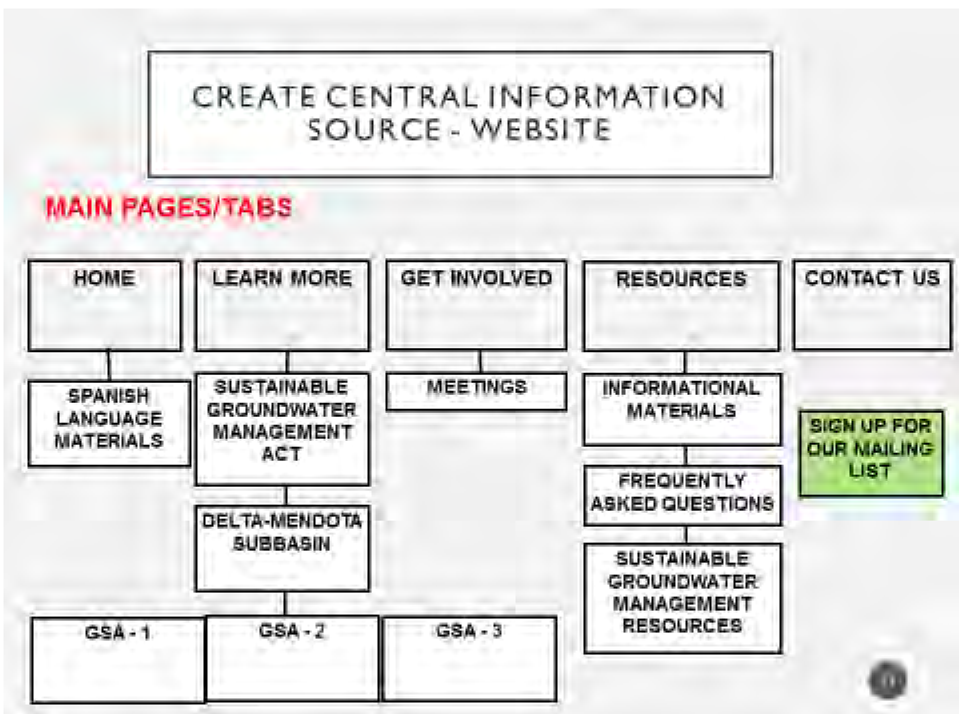


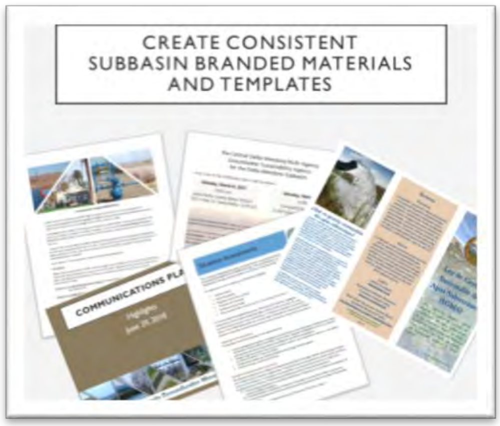
Figure 10. Website Structure

6.2.2. Meeting Calendar

A shared meeting calendar will provide a one-stop shop for stakeholders and assist in preventing meeting conflicts while creating more potential for shared activities. This calendar should include current and scheduled meetings and workshops as well as serve as the repository for agendas and meeting notes, along with copies of meeting materials and presentation.

An integrated project calendar should also be developed that links planning project milestones with communications milestones.

6.2.3. Branded Informational Flyers, Templates, PowerPoint Presentations, etc.



Subbasin level materials should have a single look and feel to create on-going consistency and visual recognition by stakeholders. Use of templates, shared presentations and flyers will create efficiencies and reinforce messaging. This communications plan incorporates some of this type of branding.

6.2.4. Periodic Newsletter

The need for regular communications cannot be overstated. One option is production of a periodic newsletter. Given the relatively short GSP(s) development process timeframe and the GSP development requirements for periodic outreach to identified stakeholders, a quarterly schedule would be realistic and achieve compliance with SGMA requirements for periodic updates to stakeholders. The newsletter should be designed so that individual GSAs can add tailored information if they choose to. For Portable Document Format (PDF) versions of the newsletter, a GSA could add a simple one or two page insert and the edition could be used as a handout or mailer. For a professional looking, email version of the newsletter, we recommend free or low cost services such as Mail Chimp or Constant Comment, which can be integrated with mailing lists.

Adding GSA specific information to an email newsletter can be done with web-links in the email to the very same PDF page prepared for the hardcopy mailer. An alternative is emailing the entire newsletter PDF as an attachment (although this format is less likely to be read than the mailer services).

6.2.5. GSP related mailing lists

Each GSA is required to develop notification lists. A central list may be utilized for GSP(s) related notifications.

6.2.6. Descriptions of Interested Parties

Each GSA is required to develop descriptions of interested parties. These lists should be updated and merged for use in the GSP(s) submittal(s). These can also be provided as background information on the website as part of constructing an administrative record. The SA in Chapter 4 provides an initial start for this documentation.

6.2.7. Issues and Interest Statements for Legally Mandatory Interested Parties

A GSP submission must include a statement of interests for listed stakeholders. As suggested earlier, this can also be included on the website.

6.2.8. Coordinated Public Workshops

SGMA requires a series of public hearings and some public workshops. Such workshops should be coordinated with other subbasin entities.

During the GSA formation process the County of Merced and a forming GSA body conducted a joint workshop to explain more about SGMA and the proposed GSA formation. Distribution of meeting flyers and notices was done concurrently, and DWR attended the event to answer questions. The GSP development process will offer similar opportunities, not only within the subbasin, but with adjacent subbasins.

6.2.9. Message Calendar

Basic messages should be associated with the planning schedule and each stage of GSP(s) development and serve as the theme for the communications materials being generated. For example, during the GSA formation period there was a need to communicate the basics of SGMA and groundwater management. During the GSP(s) initiation phase messages should focus on the basics of groundwater sustainability and the current state of the subbasin. As the GSP(s) begins to take form the specifics of the GSP(s) and what it means for each stakeholder would be the focus.

6.2.10. Press Releases and Guest Editorials

At some point in the GSP development and implementation process, it is likely that stakeholders will be asked to make changes and/or financially support a sustainability effort. It will be more productive for the GSAs and their GSP collaboration partners to frame discussions about these changes than to have others, perhaps with less knowledge, do so on their behalf. For that reason there is a need for press releases and/or guest editorials to offer the media and stakeholders accurate information offered in the context of SGMA. This type of outreach should be closely coordinated as consistency in messages is critical to stakeholder acceptance.

6.2.11. Speakers Bureau

Efforts should be made to conduct outreach at events and meetings that already occur (e.g. Farm Bureau meetings, Rotary Club, etc.). A list of knowledgeable presenters should be developed in the event an organization or other entity would like a presentation. Speakers Bureau engagements should be recorded on the planning project meeting calendar.

6.2.12. Existing Group Venues

Fully leverage the activities of existing groups.

- Maintain a roster of existing groups and typical meeting schedules with a nexus to GSP(s) development. Add the dates to the messaging calendar.
- The list of audiences, messages and existing groups should be referenced when there is a need to deploy information.
- Conduct informal outreach with the leaders of such groups to determine the best way to interact.
- Determine what communications channels these groups are using and equally leverage these, for example by placement of articles in newsletters.

6.2.13. Outreach Documentation

A central point of contact should be identified on the website and an outreach statistics inventory should be established that identifies dates, times, audiences and attendance. This information will be also be useful in conducting follow up with stakeholders as well as documenting outreach as part of GSP submittal guidelines.

6.3. Procedural and Legally Mandated Outreach

A discussion of SGMA outreach requirements was provided in Chapter 1 and a full list of requirements is contained in Appendix 1. One major feature of the requirements is a submission to DWR of the opportunities that interested parties will be given to participate in the GSP deliberations. The Situation Assessment provides an initial description that can be added to with additional outreach.

Following are the Required Interested Parties for the purpose of mandated outreach:

Table 9 provides a list of the mandated outreach and the timeframe in which is required.

Table 8. Mandated Outreach

Timeframe	Item
Prior to initiating plan development	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR.

Timeframe	Item
	2. Web posting of same information.
Prior to plan development	1. Must establish and maintain an interested persons list. 2. Must prepare a written statement describing the manner in which interested parties may participate in GSP development and implementation. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public
Prior to and with GSP submission	1. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 2. Lists of public meetings 3. Inventory of comments and summary of responses 4. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions)
90 days prior to GSP Adoption Hearing	1. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must notify cities and/or counties of geographic area 90 days in advance.
90 days or less prior to GSP Adoption Hearing	2. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Consider and review comments b. Conduct consultation within 30 days of receipt with cities or counties so requesting
GSP Adoption or Amendment	1. GSP must be adopted or amended at Public Hearing.
60 days after plan submission	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission.
Prior to adoption of fees	1. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting. 2. Public notice shall include: a. Time and place of meeting b. General explanation of matter to be considered

Timeframe	Item
	c. Statement of availability for data required to initiate or amend such fees d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance) 3. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year. 4. Includes procedural requirements per Government Code, Section 6066.
Prior to conducting a fee adoption hearing.	1. Must publish notices in a newspaper of general circulation as prescribed. 2. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 3. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.)

6.4. Items for Future Consideration

This GSP(s) Coms Plan outlines an outreach effort based on project and stakeholder needs and preferences. This document has been prepared as a working draft living document and should be updated as new information and the GSP(s) development process needs are developed.

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MEASUREMENTS & EVALUATION

A guiding principle for evaluation and measurement of the Coms Plan's success is to provide regular, unbiased reporting of progress toward achieving goals. Success may be evaluated in several ways, including process measures, outcome measures, and an annual evaluation of accomplishments. Optional evaluation measures are described below.

As part of each outreach effort debrief the following process and outcome measures will be discussed and recorded in a check sheet. The check sheets will be prepared with the goal of continuous improvement rather than criticisms.

7.2. Process Measures

Process measures track progress toward meeting the goals of the Coms Plan. These include:

- Level of attendance at outreach meetings
- Shared understanding of the overarching aims, activities, and opportunities presented by different planning approaches and project activities
- Productive dialogue among participants at meetings and events
- Sense of authentic engagement; people understand why they have been asked to participate, and feel that they can contribute meaningfully
- Timely and accurate public reporting of planning milestones
- Feedback from Coordinating Body and GSA members, regulators, stakeholders, and interested parties about the quality and availability of information materials
- Level of stakeholder interest in the GSP(s) development process information

7.3. Outcome Measures

Outcome measures track the level of success of the Coms Plan in meeting its overall goals. Some outcome measures considered for the GSP(s) development process include the following:

- Consistent participation by key stakeholders and interested parties in essential activities. Participants should have no difficulty locating the meetings, and should be informed as to when and where they will be held.
- Response from meeting participants that the engagement methods provided for a fair and balanced exchange of information.
- Feedback from interested parties that they understand how their input is used, where to track data, and what results to expect.
- The project receives quality media coverage that is accurate, complete and fair.

7.4. Mid-cycle Evaluation of Accomplishments

A mid-cycle evaluation provides an opportunity to examine the current effectiveness of the Coms Plan and provides a chance to reevaluate strategies to meet the GSP(s) development process objectives. The evaluation tasks may include:

- Preparation of an executive-level summary detailing high-level initiatives and accomplishments of the previous cycle. This evaluation should also include positive news, best practices, goals and objectives, notable changes, timelines, and priorities.
- Identifying gaps and areas for improvement.
- Highlighting how gaps and areas for improvement in the cycle has been addressed.
- Outlining process and outcome measures and their current results.

ROLES AND RESPONSIBILITIES

The GSP(s) development Coms Plan outlines numerous strategies, activities and tactics. While none are highly complex, there is a requirement for coordination and clarity regarding who will be responsible for executing the tasks.

After the planning team evaluates the timelines and priorities for each of the communications activities a recommended next step is completion of a Responsible, Accountable, Consulted, and Informed (RACI) Chart. This Chart, as displayed in **Table 10**, outlines key tasks and the assignment of roles and responsibilities for accomplishing them.

Table 9. Sample RACI Chart

Activity TYPE	SPECIFIC PRODUCT	RESPONSIBLE	ACCOUNTABLE	CONSULTED	INFORMED
Internal Staff Communications, information materials for/briefings	Draft	Person A	Person E	Person I	
	Final Draft	Person A	Person E	Person I	Project Team
List Serves, mailing lists	Customer Contacts	Person B - Person A	Person E	Person I	Project Team
	Concurrent jurisdictions	Lisa Beutler/MWH	Person G	Person I	Project Team
	Other - identified stakeholders	Person A	Person G	Person I	Project Team
Web Content and Maintenance	Draft Content and Content Refresh	Lisa Beutler/MWH/	Person G	Person H	Project Team
	Site Administration	Person A	Person G	Person H	
General public Intro Packets, Fact Sheets and Brochures	Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team
Newsletter Content	Draft	Lisa Beutler/MWH	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team

Responsible
Those who do the work to achieve the task. There is at least one person with a role of *responsible*, although others can be delegated to assist in the work required.

Accountable (also approver or final approving authority)
This is the person ultimately answerable for the correct and thorough completion of the deliverable or task, and the one who delegates the work to those responsible. There **may only** be only one *accountable* specified for each task or deliverable.

Consulted
Those whose opinions are sought, typically subject matter experts were people that are impacted by the activity; and with whom there is two-way communication.

Informed
Those who are kept up-to-date on progress, typically on the launch and completion of the task or deliverable. This is one way communication.

Role distinction
There is a distinction between a role and the individual assigned the task. Role is a descriptor of an associated set of tasks that could be performed by just one or many people.

In the case of the RACI Chart, the team may list as many people as is logical except for the Accountable role.

Scope of Work
Completion of the RACI Chart will also support development of any future scopes of work for consultant provided communication and outreach services.

LIST OF APPENDICES

Appendix 1. Public Outreach Requirements under SGMA

GSP Regulations

CODE	PUBLIC OUTREACH REQUIREMENT
§ 353.6. Initial Notification (a) Each Agency shall notify the Department, in writing, prior to initiating development of a Plan. The notification shall provide general information about the Agency's process for developing the Plan, including the manner in which interested parties may contact the Agency and participate in the development and implementation of the Plan. The Agency shall make the information publicly available by posting relevant information on the Agency's website.	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR. 2. Web posting of same information. **Timing**: *Prior to initiating development of a plan.*
§ 353.8. Comments (a) Any person may provide comments to the Department regarding a proposed or adopted Plan. (b) Pursuant to Water Code Section 10733.4, the Department shall establish a comment period of no less than 60 days for an adopted Plan that has been accepted by the Department for evaluation pursuant to Section 355.2. (c) In addition to the comment period required by Water Code Section 10733.4, the Department shall accept comments on an Agency's decision to develop a Plan as described in Section 353.6, including comments on elements of a proposed Plan under consideration by the Agency.	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission. 2. Parties may also comment on a GSA's (or GSAs') statements submitted under section 353.6 **Timing**: For GSP Submittal - *60 days after submission to DWR*
§ 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: (a) 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. (b) A list of public meetings at which the Plan was discussed or considered by the Agency. (c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency. (d) A communication section of the Plan that includes the following: (1) An explanation of the Agency's decision-making process. (2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.	5. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 6. Lists of public meetings 7. Inventory of comments and summary of responses 8. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions) **Timing**: For GSP Submittal – *with plan* For GSP Development – *continuous.* *[Note: activities should be included*

CODE	PUBLIC OUTREACH REQUIREMENT
(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin. (4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.	*in the project schedule and information posted on web.]*
§ 355.2. (c) Department Review of Adopted Plan (c) The Department (DWR) shall establish a period of no less than 60 days to receive public comments on the adopted Plan, as described in Section 353.8.	1. 60 day public review period for public comment on submitted plan. **Timing**: After GSP Submittal to DWR – *60 days*
§ 355.4. & 355.10 Criteria for Plan Evaluation The basin shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act. The Department shall evaluate an adopted Plan for compliance with this requirement as follows: (b) (4) Whether the interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected by the use of groundwater in the basin, have been considered. … (10) Whether the Agency has adequately responded to comments that raise credible technical or policy issues with the Plan.	1. Required public outreach and stakeholder information is submitted, including statement of issues and interests of beneficial users. 2. Public and stakeholder comments and questions adequately addressed during planning process. **Timing**: For GSP Submittal – *with plan* For resubmittal related to corrective action *– with submittal*

California Water Code

CODE	PUBLIC OUTREACH REQUIREMENT
10720. This part shall be known, and may be cited, as the “Sustainable Groundwater Management Act.” **10720.3** (a) This part applies to all groundwater basins in the state. … (c) The federal government or any federally recognized Indian tribe, appreciating the shared interest in assuring the sustainability of groundwater resources, may voluntarily agree to participate in the preparation or administration of a groundwater sustainability plan or groundwater management plan under this part through a joint powers authority or other agreement with local agencies in the basin. A participating tribe shall be eligible to participate fully in planning, financing, and management under this part, including eligibility for grants and technical assistance, if any exercise of regulatory authority, enforcement, or imposition and collection of fees is pursuant to	1. Tribes and the federal government may voluntarily participate in GSA governance and GSP development. **Timing**: *Prior to initiating development of a plan.*

CODE	PUBLIC OUTREACH REQUIREMENT
the tribe's independent authority and not pursuant to authority granted to a groundwater sustainability agency under this part.	
CHAPTER 4. Establishing Groundwater Sustainability Agencies [10723 - 10724]	
10723. a) Except as provided in subdivision (c), any local agency or combination of local agencies overlying a groundwater basin may decide to become a groundwater sustainability agency for that basin. (b) Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant to Section 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin.	1. Must hold public hearing in the county or counties overlying the basin, prior to becoming a GSA **Timing**: *Prior to becoming a GSA.*
10723.2 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 of the following: (a) Holders of overlying groundwater rights, including: (1) Agricultural users. (2) Domestic well owners. (b) Municipal well operators. (c) Public water systems. (d) Local land use planning agencies. (e) Environmental users of groundwater. (f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies. (g) The federal government, including, but not limited to, the military and managers of federal lands. (h) California Native American tribes. (i) Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems. (j) Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	1. Must consider interest of all beneficial uses and users of groundwater. 2. Includes specific stakeholders as listed. **Timing**: *During development of a GSP.*
10723.4. The groundwater sustainability agency shall establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents. Any person may request, in writing, to be placed on the list of interested persons.	3. Must establish and maintain an interested persons list. 4. Any person may ask to be added to the list **Timing**: *On forming a GSA.*
10723.8. (a) Within 30 days of deciding to become or form a groundwater sustainability agency, the local agency or combination of local agencies shall inform the department of its decision and its intent to undertake sustainable groundwater management. The	1. Creates notification requirements that include: a. A list of interested parties b. An explanation of how interests will be considered

CODE	PUBLIC OUTREACH REQUIREMENT
notification shall include the following information, as applicable: … (4) A list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan.	**Timing**: *On forming a GSA & with submittal of GSP*
10727.8 (a) Prior to initiating the development of a groundwater sustainability plan, the groundwater sustainability agency shall make available to the public and the department a written statement describing the manner in which interested parties may participate in the development and implementation of the groundwater sustainability plan. The groundwater sustainability agency shall provide the written statement to the legislative body of any city, county, or city and county located within the geographic area to be covered by the plan. The groundwater sustainability agency may appoint and consult with an advisory committee consisting of interested parties for the purposes of developing and implementing a groundwater sustainability plan. The groundwater sustainability agency shall 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. If the geographic area to be covered by the plan includes a public water system regulated by the Public Utilities Commission, the groundwater sustainability agency shall provide the written statement to the commission. (b) For purposes of this section, interested parties include entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	2. Agencies preparing a GSP must prepare a written statement describing the manner in which interested parties may participate in its development and implementation. 3. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public 4. GSP entities may form an advisory committee for the GSP preparation and implementation. 5. The GSP entities are to encourage active involvement of diverse social, cultural and economic elements of the affected populations. **Timing**: *On initiating GSP*
10728.4 Public Notice of Proposed Adoption, GSP Adoption Pubic Hearing A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment. The groundwater sustainability agency shall review and consider comments from any city or county that receives notice pursuant to this section and shall consult with a city or county that requests consultation within 30 days of receipt of the notice. Nothing in this section is intended to	3. GSP must be adopted or amended at Public Hearing. 4. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Notify cities and/or counties of geographic area 90 days in advance. b. Consider and review comments

<table>
<tr><th>CODE</th><th>PUBLIC OUTREACH REQUIREMENT</th></tr>
<tr><td>preclude an agency and a city or county from otherwise consulting or commenting regarding the adoption or amendment of a plan.</td><td>c. Conduct consultation within 30 days of receipt with cities or counties so requesting</td></tr>
<tr><td>10730 Fees.
(a) A groundwater sustainability agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve. A groundwater sustainability agency shall not impose a fee pursuant to this subdivision on a de minimis extractor unless the agency has regulated the users pursuant to this part.
(b) (1) Prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting, at which oral or written presentations may be made as part of the meeting.
(2) Notice of the time and place of the meeting shall include a general explanation of the matter to be considered and a statement that the data required by this section is available. The notice shall be provided by publication pursuant to Section 6066 of the Government Code, by posting notice on the Internet Web site of the groundwater sustainability agency, and by mail to any interested party who files a written request with the agency for mailed notice of the meeting on new or increased fees. A written request for mailed notices shall be valid for one year from the date that the request is made and may be renewed by making a written request on or before April 1 of each year.
(3) At least 20 days prior to the meeting, the groundwater sustainability agency shall make available to the public data upon which the proposed fee is based.
(c) Any action by a groundwater sustainability agency to impose or increase a fee shall be taken only by ordinance or resolution.
(d) (1) As an alternative method for the collection of fees imposed pursuant to this section, a groundwater sustainability agency may adopt a resolution requesting collection of the fees in the same manner as ordinary municipal ad valorem taxes.
(2) A resolution described in paragraph (1) shall be adopted and furnished to the county auditor-controller and board of supervisors on or before August 1 of each year that the alternative collection of the fees is being requested. The resolution shall include a list of parcels and the amount to be collected for each parcel.
(e) The power granted by this section is in addition to any powers a groundwater sustainability agency has under any other law.</td><td>Related to GSAs
5. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting.
6. Public notice shall include:
a. Time and place of meeting
b. General explanation of matter to be considered
c. Statement of availability for data required to initiate or amend such fees
d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance)
7. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year.
8. Includes procedural requirements per Government Code, Section 6066.

Timing: Prior to adopting fees.</td></tr>
</table>

California Government Code

CODE	PUBLIC OUTREACH REQUIREMENT
6060 Whenever any law provides that publication of notice shall be made pursuant to a designated section of this article, such notice shall be published in a newspaper of general circulation for the period prescribed, the number of times, and in the manner provided in that section. As used in this article, "notice" includes official advertising, resolutions, orders, or other matter of any nature whatsoever that are required by law to be published in a newspaper of general circulation. **6066** Publication of notice pursuant to this section shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. The period of notice commences upon the first day of publication and terminates at the end of the fourteenth day, including therein the first day.	4. Must publish notices in a newspaper of general circulation as prescribed. 5. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 6. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.) **Timing**: *Prior to adopting fees*

Appendix 2. Communications Governance

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[13] some form of communications governance is recommended.

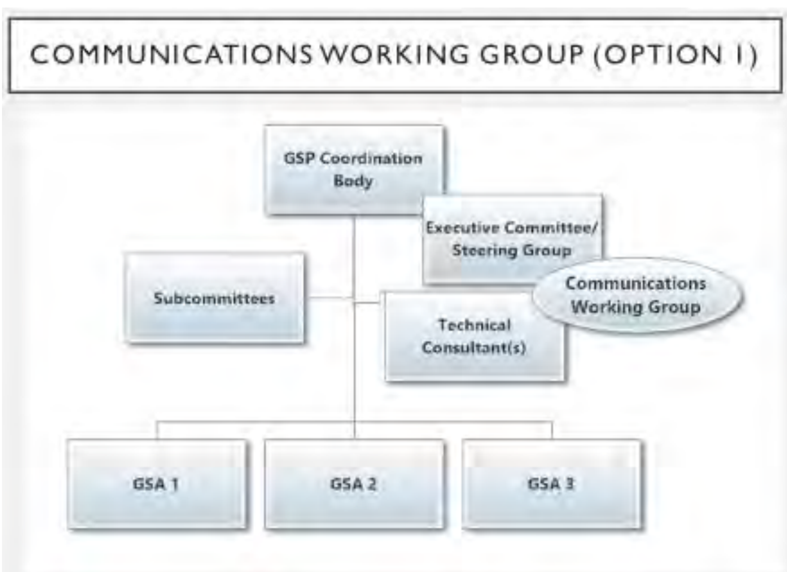
Execution of communications activities can be accomplished by an individual or multiple individuals, and/or include or be solely managed by project consultants. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. Also essential is a clear chain of command that ensures the elected representatives of GSAs are able to retain communications leadership and guidance.

A driving consideration for establishing a communications governance structure is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance to a communications team is efficient and effective.

Several governance options for consideration are offered below.

Communications Option 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based leadership function that is guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications working group that would ultimately report to the larger GSP coordinating body.



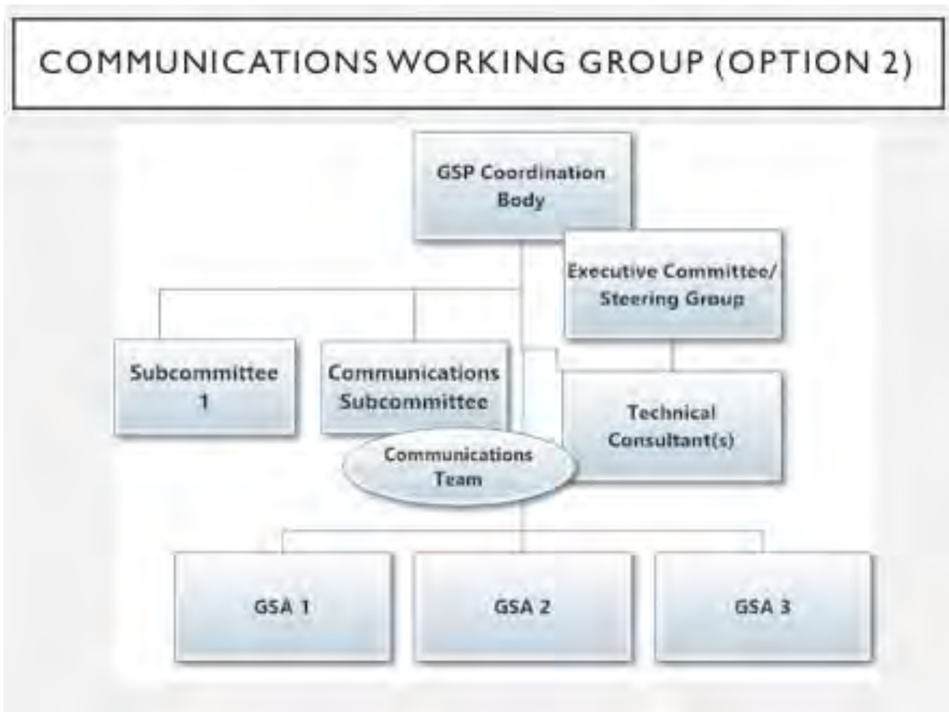
Communications Governance Option 1

Communications Option 2

[13] See Appendix 1

Appendix 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based subcommittee guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications team that is affiliated with a subcommittee and would ultimately report to the larger GSP coordinating body



Communications Governance Option 2

ATTACHMENT B. COORDINATED PUBLIC WORKSHOP SUMMARIES

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
SPRING 2018 COORDINATED WORKSHOPS

Monday, May 14, 2018, Los Banos
Wednesday, May 16, 2018, Patterson
Thursday, May 17, 2018, Mendota

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about the Sustainable Groundwater Management Act (SGMA) and introduce participants to their local Groundwater Sustainability Agency representatives. Topics covered during the workshop included what is SGMA, the Delta-Mendota Subbasin, and opportunities for public engagement.
- Workshop participants' questions and feedback are summarized as follows:
  - Are the local groundwater regulations going to be re-set on an annual basis based on the water year, snowpack, etc.?
  - Who is the governing board that will make these decisions?
  - If this is a state-wide initiative, who is the decision-making body?
  - Will the California Department of Fish and Wildlife be involved?
  - Has the State provided criteria to what is considered a "chronic loss" of groundwater?
  - Are natural springs included under SGMA?
  - What criteria will you use to measure whether or not springs are overused?
  - What is the ultimate goal of SGMA? What does it mean to us?
  - How is the water budget going to be developed?
  - The Irrigated Lands Program already has a lot of requirements for growers. Is this going to be the same level of detail and effort?
  - What is the goal SGMA is trying to achieve? How are we going to get to sustainability?
  - What will happen when the State and districts do not receive their full surface water allocation and cities keep expanding?
  - It seems to me that the biggest problem is that the State wants to export water to Southern California. How can we come up with a solution if there are factors out of our control?

- How will you know how much I am pumping?

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
FALL 2018 COORDINATED WORKSHOPS

Monday, October 22, Firebaugh
5:00 – 7:00 PM
Firebaugh Middle School MPR

Wednesday, October 24, Los Banos
4:00 – 6:00 PM
College Greens Building

Thursday, October 25, Patterson
4:00 – 6:00 PM
Patterson Senior Center

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about key Sustainable Groundwater Management Act (SGMA) topics in preparation for Groundwater Sustainability Plan (GSP) development workshops in 2019.
- The format and content of each workshop was the same. The workshops began with a 45-minute presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 45 individuals (not including GSA representatives and supporting staff) participated in the workshops. Attendance by location was as follows: Firebaugh – 5 participants; Los Banos – 23 participants; Patterson – 17 participants. Three participants requested Spanish interpretation.
- Most participants heard about the workshops through emails from their local water or irrigation district, or direct flyers and bill inserts sent to them by their water/irrigation district or municipality.
- Presentation topics included: Overview of SGMA, GSP development and implementation process, data management, hydrogeologic conceptual model, numerical and analytical models, and the water budget.
- Workshop participants' questions and feedback are summarized as follows:

  Data

    - How much historical data are the GSAs using to make their assumptions?
    - Will data from counties be used?

- Is the numerical data available on the Delta-Mendota website?
- How big will the GSAs' monitoring network be? Do the GSAs anticipate drilling new monitoring wells?
- How will the GSAs monitor water quality and subsidence? Do the GSAs already have subsidence monitoring wells and data?
- How much data have the GSAs gathered? When will the GSAs stop gathering data?
- How much data will the GSAs be collecting from individual landowners?

Models

- Will the models take into account availability of surface water supplies?
- Will the models take into account changing crops?
- Will the models take into account agricultural areas that are being converted to commercial or urban areas?

Water Budget and Sustainable Yield

- What is the sustainable yield for the Delta-Mendota Subbasin?
- It sounds like the sustainable yield will be a number that oscillates around a baseline. What is this baseline?
- How will the GSAs determine the minimum threshold for the subbasin?
- How will the water budgets account for existing and new wells?
- What are the years for the historic water budget? How was this period set?

Projects and Management Actions

- Based on what is currently known, will the GSAs be able to limit groundwater pumping in the future?
- When the GSAs come up with groundwater management policies, will the policies impact groundwater pumping on an individual level, regional level, or basin-wide level?
- Will the California Department of Water Resources (DWR) or the GSAs be the ones to limit pumping?
- Could a potential management action be limiting pumping?
- Will the GSAs be the agencies to determine if new wells can or cannot be drilled?

Integration with Other Programs/Organizations

- How much are the GSAs integrating with the Irrigated Lands Program?
- How closely do GSAs work with local farm bureaus?

Other

- Will there be an administrative fee for the GSAs to oversee GSP implementation?
- How will the costs for GSP development and implementation be covered?
- Do the GSAs know what DWR's GSP review and certification process will consist of?

- Will the GSAs in the region have influence over how surface water resources are managed on a state-wide level?
- How many GSAs were formed after SGMA passed in 2014?

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
WINTER 2019 COORDINATED WORKSHOPS

Tuesday, February 19, 2019, Los Banos
4:00 – 6:00 PM
College Greens Building

Wednesday, February 20, 2019, Patterson
4:00 – 6:00 pm
City of Patterson City Hall

Monday, March 4, 2019, Santa Nella
6:00 – 8:00 PM
Romero Elementary School

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin during February and March 2019. The purpose of the workshops was to educate stakeholders and members about the public about topics covered in the draft Groundwater Sustainability Plans (GSP) being developed for the subbasin. Topics covered during the workshop included historic and current water budgets, sustainability criteria, undesirable results, and projects and management actions.
- Workshops were promoted via emails sent to each GSA's interested parties database, flyers and utility bill inserts, and social media posts.
- The format and content of each workshop was the same. The workshops began with a short presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 30 individuals (not including GSA representatives and supporting staff) participated in the workshops. Attendance by location was as follows: Patterson – 14, Los Banos – 4, and Santa Nella – 12. Participants represented a range of beneficial users in the subbasin, including domestic well owners, agricultural water users, public water systems, and disadvantaged communities.

- Workshop participants' questions and feedback are summarized as follows:

  Water Budgets

  - Does the land surface budget include inflows from precipitation and applied water to crops?
  - Who provides the information about the inflows and outflows of the aquifer?
  - How is the aquifer recharged?
  - Do reservoirs lose water?
  - What happened between 1985 – now [regarding the historic water budget]?
  - What affect does precipitation have on the aquifer?

  Projects and Management Actions

  - Who will make the decision on who can drill wells and how much can well owners can pump?
  - Will GSAs in the subbasin be able to restrict selling of groundwater outside of the subbasin?
  - Projects and management actions should emphasize flood and stormwater capture and increased stormwater storage.
  - Will use of recycled water in new developments be considered a source of water to balance the water budget?
  - Are there percolation ponds by golf course?

  Sustainability Criteria and Undesirable Results

  - Is it the GSAs' responsibility to set the sustainability criteria for the subbasin?
  - Could this region experience seawater intrusion?
  - What's going to happen in areas like Dos Palos that have poor groundwater quality?

  Other

  - Does the GSP only cover of agricultural uses of groundwater or does it also cover residential and commercial uses of groundwater?
  - Who is doing the work to prepare the GSP?
  - How much does it cost to prepare a GSP?
  - Are there any agencies currently monitoring groundwater pumping and levels?
  - How is groundwater currently being removed from the groundwater basin?
  - How many monitoring stations have been identified? Have GSAs already identified where these monitoring pumps are?
  - Does the California Aqueduct affect the water table in the subbasin?
  - What is the rationale for the North-Central GSP group's boundaries? The north and south areas of the North-Central GSP group are very different.
  - Do water agencies in the subbasin send water to the Santa Clara Valley Water District?
  - Where are the coordinated meetings are held? What time are these meetings?
  - Will this raise our water rates?
  - The community of Tranquillity is currently experiencing land subsidence.

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
SPRING 2019 COORDINATED WORKSHOPS

Monday, May 20, 2019, Patterson
4:00 – 6:00 pm
City of Patterson City Hall

Tuesday, May 21, 2019, Los Banos
4:00 – 6:00 PM
College Greens Building

Wednesday, May 22, 2019, Santa Nella
6:30 – 8:30 PM
Romero Elementary School

Thursday, May 23, 2019, Mendota
6:00 – 8:00 PM
Mendota Library

WORKSHOP SUMMARY

- Four workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about topics covered in the draft Groundwater Sustainability Plans (GSP) being developed for the subbasin. Topics covered during the workshop included water budgets, sustainable yield, projects and management actions, and groundwater monitoring networks.
- Workshops were promoted via emails sent to each GSA's interested parties database, flyers and utility bill inserts, social media posts, and direct outreach to community stakeholders.
- The format and content of each workshop was the same. The workshops began with a short presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 30 individuals participated in the workshops. Attendance by location was as follows: Patterson – 7, Los Banos – 10, Santa Nella – 4, and Mendota – 9. Participants represented a range of beneficial users in the subbasin, including domestic well owners, agricultural water users, public water systems, and disadvantaged communities.

- Workshop participants' questions and feedback are summarized as follows:

  Water Budgets

    - Why is there a difference between the water budgets for the upper and lower aquifers?
    - Why is the change in storage negative?
    - Is there a water budget for each aquifer?
    - When the projected water budgets are finalized, will they include specific projects and management actions?
    - How was the data for the climate change factors developed?
    - Historically, California goes through periodic droughts. Do the projected water budgets account for future droughts?
    - Do the projected water budgets account for future population growth and new developments?
    - Do the water budgets account for percolation from water applied to crops?

  Projects and Management Actions

    - Will management actions include a charge for water pumping?
    - Will pumping restrictions be implemented during dry periods or drought?
    - Will the GSPs identify specific projects and management actions?
    - Will GSAs in the subbasin form a water bank?
    - If pumping restrictions are enacted, GSPs should include a provision that allows private well owners to demonstrate that they aren't overpumping or causing undesirable results.
    - The region needs more surface water storage to supplement groundwater pumping.
    - There should be restrictions on development in the region.

  Sustainable Yield

    - Does increases in groundwater demand relate to the cost of surface water supplies?

  Groundwater Monitoring

    - When local agencies monitor for groundwater, how far down do they monitor?

  GSP Adoption, Implementation and Enforcement

    - What agency approves the GSPs?
    - Will the California Department of Water Resources be the lead agency for providing oversight after the GSP is submitted?
    - Could the State Water Resources Control Board mandate pumping restrictions?
    - Will the state be looking at the drawdown of individual, private wells?
    - Where does the funding to implement GSPs come from?
    - How much will GSP implementation cost?
    - Who has to submit the annual report?

  Other

    - GSAs should be divided into even smaller units to manage projects and management actions locally.

ATTACHMENT C. EXAMPLE PUBLIC WORKSHOP PROMOTION MATERIALS

Groundwater management in our community is changing.

Learn more about how this may impact you.

Collaborating local agencies are hosting a series of public workshops about the Sustainable Groundwater Management Act. Come learn how this landmark legislation may impact our community, what we are doing about it, and how you can get involved. Representatives from local groundwater sustainability agencies will be available to answer questions. You have three opportunities to attend:

Los Banos
Monday, May 14
4:00 - 6:00 PM
San Luis & Delta-Mendota
Water Authority Office
842 6th St, Los Banos

Patterson
Wednesday, May 16
4:00 - 6:00 PM
Hammon Senior Center
1033 W Las Palmas Ave, Patterson

Mendota
Thursday, May 17
4:00 - 6:00 PM
Mendota Branch Library
Mendota Meeting Room
1246 Belmont Ave, Mendota

The content of each workshop will be the same. The first thirty minutes of each workshop will consist of an informational presentation, followed by an open house until 6:00 PM. For more information, please visit our website at: www.deltamendota.org.

We look forward to seeing you there!

El manejo del agua subterránea en nuestra comunidad está cambiando.

Obtenga más información sobre como esto puede afectarlo.

Las agencias locales colaboradoras están organizando una serie de talleres públicos sobre la Ley de gestión sostenible del agua subterránea. Venga y aprenda como esta histórica legislación puede afectar a nuestra comunidad, que estamos haciendo al respecto y como puede participar. Los representantes de las agencias locales de sostenibilidad del agua subterránea estarán disponibles para responder preguntas. Tienes tres oportunidades para asistir:

Los Baños
Martes, 14 de Mayo
4:00 - 6:00 PM
San Luis & Delta-Mendota
Water Authority Office
842 6th St, Los Baños

Patterson
Miércoles, 16 de Mayo
4:00 - 6:00 PM
Hammon Senior Center
1033 W Las Palmas Ave, Patterson

Mendota
Jueves, 17 de Mayo
4:00 - 6:00 PM
Mendota Branch Library
Mendota Meeting Room
1246 Belmont Ave, Mendota

El contenido de cada taller será el mismo. Los primeros treinta minutos de cada taller serán consisten de una presentación informativa, seguida de una jornada de puertas abiertas hasta las 6:00 P.M. Para obtener más información, visite nuestro sitio web en: www.deltamendota.org.

Public Notice

Public Groundwater Meeting

Santa Nella County Water District and other local water agencies are developing plans for the future of our groundwater resources. We want to hear from you! Come to an upcoming public workshop to learn more:

Santa Nella
Monday, March 4, 6:000 - 8:00 PM
Romero Elementary School MPR
13500 Luis Ave, Gustine, CA 95322

The first forty minutes of the workshop will consist of a bilingual informational presentation. The presentation will be followed by an interactive discussion on the region's groundwater "budget" and how to define "sustainability" for our groundwater resources. This workshop is open to people with all level of knowledge about water.

Spanish-language interpreters and materials will be available.

For more information, please visit our website at www.deltamendota.org and www.sncwd.com.

For questions or comments, email DMSGMA@sldmwa.org or contact Amy Montgomery, Santa Nella County Water District, at amontgomery@sncwd.com.

We look forward to seeing you there!

Engage in the Future of Our Water Resources!

Week of May 20th

Delta-Mendota SGMA invite you to learn why your local agencies are developing groundwater sustainability plans for the future of our groundwater. Please come to one

- **Patterson**: Mon., May 20, 4:00 – 6:00pm Patterson City Hall 1 Plaza Circle
- **Los Banos**: Tue., May 21, 4:00 – 6:00pm College Greens Building 1815 Scripps Drive
- **Santa Nella**: Wed., May 22, 6:30 – 8:30pm Romero Elem. School 13500 Luis Ave.
- **Mendota**: Thu., May 23, 6:00 – 8:00pm Mendota Library 1246 Belmont Ave.

For more information please visit www.deltamendota.org, To register visit: tinyurl.com/y3bxw3yv

PROP 1 WATER BOND 2014

#DeltaMendotaSGMA | #SLDMWA | #SGMA2020

DELTA-MENDOTA SGMA

Su Opinión es Importante!

Participe en una serie de talleres sobre el futuro de sus recursos hídricos!

Semana del 20 de mayo

Agencias locales están desarrollando planes de sostenibilidad para el futuro de los recursos hídricos del agua subterránea en la región y necesitan su opinión.
Acompáñenos en uno de los siguientes talleres:

- Patterson: Lun.,20 de Mayo , 4–6pm Ayuntamiento de Patterson 1 Plaza Circle
-Los Banos: Mar., 21 de May, 4–6pm College Greens Building 1815 Scripps Dr.
-Santa Nella: Mie., 22 de Mayo, 6:30–8:30pm Escuela Pri. Romero 13500 Luis Ave.
-Mendota: Jue., 23 de Mayo, 6–8pm Biblioteca de Mendota 1246 Belmont Ave.

PROP 1 WATER BOND 2014

Para más información visite:
www.deltamendota.org
Tel: 916-418-8288
#DeltaMendotaSGMA | #SLDMWA

DELTA-MENDOTA SGMA

DELTA-
MENDOTA
SGMA

Contact: Kirsten Pringle, Delta-Mendota Subbasin, Stantec
(916) 418-8243, Kirsten.Pringle@stantec.com

FOR IMMEDIATE RELEASE
October 19, 2018

MEDIA ADVISORY

Sustainable Groundwater Management Act Public Workshops

What: Collaborating local agencies are hosting a series of public workshops about the Sustainable Groundwater Management Act. Learn how this landmark legislation may impact our communities, the planning process, and how people can get involved. Spanish translation will be provided.

Format: There are three workshop opportunities to attend; the content of each workshop will be the same. The first 45 minutes of each workshop will consist of an informational presentation, followed by an open house.

When:

Firebaugh – Monday, October 22, 2018
5:00 - 7:00 PM
Firebaugh Middle School MPR
1600 16th Street, Firebaugh, CA

Los Banos – Wednesday, October 24, 2018
4:00 – 6:00 PM
College Greens Building
1815 Scripps Drive, Los Banos, CA

Patterson – Thursday, October 25, 2018
4:00 – 6:00 PM
Hammon Senior Center
1033 W. Las Palmas Avenue, Patterson, CA

Who: Representatives from local groundwater sustainability agencies will be available to answer questions.

Additional Resources: The Sustainable Groundwater Management Act, www.deltamendota.org/,

Background: *The Sustainable Groundwater Management Act (SGMA) is a package of three bills (AB 1739, SB 1168, and SB 1319) that provides local agencies with a framework for managing groundwater basins in a sustainable manner. Recognizing that groundwater is most effectively managed at the local level, the SGMA empowers local agencies to achieve sustainability within 20 years.*

ATTACHMENT D. STAKEHOLDER AND COMMUNITY ORGANIZATIONS CONTACTED REGARDING COORDINATED PUBLIC WORKSHOPS

Stakeholder and Community Organizations Contacted Regarding Coordinated SGMA Workshops

Organization Name	Organization Type
Fresno County Farm Bureau	Agriculture
Merced County Farm Bureau	Agriculture
North Grassland Wildlife Foundation	Agriculture
Patterson Apricot Fiesta	Agriculture
Stanislaus County Farm Bureau	Agriculture
Asociación de Charros La Internacional del Valle de Patterson	Business
Adobe Valley Ranch	Business
Gustine Chamber of Commerce	Business
Los Banos Chamber of Commerce	Business
Patterson-Westley Chamber of Commerce	Business
Santa Nella Chamber of Commerce	Business
American Association of University Women	Civic
Gustine Rotary Club	Civic
International Association of Lions Clubs - Patterson	Civic
League of United Latin American Citizens	Civic
Los Banos Lions Club	Civic
Los Banos Rotary Club	Civic
Mendota Community Corporation	Civic
Newman Lions Club	Civic
Newman Rotary Club	Civic
Newman Women's Club	Civic
Patterson Lions Club	Civic
International Association of Lions Clubs - Mendota	Civic
International Association of the Lions Clubs - Los Banos	Civic
Italian Catholic Federation of CA Inc.	Civic
Kiwanis International	Civic
Rotary International - Los Banos	Civic
Rotary International - Patterson	Civic
Firebaugh Rotary Club Inc.	Community General Public
Casa Mobile Home Park	Community/General Public
Center for Environmental Science Accuracy & Reliability	Community/General Public
Firebaugh Senior Center	Community/General Public
Friends of Green Valley Charter	Community/General Public
Friends of the Public Library	Community/General Public
Habitat for Humanity International	Community/General Public
Los Banos Senior Center	Community/General Public
Mendota Community Center	Community/General Public
Mendota Senior Center	Community/General Public
Merced County Library - Dos Palos	Community/General Public
Merced County Library - Gustine	Community/General Public
Merced County Library - Los Banos	Community/General Public
Merced County Library - Santa Nella	Community/General Public
San Joaquin River Resource Mgmt. Coalition	Community/General Public

Santa Nella RV Park	Community/General Public
Stanislaus County Library - Newman	Community/General Public
Stanislaus County Library - Patterson	Community/General Public
Dos Palos Oro Loma Joint Unified School District	Education
Firebaugh-Las Deltas Unified School District	Education
Gustine Unified School District	Education
Los Banos Unified School District	Education
Mendota Unified School District	Education
Merced College	Education
Creekside Parent Club	Education
Academy West Insurance	Other
Academy West Insurance Firebaugh	Other
Amaral & Associates Realty	Other
American Legion	Other
American Legion Auxiliary Elijah B Hayes	Other
Andrea Brandt State Farm Insurance	Other
Benevolent & Protective Order of Elks	Other
Borelli Real Estate Services	Other
California Garden Clubs Inc.	Other
Century 21 M&M & Assoc - Los Banos	Other
Century 21 M&M & Assoc - Patterson	Other
Coldwell Banker Kaljian & Assoc	Other
Eric Rodriguez - Patterson	Other
Farmers Insurance Antonio Gonzales	Other
First Prioirty of the Central Valley	Other
Greg Nunes Real Estate	Other
Joe G. Gutierez State Farm Insurance	Other
Mendota Land Co	Other
Noah’s Ark Foundation of Tracy Inc.	Other
PMZ Real Estate - Patterson	Other
PMZ Real Estate - Los Banos	Other
Rafael Ruiz - Patterson	Other
Shane P. Donion Ranch Broker	Other
The Boyd Company	Other
Valley West Properties	Other
Adventure Christian Church of Patterson	Religious
Agape Baptist Church	Religious
Bethel Community Church	Religious
Church of Christ of Patterson	Religious
Church of God of Prophecy	Religious
Connections Christian Church	Religious
Evangelical Church of Los Banos	Religious
Family Christian Center	Religious
First Baptist Church	Religious
Full Gospel Businessmen’s Fellowship International	Religious
Harvest Samoan Assembly of God	Religious

Mountain House Foursquare Church	Religious
Movimiento Familiar Cristiano Catolico	Religious
Patterson Covenant Church	Religious
Patterson Christian Fellowship	Religious
Patterson Seventh Day Adventist Church	Religious

Appendix C - Checklist for GSP Submittal

Checklist for Submittal of Delta-Mendota Subbasin Coordinated GSPs

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 3. Technical and Reporting Standards				
352.2		Monitoring Protocols	• Monitoring protocols adopted by the GSA for data collection and management • Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin	• Section 6 – Subbasin Monitoring Program; Section 7 – Subbasin Data Collection and Management • Appendix B, Technical Memorandum (TM) #5 (Assumptions for Delta-Mendota Subbasin Monitoring Network), TM #6 (Coordination of the Delta-Mendota Subbasin Data Management System)
Article 5. Plan Contents, Subarticle 1. Administrative Information				
354.4		General Information	• Executive Summary • List of references and technical studies	• See individual GSPs • Section 9 – References and individual GSPs
354.6		Agency Information	• GSA mailing address • Organization and management structure • Contact information of Plan Manager • Legal authority of GSA • Estimate of implementation costs	• Section 2 – Delta-Mendota Subbasin Governance; Section 2.1 GSA and GSP Coordination and Governance • See individual GSPs for estimate of implementation costs
354.8(a)	10727.2(a)(4)	Map(s)	• Area covered by GSP • Adjudicated areas, other agencies within the basin, and areas covered by an Alternative • Jurisdictional boundaries of federal or State land • Existing land use designations • Density of wells per square mile	• Figure CC-1: Delta-Mendota Subbasin and GSP Regions • Figure CC-18: Land Use Planning Entities • Figure CC-19: Federal and State Lands • Figure CC-20: 2014 Land Use in the Delta-Mendota Subbasin • Figures CC-13 through CC-15: Domestic, Production, and Public Well Density in the Delta-Mendota Subbasin
354.8(b)		Description of the Plan Area	• Summary of jurisdictional areas and other features	Section 3 – Delta-Mendota Subbasin Plan Area

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 5. Plan Contents, Subarticle 1. Administrative Information (Continued)				
354.8(f)	10727.2(g)	Land Use Elements or Topic Categories of Applicable General Plans	• Summary of general plans and other land use plans • Description of how implementation of the GSP may change water demands or affect achievement of sustainability and how the GSP addresses those effects • Description of how implementation of the GSP may affect the water supply assumptions of relevant land use plans • Summary of the process for permitting new or replacement wells in the basin • Information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management	• Section 3.3 – General Plans in Plan Area • See individual GSPs for description of implementation impacts on water demands and sustainability • Section 3.4 – Existing Land Use Plans and Impacts to Sustainable Groundwater Management • Section 3.6 – County Well Construction/Destruction Standards & Permitting • Section 3.3 – General Plans in Plan Area
354.8(c) 354.8(d) 354.8(e)	10727.2(g)	Water Resource Monitoring and Management Programs	• Description of water resources monitoring and management programs • Description of how the monitoring networks of those plans will be incorporated into the GSP • Description of how those plans may limit operational flexibility in the basin • Description of conjunctive use programs	Section 3.5 – Existing Water Resources Monitoring and Management Plans; Section 3.7 – Existing and Planned Conjunctive Use Programs

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 5. Plan Contents, Subarticle 1. Administrative Information (Continued)				
354.8(g)	10727.4	Additional GSP Contents	Description of Actions related to: • Control of saline water intrusion • Wellhead protection • Migration of contaminated groundwater • Well abandonment and well destruction program • Replenishment of groundwater extractions • Conjunctive use and underground storage • Well construction policies • Addressing groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects • Efficient water management practices • Relationships with State and federal regulatory agencies • Review of land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity • Impacts on groundwater dependent ecosystems	Section 3.8 – Plan Elements from California Water Code Section 10727.4
354.10		Notice and Communication	• Description of beneficial uses and users • List of public meetings • GSP comments and responses • Decision-making process • Public engagement • Encouraging active involvement • Informing the public on GSP implementation progress	• Section 8 – Stakeholder Outreach • Appendix B, TM #8 (Coordinated Noticing, Communication, and Outreach Activities in the Delta-Mendota Subbasin)
Article 5. Plan Contents, Subarticle 2. Basin Setting				
354.14		Hydrogeologic Conceptual Model	• Description of the Hydrogeologic Conceptual Model • Two scaled cross-sections • Map(s) of physical characteristics: topographic information, surficial geology, soil characteristics, surface water bodies, source and point of delivery for imported water supplies	• Section 4.1 – Hydrogeologic Conceptual Model • Appendix B, TM #2 (Assumptions for Hydrogeologic Conceptual Model of the Delta-Mendota Subbasin)

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 5. Plan Contents, Subarticle 2. Basin Setting (Continued)				
354.14(d)(4)	10727.2(a)(5)	Map of Recharge Areas	• Map delineating existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas	Figure CC-39: Recharge Areas, Seeps and Springs
	10727.2(d)(4)	Recharge Areas	• Description of how recharge areas identified in the plan substantially contribute to the replenishment of the basin	Section 4.1.10 – Topography, Surface Water, Recharge, and Imported Supplies
354.16	10727.2(a)(1) 10727.2(a)(2)	Current and Historical Groundwater Conditions	• Groundwater elevation data • Estimate of groundwater storage • Seawater intrusion conditions • Groundwater quality issues • Land subsidence conditions • Identification of interconnected surface water systems • Identification of groundwater-dependent ecosystems	Section 4.2 – Delta-Mendota Subbasin Groundwater Conditions
354.18	10727.2(a)(3)	Water Budget Information	• Description of inflows, outflows, and change in storage • Quantification of overdraft • Estimate of sustainable yield • Quantification of current, historical, and projected water budgets	• Section 4.3 – Delta-Mendota Subbasin Water Budgets • Appendix B, TM #3 (Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield)
	10727.2(d)(5)	Surface Water Supply	• Description of surface water supply used or available for use for groundwater recharge or in-lieu use	Section 4.3 – Delta-Mendota Subbasin Water Budgets
354.20		Management Areas	• Reason for creation of each management area • Minimum thresholds and measurable objectives for each management area • Level of monitoring and analysis • Explanation of how management of management areas will not cause undesirable results outside the management area • Description of management areas	• Appendix B, TM #4 (Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria) • See individual GSPs

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria				
354.24		Sustainability Goal	• Description of the sustainability goal	Section 5.2 – Coordinated Sustainability Goal and Undesirable Results
354.26		Undesirable Results	• Description of undesirable results • Cause of groundwater conditions that would lead to undesirable results • Criteria used to define undesirable results for each sustainability indicator • Potential effects of undesirable results on beneficial uses and users of groundwater	• Section 5.2 – Coordinated Sustainability Goal and Undesirable Results • Section 5.4 – Delta-Mendota Subbasin Sustainable Management Criteria (Tables CC-14 through CC-18) • Appendix B, TM #4 (Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria)
Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria (Continued)				
354.28	10727.2(d)(1) 10727.2(d)(2)	Minimum Thresholds	• Description of each minimum threshold and how they were established for each sustainability indicator • Relationship for each sustainability indicator • Description of how selection of the minimum threshold may affect beneficial uses and users of groundwater • Standards related to sustainability indicators • How each minimum threshold will be quantitatively measured	• Section 5.4 – Delta-Mendota Subbasin Sustainable Management Criteria (Tables CC-14 through CC-18) • Appendix B, TM #4 (Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria)
354.30	10727.2(b)(1) 10727.2(b)(2) 10727.2(d)(1) 10727.2(d)(2)	Measurable Objectives	• Description of establishment of the measurable objectives for each sustainability indicator • Description of how a reasonable margin of safety was established for each measurable objective • Description of a reasonable path to achieve and maintain the sustainability goal, including a description of interim milestones	• Section 5.4 – Delta-Mendota Subbasin Sustainable Management Criteria (Tables CC-14 through CC-18) • Appendix B, TM #4 (Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria)

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 5. Plan Contents, Subarticle 4. Monitoring Networks				
354.34	10727.2(d)(1) 10727.2(d)(2) 10727.2(e) 10727.2(f)	Monitoring Networks	• Description of monitoring network • Description of monitoring network objectives • Description of how the monitoring network is designed to: demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features; estimate the change in annual groundwater in storage; monitor seawater intrusion; determine groundwater quality trends; identify the rate and extent of land subsidence; and calculate depletions of surface water caused by groundwater extractions • Description of how the monitoring network provides adequate coverage of Sustainability Indicators • Density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends • Scientific rational (or reason) for site selection • Consistency with data and reporting standards • Corresponding sustainability indicator, minimum threshold, measurable objective, and interim milestone • 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 • Description of technical standards, data collection methods, and other procedures or protocols to ensure comparable data and methodologies	• Section 6 – Subbasin Monitoring Program • Appendix B, TM #5 (Assumptions for Delta-Mendota Subbasin Monitoring Network) • Section 7 – Subbasin Data Collection and Management

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
354.36		Representative Monitoring	• Description of representative sites • Demonstration of adequacy of using groundwater elevations as proxy for other sustainability indicators • Adequate evidence demonstrating site reflects general conditions in the area	• Section 6 – Subbasin Monitoring Program • Appendix B, TM #5 (Assumptions for Delta-Mendota Subbasin Monitoring Network)
Article 5. Plan Contents, Subarticle 4. Monitoring Networks (Continued)				
354.38		Assessment and Improvement of Monitoring Network	• Review and evaluation of the monitoring network • Identification and description of data gaps • Description of steps to fill data gaps • Description of monitoring frequency and density of sites	• Section 6 – Subbasin Monitoring Program • Appendix B, TM #5 (Assumptions for Delta-Mendota Subbasin Monitoring Network)
Article 5. Plan Contents, Subarticle 5. Projects and Management Actions				
354.44		Projects and Management Actions	• Description of projects and management actions that will help achieve the basin's sustainability goal • Measurable objective that is expected to benefit from each project and management action • Circumstances for implementation • Public noticing • Permitting and regulatory process • Timetable for initiation and completion, and the accrual of expected benefits • Expected benefits and how they will be evaluated • 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. • Legal authority required • Estimated costs and plans to meet those costs • Management of groundwater extractions and recharge	See individual GSPs
354.44(b)(2)	10727.2(d)(3)		• Overdraft mitigation projects and management actions	See individual GSPs

GSP Regulations Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 8. Interagency Agreements				
357.4	10727.6	Coordination Agreements - Shall be submitted to the Department together with the GSPs for the basin and, if approved, shall become part of the GSP for each participating Agency.	Coordination Agreements shall describe the following: • A point of contact • Responsibilities of each Agency • Procedures for the timely exchange of information between Agencies • Procedures for resolving conflicts between Agencies • How the Agencies have used the same data and methodologies to coordinate GSPs • How the GSPs implemented together satisfy the requirements of SGMA • Process for submitting all Plans, Plan amendments, supporting information, all monitoring data and other pertinent information, along with annual reports and periodic evaluation • A coordinated data management system for the basin • Coordination agreements shall identify adjudicated areas within the basin, and any local agencies that have adopted an Alternative that has been accepted by the Department	• Section 2.1.2 – Intra-Basin Coordination; Section 2.1.3 – Inter-basin Agreements • Appendix B, TM #1 (Common Datasets and Assumptions used in the Delta-Mendota Subbasin GSPs), TM #6 (Coordination of the Delta-Mendota Subbasin Data Management System), TM #7 (Adoption and Use of the Subbasin Coordination Agreement)

Appendix D - Interbasin Agreements

Inter-Basin Agreement Between Northern & Central Delta-Mendota GSP Region and Westlands Water District

DATA SHARING AGREEMENT

Westlands Water District (Westlands) and the San Luis & Delta-Mendota Water Authority, on behalf of the Northern Delta-Mendota Region GSAs and the Central Delta-Mendota Region Multi-Agency GSA (GSAs), (collectively the Parties) desire to establish a set of common assumptions on groundwater conditions on either side of the boundary between Westlands' service area and the Delta-Mendota Subbasin to be used for development of Groundwater Sustainability Plans (GSPs) related to the implementation of the Sustainable Groundwater Management Act (SGMA). To further that effort to develop a set of common assumptions, the Parties agree to provide each other with the following recorded, measured, estimated and/or simulated modeling data located within five (5) miles of the boundary between Westlands' service area and the Delta-Mendota Subbasin:

- Well location (latitude and longitude, preferably in a GIS shapefile)
- Ground surface elevation at well location, including elevation datum
- Depth to groundwater readings from 1960s to present as available per well (preferably in excel or electronic tabular format)
- Water surface elevation (if already in tabular format, otherwise it will be calculated from elevation less depth measured)
- Well driller's log (if available)
- Well information (perforated intervals, seal depth, pumping capacity, water quality, etc., if available)
- Agricultural practices (crop type, irrigation method (flood or drip), surface or groundwater application, etc., if available)
- Canal and irrigation ditch Information (location, dimension, flow direction, etc., if available)
- Tile drain (location, depth, discharge, flow direction, etc., if available)
- Subsidence data (if available)
- Historical reports and associated data, including but not limited to the Grasslands Groundwater Quality Assessment Report

The Parties understand that the requested data will be shared with their consultants, to other stakeholders in their respective basins, and that the information may be made public through the development of Westlands' and the Northern and Central Delta-Mendota Region GSA's respective GSPs and the supporting documentation for those GSPs. Other than publishing information for such purposes, neither Party will disclose the other Party's information to any third party, except if that other Party determines, at its sole discretion, the disclosure is required by law. Each Party may review preliminary results before publishing the information; provided that if a review of preliminary results is desired, the Party seeking to review will make that request in writing to the other party.

The Parties and their authorized representatives, by signatures below, agree to the Data Sharing Agreement.

Note: Return one signature copy to WWD

Westlands Water District:
By: ______________________
Title: CHIEF OPERATING OFFICER
Date: 4/23/18

SLDMWA on behalf of the Parties:
By: ______________________
Title: Assistant Executive Director
Date: 4/12/18

Note: Return one signature copy to WWD

Inter-Basin Agreement Between San Joaquin River Exchange Contractors GSP Region and Westlands Water District

DATA SHARING AGREEMENT

Westlands Water District (Westlands) and Central California Irrigation District (CCID), (collectively the Parties) desire to establish a set of common assumptions on groundwater conditions on either side of the boundary between Westlands' service area and the Delta-Mendota Subbasin to be used for development of Groundwater Sustainability Plans (GSPs) related to the implementation of the Sustainable Groundwater Management Act (SGMA). To further that effort to develop a set of common assumptions, the Parties agree to provide each other with the following recorded, measured, estimated and/or simulated modeling data located within five (5) miles of the boundary between Westlands' service area and the Delta-Mendota Subbasin:

- Well location (latitude and longitude, preferably in a GIS shapefile)
- Ground surface elevation at well location, including elevation datum
- Depth to groundwater readings from 1960s to present as available per well (preferably in excel or electronic tabular format)
- Water surface elevation (if already in tabular format, otherwise it will be calculated from elevation less depth measured)
- Well driller's log (if available)
- Well information (perforated intervals, seal depth, pumping capacity, water quality, etc., if available)
- Agricultural practices (crop type, irrigation method (flood or drip), surface or groundwater application, etc., if available)
- Canal and irrigation ditch Information (location, dimension, flow direction, etc., if available)
- Tile drain (location, depth, discharge, flow direction, etc., if available)
- Subsidence data (if available)
- Historical reports and associated data, including but not limited to the Grasslands Groundwater Quality Assessment Report

The Parties understand that the information will be shared with their consultants, to other stakeholders in their respective basins, and that the information will be made public through the development of Westlands' and CCID's GSA's respective GSPs and the supporting documentation for those GSPs. Other than publishing information for such purposes, neither Party will disclose the other Party's information to any third party, except if that other Party determines, at its sole discretion, the disclosure is required by law. Each Party may review preliminary results before publishing the information, provided that if a review of preliminary results is desired, the Party seeking to review will make that request in writing to the other party.

The Parties and their authorized representatives, by signatures below, agree to the Data Sharing Agreement.

Westlands Water District:	Central California Irrigation District:
By: [signature]	By: [signature]
Title: CHIEF OPERATING OFFICER	Title: General Manager
Date: May 16, 2018	Date: 5-14-18

Note: Return one signature copy to WWD

Appendix E - Delta-Mendota Subbasin Communications Plan

Common Chapter for the Delta-Mendota Subbasin Groundwater Sustainability Plan

Delta Mendota Subbasin Groundwater Management

Sustainable Groundwater Management Act Communications Plan

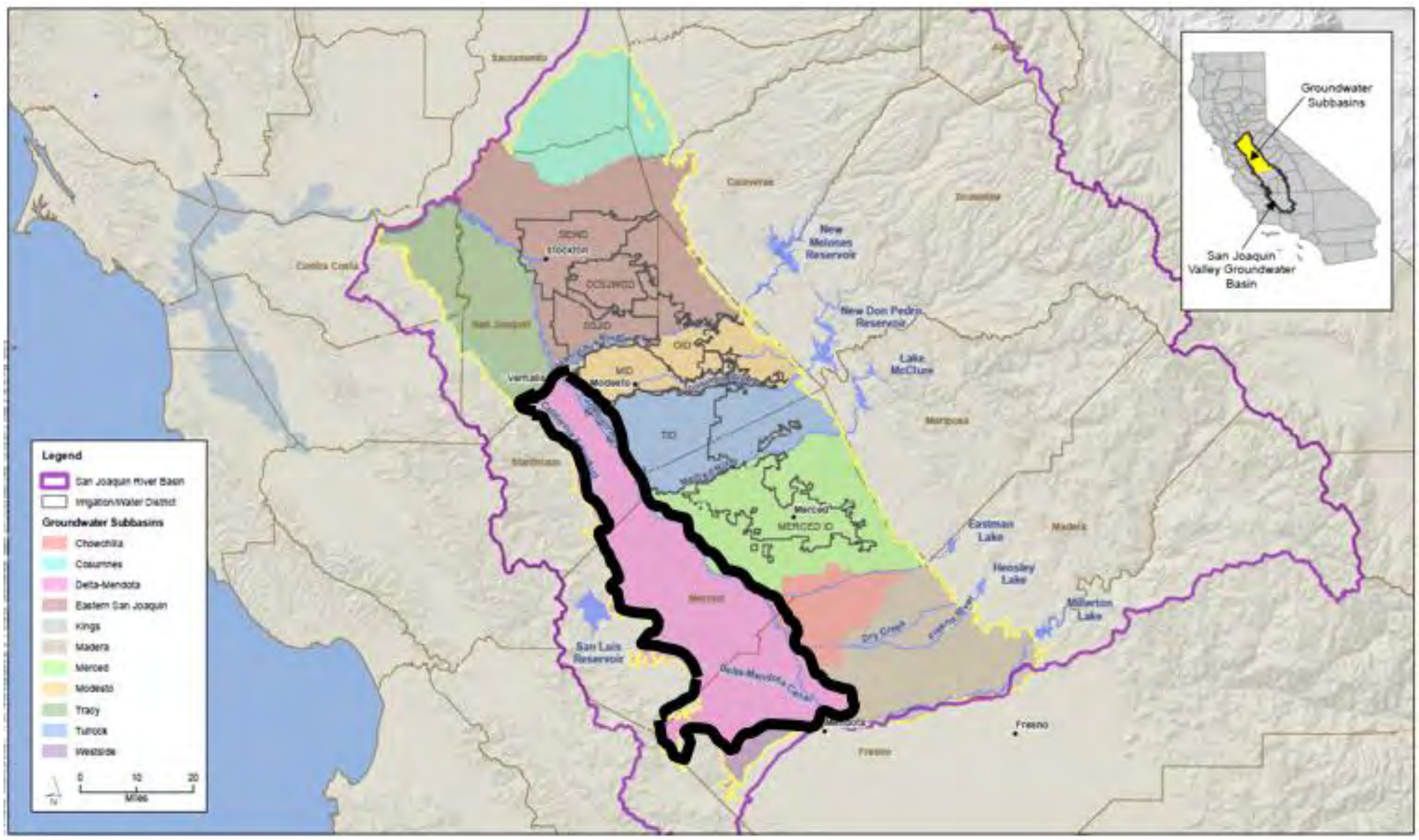


Figure 9-1
Vicinity Map of Groundwater Subbasins

Prepared by:
Lisa Beutler, MWH/Stantec,
Via CA Dept. of Water Resources,
Facilitation Services Technical Assistance

June 2017

MWH
Stantec

Forward: How to use this Plan

This Communication Plan provides a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. Its purpose is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. It is presented as a working public draft, and should be considered a living document that is continuously refined and updated as circumstances suggest.

Chapter 1*:* *Introduction and Background* provides text and information about SGMA and the Delta Mendota Subbasin that can be repurposed directly into websites or printed materials by agencies and/or entities with an interest in SGMA and how it will affect the subbasin. This section also describes the communications activities mandated by SGMA.

Chapter 2: *Communications Plan Overview* provides communications planning goals and objectives as well as the scope. This section can be used in support of project management activities.

Chapter 3: *Situation Assessment* provides some of the context for communications activities. This section can be used in developing required assessments of stakeholder issues and interests. It also informs project management activities.

Chapter 4: *Audiences and Messages* identifies key subbasin audiences and message points for specific audience segments. The goal of this chapter is to provide information that can be used by the subbasin GSAs in preparing to work with key stakeholders.

Chapter 5: *Risk Management* is the summary of a communications risk assessment that considers subbasin communications strengths and weakness and proposes on-going adjustments based on best communication management practices. This section informs project management activities and provides a context for some of the recommended communications tactics.

Chapter 6: *Tactical Approaches* offers a communications to do list with specific communications activities relevant for project phases and subbasin audiences.

Chapter 7: *Measurements and Evaluation* outlines methods to determine the effectiveness of outreach and engagement.

Chapter 8: *Roles and Responsibilities* provides a sample list of tasks and illustrates the types of communications roles and responsibilities which might be assigned. This section should be incorporated into project management plans.

Subbasin GSAs should feel free to repurpose any or all parts of the document that will assist them in meeting SGMA requirements.

This document was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program and completed by the Communication and Engagement Group of MWH/Stantec.

Delta Mendota Subbasin
Sustainable Groundwater Management Act
Communications Plan
Working Draft

Contents

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List of Acronyms and Abbreviations

Item	Description
Basin	Groundwater Basin or Subbasin
Coms Plan	Delta Mendota Subbasin, Sustainable Groundwater Management Act, Working Draft Communications Plan
CSD	Community Service District(s):
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
DAC	Disadvantaged Communities
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
IRWMP	Integrated Resource Water Management Plan
PDF	Portable Document Format
RCD	Resource Conservation District(s)
SGMA	Sustainable Groundwater Management Act
SLDMWA	San Luis Delta- Mendota Water Authority
State Board	State Water Resources Control Board

Item	Description
SA	Situation Assessment
USGS	United States Geological Survey

Revision History

Table 1. Revision History

Revision History			
Revision/Dock Title #	Date of Release	Author	Summary of Changes

INTRODUCTION AND BACKGROUND

The purpose of this Communication Plan is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. Its chapters identify key stakeholders and provide a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. The plan was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program.

1.1. SGMA Basics[1]

After decades of debate, in 2014 California lawmakers adopted SGMA. This far-reaching law seeks to bring the State's critically important groundwater basins into a sustainable regime of pumping and recharge. The change in water management laws has created new obligations for residents and water managers in the Delta-Mendota Groundwater Subbasin. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members in implementation of this law.

SGMA requires, **by June 30, 2017**, the formation of locally-controlled GSAs in many of the State's groundwater basins and subbasins (basins). A GSA is responsible for developing and implementing a **groundwater sustainability plan** (GSP). These plans assist the basins in meeting sustainability goals. The primary goal is to maintain sustainable yields without causing undesirable results.

1.1.1. GSAs & GSPs

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. A single local agency can decide to become a GSA, or a combination of local agencies can decide to form a GSA by using either a Joint Power Authority (JPA), a memorandum of agreement (MOA), or other legal agreement. If no agency assumes this role the GSA responsibility defaults to the County; however, the County may decline.

A GSP may be any of the following *(Water Code § 10727(b)):*

- A single plan covering the entire basin developed and implemented by one GSA.
- A single plan covering the entire basin developed and implemented by multiple GSAs.

[1] Sections on SGMA are largely drawn, in whole or in part, from publicly available materials from the Department of Water Resources. For more see: http://www.water.ca.gov/groundwater/sgm

- Subject to Water Code Section 10727.6, multiple plans implemented by multiple GSAs and coordinated pursuant to a single coordination agreement that covers the entire basin.

If local agencies are unable to form an approved GSA and/or prepare an approved GSP in the required timeframe, then the basin or subbasin would be considered unmanaged. Unmanaged groundwater basins and subbasins are subject to State Water Resources Control Board (State Board) oversight. This is true even if the vast majority of the subbasin is covered by a plan. Should intervention occur, the State Board is authorized to recover its costs from the GSAs.

1.2. SGMA Communications and Engagement Requirements

SGMA includes specific requirements for communications and engagement by each planning phase. **Figure 1** (next page) illustrates the requirements and provides water code references. The GSP submittal guidelines also describe the outreach and engagement documentation to be submitted with the plan. **Table 2** describes the submittal requirements. A full list of codes and requirements is also provided in **Appendix 1**.

Table 2. GSP Submittal Requirements[2]

GSP Regulations Section	Requirement	Description
Article 5. Plan Contents, Sub-article 1. Administrative Information		
354.10	Notice and Communication	• Description of beneficial uses and users • List of public meetings with dates • GSP comments and responses • Decision-making process • Public engagement process • Method(s) to encouraging active involvement • Steps to inform the public on GSP implementation progress

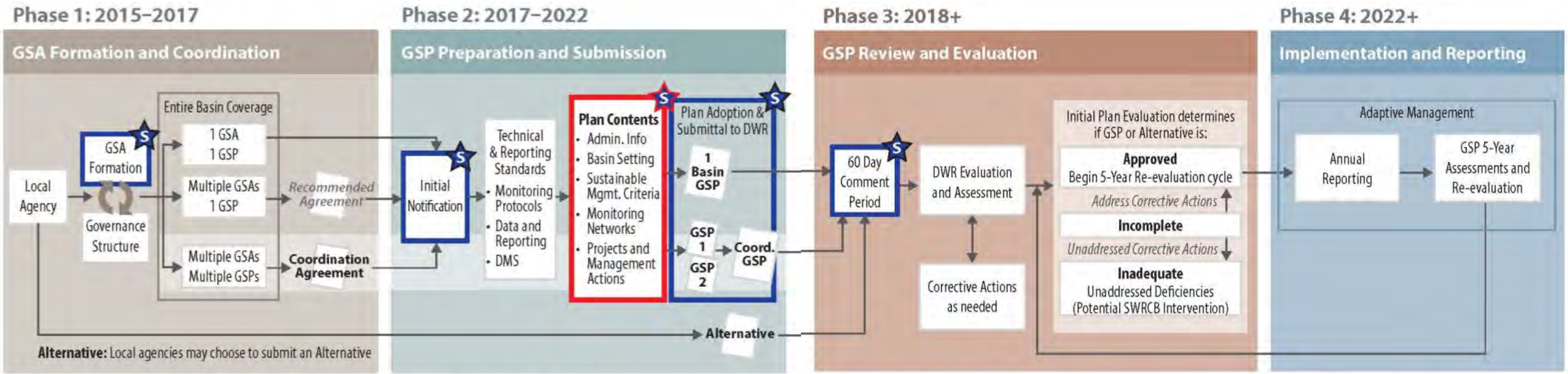
1.3. Planning Approach

While the SLDMWA is assisting with the coordination of GSP(s) development, this Communications Plan (Coms Plan) is offered for the voluntary use of all of the GSAs of the Delta-Mendota Subbasin. A full Coms Plan schedule should be developed in conjunction with the overall GSP(s) development schedule. One additional option is for the Coordination Committee of GSAs to provide overall communications guidance. This could potentially be included in a section of the Coordination Agreement.

[2] Guidance Document for the Sustainable Management of Groundwater, Preparation Checklist for GSP Submittal, Department of Water Resources, December 2016

Figure 1. Stakeholder Engagement Requirements

Stakeholder Engagement Requirements by Phase



Phase 1 Engagement Requirements

- **Establish and Maintain List of Interested Parties** §10723.4
- **GSA Formation Public Notice** §10723(b)
- **GSA Formation Public Hearing** §10723(b)
- **GSA Formation (due 6/30/17)** §10723(b)
  Notify DWR:
  - Include list of interested parties
  - Explain how parties' interests will be considered
- **Pre-GSP Development** §10727.8
  Provide a written statement describing how interested parties may participate to:
  - DWR
  - Cities within the GSA boundary
  - Counties within the GSA boundary

Phase 2 Engagement Requirements

- **GSP Initial Notification** §353.6*
- **GSP Preparation** §10727.8 and §10723.2
  - Encourage active involvement
  - Consider beneficial uses and users of groundwater when describing *Undesirable Results, Minimum Thresholds, and Projects & Actions*
- **GSP Communications Section** §354.10*
  - GSA decision-making process
  - Opportunities for engagement and how public input is used
  - How GSA encourages active involvement
  - Method of informing the public
- **Public Notice of Proposed Adoption** §10728.4
- **GSP Adoption Public Hearing** §10728.4
- **GSP Submittal** §354.10*
  - Include a summary of communications: description of beneficial uses/users, list of public meetings, comments received/responses

Phase 3 Engagement Requirements

- **60 Day Comment Period** §353.8*
  - Any person may provide comments to DWR regarding a proposed or adopted GSP via the SGMA Portal at http://sgma.water.ca.gov/portal/
  - Comments will be posted to DWR's website

Phase 4 Engagement Requirements

- **Public Notices and Meetings** §10730
  - Before amending a GSP
  - Prior to imposing or increasing a fee
- **Encourage Active Involvement** §10727.8

Engagement Requirements Applicable to ALL PHASES

- **Beneficial Uses and Users** §10723.2
  Consider interests of all beneficial uses and users of groundwater
- **Advisory Committee** §10727.8
  GSA may appoint and consult with an advisory committee
- **Public Notices and Meetings** §10730
  - Before electing to be a GSA
  - Before adopting or amending a GSP
  - Prior to imposing or increasing a fee
- **Encourage Active Involvement** §10727.8
  Encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin
- **Native American Tribes** §10720.3
  - May voluntarily agree to participate
  - See Engagement with Tribal Government Guidance Document
- **Federal Government** §10720.3
  - May voluntarily agree to participate

Stakeholder Input　　*Stakeholders should be informed throughout the development of Plan Content*

Code References: §(#) = SGMA, §(#)* = GSP Regulations

Source: Guidance Document for Groundwater Sustainability Plan Stakeholder Communication and Engagement Department of Water Resources, June 2017

An important additional step will be establishing, in conjunction with the multiple GSAs, the roles and responsibilities for implementing the Coms Plan.

1.4. SGMA and the Delta Mendota Subbasin[3]

The Delta-Mendota Subbasin of the San Joaquin Valley Groundwater Basin is a long, relatively narrow groundwater basin that covers portions of five counties, from north to south, San Joaquin, Stanislaus, Merced, Madera and Fresno Counties (see **Figure 2**). The Delta-Mendota sub-basin is bounded on the west by the Tertiary and older marine sediments of the Coast Ranges. The northern boundary (from west to east) begins on the west by following the Stanislaus/San Joaquin County line, then deviates to the north to encapsulate all of the Del Puerto Water District before returning back to the Stanislaus/San Joaquin County line. The boundary continues east then deviates north again to encapsulate all of the West Stanislaus Irrigation District before returning back to the Stanislaus/San Joaquin County line. The boundary continues to follow the Stanislaus/San Joaquin County line east until it intersects with the San Joaquin River.

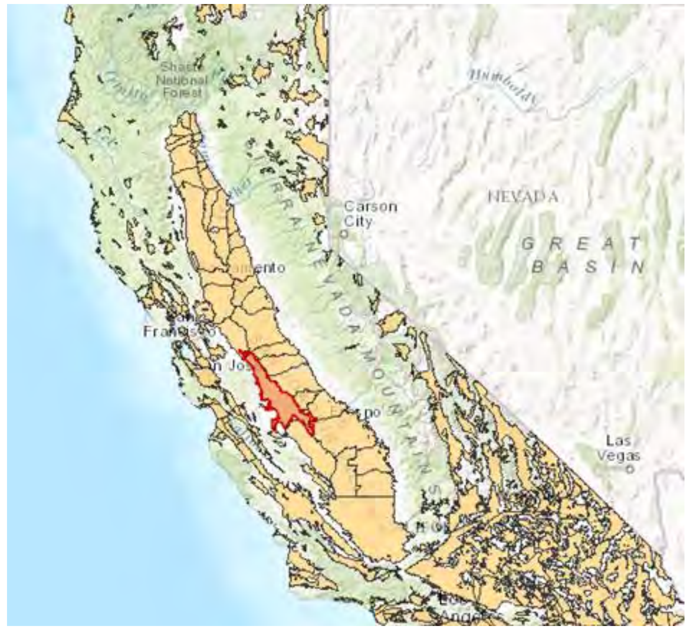


Figure 2. Delta Mendota Subbasin

The eastern boundary (from north to south) follows the San Joaquin River to within Township 11S, where it jogs eastward along the northern boundary of Columbia Canal Company and then follows the eastern boundary of Columbia Canal company until intersecting the northern boundary of the Aliso Water District. The boundary then heads east following the northern and then eastern boundary of the Aliso Water District until intersecting the Madera/Fresno County line. The boundary then heads westerly following the Madera/Fresno County line to the eastern boundary of the Farmers Water District. The boundary then heads southerly along the eastern boundary of the Farmers Water District, and continues southerly along the section line to the intersection with the northern right-of-way of the railroad. The boundary then heads east along the northern right-of-way of the railroad until intersecting with the western boundary of the Mid-Valley Water District. The boundary then heads south along the western boundary of the Mid-Valley Water District to the intersection with the northern boundary of Reclamation District 1606. The boundary then heads west and then south following the boundary of Reclamation District 1606 and James Irrigation District until its intersection with the Westlands Water District boundary.

The southern boundary (from east to west) matches the northerly boundaries of Westlands Water District legal jurisdictional boundary last revised in 2006. The boundary then

[3] Information related to the Delta Mendota subbasin is drawn directly from http://sgma.water.ca.gov/basinmod/basinrequest/preview/23.

proceeds west along the southernmost boundary of the San Luis Water District. The boundary then projects westward from this alignment until intersecting the Delta-Mendota sub-basin Western boundary described above.

1.5. Delta-Mendota Subbasin GSP Planning

The GSAs of the Delta-Mendota Subbasin intend to work together to meet Sustainable Groundwater Management Act (SGMA) requirements and prepare a Groundwater Sustainability Plan (GSP) or coordinated Sustainability Plans by June 31, 2020. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members and non-members in planning and implementation of this law and has been directly assisting a subset of the local GSA eligible agencies in organizing to accomplish required SGMA tasks. The SLDMWA has also hosted informal, information meetings with all of the subbasin GSAs.

While SLDMWA coordinated GSAs are confident in their ability to prepare a GSP for the areas under their jurisdiction, SGMA requires that an approved GSP or multiple coordinated GSPs are in place to provide sustainable management for the entire subbasin. The identified GSAs have been asked to determine how they wish to proceed in individual GSP development or a coordinated single GSP by July 2017 and whether or not they wish to participate in the Prop 1 Sustainable Groundwater Planning Grant as a joint request.

1.6. Delta Mendota Subbasin GSAs

Following are the DWR identified agencies (as of June 15, 2017).[4]

1. Aliso Water District
2. Central Delta-Mendota Region Multi-Agency GSA
3. City of Dos Palos
4. City of Firebaugh
5. City of Gustine
6. City of Los Baños
7. City of Mendota
8. City of Newman
9. City of Patterson
10. County of Madera—3
11. DM-II
12. Farmers Water District
13. Fresno County—Management Area ‘A’
14. Fresno County—Management Area ‘B’
15. Grasslands Groundwater Sustainability Agency
16. Merced County—Delta-Mendota

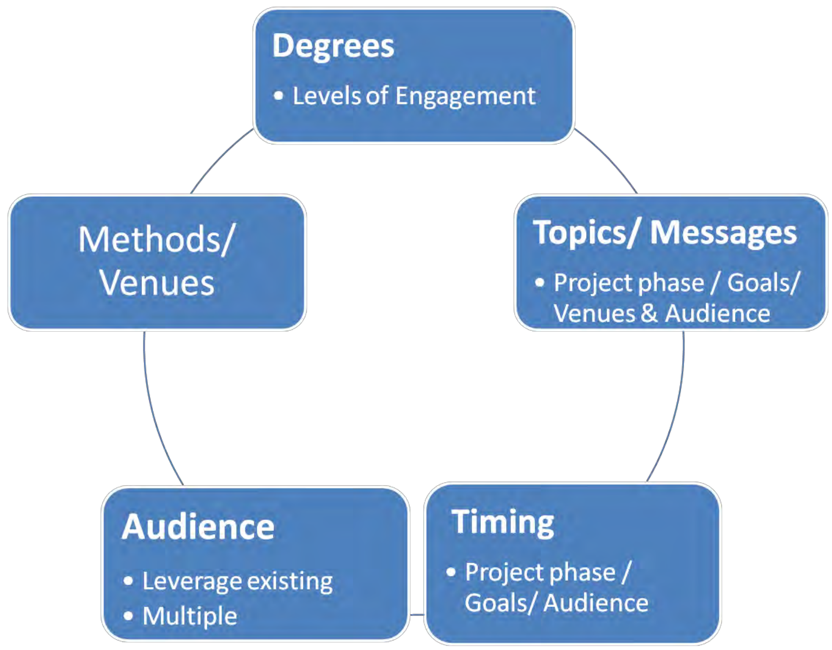
[4] See: http://sgma.water.ca.gov/portal/

17. Northwestern Delta-Mendota GSA
18. Ora Loma Water District
19. Patterson Irrigation District
20. San Joaquin River Exchange Contractors Water Authority
21. Turner Island Water District-2
22. West Stanislaus Irrigation District GSA
23. Widren Water District GSA

COMMUNICATIONS PLAN OVERVIEW

Communication is the process of transmitting ideas and information. According to the Project Management Institute, 75%-90% of a project manager's time is spent communicating. A Coms Plan provides the purpose, method, messages, timing, intensity, and audience of the communication, then describes who will do the communicating, and the frequency of the communication (see **Figure 3**.)

Figure 3. Elements of a Communications Plan



2.1. Purpose

The purpose of the Delta-Mendota Subbasin, Sustainable Groundwater Management Act, Coms Plan is to outline the information and communications needs of the project stakeholders and provide a roadmap to meet them. The Coms Plan then identifies how communications activities, processes, and procedures will be managed throughout the project life cycle.

2.2. Importance

While communications are important in every project, a well-executed communications strategy will be essential to the success of the GSP(s) development and adoption process. The financial and regulatory stakes are high and communication missteps can create project risks. Further, development of a viable GSP(s) will require an on-going collaboration among all the stakeholders, both organizational and external. The plan will be comprehensive and consider multiple variables, a range of system elements and project costs and benefits. Stakeholder input will be needed to refine GSP requirements and fully

define the water management system, and potential impacts, costs and benefits that may result in managing for sustainability.

2.3. Scope

The plan focuses on formal communication elements. Other communication channels exist on informal levels and enhance those discussed within this plan. This plan is not intended to limit, but to enhance communication practices. Open, ongoing communication between stakeholders is critical to the success of the project.

2.4. Communications Goal

Development, adoption and implementation of the GSP(s) will require basin external stakeholders, other agencies, staff, managers, and the multiple GSA Boards to evaluate choices, make decisions and commit resources.

The core communications goal is to plan for and efficiently deliver clear and succinct information:

- At the right time
- To the right people
- With a resonating message

This is done to facilitate quality decision making and build accompanying public support

2.5. Communications Objectives

The Coms Plan Objectives are to present strategies and actions that are:

- Realistic and action-oriented
- Specific and measurable
- Minimal in number (a few well delivered are better than many mediocre efforts)
- Audience relevant

2.6. Strategic Approach

Three primary communications strategies have been identified for the GSP(s) development.

1) Fully leverage the activities of existing groups. This practical approach is cost effective and respectful of the limited time that stakeholders have to participate in collaborative processes.
2) Provide targeted, communications and outreach to opinion leaders in key stakeholder segments.
3) Provide user friendly information and intermittent opportunities through existing communication channels and open houses or workshops to allow interested stakeholders (internal and external) to engage commensurate with their degree of interest.

2.7. Communications Governance, Communications Team

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[5], some form of communications governance is recommended. Several governance options for consideration are offered in Appendix 2. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. For the purpose of this document, an assumption is made that some form of governance will be identified and a communications team (which may be an individual or multiple individuals, and/or include the project consultants) is designated.

A driving consideration for this recommendation is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance is efficient and effective.

2.8. Constraints

All projects are subject to limitations and constraints as they must be within scope and adhere to budget, scheduling, and resource requirements. These constraints can be even more challenging in projects with multiple agencies as will be the case with the development and coordination of multiple GSPs.

There are also legislative, regulatory, technology, and other organizational policy requirements which must be followed as part of communications management. These limitations must be clearly understood and communicated where appropriate. While communications management is arguably one of the most important aspects of project management, it must be done in an effective and strategic manner recognizing and balancing the multiple constraints.

All project communication activities should occur within the project's approved budget, schedule, and resource allocations. The GSP(s) project managers and the leadership of the participating GSAs should have identified roles in ensuring that communication activities are performed.

To the extent possible, to support collaboration and reduce costs, GSP(s) partners should utilize standardized formats and templates as well as project file management and collaboration tools.

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[5] See Appendix 1

SITUATION ASSESSMENT

3.1. *Introduction*

The challenges of asking a community to make changes in how things are done, or forging an agreement among multiple parties are often large. Prior to preparing a Coms Plan, a neutral, 3rd party facilitator conducted a stakeholder Situation Assessment (SA).

The facilitator's role was to provide an independent evaluation of potential stakeholder's interest in coordination and governance for GSA formation and GSP development and identify any barriers or concerns that would need to be addressed for the GSA formation process and GSP(s) development to be successful.

3.2. *Situation Assessments*

An SA is an information-gathering process that informs outreach, engagement and collaboration. As part of preparing the basin communication's process, it was important to know more about:

- Stakeholder Categories
- Opinion leaders
- Regulatory and political context
- Advocates and detractors
- Attitudes and knowledge
- Other elements useful to the crafting of decisions

An assessment is also a low risk approach to education and signaling a future relationship. It facilitates the community's appraisal of its needs, wants and values. A well-crafted assessment sets the stage for the parties to better understand and interpret their situation so that they can make informed decisions for actions, in the short term and for the future.

The Delta-Mendota subbasin SA included background research and interviews. Interviews were usually with individuals but in a few cases a very small group was convened. To encourage candor, the results of the input process were bundled so those interviewed were not individually identified unless they explicitly indicated they wished to share their individual response.

3.3. *Background Research*

The facilitator worked closely with the SLDMWA and DWR to identify useful documents, plans and activities that might inform the overall communications planning process.

3.4. *Interviews and Consultations*

Using information gathered during the background research and similar GSA formation efforts throughout the state, the facilitator worked with the SLDMWA to craft interview questions. The facilitator also provided some selection criteria to the SLDWMA to help identify a representative group of interview candidates. Once selected, the SLDMWA staff and facilitation team invited the interviewees to participate. In addition to full interviews,

additional calls and in person communications were conducted to acquire amplifying information. **Figure 4** provides a quick overview.

Figure 4. Interview and Consultation Quick Facts

Number of Contacts: 30

Dates of Calls and Interviews Conducted:
February to May 2017

Average Length: 1 hr.
(Shortest = 20 mins., Longest = 1.5 hrs)

Selected participants were all engaged or otherwise stakeholders in some aspect of the basin GSA development process.

A project background sheet was provided in advance of each formal interview and used again during the interviewee discussions with the facilitator. Each interview followed the same format and included 16-18 questions (depending on whether or not a follow-up question was needed).

The questions covered the following topics pertaining to the GSA formations and GSP(s) development:

1. Overarching perspectives from each key stakeholder on general groundwater conditions, GSA governance; subbasin management and associated SGMA compliance
2. Preferred methods to achieve groundwater sustainability consistent with SGMA requirements
3. The level of agreement/conflict around groundwater governance across the range of stakeholder perspectives
4. Experience with facilitated processes, outreach and engagement, and the goals for such support
5. Potential configurations of governance and formations of GSAs and GSP development

3.5. *Summary of key findings*

Interview results indicate an overall positive environment for the project and project communications; however, the effort will require interactions of a large number of parties and planning for an extremely complex system. Following are the reflections, ideas and suggestions of those contacted.

3.5.1. Related to Groundwater Sources and Trends

- *Significant observed impacts associated with Weather, Water Project Deliveries and Cropping Patterns* – Participants observed a declining

groundwater situation and were able to attribute it to drought and weather (particularly timing of seasonal rainfall and periods of prolonged, higher temperatures), conversion to permanent crops, and significant changes in access to surface water.

- *Surface & Groundwater Nexus* – As noted in comments related to access to surface water, there was a clear understanding of the surface/groundwater nexus. Many believed that any realistic solution would have to include a full assessment of the region's surface water future.

- *Extremely Complex Systems* – Many of those interviewed reported that parts of the subbasin were doing fine and could, with good management, be sustainable. They described problems as being primarily in pockets of the subbasin. They also characterized some parts of the subbasin as not being managed sustainably and indicated that they believe this would have continued had SGMA not passed. While it was generally agreed that it would have been better if SGMA was not driving the change, they felt change would not occur without something like SGMA. Several of the participants were able to describe specific locations and situations that illustrated this.

  Issues related to operations of the Bureau of Reclamation, the Delta-Mendota Canal (DMC), the Mendota Pool and restoration activities are of keen interest to all the stakeholders. Everyone was familiar with issues of subsidence and with the facts and figures represented in graphics like those in **Figure 5**, prepared by the United States Geological Survey (USGS).[6]

  Many perceived that groundwater supplies for municipal uses in some parts of the basin were at risk.

- *Historic Rights and Arrangements* – Access to surface water is based on numerous historic rights and agreements as well as more contemporary agreements. As such there is no **single** description of the status of surface water availability among the many subbasin GSAs,[7] although there is a strong understanding of the rights and arrangements that do exist.[8]

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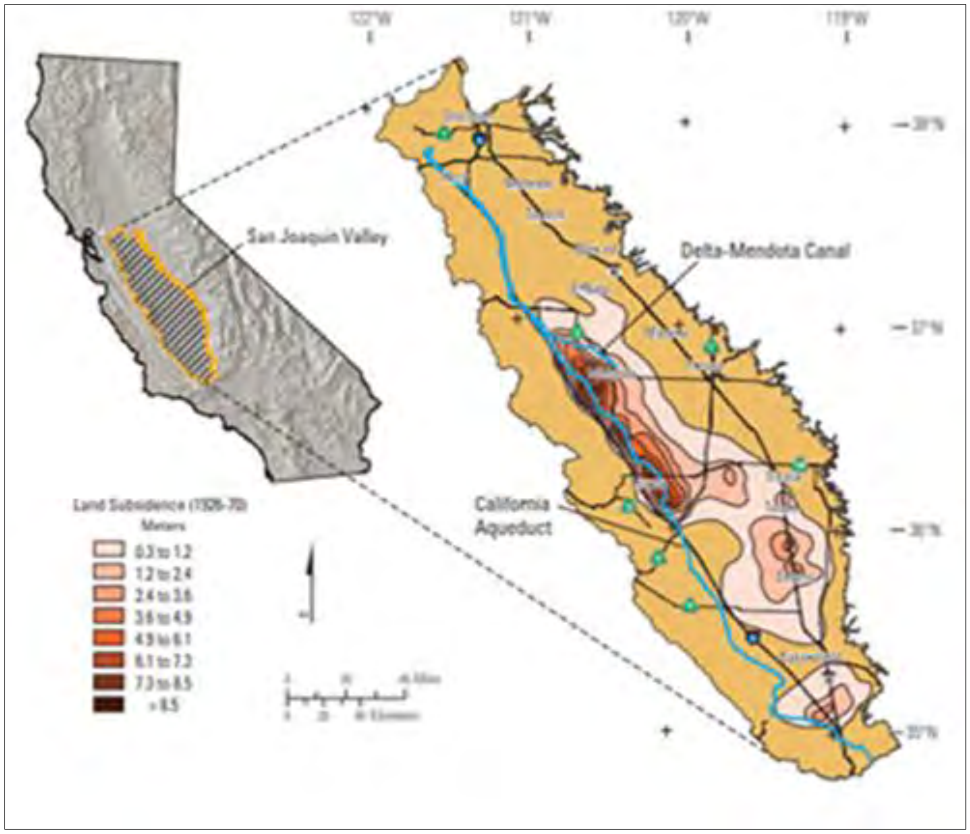
[6] U.S. Department of the Interior | U.S. Geological Survey: https://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html, Page Last Modified: Monday, 20-Mar-2017 22:39:47 EDT

[7] A full inventory of water rights and arrangements for the subbasin GSAs is recommended to be prepared as part of the GSP planning process.

[8] In 2010 there were 1,403 water rights claimed in the San Joaquin Delta watershed, the largest number of any watershed in the State. [Source: Associated Press: Original data source is State Water Resources Control Board eWRIMS, Database

Figure 5. USGS Illustration of the DMC and Subsidence



The hierarchy of water rights as well as laws related to groundwater rights will be a significant factor in GSP negotiations.

Another historical factor related to sustainability is the character of land ownership. There was a perceived difference in the values placed on sustainability by multi-generational family farms versus investor driven agriculture and/or water development.

3.5.2. Related to GSA Governance; Subbasin Management and SGMA Compliance

- *Numbers* - The subbasin includes numerous Water Agencies (35) and other potential GSA eligible agencies including Cities and Counties (such as Dos Palos, Firebaugh, Gustine, Los Baños, Mendota, Newman, Patterson, Fresno, Madera, Merced, San Joaquin, and Stanislaus) and Community Service Districts (CSDs) including among others Grayson, Westley, and Volta, as well as multiple Resource Conservation Districts (RCDs) that for the most part were within the general boundaries of other GSA eligible authorities (Panoche, Poso and Grasslands as an example).

  By the June 30, 2017 filing deadline, 23 eligible entities had formally filed GSA formations and met SGMA requirements for subbasin coverage.

Even with this large number of GSA entities, during the SA interviews and in a follow-up survey, most agencies indicated a preference for a reduced number of GSPs and potentially just one or two.

At the time of this assessment there was not a full understanding of all of the potential requirements of being a GSA and ultimately what might be required to prepare a compliant GSP.

Table 3. Number of Subbasin Public Water Agencies

Number of Public Water Agencies

- Merced County
- Fresno County
- Broadview WD
- Centinella WD
- Central California ID,
- Davis WD
- Del Puerto WD
- Eagle Field WD
- El Solyo WD
- Farmers WD
- Firebaugh Canal WD

- Foothill WD
- Fresno Slough WD
- Grasslands WD
- Hospital WD
- Kern Canon WD
- Laguna WD
- Mercy Springs WD
- Mustang WD
- Oak Flat WD
- Orestimba WD
- Oro Loma WD
- Pacheco WD

- Panoche WD
- Patterson WD
- Romero WD
- Salado WD
- San Luis Canal Company
- San Luis WD
- Santa Nella C.WD
- Sunflower WD
- Tranquility ID
- West Stanislaus ID
- Widren WD
- Quinto WD

At the time of this assessment participants did not fully recognize the potential number of stakeholders and/or the requirements to conduct outreach.

- *Subbasin Governance Structures* – Many individuals and entities within the subbasin have experience working in cooperative governance and related structures. For example, the SLDMWA provides leadership for an Integrated Resource Water Management Plan (IRWMP) illustrated in **Figure 6**[9] on the following page. Many of the stakeholders are also involved with Irrigated Lands Coalitions (see **Figure 7**).[10]

  Likewise, many are also involved in efforts related to the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) initiative (see **Figure 8**).

[9] Source : San Luis & Delta-Mendota Water Authority, Westside-San Joaquin Integrated Water Resources Plan, July 2014

[10] Source: Central Valley Regional Water Resources Control Board

Existing Cooperative / Collaborative Governance Structures with Delta Mendota Subbasin Stakeholders

Figure 6. Integrated Regional Water Management Groups

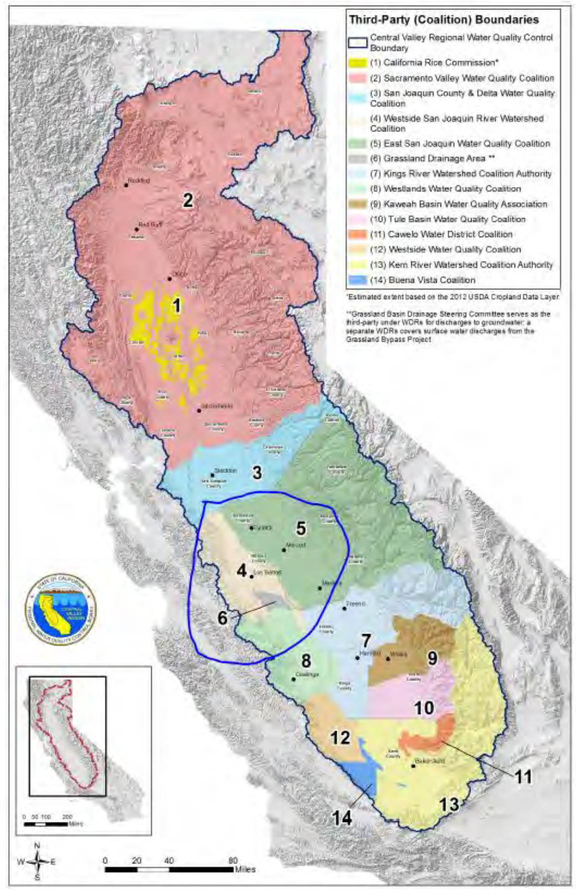


Figure 7. Irrigated Lands Coalitions

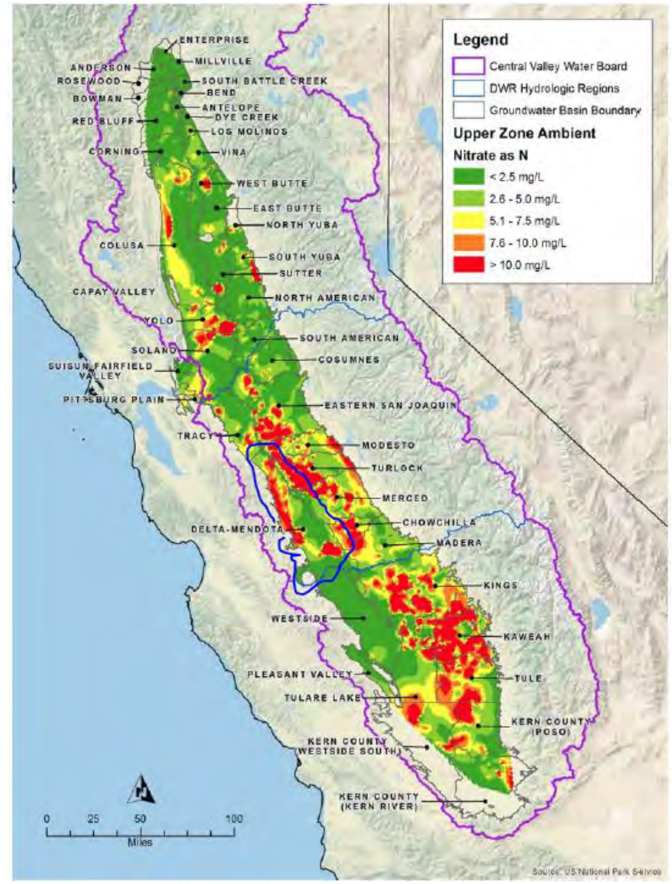


Figure 8. CV-Salts Initiative

CV-Salts was launched to develop sustainable salinity and nitrate management planning for the Central Valley. (See **Figure 8**.[11])

Finally, there are multiple arrangements in place related to surface water transfers and other previous groundwater management planning efforts.

Experience with these programs has created a capacity for collaborative planning that will be essential for GSP development. It also creates opportunities to access and leverage existing stakeholder meetings and events rather than needing to convene multiple new stakeholder processes.

3.5.3. Issues to be Addressed in Creating a Sustainability Plan

Some of the participants indicated they had an extremely good understanding of their section of the subbasin, with exact and extensive records to support their perspective. They found that making projections using historical data had been more reliable than some of the groundwater models that were in use.

In thinking about development of a GSP they felt there could be some difficulty in developing water balances due to lack of quality data for some locations. Another mild concern was the potential for disagreements about the selection of a groundwater model(s) or reconciling differences among methods.

Still another concern was the capacity of the GSAs and/or GSA members to fully participate. Some of these agencies are very lightly staffed and have varying levels of knowledge related to groundwater management. All of the participants had significant other duties prior to the passage of SGMA.

One concern, expressed after completion of the assessment, was the potential for some agencies to simply opt out of participating in the development of a GSP but still receive the benefits of the region having an approved plan without having contributed to the larger good of the subbasin.

3.5.4. Representation

The State Board lists the following as Required Interested Parties for the purpose of SGMA outreach:

- All Groundwater Users
- Holders of Overlying Rights (agriculture and domestic)
- Municipal Well Operators and Public Water Systems
- Tribes
- Counties
- Planning Departments /Land Use
- Local Landowners
- Disadvantaged communities
- Business

[11] Ibid

- Federal Government
- Environmental Uses
- Surface Water Users (if connection between surface and ground water)

All of these stakeholder categories were contacted in the interview process excepting tribes. In the case of tribes, there are no classified tribal lands in the Delta-Mendota subbasin, therefore no planning, outreach or communication needs are currently anticipated for tribes.

Due to subbasin characteristics, a primary focus of the assessment was on agricultural, disadvantaged communities (DACs) and municipal groundwater users.

- *Related to Agricultural Representation* - most respondents believed that the elected leadership of the GSA agencies would do a good job in representing agriculture and noted that many of them were growers themselves. It was also noted that farmers were busy and would be far more interested in any specifics of a GSP that would impact operations or the degree of certainty about water availability than the particulars of GSA governance.

- *Regarding DACs* - Much of the subbasin and its counties (San Joaquin, Stanislaus, Merced, and Fresno) have communities that meet the DAC definition and the region is generally considered disadvantaged. The ability of DACs to participate in GSP development was considered limited and it was thought that there would be a need for specific and direct outreach to DACs through elected leadership and via use of trusted community advocates. As part of the SA, several of those interviewed identified themselves as being able to represent a DAC perspective and one in particular was particularly concerned about the availability of Spanish language materials. As a result, Spanish language materials were included in the meeting materials of the public GSA adoption meetings and the SLDMWA provided a fluent Spanish speaker to assist with meetings.

In the past, to promote DAC identification and involvement, the Westside-San Joaquin IRWM previously conducted an extensive survey of private and public community representatives to educate and encourage understanding of the IRWM process, to help understand the issues confronted by DACs, and to

better address the needs of minority and/or low-income communities. This effort resulted in identification of DACs in the Region and an initial list of 22 projects that would benefit DACs and low-income communities. Given known constraints on this community it is recommended that more focused DAC outreach should be coordinated with the IRWM. This effort is now in progress.

- *Regarding Municipals* - The SA outreach also included interviewing Municipal Stakeholders. A significant number of the Cities are fully dependent on wells for water supply and issues related groundwater management are of grave concern. These representatives all felt that even while it would be difficult to make time to participate in GSAs and GSP development, that they must make the time. Many had also determined that they wished to form their own GSA to reflect their specific interests in any kind of broader GSP negotiation.

- *Regarding Environmental Interests* - There appeared to be a less defined stakeholder segment representing traditional, environmentally focused issues. Outreach was made to subbasin government agencies that often serve as a surrogate for these interests and an informal consultation occurred with a representative of the Planning and Conservation League to identify any known, active stakeholders. However, no specific entity or individual was identified by those contacted. A general perception was that this community would desire engagement and would designate representatives if the GSP development was thought to potentially impact existing restoration or other environmental concerns but the formation of GSAs per-se, was of less interest. The next phase of communications should include outreach to organizations such as Audubon, the Nature Conservancy and Ducks Unlimited just to ensure due diligence. These connections will be important going forward, particularly if environmental issues are identified.

- *Regarding Industrial Users* – The region includes some industrial water users. This sector has a relatively lower percent of water use compared to other subbasins users; however, representatives of the sector pointed out how essential access to water was to their industry. The interviewees also emphasized how important these industries were to the local economies. There was a stated concern about representation since there didn't appear to be a direct way to engage, particularly with multiple GSAs being formed.

- *Regarding Counties & Planning Agencies* – All of the subbasin counties have designated representatives and all are assisting with GSA coverage for areas not otherwise covered by a GSA. All of the city and county representatives had direct engagement with the planning arms of their jurisdictions, or were staff to the planning departments. These representatives, like the municipal representatives, viewed this as critical issue even as it creates new workload for the already busy entities.

3.5.5. Communications and Facilitation Preferences

Participants were asked to describe their communications preferences. Several offered specific suggestions on written materials. Most did not believe there would be a need for a high frequency of communications directly with non-GSA stakeholders.

Several suggested using regularly scheduled activities of existing groups and gatherings to share information rather than creating stand-alone events. They listed annual meetings of the water agencies as one good venue as well as meetings related to the IRWM and Irrigated Lands. Several also thought that it would be good to go to places like Farmers Markets, particularly for the disadvantaged communities, and County Fairs.

Farm Bureau representatives also indicated a willingness to support outreach efforts. The Merced Farm Bureau, in particular, has already helped to advertise public meetings related to GSA formations.

Related to facilitation there was not a broad exposure to professional facilitators among many of the stakeholders. Even so, participants consistently listed qualities such as fairness and transparency, a good understanding of the issues, and confidence as helpful facilitator strengths. There was a sense that the GSAs would not need hand holding but that facilitation could be useful for helping the stakeholders forge decisions and making what many believed would need to be compromises.

3.5.6. Success Factors, Barriers to Success

The participants were asked to describe their view on the odds for success as well as any barriers that would prevent successful completion of a GSP.

Overall, most participants expressed a medium to high likelihood for success. They noted that the carrot (grants and technical support) and stick (significant regulatory intervention) by the State creates a dynamic that is supportive to success.

Participants stated barriers related to the capacity of the GSAs to participate and ultimately agree to, and implement changes. The much diffused governance structure of multiple GSAs amplifies this dilemma as do actions beyond the control of the subbasin entities (such as climate and water deliveries).

In addition to perceived barriers, participants outlined their thoughts on opportunities and success strategies.

- *Drought* – While the drought was unwelcome it increased awareness of the need for changes. Many felt it would be easier to move forward while the topic is prominent in everyone's minds.
- *Short and Long Game* – Several suggested it will be important to have a plan that includes long and short term strategies and activities.
- *Integrated Planning* – Many of the participants emphasized the importance of integrated planning.

3.5.7. Other Comments and Advice

Many participants expressed appreciation for being contacted and invited the facilitator to contact them again if there were questions.

3.6. *Promising messages and methods*

Three primary communications strategies have already been identified for the GSP(s) development:

- Leveraging the activities of existing groups
- Providing targeted, communications and outreach to opinion leaders in key stakeholder segments
- Providing user friendly information and intermittent opportunities for a broader range of stakeholders

The same strategies aligned with the recommendations of the SA participants. These methods will allow stakeholders to engage commensurate with their degree of interest while providing sufficient information to ensure long-term success for plan development and implementation.

AUDIENCES AND MESSAGES

GSA formation and GSP(s) development**,** like most large planning efforts, consists of a broad range of stakeholders with differing interests and influence.

4.1. Two Core Audience Segments

This Coms Plan Anticipates two core audience segments. First is the subbasin GSA Boards and the communications among and between themselves. This audience segment is significant in size given that 23 GSAs will be working to develop a GSP(s) and each GSA has its own Board and audiences.

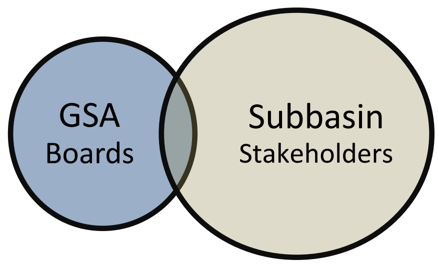


Figure 9. Two Core Audience Segments

The second audience is the subbasin stakeholders as identified in SGMA. This audience is also large. Many of the stakeholders are shared by the GSA Boards and some of the larger stakeholder segments are also represented on the GSA Boards (see **Figure 9**).

Nearly all of the communications strategies apply to both segments; however, some strategies apply to one or the other specifically and are so identified.

4.2. Communications and Change Management

The process of adopting and implementing a GSP will require significant change management. Communications planning should encompass basic change management approaches. Messages should also evolve over time and be tied to the planning process and key decision points. Then, for each audience and each major planning step, communications must do the following:

1. Describe what the actual proposed plan (change) is
2. Articulate how the change will directly impact the category of stakeholder involved
3. Outline the methods that will be used to implement the plan (change)
4. Define the costs and benefits of changing and not changing, and what future conditions will be if change does not occur
5. Consider unintended consequences and others that may also be impacted by the same change then develop a strategy to engage them
6. Offer opportunities for input and for stakeholders and others to improve the approach

The communications requirements for large changes are often underestimated. Some experts indicate that messages may need to be delivered up to 8 different times to be fully absorbed. Communications needs will also evolve as the GSP planning progresses. **Table 4** provides a sample of early communications that focus on SGMA and groundwater basics.

Table 4. Sample – Early Phase Message Elements for Subbasin Stakeholders

Element	What the Change Is	How it will affect the Stakeholder	How the change will be Implemented	Why it is a good idea
Early Phase GSP Development	• Locally governed GSAs will work together to sustainably manage ground water. • The Subbasin /Basin is required to ensure Sustainable Groundwater Management by submitting a sustainability plan by 2020. • The plan must be implemented and found to result in sustainable management by 2040.	(Unique to audience type) • Changes in the current methods of acquiring and utilizing groundwater may occur. • May affect future decisions related to crop types and decisions related to conjunctively using surface water. • May provide additional project resources to the DAC communities.	A collaborative approach is being undertaken to prepare the plan with multiple GSAs coordinating with the SLDMWA as the planning organizer.	• Sustainable and wise use of groundwater allows for the success of future generations and creates greater certainty for today's beneficial users. • Failure to act may result in negative regulatory consequences.

As part of the GSP planning process, the next phase of communications will also need to communicate the requirements for sustainability and how they are achieved in the context of the Delta-Mendota subbasin. Then, communications related to GSP specifics and adoption will require additional outreach, targeted to specific audiences.

4.3. *Tied to Decision Making*

Communications should also be tightly linked to decision making. For each anticipated decision, stakeholders for that decision should be identified and the following addressed.

1. Who (Is the stakeholder)
    a. An impacted party?
    b. A potential planning partner?
    c. A potential provider of services or resources?
    d. A regulator of the activity?
    (Note: Maybe more than one category.)

2. What (What is the interest of the stakeholder? How will the stakeholder be affected? What are the stakeholders' needs?)
3. Who (Who is the right messenger for the information)
4. How (How should the information be delivered? What are the best methods?)
5. When (What is the appropriate timing for the messages?)
6. Engagement and Knowledge Transfer (How do we create two-way communications?))

Table 5 illustrates some of these ideas.

Table 5. Communications Planning Questions

Who	Interest	Messenger	Delivery	Timing	Knowledge Transfer
• Impacted • Partner • Provider • Regulator	• How will decision affect? • What will stakeholder need?	• Who is a trusted information Source? • How do we ID and Partner	• What are the best delivery methods?	• When should we conduct outreach?	• What do the stakeholders know that we need to know?

4.4. GSA Boards

Due to the multiple subbasin GSAs, specific focus is needed on communications to keep them informed, provide consistent updates and information that the Boards can use in their own outreach, and support their decision making. Primary objectives for communications with the subbasin GSA Boards are to ensure:

- Consistent understanding of the requirements for a GSP and/or GSP coordination
- On-going access to current information
- Timely notice of any significant developments or decision points that may require changes to policies and/or require some other board action
- Confidence that the GSP(s) will be accepted by the GSA's stakeholders

Key communications activities involving the Board include;

1. Providing short and digestible pieces of information to ensure each Board member can quickly articulate to his/her constituents on key matters and remain sufficiently informed so that no decision points are surprises.
2. Provide user-friendly informational materials to be used with public audiences, and will support the Board with their own constituent outreach.
3. Utilize regular Board communications for routine updates and reserve specific Board agenda items for highly significant discussion items.

4.5. Primary Audiences

There are several core stakeholder groups that will require ongoing communications and tailored messaging throughout the planning process. They are:

- Agriculture
- Disadvantaged Communities
- Municipals

Other stakeholders requiring special consideration include:

- Industrial Users/ Business
- Regulators (State and Federal)
- Potential Partners
- Environmental Organizations
- Federal Agencies

While all of the stakeholder types are important to engage for development of a GSP, the first three will be most affected by any changes that might be proposed as a result of the *GSP(s)*.

The following provides an outline of key messages and activities in support of each of the audience types.

4.2.1. Agricultural

Messages about the GSP(s) development should feature the overall desirability of a sustainable management approach how the plan will contribute to management certainty and protect against regulatory oversight.

In thinking about irrigation users it is also important to remember that one size does not fit all.

4.2.2. Disadvantaged Communities

Messages developed for this sector should be tailored and specific to the community. This type of outreach is often best served by use of surrogates and trusted messengers. As identified in the SA, these messages should be aligned with activities of the IRWM, especially given the high, current dependence of many on unsustainable water sources. Messages about ways to access the increased availability of resources due to grant incentives should also be considered.

A specific outreach method to consider relates to the predominance of cells phones within the communities. According to the Pew Research Center, "over 50 percent of low-income households own a smartphone. Smartphone penetration in this demographic creates substantial opportunities for utilities to reach disadvantaged communities with software solutions like customer self-service platforms and targeted digital communications."[12]

4.2.3. Municipals

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[12] Secondary Source: Water Smart. https://www.watersmart.com/rethinking-disadvantaged-community-engagement/ (accessed June 1, 2017)

Some care will be needed to address tensions related to the relative percentages of use by Municipal agencies and what constitutes highest and best beneficial uses within an agricultural region. A promising interaction with this community would involve collaboration on messaging to achieve mutually beneficial goals.

Some thought it might be possible for the municipal agencies to provide in-kind support to the GSP development process through support for project websites and mailing lists, production of meeting notices, assistance to the planning process from in-house public information professionals and offering access to physical meeting spaces.

Municipals may need assistance in making the case for the need to think at a Basin scale rather than more local terms.

4.2.4. Business and Industry Interests

Business and industry interests seek assurances about the availability of water for operations and the viability of the farming industry in the region. Messages for these audiences should focus on how the GSP(s) development will contribute to sustainability and how these audiences can participate in discussion specific to their interests.

4.2.5. Regional/Statewide Interests and Regulators

Some degree of uncertainty remains in the overall legal, legislative and regulatory environment as it relates to SGMA implementation.

It is in the interest of the subbasin stakeholders to engage state and federal agencies and regulators throughout the process. These parties may have resources to assist the subbasin and a cooperative attitude will build good will in the event that adjustments are needed to achieve SGMA compliance.

4.2.6. Potential Agency Partners

A variety of collaborations to achieve GSP(s) development goals may be possible. The GSAs should consider the potential for collaboration with non-GSA members and inter-basin (adjacent subbasin) partners, as part of plan deliberations.

4.2.7. GSP Coordinators Planning Forum

A planning forum for subbasin GSP coordinators should be established to further inform a coordination strategy. This forum would include agency representatives as well as the consultant teams and be used for the sole purpose of coordination and mutual support. It is anticipated that this body might meet on a quarterly or as needed basis. This forum would also provide a central point of contact for adjacent subbasin coordinators.

4.2.8. Environmental Community

As noted in the SA, this community will be interested in a GSP features. The focus of messaging for this group being on how the GSP(s) development will contribute to a sustainable regional water portfolio. Special effort should be made to identify specific

topics of interest. For example, as part of GSP development, a list of groundwater dependent species may be created, or impacts to wetlands may be identified. These types of lists would highlight where input from the environmental community might be needed.

4.2.9. Federal Government

Federal representatives interviewed for the assessment asked to be kept informed of subbasin SGMA activities. These agencies have a direct interest in surface water integration as well as SGMA activities that could impact wetlands restoration efforts or groundwater dependent ecosystems and species.

RISK MANAGEMENT

Risk management is the identification, assessment, and prioritization of risks (defined as *the effect of uncertainty on achieving objectives*) followed by coordinated, efficient and economical strategies and actions to minimize, monitor, and control the probability and/or impact of negative events. Strategies and actions may also be used to avert risk by leveraging strengths and opportunities.

Risks can come from uncertainty in economic factors, threats from project failures (at any phase), regulatory and legal uncertainties, natural causes and disasters (drought, flood, etc.), as well as dissention from adversaries, or events of uncertain or unpredictable circumstances. Several risk management standards have been developed. This analysis utilizes those from the Project Management Institute.

Table 6 outlines standardized risk categories and translates them to outreach risks.

Table 6. Risk Factors

RISK CATEGORY	Outreach RISK FACTORS
Technical, quality, or performance	• Realistic performance goals, scope and objectives
Project management	• Quality of outreach design • Outreach deployment and change management • Appropriate allocation of time and resources • Adequate support for Outreach in project management plans
Organizational / Internal	• Executive Sponsorship • Proper prioritization of efforts • Conflicts with other functions • Distribution of workload between organizational and consultant teams
Historical	• Past experiences with similar projects • Organizational relations with stakeholders • Policy and data adequacy • Media and stakeholder fatigue*
External	• Legal and regulatory environment • Changing priorities • Risks related to political dynamics

5.1. Technical, quality, or performance

The subbasin is fortunate to have a high level of water knowledge and skilled personnel available to assist with GSP planning. In general, stakeholder expectations for outreach and performance goals, scope and objectives are attainable. The larger concern in this category is properly communicating the scope of the GSP(s) development and the need for extensive coordination and outreach among a number of parties. Communication of SGMA

requirements for outreach as a planning requirement should be an ongoing consideration and appears to be underestimated in emphasis.

5.2. Project management

A number of positive project management factors are present for the GSP(s) development outreach. Project managers view outreach as an important planning element. The outreach design is based on best management practices and industry standards. It is not overly complicated and with technical services support from DWR and other sources, sufficient resources should be available to properly execute it. Procedures and practices are already in place that can be leveraged to achieve communication goals.

The primary concern in this category relates to GSP coordination. This type of outreach will require additional assessment as the individual GSAs will determine their own protocols for representation.

5.3. Organizational / Internal

Conflicts with other GSA member functions and/or conflicts with outreach activities by efforts that include the same stakeholders (e.g. Irrigated Lands, IRWM, and CV-Salts) should be monitored.

One additional consideration will be the distribution of workload between GSA, organizational and consultant teams. Clear roles and responsibilities must be defined and continuous interaction in place to ensure successful execution.

The GSP(s) development process will also need identified, high level spokespersons or champions. These individuals should be able to discuss subbasin planning with the media, in discussions with regulators and potentially at professional conferences.

5.4. External

The legal and regulatory environment of the GSP(s) development process is complex and evolving. Ongoing issues with surface water deliveries and changing agricultural market conditions are outside of the control of the parties. It will be important for mechanisms to be in place that allow for relatively rapid responses to changing conditions.

5.5. Historical

The primary stakeholders in this process generally view interactions and meetings as productive. There is a history of cooperation and a willingness to work together to save costs and achieve better outcomes.

TACTICAL APPROACHES

Following are specific tactical approaches that may be utilized to deliver the activities, messages, and recommendations of the previous chapters. These approaches are based on best communication practices and grounded in the public participation philosophy of the International Association for Public Participation, Public Participation Spectrum as illustrated in **Table 7**.

The Spectrum represents a philosophy that outreach should match the desired level of input from both the stakeholder and the organizational entity.

Table 7. IAP2 Public Participation Spectrum

IAP2 Public Participation Spectrum

Developed by the International Association for Public Participation

INCREASING LEVEL OF PUBLIC IMPACT

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public Participation Goal:	To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public issues and concerns are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the Public:	We will keep You informed.	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and issues are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example Tools:	• Fact sheets • Web Sites • Open houses	• Public comment • Focus groups • Surveys • Public meetings	• Workshops • Deliberate polling	• Citizen Advisory Committees • Consensus-building • Participatory decision-making	• Citizen juries • Ballots • Delegated decisions

Based on the assessment findings for the GSP(s) development, most stakeholders would simply like to be <u>INFORMED</u> unless there is a potential for significant changes that may include that stakeholder. Tactics for this group will include fact sheets, websites, open houses, briefings, and informational items placed in publications they already read.

The next largest group of stakeholders, primarily groundwater pumpers and disadvantaged communities, wish to be <u>CONSULTED</u>. This group will have access to all the materials

prepared as part of the informational phase. In addition they should be invited to provide comments on written materials and planning concepts and participate in focused workshops and/or briefings. They should also be invited to attend larger public meetings.

The development of some GSP features may require a higher degree of INVOLVEMENT. This would focus on engagement of a subset of stakeholders that may experience significant impacts associated with SGMA.

COLLABORATION opportunities have also been identified; however, they are of a different character than defined in the Spectrum. Collaboration in this GSP(s) development process will focus on working with partners that have mutual goals to achieve those goals together. This will more resemble a partnership than a public engagement activity.

6.1. Communications Coordination.

Each GSA is required to perform legally mandated outreach activities and the GSP submission guidelines require a minimum level of engagement.

The subbasin GSAs should coordinate outreach activities even if there is a decision to move forward with multiple GSPs. In addition to efficiency and cost savings (the GSAs can share resources) this strategy will allow for consistency in messaging and reduce confusion for stakeholders that may not know what GSA jurisdiction they are in, and/or are in multiple GSA jurisdictions. Following are suggested options for communications coordination.

1. Website
2. Meeting calendar
3. Branded informational Flyers, Templates, PowerPoint Presentations, etc.
4. Periodic newsletter
5. GSP related mailing lists
6. Descriptions of interested parties
7. Issues and interest statements for legally mandatory interested parties
8. Public workshops
9. Message calendar
10. Press releases and guest editorials
11. Speakers Bureau
12. Existing group venues
13. Outreach documentation

6.2. Tactics

6.2.1. Website

As part of the communications plan development, a list of website concepts and draft website content was prepared. The following describes the proposed approach:

a. Centralized – Establish a centralized website for the entire subbasin.

b. Individual GSAs – Posting of material to a website is part of the SGMA requirements. Those GSAs with their own webpages can link to and from the centralized site if they wish to provide their own customized information. For those GSAs without their own website, courtesy pages would be provided as an added feature of the main site. The courtesy pages would all use a single template with the same information to facilitate easy management and updates. Individual GSAs choosing to take advantage of the courtesy pages would be responsible for ensuring that information is current. The page should include a "Last Updated" box to indicate the timeliness of the information.

c. **Basic features** – A basic website framework has already been developed along with introductory information that has prepopulated each page. **Figure 10** illustrates the basic content of the site and includes:
   1. Background information
   2. Information about getting involved, including meeting information
   3. A separate link for Spanish Language materials
   4. Frequently asked questions
   5. Links to GSAs
   6. Contact information

   Should a GSA decide to not participate in the Central website, a similar structure could be utilized.

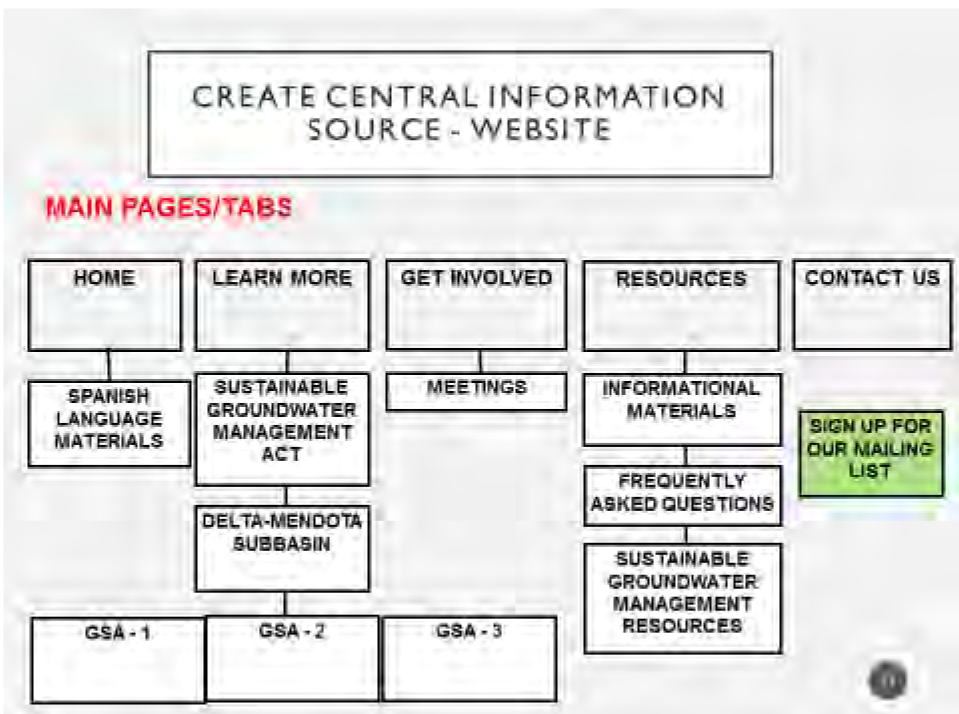


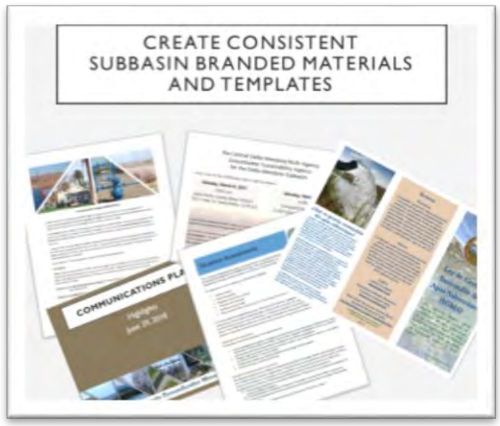
Figure 10. Website Structure

6.2.2. Meeting Calendar

A shared meeting calendar will provide a one-stop shop for stakeholders and assist in preventing meeting conflicts while creating more potential for shared activities. This calendar should include current and scheduled meetings and workshops as well as serve as the repository for agendas and meeting notes, along with copies of meeting materials and presentation.

An integrated project calendar should also be developed that links planning project milestones with communications milestones.

6.2.3. Branded Informational Flyers, Templates, PowerPoint Presentations, etc.



Subbasin level materials should have a single look and feel to create on-going consistency and visual recognition by stakeholders. Use of templates, shared presentations and flyers will create efficiencies and reinforce messaging. This communications plan incorporates some of this type of branding.

6.2.4. Periodic Newsletter

The need for regular communications cannot be overstated. One option is production of a periodic newsletter. Given the relatively short GSP(s) development process timeframe and the GSP development requirements for periodic outreach to identified stakeholders, a quarterly schedule would be realistic and achieve compliance with SGMA requirements for periodic updates to stakeholders. The newsletter should be designed so that individual GSAs can add tailored information if they choose to. For Portable Document Format (PDF) versions of the newsletter, a GSA could add a simple one or two page insert and the edition could be used as a handout or mailer. For a professional looking, email version of the newsletter, we recommend free or low cost services such as Mail Chimp or Constant Comment, which can be integrated with mailing lists.

Adding GSA specific information to an email newsletter can be done with web-links in the email to the very same PDF page prepared for the hardcopy mailer. An alternative is emailing the entire newsletter PDF as an attachment (although this format is less likely to be read than the mailer services).

6.2.5. GSP related mailing lists

Each GSA is required to develop notification lists. A central list may be utilized for GSP(s) related notifications.

6.2.6. Descriptions of Interested Parties

Each GSA is required to develop descriptions of interested parties. These lists should be updated and merged for use in the GSP(s) submittal(s). These can also be provided as background information on the website as part of constructing an administrative record. The SA in Chapter 4 provides an initial start for this documentation.

6.2.7. Issues and Interest Statements for Legally Mandatory Interested Parties

A GSP submission must include a statement of interests for listed stakeholders. As suggested earlier, this can also be included on the website.

6.2.8. Coordinated Public Workshops

SGMA requires a series of public hearings and some public workshops. Such workshops should be coordinated with other subbasin entities.

During the GSA formation process the County of Merced and a forming GSA body conducted a joint workshop to explain more about SGMA and the proposed GSA formation. Distribution of meeting flyers and notices was done concurrently, and DWR attended the event to answer questions. The GSP development process will offer similar opportunities, not only within the subbasin, but with adjacent subbasins.

6.2.9. Message Calendar

Basic messages should be associated with the planning schedule and each stage of GSP(s) development and serve as the theme for the communications materials being generated. For example, during the GSA formation period there was a need to communicate the basics of SGMA and groundwater management. During the GSP(s) initiation phase messages should focus on the basics of groundwater sustainability and the current state of the subbasin. As the GSP(s) begins to take form the specifics of the GSP(s) and what it means for each stakeholder would be the focus.

6.2.10. Press Releases and Guest Editorials

At some point in the GSP development and implementation process, it is likely that stakeholders will be asked to make changes and/or financially support a sustainability effort. It will be more productive for the GSAs and their GSP collaboration partners to frame discussions about these changes than to have others, perhaps with less knowledge, do so on their behalf. For that reason there is a need for press releases and/or guest editorials to offer the media and stakeholders accurate information offered in the context of SGMA. This type of outreach should be closely coordinated as consistency in messages is critical to stakeholder acceptance.

6.2.11. Speakers Bureau

Efforts should be made to conduct outreach at events and meetings that already occur (e.g. Farm Bureau meetings, Rotary Club, etc.). A list of knowledgeable presenters should be developed in the event an organization or other entity would like a presentation. Speakers Bureau engagements should be recorded on the planning project meeting calendar.

6.2.12. Existing Group Venues

Fully leverage the activities of existing groups.

- Maintain a roster of existing groups and typical meeting schedules with a nexus to GSP(s) development. Add the dates to the messaging calendar.
- The list of audiences, messages and existing groups should be referenced when there is a need to deploy information.
- Conduct informal outreach with the leaders of such groups to determine the best way to interact.
- Determine what communications channels these groups are using and equally leverage these, for example by placement of articles in newsletters.

6.2.13. Outreach Documentation

A central point of contact should be identified on the website and an outreach statistics inventory should be established that identifies dates, times, audiences and attendance. This information will be also be useful in conducting follow up with stakeholders as well as documenting outreach as part of GSP submittal guidelines.

6.3. Procedural and Legally Mandated Outreach

A discussion of SGMA outreach requirements was provided in Chapter 1 and a full list of requirements is contained in Appendix 1. One major feature of the requirements is a submission to DWR of the opportunities that interested parties will be given to participate in the GSP deliberations. The Situation Assessment provides an initial description that can be added to with additional outreach.

Following are the Required Interested Parties for the purpose of mandated outreach:

Table 9 provides a list of the mandated outreach and the timeframe in which is required.

Table 8. Mandated Outreach

Timeframe	Item
Prior to initiating plan development	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR.

Timeframe	Item
	2. Web posting of same information.
Prior to plan development	1. Must establish and maintain an interested persons list. 2. Must prepare a written statement describing the manner in which interested parties may participate in GSP development and implementation. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public
Prior to and with GSP submission	1. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 2. Lists of public meetings 3. Inventory of comments and summary of responses 4. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions)
90 days prior to GSP Adoption Hearing	1. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must notify cities and/or counties of geographic area 90 days in advance.
90 days or less prior to GSP Adoption Hearing	2. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Consider and review comments b. Conduct consultation within 30 days of receipt with cities or counties so requesting
GSP Adoption or Amendment	1. GSP must be adopted or amended at Public Hearing.
60 days after plan submission	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission.
Prior to adoption of fees	1. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting. 2. Public notice shall include: a. Time and place of meeting b. General explanation of matter to be considered

Timeframe	Item
	c. Statement of availability for data required to initiate or amend such fees d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance) 3. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year. 4. Includes procedural requirements per Government Code, Section 6066.
Prior to conducting a fee adoption hearing.	1. Must publish notices in a newspaper of general circulation as prescribed. 2. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 3. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.)

6.4. Items for Future Consideration

This GSP(s) Coms Plan outlines an outreach effort based on project and stakeholder needs and preferences. This document has been prepared as a working draft living document and should be updated as new information and the GSP(s) development process needs are developed.

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MEASUREMENTS & EVALUATION

A guiding principle for evaluation and measurement of the Coms Plan's success is to provide regular, unbiased reporting of progress toward achieving goals. Success may be evaluated in several ways, including process measures, outcome measures, and an annual evaluation of accomplishments. Optional evaluation measures are described below.

As part of each outreach effort debrief the following process and outcome measures will be discussed and recorded in a check sheet. The check sheets will be prepared with the goal of continuous improvement rather than criticisms.

7.2. Process Measures

Process measures track progress toward meeting the goals of the Coms Plan. These include:

- Level of attendance at outreach meetings
- Shared understanding of the overarching aims, activities, and opportunities presented by different planning approaches and project activities
- Productive dialogue among participants at meetings and events
- Sense of authentic engagement; people understand why they have been asked to participate, and feel that they can contribute meaningfully
- Timely and accurate public reporting of planning milestones
- Feedback from Coordinating Body and GSA members, regulators, stakeholders, and interested parties about the quality and availability of information materials
- Level of stakeholder interest in the GSP(s) development process information

7.3. Outcome Measures

Outcome measures track the level of success of the Coms Plan in meeting its overall goals. Some outcome measures considered for the GSP(s) development process include the following:

- Consistent participation by key stakeholders and interested parties in essential activities. Participants should have no difficulty locating the meetings, and should be informed as to when and where they will be held.
- Response from meeting participants that the engagement methods provided for a fair and balanced exchange of information.
- Feedback from interested parties that they understand how their input is used, where to track data, and what results to expect.
- The project receives quality media coverage that is accurate, complete and fair.

7.4. Mid-cycle Evaluation of Accomplishments

A mid-cycle evaluation provides an opportunity to examine the current effectiveness of the Coms Plan and provides a chance to reevaluate strategies to meet the GSP(s) development process objectives. The evaluation tasks may include:

- Preparation of an executive-level summary detailing high-level initiatives and accomplishments of the previous cycle. This evaluation should also include positive news, best practices, goals and objectives, notable changes, timelines, and priorities.
- Identifying gaps and areas for improvement.
- Highlighting how gaps and areas for improvement in the cycle has been addressed.
- Outlining process and outcome measures and their current results.

ROLES AND RESPONSIBILITIES

The GSP(s) development Coms Plan outlines numerous strategies, activities and tactics. While none are highly complex, there is a requirement for coordination and clarity regarding who will be responsible for executing the tasks.

After the planning team evaluates the timelines and priorities for each of the communications activities a recommended next step is completion of a Responsible, Accountable, Consulted, and Informed (RACI) Chart. This Chart, as displayed in **Table 10**, outlines key tasks and the assignment of roles and responsibilities for accomplishing them.

Table 9. Sample RACI Chart

Activity TYPE	SPECIFIC PRODUCT	RESPONSIBLE	ACCOUNTABLE	CONSULTED	INFORMED
Internal Staff Communications, information materials for/briefings	Draft	Person A	Person E	Person I	
	Final Draft	Person A	Person E	Person I	Project Team
List Serves, mailing lists	Customer Contacts	Person B - Person A	Person E	Person I	Project Team
	Concurrent jurisdictions	Lisa Beutler/MWH	Person G	Person I	Project Team
	Other - identified stakeholders	Person A	Person G	Person I	Project Team
Web Content and Maintenance	Draft Content and Content Refresh	Lisa Beutler/MWH/	Person G	Person H	Project Team
	Site Administration	Person A	Person G	Person H	
General public Intro Packets, Fact Sheets and Brochures	Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team
Newsletter Content	Draft	Lisa Beutler/MWH	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team

Responsible
Those who do the work to achieve the task. There is at least one person with a role of *responsible*, although others can be delegated to assist in the work required.

Accountable (also approver or final approving authority)
This is the person ultimately answerable for the correct and thorough completion of the deliverable or task, and the one who delegates the work to those responsible. There **may only** be only one *accountable* specified for each task or deliverable.

Consulted
Those whose opinions are sought, typically subject matter experts were people that are impacted by the activity; and with whom there is two-way communication.

Informed
Those who are kept up-to-date on progress, typically on the launch and completion of the task or deliverable. This is one way communication.

Role distinction
There is a distinction between a role and the individual assigned the task. Role is a descriptor of an associated set of tasks that could be performed by just one or many people.

In the case of the RACI Chart, the team may list as many people as is logical except for the Accountable role.

Scope of Work
Completion of the RACI Chart will also support development of any future scopes of work for consultant provided communication and outreach services.

LIST OF APPENDICES

Appendix 1-Public Outreach Requirements under SGMA

Appendix 2-Communications Governance

Appendix 1. Public Outreach Requirements under SGMA

GSP Regulations

CODE	PUBLIC OUTREACH REQUIREMENT
§ 353.6. Initial Notification (a) Each Agency shall notify the Department, in writing, prior to initiating development of a Plan. The notification shall provide general information about the Agency's process for developing the Plan, including the manner in which interested parties may contact the Agency and participate in the development and implementation of the Plan. The Agency shall make the information publicly available by posting relevant information on the Agency's website.	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR. 2. Web posting of same information. **Timing**: *Prior to initiating development of a plan.*
§ 353.8. Comments (a) Any person may provide comments to the Department regarding a proposed or adopted Plan. (b) Pursuant to Water Code Section 10733.4, the Department shall establish a comment period of no less than 60 days for an adopted Plan that has been accepted by the Department for evaluation pursuant to Section 355.2. (c) In addition to the comment period required by Water Code Section 10733.4, the Department shall accept comments on an Agency's decision to develop a Plan as described in Section 353.6, including comments on elements of a proposed Plan under consideration by the Agency.	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission. 2. Parties may also comment on a GSA's (or GSAs') statements submitted under section 353.6 **Timing**: For GSP Submittal - *60 days after submission to DWR*
§ 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: (a) 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. (b) A list of public meetings at which the Plan was discussed or considered by the Agency. (c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency. (d) A communication section of the Plan that includes the following: (1) An explanation of the Agency's decision-making process. (2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.	5. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 6. Lists of public meetings 7. Inventory of comments and summary of responses 8. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions) **Timing**: For GSP Submittal – *with plan* For GSP Development – *continuous.* *[Note: activities should be included*

CODE	PUBLIC OUTREACH REQUIREMENT
(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin. (4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.	*in the project schedule and information posted on web.]*
§ 355.2. (c) Department Review of Adopted Plan (c) The Department (DWR) shall establish a period of no less than 60 days to receive public comments on the adopted Plan, as described in Section 353.8.	1. 60 day public review period for public comment on submitted plan. **Timing**: After GSP Submittal to DWR – *60 days*
§ 355.4. & 355.10 Criteria for Plan Evaluation The basin shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act. The Department shall evaluate an adopted Plan for compliance with this requirement as follows: (b) (4) Whether the interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected by the use of groundwater in the basin, have been considered. … (10) Whether the Agency has adequately responded to comments that raise credible technical or policy issues with the Plan.	1. Required public outreach and stakeholder information is submitted, including statement of issues and interests of beneficial users. 2. Public and stakeholder comments and questions adequately addressed during planning process. **Timing**: For GSP Submittal – *with plan* For resubmittal related to corrective action *– with submittal*

California Water Code

CODE	PUBLIC OUTREACH REQUIREMENT
10720. This part shall be known, and may be cited, as the "Sustainable Groundwater Management Act." **10720.3** (a) This part applies to all groundwater basins in the state. … (c) The federal government or any federally recognized Indian tribe, appreciating the shared interest in assuring the sustainability of groundwater resources, may voluntarily agree to participate in the preparation or administration of a groundwater sustainability plan or groundwater management plan under this part through a joint powers authority or other agreement with local agencies in the basin. A participating tribe shall be eligible to participate fully in planning, financing, and management under this part, including eligibility for grants and technical assistance, if any exercise of regulatory authority, enforcement, or imposition and collection of fees is pursuant to	1. Tribes and the federal government may voluntarily participate in GSA governance and GSP development. **Timing**: *Prior to initiating development of a plan.*

CODE	PUBLIC OUTREACH REQUIREMENT
the tribe's independent authority and not pursuant to authority granted to a groundwater sustainability agency under this part.	
CHAPTER 4. Establishing Groundwater Sustainability Agencies [10723 - 10724]	
10723. a) Except as provided in subdivision (c), any local agency or combination of local agencies overlying a groundwater basin may decide to become a groundwater sustainability agency for that basin. (b) Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant to Section 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin.	1. Must hold public hearing in the county or counties overlying the basin, prior to becoming a GSA **Timing**: *Prior to becoming a GSA.*
10723.2 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 of the following: (a) Holders of overlying groundwater rights, including: (1) Agricultural users. (2) Domestic well owners. (b) Municipal well operators. (c) Public water systems. (d) Local land use planning agencies. (e) Environmental users of groundwater. (f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies. (g) The federal government, including, but not limited to, the military and managers of federal lands. (h) California Native American tribes. (i) Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems. (j) Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	1. Must consider interest of all beneficial uses and users of groundwater. 2. Includes specific stakeholders as listed. **Timing**: *During development of a GSP.*
10723.4. The groundwater sustainability agency shall establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents. Any person may request, in writing, to be placed on the list of interested persons.	3. Must establish and maintain an interested persons list. 4. Any person may ask to be added to the list **Timing**: *On forming a GSA.*
10723.8. (a) Within 30 days of deciding to become or form a groundwater sustainability agency, the local agency or combination of local agencies shall inform the department of its decision and its intent to undertake sustainable groundwater management. The	1. Creates notification requirements that include: a. A list of interested parties b. An explanation of how interests will be considered

CODE	PUBLIC OUTREACH REQUIREMENT
notification shall include the following information, as applicable: … (4) A list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan.	**Timing**: *On forming a GSA & with submittal of GSP*
10727.8 (a) Prior to initiating the development of a groundwater sustainability plan, the groundwater sustainability agency shall make available to the public and the department a written statement describing the manner in which interested parties may participate in the development and implementation of the groundwater sustainability plan. The groundwater sustainability agency shall provide the written statement to the legislative body of any city, county, or city and county located within the geographic area to be covered by the plan. The groundwater sustainability agency may appoint and consult with an advisory committee consisting of interested parties for the purposes of developing and implementing a groundwater sustainability plan. The groundwater sustainability agency shall 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. If the geographic area to be covered by the plan includes a public water system regulated by the Public Utilities Commission, the groundwater sustainability agency shall provide the written statement to the commission. (b) For purposes of this section, interested parties include entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	2. Agencies preparing a GSP must prepare a written statement describing the manner in which interested parties may participate in its development and implementation. 3. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public 4. GSP entities may form an advisory committee for the GSP preparation and implementation. 5. The GSP entities are to encourage active involvement of diverse social, cultural and economic elements of the affected populations. **Timing**: *On initiating GSP*
10728.4 Public Notice of Proposed Adoption, GSP Adoption Pubic Hearing A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment. The groundwater sustainability agency shall review and consider comments from any city or county that receives notice pursuant to this section and shall consult with a city or county that requests consultation within 30 days of receipt of the notice. Nothing in this section is intended to	3. GSP must be adopted or amended at Public Hearing. 4. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Notify cities and/or counties of geographic area 90 days in advance. b. Consider and review comments

CODE	PUBLIC OUTREACH REQUIREMENT
preclude an agency and a city or county from otherwise consulting or commenting regarding the adoption or amendment of a plan.	c. Conduct consultation within 30 days of receipt with cities or counties so requesting
10730 Fees. (a) A groundwater sustainability agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve. A groundwater sustainability agency shall not impose a fee pursuant to this subdivision on a de minimis extractor unless the agency has regulated the users pursuant to this part. (b) (1) Prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting, at which oral or written presentations may be made as part of the meeting. (2) Notice of the time and place of the meeting shall include a general explanation of the matter to be considered and a statement that the data required by this section is available. The notice shall be provided by publication pursuant to Section 6066 of the Government Code, by posting notice on the Internet Web site of the groundwater sustainability agency, and by mail to any interested party who files a written request with the agency for mailed notice of the meeting on new or increased fees. A written request for mailed notices shall be valid for one year from the date that the request is made and may be renewed by making a written request on or before April 1 of each year. (3) At least 20 days prior to the meeting, the groundwater sustainability agency shall make available to the public data upon which the proposed fee is based. (c) Any action by a groundwater sustainability agency to impose or increase a fee shall be taken only by ordinance or resolution. (d) (1) As an alternative method for the collection of fees imposed pursuant to this section, a groundwater sustainability agency may adopt a resolution requesting collection of the fees in the same manner as ordinary municipal ad valorem taxes. (2) A resolution described in paragraph (1) shall be adopted and furnished to the county auditor-controller and board of supervisors on or before August 1 of each year that the alternative collection of the fees is being requested. The resolution shall include a list of parcels and the amount to be collected for each parcel. (e) The power granted by this section is in addition to any powers a groundwater sustainability agency has under any other law.	Related to GSAs 5. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting. 6. Public notice shall include: a. Time and place of meeting b. General explanation of matter to be considered c. Statement of availability for data required to initiate or amend such fees d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance) 7. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year. 8. Includes procedural requirements per Government Code, Section 6066. **Timing**: *Prior to adopting fees.*

California Government Code

CODE	PUBLIC OUTREACH REQUIREMENT
6060 Whenever any law provides that publication of notice shall be made pursuant to a designated section of this article, such notice shall be published in a newspaper of general circulation for the period prescribed, the number of times, and in the manner provided in that section. As used in this article, “notice” includes official advertising, resolutions, orders, or other matter of any nature whatsoever that are required by law to be published in a newspaper of general circulation. **6066** Publication of notice pursuant to this section shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. The period of notice commences upon the first day of publication and terminates at the end of the fourteenth day, including therein the first day.	4. Must publish notices in a newspaper of general circulation as prescribed. 5. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 6. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.) **Timing**: *Prior to adopting fees*

Appendix 2. Communications Governance

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[13] some form of communications governance is recommended.

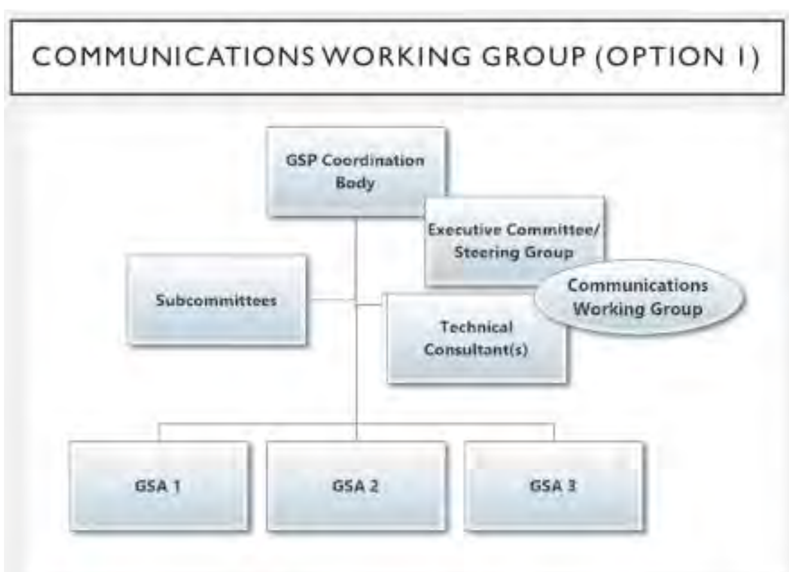
Execution of communications activities can be accomplished by an individual or multiple individuals, and/or include or be solely managed by project consultants. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. Also essential is a clear chain of command that ensures the elected representatives of GSAs are able to retain communications leadership and guidance.

A driving consideration for establishing a communications governance structure is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance to a communications team is efficient and effective.

Several governance options for consideration are offered below.

Communications Option 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based leadership function that is guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications working group that would ultimately report to the larger GSP coordinating body.



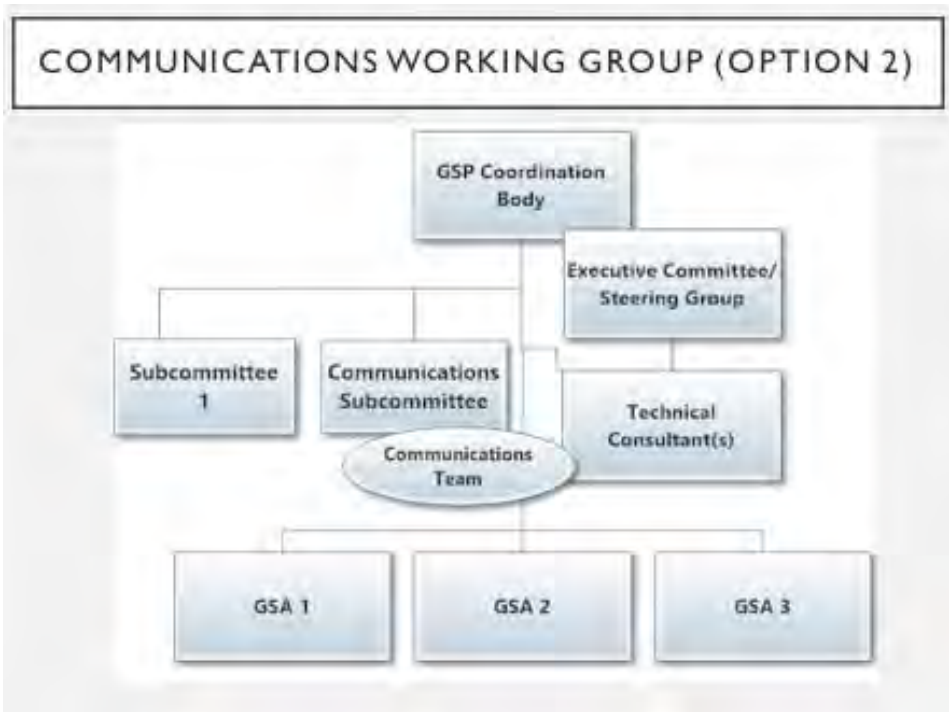
Communications Governance Option 1

Communications Option 2

[13] See Appendix 1

Appendix 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based subcommittee guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications team that is affiliated with a subcommittee and would ultimately report to the larger GSP coordinating body



Communications Governance Option 2

Appendix F - Summaries of Coordinated Workshops

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
SPRING 2018 COORDINATED WORKSHOPS

Monday, May 14, 2018, Los Banos
Wednesday, May 16, 2018, Patterson
Thursday, May 17, 2018, Mendota

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about the Sustainable Groundwater Management Act (SGMA) and introduce participants to their local Groundwater Sustainability Agency representatives. Topics covered during the workshop included what is SGMA, the Delta-Mendota Subbasin, and opportunities for public engagement.
- Workshop participants' questions and feedback are summarized as follows:
  - Are the local groundwater regulations going to be re-set on an annual basis based on the water year, snowpack, etc.?
  - Who is the governing board that will make these decisions?
  - If this is a state-wide initiative, who is the decision-making body?
  - Will the California Department of Fish and Wildlife be involved?
  - Has the State provided criteria to what is considered a "chronic loss" of groundwater?
  - Are natural springs included under SGMA?
  - What criteria will you use to measure whether or not springs are overused?
  - What is the ultimate goal of SGMA? What does it mean to us?
  - How is the water budget going to be developed?
  - The Irrigated Lands Program already has a lot of requirements for growers. Is this going to be the same level of detail and effort?
  - What is the goal SGMA is trying to achieve? How are we going to get to sustainability?
  - What will happen when the State and districts do not receive their full surface water allocation and cities keep expanding?
  - It seems to me that the biggest problem is that the State wants to export water to Southern California. How can we come up with a solution if there are factors out of our control?

- How will you know how much I am pumping?

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
FALL 2018 COORDINATED WORKSHOPS

Monday, October 22, Firebaugh
5:00 – 7:00 PM
Firebaugh Middle School MPR

Wednesday, October 24, Los Banos
4:00 – 6:00 PM
College Greens Building

Thursday, October 25, Patterson
4:00 – 6:00 PM
Patterson Senior Center

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about key Sustainable Groundwater Management Act (SGMA) topics in preparation for Groundwater Sustainability Plan (GSP) development workshops in 2019.
- The format and content of each workshop was the same. The workshops began with a 45-minute presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 45 individuals (not including GSA representatives and supporting staff) participated in the workshops. Attendance by location was as follows: Firebaugh – 5 participants; Los Banos – 23 participants; Patterson – 17 participants. Three participants requested Spanish interpretation.
- Most participants heard about the workshops through emails from their local water or irrigation district, or direct flyers and bill inserts sent to them by their water/irrigation district or municipality.
- Presentation topics included: Overview of SGMA, GSP development and implementation process, data management, hydrogeologic conceptual model, numerical and analytical models, and the water budget.
- Workshop participants' questions and feedback are summarized as follows:

  Data

    - How much historical data are the GSAs using to make their assumptions?
    - Will data from counties be used?

- Is the numerical data available on the Delta-Mendota website?
- How big will the GSAs' monitoring network be? Do the GSAs anticipate drilling new monitoring wells?
- How will the GSAs monitor water quality and subsidence? Do the GSAs already have subsidence monitoring wells and data?
- How much data have the GSAs gathered? When will the GSAs stop gathering data?
- How much data will the GSAs be collecting from individual landowners?

Models

- Will the models take into account availability of surface water supplies?
- Will the models take into account changing crops?
- Will the models take into account agricultural areas that are being converted to commercial or urban areas?

Water Budget and Sustainable Yield

- What is the sustainable yield for the Delta-Mendota Subbasin?
- It sounds like the sustainable yield will be a number that oscillates around a baseline. What is this baseline?
- How will the GSAs determine the minimum threshold for the subbasin?
- How will the water budgets account for existing and new wells?
- What are the years for the historic water budget? How was this period set?

Projects and Management Actions

- Based on what is currently known, will the GSAs be able to limit groundwater pumping in the future?
- When the GSAs come up with groundwater management policies, will the policies impact groundwater pumping on an individual level, regional level, or basin-wide level?
- Will the California Department of Water Resources (DWR) or the GSAs be the ones to limit pumping?
- Could a potential management action be limiting pumping?
- Will the GSAs be the agencies to determine if new wells can or cannot be drilled?

Integration with Other Programs/Organizations

- How much are the GSAs integrating with the Irrigated Lands Program?
- How closely do GSAs work with local farm bureaus?

Other

- Will there be an administrative fee for the GSAs to oversee GSP implementation?
- How will the costs for GSP development and implementation be covered?
- Do the GSAs know what DWR's GSP review and certification process will consist of?

- Will the GSAs in the region have influence over how surface water resources are managed on a state-wide level?
- How many GSAs were formed after SGMA passed in 2014?

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
WINTER 2019 COORDINATED WORKSHOPS

Tuesday, February 19, 2019, Los Banos
4:00 – 6:00 PM
College Greens Building

Wednesday, February 20, 2019, Patterson
4:00 – 6:00 pm
City of Patterson City Hall

Monday, March 4, 2019, Santa Nella
6:00 – 8:00 PM
Romero Elementary School

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin during February and March 2019. The purpose of the workshops was to educate stakeholders and members about the public about topics covered in the draft Groundwater Sustainability Plans (GSP) being developed for the subbasin. Topics covered during the workshop included historic and current water budgets, sustainability criteria, undesirable results, and projects and management actions.
- Workshops were promoted via emails sent to each GSA's interested parties database, flyers and utility bill inserts, and social media posts.
- The format and content of each workshop was the same. The workshops began with a short presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 30 individuals (not including GSA representatives and supporting staff) participated in the workshops. Attendance by location was as follows: Patterson – 14, Los Banos – 4, and Santa Nella – 12. Participants represented a range of beneficial users in the subbasin, including domestic well owners, agricultural water users, public water systems, and disadvantaged communities.

- Workshop participants' questions and feedback are summarized as follows:

Water Budgets

- Does the land surface budget include inflows from precipitation and applied water to crops?
- Who provides the information about the inflows and outflows of the aquifer?
- How is the aquifer recharged?
- Do reservoirs lose water?
- What happened between 1985 – now [regarding the historic water budget]?
- What affect does precipitation have on the aquifer?

Projects and Management Actions

- Who will make the decision on who can drill wells and how much can well owners can pump?
- Will GSAs in the subbasin be able to restrict selling of groundwater outside of the subbasin?
- Projects and management actions should emphasize flood and stormwater capture and increased stormwater storage.
- Will use of recycled water in new developments be considered a source of water to balance the water budget?
- Are there percolation ponds by golf course?

Sustainability Criteria and Undesirable Results

- Is it the GSAs' responsibility to set the sustainability criteria for the subbasin?
- Could this region experience seawater intrusion?
- What's going to happen in areas like Dos Palos that have poor groundwater quality?

Other

- Does the GSP only cover of agricultural uses of groundwater or does it also cover residential and commercial uses of groundwater?
- Who is doing the work to prepare the GSP?
- How much does it cost to prepare a GSP?
- Are there any agencies currently monitoring groundwater pumping and levels?
- How is groundwater currently being removed from the groundwater basin?
- How many monitoring stations have been identified? Have GSAs already identified where these monitoring pumps are?
- Does the California Aqueduct affect the water table in the subbasin?
- What is the rationale for the North-Central GSP group's boundaries? The north and south areas of the North-Central GSP group are very different.
- Do water agencies in the subbasin send water to the Santa Clara Valley Water District?
- Where are the coordinated meetings are held? What time are these meetings?
- Will this raise our water rates?
- The community of Tranquillity is currently experiencing land subsidence.

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
SPRING 2019 COORDINATED WORKSHOPS

Monday, May 20, 2019, Patterson
4:00 – 6:00 pm
City of Patterson City Hall

Tuesday, May 21, 2019, Los Banos
4:00 – 6:00 PM
College Greens Building

Wednesday, May 22, 2019, Santa Nella
6:30 – 8:30 PM
Romero Elementary School

Thursday, May 23, 2019, Mendota
6:00 – 8:00 PM
Mendota Library

WORKSHOP SUMMARY

- Four workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about topics covered in the draft Groundwater Sustainability Plans (GSP) being developed for the subbasin. Topics covered during the workshop included water budgets, sustainable yield, projects and management actions, and groundwater monitoring networks.
- Workshops were promoted via emails sent to each GSA's interested parties database, flyers and utility bill inserts, social media posts, and direct outreach to community stakeholders.
- The format and content of each workshop was the same. The workshops began with a short presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 30 individuals participated in the workshops. Attendance by location was as follows: Patterson – 7, Los Banos – 10, Santa Nella – 4, and Mendota – 9. Participants represented a range of beneficial users in the subbasin, including domestic well owners, agricultural water users, public water systems, and disadvantaged communities.

- Workshop participants' questions and feedback are summarized as follows:

  Water Budgets

  - Why is there a difference between the water budgets for the upper and lower aquifers?
  - Why is the change in storage negative?
  - Is there a water budget for each aquifer?
  - When the projected water budgets are finalized, will they include specific projects and management actions?
  - How was the data for the climate change factors developed?
  - Historically, California goes through periodic droughts. Do the projected water budgets account for future droughts?
  - Do the projected water budgets account for future population growth and new developments?
  - Do the water budgets account for percolation from water applied to crops?

  Projects and Management Actions

  - Will management actions include a charge for water pumping?
  - Will pumping restrictions be implemented during dry periods or drought?
  - Will the GSPs identify specific projects and management actions?
  - Will GSAs in the subbasin form a water bank?
  - If pumping restrictions are enacted, GSPs should include a provision that allows private well owners to demonstrate that they aren't overpumping or causing undesirable results.
  - The region needs more surface water storage to supplement groundwater pumping.
  - There should be restrictions on development in the region.

  Sustainable Yield

  - Does increases in groundwater demand relate to the cost of surface water supplies?

  Groundwater Monitoring

  - When local agencies monitor for groundwater, how far down do they monitor?

  GSP Adoption, Implementation and Enforcement

  - What agency approves the GSPs?
  - Will the California Department of Water Resources be the lead agency for providing oversight after the GSP is submitted?
  - Could the State Water Resources Control Board mandate pumping restrictions?
  - Will the state be looking at the drawdown of individual, private wells?
  - Where does the funding to implement GSPs come from?
  - How much will GSP implementation cost?
  - Who has to submit the annual report?

  Other

  - GSAs should be divided into even smaller units to manage projects and management actions locally.

Appendix G - Examples of Promotional Materials

Groundwater management in our community is changing.

Learn more about how this may impact you.

Collaborating local agencies are hosting a series of public workshops about the Sustainable Groundwater Management Act. Come learn how this landmark legislation may impact our community, what we are doing about it, and how you can get involved. Representatives from local groundwater sustainability agencies will be available to answer questions. You have three opportunities to attend:

Los Banos
Monday, May 14
4:00 - 6:00 PM
San Luis & Delta-Mendota
Water Authority Office
842 6th St, Los Banos

Patterson
Wednesday, May 16
4:00 - 6:00 PM
Hammon Senior Center
1033 W Las Palmas Ave, Patterson

Mendota
Thursday, May 17
4:00 - 6:00 PM
Mendota Branch Library
Mendota Meeting Room
1246 Belmont Ave, Mendota

The content of each workshop will be the same. The first thirty minutes of each workshop will consist of an informational presentation, followed by an open house until 6:00 PM. For more information, please visit our website at: www.deltamendota.org.

We look forward to seeing you there!

El manejo del agua subterránea en nuestra comunidad está cambiando.

Obtenga más información sobre como esto puede afectarlo.

Las agencias locales colaboradoras están organizando una serie de talleres públicos sobre la Ley de gestión sostenible del agua subterránea. Venga y aprenda como esta histórica legislación puede afectar a nuestra comunidad, que estamos haciendo al respecto y como puede participar. Los representantes de las agencias locales de sostenibilidad del agua subterránea estarán disponibles para responder preguntas. Tienes tres oportunidades para asistir:

Los Baños
Martes, 14 de Mayo
4:00 - 6:00 PM
San Luis & Delta-Mendota
Water Authority Office
842 6th St, Los Baños

Patterson
Miércoles, 16 de Mayo
4:00 - 6:00 PM
Hammon Senior Center
1033 W Las Palmas Ave, Patterson

Mendota
Jueves, 17 de Mayo
4:00 - 6:00 PM
Mendota Branch Library
Mendota Meeting Room
1246 Belmont Ave, Mendota

El contenido de cada taller será el mismo. Los primeros treinta minutos de cada taller serán consisten de una presentación informativa, seguida de una jornada de puertas abiertas hasta las 6:00 P.M. Para obtener más información, visite nuestro sitio web en: www.deltamendota.org.

Public Notice

Public Groundwater Meeting

Santa Nella County Water District and other local water agencies are developing plans for the future of our groundwater resources. We want to hear from you! Come to an upcoming public workshop to learn more:

Santa Nella
Monday, March 4, 6:000 - 8:00 PM
Romero Elementary School MPR
13500 Luis Ave, Gustine, CA 95322

The first forty minutes of the workshop will consist of a bilingual informational presentation. The presentation will be followed by an interactive discussion on the region's groundwater "budget" and how to define "sustainability" for our groundwater resources. This workshop is open to people with all level of knowledge about water.

Spanish-language interpreters and materials will be available.

For more information, please visit our website at www.deltamendota.org and www.sncwd.com.

For questions or comments, email DMSGMA@sldmwa.org or contact Amy Montgomery, Santa Nella County Water District, at amontgomery@sncwd.com.

We look forward to seeing you there!

Engage in the Future of Our Water Resources!

Week of May 20th

Delta-Mendota SGMA invite you to learn why your local agencies are developing groundwater sustainability plans for the future of our groundwater. Please come to one

- **Patterson**: Mon., May 20, 4:00 – 6:00pm Patterson City Hall 1 Plaza Circle
- **Los Banos**: Tue., May 21, 4:00 – 6:00pm College Greens Building 1815 Scripps Drive
- **Santa Nella**: Wed., May 22, 6:30 – 8:30pm Romero Elem. School 13500 Luis Ave.
- **Mendota**: Thu., May 23, 6:00 – 8:00pm Mendota Library 1246 Belmont Ave.

For more information please visit www.deltamendota.org, To register visit: tinyurl.com/y3bxw3yv

PROP 1 WATER BOND 2014

#DeltaMendotaSGMA | #SLDMWA | #SGMA2020

DELTA-MENDOTA SGMA

Su Opinión es Importante!

Participe en una serie de talleres sobre el futuro de sus recursos hídricos!

Semana del 20 de mayo

Agencias locales están desarrollando planes de sostenibilidad para el futuro de los recursos hídricos del agua subterránea en la región y necesitan su opinión.

Acompáñenos en uno de los siguientes talleres:

- Patterson: Lun.,20 de Mayo , 4–6pm Ayuntamiento de Patterson 1 Plaza Circle
-Los Banos: Mar., 21 de May, 4–6pm College Greens Building 1815 Scripps Dr.
-Santa Nella: Mie., 22 de Mayo, 6:30–8:30pm Escuela Pri. Romero 13500 Luis Ave.
-Mendota: Jue., 23 de Mayo, 6–8pm Biblioteca de Mendota 1246 Belmont Ave.

PROP 1 WATER BOND 2014

Para más información visite:
www.deltamendota.org
Tel: 916-418-8288
#DeltaMendotaSGMA | #SLDMWA

DELTA-MENDOTA SGMA

DELTA-MENDOTA SGMA

Contact: Kirsten Pringle, Delta-Mendota Subbasin, Stantec
(916) 418-8243, Kirsten.Pringle@stantec.com

FOR IMMEDIATE RELEASE
October 19, 2018

MEDIA ADVISORY

Sustainable Groundwater Management Act Public Workshops

What: Collaborating local agencies are hosting a series of public workshops about the Sustainable Groundwater Management Act. Learn how this landmark legislation may impact our communities, the planning process, and how people can get involved. Spanish translation will be provided.

Format: There are three workshop opportunities to attend; the content of each workshop will be the same. The first 45 minutes of each workshop will consist of an informational presentation, followed by an open house.

When: **Firebaugh – Monday, October 22, 2018**
5:00 - 7:00 PM
Firebaugh Middle School MPR
1600 16th Street, Firebaugh, CA

Los Banos – Wednesday, October 24, 2018
4:00 – 6:00 PM
College Greens Building
1815 Scripps Drive, Los Banos, CA

Patterson – Thursday, October 25, 2018
4:00 – 6:00 PM
Hammon Senior Center
1033 W. Las Palmas Avenue, Patterson, CA

Who: Representatives from local groundwater sustainability agencies will be available to answer questions.

Additional Resources: The Sustainable Groundwater Management Act, www.deltamendota.org/,

Background: *The Sustainable Groundwater Management Act (SGMA) is a package of three bills (AB 1739, SB 1168, and SB 1319) that provides local agencies with a framework for managing groundwater basins in a sustainable manner. Recognizing that groundwater is most effectively managed at the local level, the SGMA empowers local agencies to achieve sustainability within 20 years.*

Appendix H - List of Stakeholders and Community Organizations Contacted

Stakeholder and Community Organizations Contacted Regarding Coordinated SGMA Workshops

Organization Name	Organization Type
Fresno County Farm Bureau	Agriculture
Merced County Farm Bureau	Agriculture
North Grassland Wildlife Foundation	Agriculture
Patterson Apricot Fiesta	Agriculture
Stanislaus County Farm Bureau	Agriculture
Asociación de Charros La Internacional del Valle de Patterson	Business
Adobe Valley Ranch	Business
Gustine Chamber of Commerce	Business
Los Banos Chamber of Commerce	Business
Patterson-Westley Chamber of Commerce	Business
Santa Nella Chamber of Commerce	Business
American Association of University Women	Civic
Gustine Rotary Club	Civic
International Association of Lions Clubs - Patterson	Civic
League of United Latin American Citizens	Civic
Los Banos Lions Club	Civic
Los Banos Rotary Club	Civic
Mendota Community Corporation	Civic
Newman Lions Club	Civic
Newman Rotary Club	Civic
Newman Women's Club	Civic
Patterson Lions Club	Civic
International Association of Lions Clubs - Mendota	Civic
International Association of the Lions Clubs - Los Banos	Civic
Italian Catholic Federation of CA Inc.	Civic
Kiwanis International	Civic
Rotary International - Los Banos	Civic
Rotary International - Patterson	Civic
Firebaugh Rotary Club Inc.	Community General Public
Casa Mobile Home Park	Community/General Public
Center for Environmental Science Accuracy & Reliability	Community/General Public
Firebaugh Senior Center	Community/General Public
Friends of Green Valley Charter	Community/General Public
Friends of the Public Library	Community/General Public
Habitat for Humanity International	Community/General Public
Los Banos Senior Center	Community/General Public
Mendota Community Center	Community/General Public
Mendota Senior Center	Community/General Public
Merced County Library - Dos Palos	Community/General Public
Merced County Library - Gustine	Community/General Public
Merced County Library - Los Banos	Community/General Public
Merced County Library - Santa Nella	Community/General Public
San Joaquin River Resource Mgmt. Coalition	Community/General Public

Santa Nella RV Park	Community/General Public
Stanislaus County Library - Newman	Community/General Public
Stanislaus County Library - Patterson	Community/General Public
Dos Palos Oro Loma Joint Unified School District	Education
Firebaugh-Las Deltas Unified School District	Education
Gustine Unified School District	Education
Los Banos Unified School District	Education
Mendota Unified School District	Education
Merced College	Education
Creekside Parent Club	Education
Academy West Insurance	Other
Academy West Insurance Firebaugh	Other
Amaral & Associates Realty	Other
American Legion	Other
American Legion Auxiliary Elijah B Hayes	Other
Andrea Brandt State Farm Insurance	Other
Benevolent & Protective Order of Elks	Other
Borelli Real Estate Services	Other
California Garden Clubs Inc.	Other
Century 21 M&M & Assoc - Los Banos	Other
Century 21 M&M & Assoc - Patterson	Other
Coldwell Banker Kaljian & Assoc	Other
Eric Rodriguez - Patterson	Other
Farmers Insurance Antonio Gonzales	Other
First Prioirty of the Central Valley	Other
Greg Nunes Real Estate	Other
Joe G. Gutierez State Farm Insurance	Other
Mendota Land Co	Other
Noah’s Ark Foundation of Tracy Inc.	Other
PMZ Real Estate - Patterson	Other
PMZ Real Estate - Los Banos	Other
Rafael Ruiz - Patterson	Other
Shane P. Donion Ranch Broker	Other
The Boyd Company	Other
Valley West Properties	Other
Adventure Christian Church of Patterson	Religious
Agape Baptist Church	Religious
Bethel Community Church	Religious
Church of Christ of Patterson	Religious
Church of God of Prophecy	Religious
Connections Christian Church	Religious
Evangelical Church of Los Banos	Religious
Family Christian Center	Religious
First Baptist Church	Religious
Full Gospel Businessmen’s Fellowship International	Religious
Harvest Samoan Assembly of God	Religious

Mountain House Foursquare Church	Religious
Movimiento Familiar Cristiano Catolico	Religious
Patterson Covenant Church	Religious
Patterson Christian Fellowship	Religious
Patterson Seventh Day Adventist Church	Religious

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Prepared by: WOODARD & CURRAN

In association with: PROVOST & PRITCHARD CONSULTING GROUP

1545 River Park Dr., Suite 425
Sacramento, CA 95815
916.999.8700

Appendix C. Cost Sharing Agreement – Delta-Mendota Subbasin Coordination

COST SHARING AGREEMENT
Delta-Mendota Subbasin Coordination

This Cost Sharing Agreement ("**Agreement**") is made effective as of December 12, 2018 by and among the groundwater sustainability agencies within the Delta-Mendota Subbasin and the San Luis & Delta-Mendota Water Authority ("**SLDMWA**"). The entities listed above may be referred to herein individually as a "**Party**" or jointly as "**Parties**." For purposes of this Agreement, the "**Effective Date**" shall be the date the last Party executes this Agreement.

RECITALS

A. The Sustainable Groundwater Management Act ("**SGMA**") requires all groundwater subbasins designated as high or medium priority to manage groundwater in a sustainable manner.

B. The Delta-Mendota Subbasin (Basin Number 5-22.07, DWR Bulletin 118) within the San Joaquin Valley Groundwater Basin ("**Subbasin**"), has been designated as a high-priority basin by the California Department of Water Resources ("**DWR**").

C. The Delta-Mendota Subbasin includes multiple groundwater sustainability agencies ("**GSAs**") that intend to manage the Subbasin through the development and implementation of multiple different groundwater sustainability plans ("**GSPs**").

D. The GSA parties to this Agreement ("**GSA Parties**") have organized into groundwater sustainability plan ("**GSP**") groups ("**GSP Groups**") and have agreed to be represented by "**GSP Group Representatives**," on terms to be developed and implemented by separate agreements between each GSP Group and the parties within such GSP Group.

E. SGMA allows local agencies to engage in the sustainable management of groundwater, but requires GSAs in all basins that are managed by more than one GSP to enter into a Coordination Agreement to coordinate the multiple GSPs to sustainably manage the Subbasin pursuant to SGMA.

F. The GSP Groups desire to dictate terms describing the mechanisms for the sharing of the costs associated with the coordination activities described in below and in a Delta-Mendota Subbasin Coordination Agreement ("**Coordination Agreement**") that the Parties plan to execute. The Coordination Agreement will establish a Coordination Committee ("**Coordination Committee**") to provide the forum for the parties to accomplish the coordination obligation of SGMA and will enumerate the Coordination Committee's responsibilities. The Coordination Agreement will also establish the roles of Secretary and Plan Manager and enumerate their respective responsibilities.

G. The SLDMWA has been assisting the GSP Groups with SGMA compliance, and will act as the initial Secretary of the Coordination Committee ("**Secretary**") and the initial Plan Manager with respect to the Coordination Agreement ("**Plan Manager**"). As part of that effort, the SLDMWA and/or its agents agrees to undertake all activities required of it under the

Coordination Agreement, so long as each GSP Group reimburses the SLDMWA for that GSP Group's apportioned share of the "**Coordinated Plan Expenses**," described in Section 2 below.

H. The Parties desire to enter into this Agreement to refine the Parties' informal agreements prior to the date of execution and to accomplish all of the foregoing matters on the terms and conditions set forth herein.

NOW, THEREFORE, based on the Recitals set forth above and on the terms and conditions set forth herein, the Parties agree as follows:

AGREEMENT

1. Administrative Coordination. For so long as desired by the Coordination Committee, the SLDMWA will be responsible for undertaking all activities required of it under the Coordination Agreement including, but not limited to: intrabasin coordination; activities required in its role as Secretary; activities required in its role as Plan Manager; and entering into professional services agreement(s) and any supplemental agreements required for the consultant work necessary to meet the objectives of the Coordination Agreement.

2. Coordinated Plan Expenses. The Parties agree that **Coordinated Plan Expenses** incurred under the Coordination Agreement shall mean any expenses incurred by the Secretary and Plan Manager at the direction of the Coordination Committee within approved annual cost estimates pursuant to Section 5 of this Cost Sharing Agreement for purposes of developing and implementing the Coordination Agreement, including actual expenses incurred in executing obligations under the Coordination Agreement for intrabasin and interbasin coordination beginning in August 2017. The GSA Parties agree to make payments for Coordinated Plan Expenses through their GSP Groups, described in Section 6 below.

3. Participation Percentages. The Parties acknowledge and agree that the participation percentages in Exhibit "A" ("**Participation Percentages**") shall be utilized to determine the share of Coordinated Plan Expenses allocated to each GSP Group.

    a. Initial Participation Percentages. Coordinated Plan Expenses will be paid proportionally by each GSP Group through the Responsible Agency to Invoice ("**Responsible Agency**") identified on Exhibit "A," pursuant to each GSP Group's respective Participation Percentage, which is initially set in equal percentages, as indicated in Exhibit "A."

    b. Updated Participation Percentages. Participation Percentages may be evaluated by the Coordination Committee from time to time, including to consider new information concerning the relative contribution or responsibility of each GSP Group towards achieving the Subbasin-wide sustainability goal of their coordinated GSPs.

    c. Ongoing Documentation of Participation Percentages. The most current Participation Percentages of each GSP Group shall be dated and attached as Exhibit "A" to this Agreement, effective upon the date approved by the Parties under delegated authority by their respective GSP Groups, without any further Amendment to this Agreement being required.

4. Obligations Outside of Cost Sharing Agreement. It is the responsibility and obligation of each GSA Party under this Agreement that is part of a multi-party GSP Group to provide documentation to the Secretary and the Coordination Committee establishing that such GSP Group has a binding agreement or mechanism assuring that the GSP Group will pay its Participation Percentage set forth on Exhibit "A," as said Exhibit "A" may be modified or amended from time to time (pursuant to a modification or amendment of this Agreement under Section 14, below), including documentation of provisions regarding the default or withdrawal of any GSA Party within such GSP Group. Provided, that the Secretary shall not be obligated to evaluate or provide an opinion on the legal sufficiency of the documentation.

5. Cost Estimates. The SLDMWA will obtain and provide the GSP Groups, through the GSP Group Representatives on the Coordination Committee, with a written estimate ("**Estimate**") of the cost of each task required for executing its obligations under the Coordination Agreement prior to March 1 each year, and as new tasks arise. Each Estimate will be subject to approval by the Coordination Committee, pursuant to the Coordination Agreement. The SLDMWA shall account for Coordinated Plan Expenses in accordance with standard public agency accounting procedures and shall invoice amounts to be collected from the GSP Groups in accordance with Section 6 below. All costs related to workgroups shall be the responsibility of each Party providing the workgroup participant.

6. Invoicing and Payment. The SLDMWA shall bill the GSP Groups, through the Responsible Agency identified on Exhibit "A," for all Coordinated Plan Expenses based upon their respective Participation Percentages, upon receipt of each individual invoice. Payment is due from each Responsible Agency thirty (30) days following receipt of the invoice by the Responsible Agency. Amounts in arrears for more than thirty (30) days shall earn interest at the applicable legal rate. Each Responsible Agency is responsible to collect payment from members of its GSP Group, if any.

7. Reporting. The SLDMWA shall present a cumulative Coordinated Plan Expense report to the GSP Groups on a monthly basis, through the Responsible Agency identified on Exhibit "A." Each Invoice, described in Section 6 above, shall be accompanied by a Coordinated Plan Expenses report ("**Report**"). The Report shall consist of a cumulative itemized statement of all costs and expenses incurred pursuant to the Coordination Agreement and any disbursement of funds received by the SLDMWA under this Agreement.

8. Records. The SLDMWA shall maintain separate records regarding Coordinated Plan Expenses, including records of billing and payment and other documents related to the execution of its obligations under the Coordination Agreement. The Parties and their designated agents shall have the right to inspect all records maintained by the SLDMWA associated with this Cost Sharing Agreement at any time within normal business hours, with fifteen (15) business days' advance notice to the SLDMWA in writing.

9. Notice. Whenever notice is required to be in writing, it shall be provided to the GSP Groups, through the Responsible Agency identified on Exhibit "A." Notice shall be provided to the SLDMWA at the following address:

   San Luis & Delta-Mendota Water Authority
   P.O. Box 2157
   Los Banos, CA 93635
   Attn: Andrew Garcia
   E-mail: andrew.garcia@sldmwa.org

If sent by United States Mail, notice will be considered to have been given forty-eight (48) hours after it has been deposited in the United States Mail, addressed as set forth above, with postage prepaid. If sent by overnight delivery service, notice will be considered to have been given twenty-four (24) hours after it has been deposited with the overnight delivery service. Any GSP Group may change the Responsible Agency for notice or that Responsible Agency's address for these purposes by giving written notice of the change to all other Parties. The SLDMWA may also change its address or contact by giving written notice of the change to all other Parties.

10. Law Governing. This Agreement is made in the State of California under the constitution and laws of the State of California and is to be so construed.

11. Section Headings. All section headings in this Agreement are for convenience of reference only and are not to be construed as modifying or governing this language in the section referred to or to define or limit the scope of any provision of this Agreement.

12. Entire Agreement. This Agreement (including the preamble and Recitals) constitutes the entire Agreement between the Parties and supersedes prior agreements or discussions relating to the matters set forth herein, if any, both written and oral.

13. Severability. If any provision of this Agreement is held to be invalid or unenforceable, the remaining provisions of this Agreement shall remain in full force and effect.

14. Modification or Amendment. The Parties hereby agree that, this Agreement may be supplemented, amended, or modified only by the mutual written agreement of the Parties. No supplement, amendment, or modification of this Agreement shall be binding unless it is in writing and signed by all Parties.

15. Withdrawal.

    a. Withdrawal by a GSA Party. A GSA Party may withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon thirty (30) days written notice to all other Parties. Any GSA Party who withdraws shall remain obligated to pay its share of all Coordinated Plan Expenses accrued prior to the effective date of such withdrawal. The SLDMWA will notify DWR within thirty (30) days of any GSA Party's withdrawal from this Agreement.

b. Withdrawal by the SLDMWA. The SLDMWA may withdraw from this Agreement effective: (1) upon notification by the Coordination Committee that the SLDMWA's services are no longer required as Secretary and Plan Manager; or (2) upon sixty (60) days written notice by the SLDMWA to the GSA Parties. In the event the SLDMWA withdraws from this Agreement, such withdrawal shall terminate this Agreement, unless the Coordination Committee names a successor Secretary and Plan Manager pursuant to the Coordination Agreement, and the Parties and such successor entity or entities agree to continue the Agreement with the successor Secretary and Plan Manager agreeing to assume the role of the SLDMWA. If the Agreement continues between the GSA Parties and a successor to the SLDMWA, the SLDMWA agrees to reasonably cooperate in the transition to its successor; provided, the SLDMWA shall not be liable for performance of duties under this Agreement following the Coordination Committee's notice or the sixty (60)-day notice period set forth in this subsection, whichever is applicable.

16. Term. As modified pursuant to Section 14, this Agreement shall continue for a term coterminous with the requirements of SGMA.

17. Indemnification. The Parties agree that the GSA Parties shall, in proportion to the respective Participation Percentages of their GSP Groups, hold the SLDMWA free and harmless from and indemnify the SLDMWA against any and all costs, losses, damages, claims, and liabilities arising from this Agreement, unless such costs, losses, damages, claims, or liabilities are attributable to the sole negligence or willful misconduct of the SLDMWA. The Parties acknowledge that each GSP Group intends to pay only its share of Coordinated Plan Expenses, but acknowledge that the GSP Group may be required to pay an adjusted Participation Percentage (pursuant to a modification or amendment of this Agreement under Section 14, above) to meet its obligation to the SLDMWA and seek its remedy against any defaulting GSP Group.

18. Construction of Agreement. The Parties acknowledge that each has informed and able counsel to advise it concerning the terms of this Agreement, and agree that no Party shall be deemed the drafting Party in any dispute involving construction of the terms of the Agreement.

19. Counterparts. This Agreement may be executed in multiple counterparts, each of which shall be deemed an original, but all of which, together, shall constitute one and the same instrument.

20. No Partnership. The Parties hereto do not intend to create a partnership for federal income tax purposes or state law purposes, and nothing herein shall be construed to create such a partnership. The provisions set forth in this Agreement, and the respective obligations of each Party hereto, shall be construed consistently with such intent.

21. Procedures for Resolving Conflicts. In the event of any dispute arising from or relating to this Agreement, the disputing Party shall, within thirty (30) calendar days of discovery of the events giving rise to the dispute, notify all Parties to this Agreement in writing of the basis for the dispute. Within thirty (30) calendar days of receipt of said notice, all interested Parties shall meet and confer in a good-faith attempt to informally resolve the dispute. All disputes that are not resolved informally shall be settled by non-binding arbitration. Within ten (10) days

following the failed informal proceedings, each interested Party shall nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties shall rank their top three among all nominated arbitrators, awarding 3 points to the top choice, 2 points to the second choice, 1 point to the third choice, and zero points to all others. Each interested Party shall forward its tally to the SLDMWA, who shall tabulate the points and notify the interested Parties of the name of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The SLDMWA may also develop procedures for approval by the Parties, for selection in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines or ceases to act. The arbitration shall be administered in accordance with the procedures set forth in the California Code of Civil Procedure, section 1280, et seq., and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring a legal action relating to the controversy. Any dispute resolution or arbitration under this Section, however, will not terminate the Parties' obligations under Sections 2, 4, and 6 nor the Parties' obligations under Section 16.

22. Authorized Signature. Each Party represents that the individual signing this Agreement on its behalf is duly authorized to execute this Agreement and will legally bind that Party to the terms of this Agreement.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement.

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:** 05/22/2018		
Signature [signature]			
Name of Representative: Vince Lucchesi			
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
DM II GSA			
Del Puerto Water District	**Date:**	**Oak Flat Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			

following the failed informal proceedings, each interested Party shall nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties shall rank their top three among all nominated arbitrators, awarding 3 points to the top choice, 2 points to the second choice, 1 point to the third choice, and zero points to all others. Each interested Party shall forward its tally to the SLDMWA, who shall tabulate the points and notify the interested Parties of the name of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The SLDMWA may also develop procedures for approval by the Parties, for selection in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines or ceases to act. The arbitration shall be administered in accordance with the procedures set forth in the California Code of Civil Procedure, section 1280, et seq., and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring a legal action relating to the controversy. Any dispute resolution or arbitration under this Section, however, will not terminate the Parties' obligations under Sections 2, 4, and 6 nor the Parties' obligations under Section 16.

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IN WITNESS WHEREOF, the Parties hereto have executed this Agreement.

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:**		
Signature			
Name of Representative:			
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:** 5/16/18		
Signature Robert Pierce			
Name of Representative: Robert Pierce, General Manager			
DM II GSA			
Del Puerto Water District	**Date:**	**Oak Flat Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			

following the failed informal proceedings, each interested Party shall nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties shall rank their top three among all nominated arbitrators, awarding 3 points to the top choice, 2 points to the second choice, 1 point to the third choice, and zero points to all others. Each interested Party shall forward its tally to the SLDMWA, who shall tabulate the points and notify the interested Parties of the name of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The SLDMWA may also develop procedures for approval by the Parties, for selection in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines or ceases to act. The arbitration shall be administered in accordance with the procedures set forth in the California Code of Civil Procedure, section 1280, et seq., and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring a legal action relating to the controversy. Any dispute resolution or arbitration under this Section, however, will not terminate the Parties' obligations under Sections 2, 4, and 6 nor the Parties' obligations under Section 16.

22. Authorized Signature. Each Party represents that the individual signing this Agreement on its behalf is duly authorized to execute this Agreement and will legally bind that Party to the terms of this Agreement.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement.

<table>
<tr><td colspan="4">PATTERSON IRRIGATION DISTRICT GSA</td></tr>
<tr><td>Patterson Irrigation District</td><td>Date:</td><td>Twin Oaks Irrigation Company</td><td>Date:</td></tr>
<tr><td colspan="2">Signature</td><td colspan="2">Signature</td></tr>
<tr><td colspan="2">Name of Representative:</td><td colspan="2">Name of Representative:</td></tr>
<tr><td colspan="4">WEST STANISLAUS IRRIGATION DISTRICT GSA 1</td></tr>
<tr><td>West Stanislaus Irrigation District</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
<tr><td colspan="4">DM II GSA</td></tr>
<tr><td>Del Puerto Water District</td><td>Date: 8/28/18</td><td>Oak Flat Water District</td><td>Date: 8/28/18</td></tr>
<tr><td colspan="2">Signature Anthea C Hansen</td><td colspan="2">Signature Anthea C Hansen</td></tr>
<tr><td colspan="2">Name of Representative: Anthea C Hansen</td><td colspan="2">Name of Representative: Anthea C Hansen</td></tr>
<tr><td colspan="4">CITY OF PATTERSON GSA</td></tr>
<tr><td>City of Patterson</td><td colspan="3">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
</table>

following the failed informal proceedings, each interested Party shall nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties shall rank their top three among all nominated arbitrators, awarding 3 points to the top choice, 2 points to the second choice, 1 point to the third choice, and zero points to all others. Each interested Party shall forward its tally to the SLDMWA, who shall tabulate the points and notify the interested Parties of the name of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The SLDMWA may also develop procedures for approval by the Parties, for selection in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines or ceases to act. The arbitration shall be administered in accordance with the procedures set forth in the California Code of Civil Procedure, section 1280, et seq., and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring a legal action relating to the controversy. Any dispute resolution or arbitration under this Section, however, will not terminate the Parties' obligations under Sections 2, 4, and 6 nor the Parties' obligations under Section 16.

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IN WITNESS WHEREOF, the Parties hereto have executed this Agreement.

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:**		
Signature			
Name of Representative:			
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
DM II GSA			
Del Puerto Water District	**Date:**	**Oak Flat Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CITY OF PATTERSON GSA			
City of Patterson	**Date:** 9/20/18		
Signature			
Name of Representative: Ken Irwin			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:** 7/31/18	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative: Jerold R. O'Banion		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:** 7/31/18	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative: Jerold R. O'Banion		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:**		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:** 10/9/18
Signature		**Signature**	
Name of Representative:		**Jim DeMartini, Chairman**	
		APPROVED AS TO FORM: **John P. Doering** **County Counsel, Stanislaus County**	
		BY:	**Date:** 10/3/18
		Asst **County Counsel:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:**		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	

CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date: 8/13/18	Panoche Water District	Date:
Signature		Signature	
Name of Representative: Lon Martin		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	

ORO LOMA WATER DISTRICT GSA	
Oro Loma Water District	Date:
Signature	
Name of Representative:	

WIDREN WATER DISTRICT GSA	
Widren Water District	Date:
Signature	
Name of Representative:	

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA	
San Joaquin River Exchange Contractors GSA	Date:
Signature	
Name of Representative:	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature** [signature] 07/31/18	
Name of Representative:		**Name of Representative:** John Bennett	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature** [signature] 8/2/18	
Name of Representative:		**Name of Representative:** Aaron Barcellos	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:** 7/31/18
Signature		**Signature** [signature]	
Name of Representative:		**Name of Representative:** Michael Linneman	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:**		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:** 6/20/18	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative: Jerry Salvador		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:**		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date: 8-6-18
Signature		Signature [signature]	
Name of Representative:		Name of Representative: Elizabeth Reeves	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	Date:		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature Randall Miles 6-27-18		**Signature**	
Name of Representative: Randall Miles		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:**		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative: Amy Montgomery		**Name of Representative:**	
Santa Nella County Water District	**Date:** 9/14/18	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:**		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	

CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date: 8/21/18
Signature		Signature [signature]	
Name of Representative:		Name of Representative: Sal Quintero	

ORO LOMA WATER DISTRICT GSA	
Oro Loma Water District	Date:
Signature	
Name of Representative:	

WIDREN WATER DISTRICT GSA	
Widren Water District	Date:
Signature	
Name of Representative:	

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA	
San Joaquin River Exchange Contractors GSA	Date:
Signature	
Name of Representative:	

ATTEST:
BERNICE E. SEIDEL
Clerk of the Board of Supervisors
County of Fresno, State of California
By [signature] Deputy

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative: Steve Sloan			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	Date:		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:** 6.20.18		
Signature [signature]			
Name of Representative: Jean Sagouspe			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:**		
Signature			
Name of Representative:			

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
San Joaquin River Exchange Contractors GSA	**Date:** 9/7/18		
Signature			
Name of Representative: Chris White			

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:** 8/6/2018
Signature President	
Name of Representative: DONALD SKINNER, President	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA -3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
MERCED COUNTY DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	Date:
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	Date: 12/12/18
Signature	
Name of Representative: Cristian Gonzalez	
CITY OF FIREBAUGH GSA	
City of Firebaugh	Date:
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	Date:
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	Date:
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	Date:
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	Date:
Signature	
Name of Representative:	
COUNTY OF MADERA -3 GSA	
County of Madera	Date:
Signature	
Name of Representative:	
MERCED COUNTY DELTA-MENDOTA GSA	
County of Merced	Date:
Signature	
Name of Representative:	

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:** 9-25-18
Signature [signature]	
Name of Representative: Ben Gallegos	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA -3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
MERCED COUNTY DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:** November 14, 2018
Signature	
Name of Representative: Alex Terrazas, City Manager	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA -3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
MERCED COUNTY DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	7/9/2018
Name of Representative: April Hogue	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA -3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
MERCED COUNTY DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA	
San Joaquin River Exchange Contractors GSA	**Date:**
Signature	
Name of Representative:	
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative: Doug Dunford	
CITY OF GUSTINE GSA	
City of Gustine	**Date:** 9/18/18
Signature [signature]	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	

Name of Representative:	
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA	
San Joaquin River Exchange Contractors GSA	**Date:**
Signature	
Name of Representative:	

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:** 15 AUG 18
Signature [signature]	
Name of Representative: Michael E. Holland	
COUNTY OF MADERA -3 GSA	

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA -3 GSA	
County of Madera	**Date:** 10-02-2018 9-11-18
Signature	
Name of Representative: Tom Wheeler	MICHAEL LINDEN, PER COUNTY COUNSEL
MERCED COUNTY DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA -3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
MERCED COUNTY DELTA-MENDOTA GSA	
County of Merced	**Date:** 7/31/18
Signature [signature]	
Name of Representative: Jerald R. O'Banion	

GRASSLAND GSA			
Grassland Water District	**Date:** 7-10-2018	**Grassland Resource Conservation District**	**Date:** 7-10-2018
Signature		**Signature**	
Name of Representative: Pepper Snyder		**Name of Representative:** Dennis Campini	
FARMERS WATER DISTRICT GSA			
Farmers Water District	**Date:**		
Signature			
Name of Representative:			
FRESNO COUNTY MANAGEMENT AREA A+B GSAs			
County of Fresno	**Date:**		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	**Date:**		
Signature			
Name of Representative:			
SAN LUIS & DELTA-MENDOTA WATER AUTHORITY			
San Luis & Delta-Mendota Water Authority	**Date:**		
Signature			
Name of Representative:			

GRASSLAND GSA			
Grassland Water District	**Date:**	**Grassland Resource Conservation District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
FARMERS WATER DISTRICT GSA			
Farmers Water District	**Date:** 9-14-18		
Signature [signature]			
Name of Representative: JIM STILLWELL			
FRESNO COUNTY MANAGEMENT AREA A+B GSAs			
County of Fresno	**Date:**		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	**Date:**		
Signature			
Name of Representative:			
SAN LUIS & DELTA-MENDOTA WATER AUTHORITY			
San Luis & Delta-Mendota Water Authority	**Date:**		
Signature			
Name of Representative:			

GRASSLAND GSA			
Grassland Water District	**Date:**	**Grassland Resource Conservation District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	

FARMERS WATER DISTRICT GSA	
Farmers Water District	**Date:**
Signature	
Name of Representative:	

FRESNO COUNTY MANAGEMENT AREA A+B GSAs	
County of Fresno	**Date:** August 21, 2018
Signature [signature]	
Name of Representative: Sal Quintero	

ATTEST:
BERNICE E. SEIDEL
Clerk of the Board of Supervisors
County of Fresno, State of California

By [signature] Deputy

ALISO WATER DISTRICT GSA	
Aliso Water District	**Date:**
Signature	
Name of Representative:	

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	**Date:**
Signature	
Name of Representative:	

GRASSLAND GSA			
Grassland Water District	**Date:**	**Grassland Resource Conservation District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
FARMERS WATER DISTRICT GSA			
Farmers Water District	**Date:**		
Signature			
Name of Representative:			
FRESNO COUNTY MANAGEMENT AREA A+B GSAs			
Fresno County	**Date:**		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	**Date:** 10-23-18		
Signature Roy Catania			
Name of Representative: ROY CATANIA, BOARD PRESIDENT			
SAN LUIS & DELTA-MENDOTA WATER AUTHORITY			
San Luis & Delta-Mendota Water Authority	**Date:**		
Signature			
Name of Representative:			

GRASSLAND GSA			
Grassland Water District	Date:	Grassland Resource Conservation District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	

FARMERS WATER DISTRICT GSA	
Farmers Water District	Date:
Signature	
Name of Representative:	

FRESNO COUNTY MANAGEMENT AREA A+B GSAs	
County of Fresno	Date:
Signature	
Name of Representative:	

ALISO WATER DISTRICT GSA	
Aliso Water District	Date:
Signature	
Name of Representative:	

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	Date: 8/6/18
Signature Frances C. Mizuno	
Name of Representative: Frances Mizuno	

EXHIBIT A – GSP Groups and Responsible Agencies to Invoice

	Groundwater Sustainability Plan Group	Responsible Agency to Invoice / Address	Participation Percentage
1	**Northern / Central Delta-Mendota Region – 2 Representatives** Central DM Subgroup – 1 Member representing the following: Central Delta-Mendota Multi-Agency GSA Oro Loma Water District GSA Widren Water District GSA Northern DM Subgroup – 1 Member representing the following: City of Patterson GSA DM-II GSA Northwestern Delta-Mendota GSA Patterson Irrigation District GSA West Stanislaus Irrigation District-GSA 1	San Luis & Delta-Mendota Water Authority (for invoices) P.O. Box 2157 Los Banos, CA 93635 Attn: Andrew Garcia West Stanislaus Irrigation District (for other notices) 116 E Street P.O. Box 37 Westley, CA 95387 Attn: Robert Pierce	16.7%
2	**San Joaquin River Exchange Contractors – 2 Representatives** City of Dos Palos GSA City of Firebaugh GSA City of Gustine GSA City of Los Banos GSA City of Mendota GSA City of Newman GSA Madera County GSA Merced County Delta-Mendota GSA San Joaquin River Exchange Contractors GSA Turner Island Water District-2 GSA	San Joaquin River Exchange Contractors 541 H Street P.O. Box 2115 Los Banos, CA 95363 Attn: Steve Chedester	16.7%
3	**Farmers Water District – 1 Representative** Farmers Water District GSA	Farmers Water District 4460 W. Shaw Ave., #219 Fresno, CA 93722 Attn: Jim Stillwell	16.7%
4	**Aliso Water District – 1 Representative** Aliso Water District GSA	Aliso Water District 10302 Avenue 7-1/2 Firebaugh, CA 93622 Attn: Roy Catania	16.7%
5	**Grassland Water District – 1 Representative** Grassland Water District GSA Grassland WD and Grassland Resource Conservation District Merced County Delta-Mendota GSA	Grassland Water District 200 W. Willmont Ave. Los Banos, CA 93635 Attn: Ricardo Ortega	16.7%

6	**Fresno County Management Area A & B – 1 Representative** Fresno County Management Area A GSA Fresno County Management Area B GSA	County of Fresno Department of Public Works and Planning 2220 Tulare St., 6th Floor Fresno, CA 93721 Attn: Division of Water and Natural Resources	16.7%

Appendix D. Notice of Intent to Develop a GSP

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS
GROUNDWATER SUSTAINABILITY AGENCY
541 H Street/Post Office Box 2115
Los Banos, CA 93635
(209) 827-8616

November 6, 2017

Via E-mail and U.S. Mail
Trevor Joseph, Section Chief
Department of Water Resources
PO Box 942836
Sacramento, CA 94236

RE: ***Notice of Intent to Develop a Groundwater Sustainability Plan***

Dear Mr. Joseph:

The San Joaquin River Exchange Contractors Groundwater Sustainability Agency (Exchange Contractors GSA), pursuant to California Water Code Section 10727.8, 353.6, hereby gives notice to the California Department of Water Resources (DWR) that it will initiate development of a Groundwater Sustainability Plan (GSP) for the portion of the Delta-Mendota Subbasin 5-22.07 within the boundaries of the Exchange Contractors GSA.

Interested parties may participate in the planning and development of the GSP by attending the Exchange Contractors GSA monthly board meetings held on the first Friday of the month beginning at 8:00am. The meetings are held at the Exchange Contractors' office located at 541 H Street, Los Banos, CA 93635. For more information or questions, please refer to the SJRECWA website at www.sjrecwa.net/groundwater.

The Exchange Contractors GSA has engaged each city and county located within the geographic area to be covered by the plan and intends to jointly develop a GSP with the following GSA's: City of Newman, City of Gustine, City of Los Banos, City of Dos Palos, City of Firebaugh, City of Mendota, Turner Island Water District-2, County of Madera-3, portion of Merced County – Delta-Mendota, and a portion of Fresno County Management Area B.

The Exchange Contractors GSA looks forward to working with DWR to develop and implement a GSP. Should DWR have any questions about this notice, please contact Steve Chedester by email at schedester@sjrecwa.net or by phone at (209) 827-8616.

Sincerely

Steve Chedester,
Executive Director

Appendix E. List of Public Meetings

DATE	MEETING DESCRIPTION	MEETING LOCATION
1/27/2015	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
3/10/2015	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
11/13/2015	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
12/18/2015	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
2/12/2016	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
2/23/2016	Newman City Council Meeting	938 Fresno Street, Newman, CA 95360
3/15/2016	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
8/24/2016	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
9/2/2016	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
9/28/2016	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
10/7/2016	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
10/27/2016	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
11/2/2016	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
11/8/2016	Newman City Council Meeting	938 Fresno Street, Newman, CA 95360
11/16/2016	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
11/22/2016	City of Mendota City Council	643 Quince Street, Mendota, CA 93640
12/9/2016	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
12/15/2016	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
1/6/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
1/10/2017	City of Mendota City Council	643 Quince Street, Mendota, CA 93640
1/18/2017	Los Banos City Council Meeting	520 J Street, Los Banos, CA 93635
1/23/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
1/24/2017	Madera County GSA Meeting	200 West 4th Street, Madera, CA 93637
2/3/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
2/8/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
3/3/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
3/7/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
3/21/2017	Dos Palos City Council Meeting	1554 Golden Gate Avenue, Dos Palos, CA 93620
3/22/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
3/23/2017	SLCC Annual Grower Meeting	11704 W. Henry Miller Road, Dos Palos, CA
3/27/2017	CCID Annual Grower Meeting	1335 West I Street, Los Banos, CA 93635
3/31/2017	Merced County Board of Supervisor	2222 M Street, Merced, CA 95340
4/3/2017	Firebaugh City Council Meeting	1655 13th Street, Firebaugh, CA 93622
4/7/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
4/12/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
4/12/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
5/2/2017	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
5/5/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
5/8/2017	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
5/24/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
6/2/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635

DATE	MEETING DESCRIPTION	MEETING LOCATION
6/24/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
6/28/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
7/10/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
7/18/2017	Dos Palos City Council Meeting	1554 Golden Gate Avenue, Dos Palos, CA 93620
7/18/2017	Madera County GSA Meeting	200 West 4th Street, Madera, CA 93637
7/26/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
7/27/2017	SLCC Board Meeting	11704 W. Henry Miller Road, Dos Palos, CA
8/4/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
8/23/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
8/29/2017	Merced County Board of Supervisor	2222 M Street, Merced, CA 95340
9/1/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
9/11/2017	DM Technical Subcommittee	842 6th Street, Los Banos, CA 93635
9/13/2017	DM Coordination Committee	842 6th Street, Los Banos, CA
9/25/2017	DM Technical Subcommittee	843 6th Street, Los Banos, CA 93635
9/27/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
9/29/2017	Self-Help Enterprises - Fresno County School Roundtable	1117 Van Ness Avenue, Fresno, CA 93721
10/6/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
10/10/2017	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
10/25/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
11/3/2017	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
11/13/2017	DM Technical Subcommittee	844 6th Street, Los Banos, CA 93635
11/16/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
11/21/2017	Madera County GSA Meeting	200 West 4th Street, Madera, CA 93637
12/8/2017	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
12/12/2017	DM Technical Subcommittee	845 6th Street, Los Banos, CA 93635
12/12/2017	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
12/13/2017	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
1/5/2018	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
1/8/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
1/10/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
1/22/2018	DM Technical Subcommittee	846 6th Street, Los Banos, CA 93635
1/24/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
1/25/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
2/2/2018	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
2/14/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
2/16/2018	TIWD GSA Meeting	1269 West I Street, Los Banos, CA 93635
2/20/2018	DM Technical Subcommittee	847 6th Street, Los Banos, CA 93635
2/21/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
2/22/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
2/28/2018	DM Communications Subcommittee	858 6th Street, Los Banos, CA 93635
3/1/2018	Fresno County Public Meeting	2220 Tulare Street, Fresno, CA 93721

DATE	MEETING DESCRIPTION	MEETING LOCATION
3/1/2018	Merced County Farm Bureau – Water Symposium	2145 Wardrobe Ave, Merced, CA 95341
3/2/2018	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
3/13/2018	TIWD GSA Meeting	1269 West I Street, Los Banos, CA 93635
3/21/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
3/22/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
3/22/2018	SLCC Annual Grower Meeting	11704 W. Henry Miller Road, Dos Palos, CA
3/27/2018	DM Communications Subcommittee	859 6th Street, Los Banos, CA 93635
3/28/2018	CCID Annual Grower Meeting	1335 West I Street, Los Banos, CA 93635
3/28/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
4/6/2018	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
4/11/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
4/17/2018	DM Technical Subcommittee	848 6th Street, Los Banos, CA 93635
4/18/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
4/24/2018	Madera County GSA Meeting	200 West 4th Street, Madera, CA 93637
4/26/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
5/4/2018	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
5/8/2018	TIWD GSA Meeting	1269 West I Street, Los Banos, CA 93635
5/14/2018	DM Public Workshop	867 6th Street, Los Banos, CA 93635
5/15/2018	DM Technical Subcommittee	849 6th Street, Los Banos, CA 93635
5/16/2018	Public Workshop	1033 W Las Palmas Ave, Patterson 95363
5/17/2018	Public Workshop	1246 Belmont Ave, Mendota 93640
5/22/2018	CCC Annual Grower Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
5/23/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
5/24/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
5/28/2018	CCC Annual Shareholder's Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
5/29/2018	DM Communications Subcommittee	860 6th Street, Los Banos, CA 93635
5/29/2018	Dos Palos City Council Meeting	1554 Golden Gate Avenue, Dos Palos, CA 93620
5/30/2018	Madera County GSA Advisory Committee	200 West 4th Street, Madera, CA 93637
6/1/2018	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
6/4/2018	DM Technical Subcommittee	850 6th Street, Los Banos, CA 93635
6/11/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
6/11/2018	DM Technical Subcommittee	851 6th Street, Los Banos, CA 93635
6/13/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
6/19/2018	DM Technical Subcommittee	852 6th Street, Los Banos, CA 93635
6/20/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
6/22/2018	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
6/26/2018	DM Communications Subcommittee	861 6th Street, Los Banos, CA 93635
6/28/2018	Dos Palos City Council Meeting	1554 Golden Gate Avenue, Dos Palos, CA 93620
7/6/2018	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
7/14/2018	DM Communications Subcommittee	862 6th Street, Los Banos, CA 93635

DATE	MEETING DESCRIPTION	MEETING LOCATION
7/17/2018	DM Technical Subcommittee	853 6th Street, Los Banos, CA 93635
7/18/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
7/24/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
7/26/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
7/31/2018	Merced County Board of Supervisor	2222 M Street, Merced, CA 95340
7/31/2018	TIWD GSA Meeting	1269 West I Street, Los Banos, CA 93635
8/3/2018	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
8/13/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
8/14/2018	Newman City Council Meeting	938 Fresno Street, Newman, CA 95360
8/15/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
8/19/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
8/21/2018	DM Technical Subcommittee	854 6th Street, Los Banos, CA 93635
8/21/2018	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
8/24/2018	GDE Workshop with CDFW, The Nature Conservancy and Audobon Society	867 6th Street, Los Banos, CA 93635
8/29/2018	Madera County GSA Advisory Committee	200 West 4th Street, Madera, CA 93637
9/5/2018	Firebaugh City Council Meeting	1655 13th Street, Firebaugh, CA 93622
9/7/2018	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
9/10/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
9/11/2018	DM Communications Subcommittee	863 6th Street, Los Banos, CA 93635
9/18/2018	City of Gustine City Council	352 Fifth Street, Gustine, CA 95322
9/18/2018	DM Technical Subcommittee	855 6th Street, Los Banos, CA 93635
9/19/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
9/26/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
10/1/2018	DM Communications Subcommittee	864 6th Street, Los Banos, CA 93635
10/2/2018	Madera County GSA Meeting	200 West 4th Street, Madera, CA 93637
10/5/2018	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
10/16/2018	DM Technical Subcommittee	856 6th Street, Los Banos, CA 93635
10/17/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
10/19/2018	DM Communications Subcommittee	865 6th Street, Los Banos, CA 93635
10/22/2018	Public Workshop	1600 16th Street, Firebaugh, CA 93622
10/24/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
10/24/2018	Madera County GSA Advisory Committee	200 West 4th Street, Madera, CA 93637
10/24/2018	Public Workshop	1815 Scripps Drive, Los Banos, CA 93635
10/25/2018	Public Workshop	1033 W Las Palmas Ave, Patterson 95363
10/25/2018	SLCC Board Meeting	11704 W. Henry Miller Road, Dos Palos, CA
10/30/2018	DM Communications Subcommittee	866 6th Street, Los Banos, CA 93635
11/2/2018	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
11/7/2018	Los Banos City Council Meeting	520 J Street, Los Banos, CA 93635
11/13/2018	City of Mendota City Council	643 Quince Street, Mendota, CA 93640
11/13/2018	TIWD GSA Meeting	1269 West I Street, Los Banos, CA 93635

DATE	MEETING DESCRIPTION	MEETING LOCATION
11/14/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
11/19/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
11/21/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
11/27/2018	DM Communications Subcommittee	867 6th Street, Los Banos, CA 93635
12/4/2018	DM Technical Subcommittee	857 6th Street, Los Banos, CA 93635
12/4/2018	Madera County GSA Meeting	200 West 4th Street, Madera, CA 93637
12/4/2018	TIWD GSA Meeting	1269 West I Street, Los Banos, CA 93635
12/7/2018	SJREC GSA Meeting	541 H Street, Los Banos, CA 93635
12/10/2018	DM Coordination Committee	842 6th Street, Los Banos, CA 93635
12/11/2018	City of Mendota City Council	643 Quince Street, Mendota, CA 93640
12/19/2018	CCC Board Meeting	6770 Avenue 7-1/2, Firebaugh, CA 93622
12/19/2018	CCID Board Meeting	1335 West I Street, Los Banos, CA 93635
1/4/2019	SJRECWA Board Meeting	541 H Street, Los Banos, CA 93635
1/8/2019	Madera County GSA Meeting	200 West 4th Street, Madera, CA 93637
1/8/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
1/15/2019	TIWD GSA Meeting	1269 West I Street, Los Banos, CA 93635
1/15/2019	TIWD Special Meeting GSA-2	1269 West I Street, Los Banos, CA 93635
1/29/2019	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
2/12/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
3/5/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
4/2/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
4/23/2019	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
5/7/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
5/14/2019	Fresno County Board of Supervisors	2281 Tulare Street, Fresno, CA 93721
5/15/2019	Los Banos City Council Meeting	520 J Street, Los Banos, CA 93635
5/30/2019	TIWD Special Meeting GSA-2	1269 West I Street, Los Banos, CA 93635
6/4/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
6/30/2019	TIWD Special Meeting GSA-2	1269 West I Street, Los Banos, CA 93635
7/2/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
8/5/2019	Firebaugh City Council Meeting	1655 13th Street, Firebaugh, CA 93622
8/6/2019	Gustine City Council Meeting	352 5th Street, Gustine, CA 95322
8/6/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
9/3/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
9/4/2019	Los Banos City Council Meeting/GSP Update	520 J Street, Los Banos, CA 93635
10/8/2019	Madera County SGMA Meeting	200 West 4th Street, Madera, CA 93637
11/19/2019	TIWD-2 Public Hearing and GSP Adoption	1269 West I Street, Los Banos, CA 93635
11/19/2019	County of Fresno Public Hearing and GSP Adoption	2281 Tulare Street, Fresno, CA 93721
12/2/2019	City of Firebaugh Public Hearing and GSP Adoption	1655 13th Street, Firebaugh, CA 93622
12/3/2019	City of Gustine Public Hearing and GSP Adoption	352 5th Street, Gustine, CA 95322

DATE	MEETING DESCRIPTION	MEETING LOCATION
12/4/2019	City of Los Banos Public Hearing and GSP Adoption	520 J Street, Los Banos, CA 93635
12/10/2019	City of Mendota Public Hearing and GSP Adoption	643 Quince Street, Mendota, CA 93640
12/10/2019	County of Merced Public Hearing and GSP Adoption	2222 M Street, Merced, CA 95340
12/10/2019	City of Newman Public Hearing and GSP Adoption	938 Fresno Street, Newman, CA 95360
12/13/2019	SJREC GSA Public Hearing and GSP Adoption	541 H Street, Los Banos, CA 93635
12/17/2019	City of Dos Palos Public Hearing and GSP Adoption	1554 Golden Gate Avenue, Dos Palos, CA 93620
12/17/2019	County of Madera Public Hearing and GSP Adoption	200 West 4th Street, Madera, CA 93637

Appendix F. List of Interested Parties

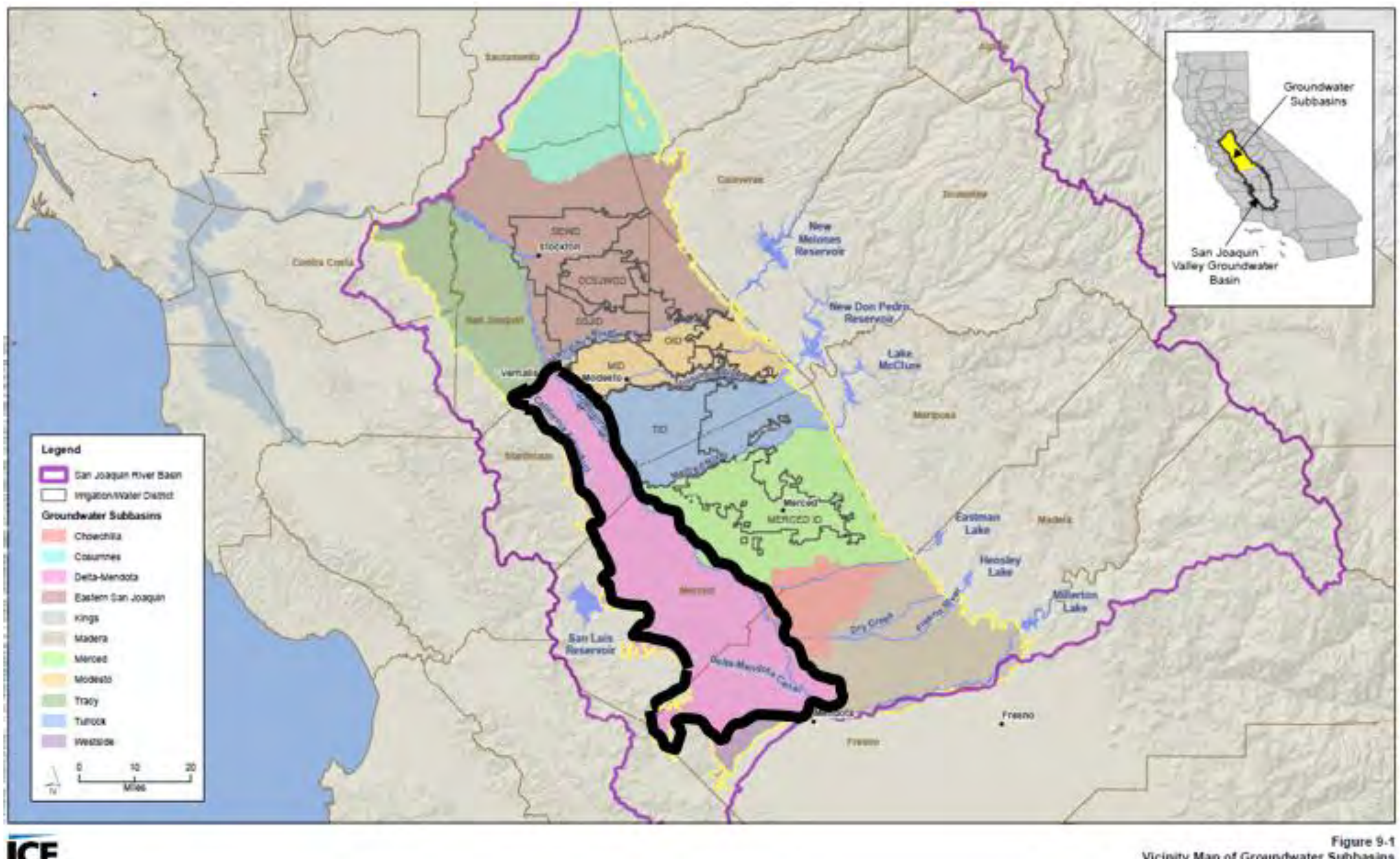
INTERESTED PARTIES FOR THE SJREC GSP GROUP			
Agency/Affiliation	**Contact**	**Address**	**Email**
Madera County Farm Bureau	Christina Beckstead	1102 S. Pine Street, Madera, CA 93637	cbeckstead@maderafb.com
Mayer Brown LLP, Litigation Paralegal	David West	350 S. Grand Avenue, 25th Floor, Los Angeles, CA 90071	dwest@mayerbrown.com
CDFW, Water Branch	Briana 'Bri' Seapy	830 S Street, Sacramento, CA 95811	groundwater@wildlife.ca.gov
Grower in FCWD	Sal Fuentes		afuentes4681@sbcglobal.net
The Nature Conservancy	Sandi Matsumoto	555 Capitol Mall, Suite 1290 Sacramento, CA 95814	
King Ranch Inc	Lisa Ford	Three Riverway Suite 1600 Houston, TX 77056-1967	lford@king-ranch.com
Morningstar Company	Jayne Gonsalves		jgonsalves@morningstarco.com
Westlands Water District	Kitty Campbell		kcampbell@westlandswater.org
Morningstar Company	Ron Dalforno		rdalforno@morningstarco.com
Self Help Enterprises	Sal Alhomedi		sala@selfhelpenterprises.org
County of Madera	Stephanie Anagnoson		stephanie.anagnoson@maderacounty.com

GSA'S IN THE DELTA-MENDOTA SUBBASIN			
Agency	**Contact**	**Address**	**Email**
City of Dos Palos GSA	Darrell Fonseca	2174 Blossom Street, Dos Palos, CA 93620	cityofdp@cityofdp.com
	Garth Pecchenino		garth.pecchenino@qkinc.com
City of Gustine	Doug Dunford	352 Fifth Street, PO Box 16, Gustine, CA 95322	ddunfird@cityofgustine.com
DM-II (Del Puerto WD)	Anthea Hansen	PO Box 1596, Patterson, CA 95363	ahansen@delpuertowd.org
Ora Loma Water District	Steve Sloan	264 I Street, Los Banos, CA 93635	d.raineri@sbcglobal.net
Fresno County - Management Area B	Bernard Jimenez	2220 Tulare Street, 6th Floor, Fresno, CA 93721	bjimenez@co.fresno.ca.us
Fresno County - Management Area A	Bernard Jimenez	2220 Tulare Street, 6th Floor, Fresno, CA 93721	bjimenez@co.fresno.ca.us
City of Firebaugh	Mario Gouveia	456 Sixth Street, Gustine, CA 95322	mgouveia@gouveiaengineering.com
	Ben Gallegos	1133 P Street, Firebaugh, CA 93622	bgallegos@ci.firebaugh.ca.us
Central Delta-Mendota Region Multi-Agency GSA	Andrew Garcia	15990 Kelso Road, Byron, CA 94514	andrew.garcia@sldmwa.org
Widren Water District GSA	Damian Aragona	259 I Street, Los Banos, CA 93635	damian@jpprop.org
Merced County - Delta Mendota	Lacey Kiriakou	2222 M Street, Merced, CA 95340	lkiriakou@countyofmerced.com
Turner Island Water District - 2	Donald Skinner	1269 W. I Street, Los Banos, CA 93635	dskinner@wolfseninc.com
Northwestern Delta-Mendota GGSA	Walter Ward	3800 Cornucopia Way, Suite C, Modesto, CA 95358	wward@envres.org
City of Patterson	Ken Irwin	1 Plaza, PO Box 667, Patterson, CA 95363	kirwin@ci.patterson.ca.us
County of Madera - 3	Stephanie Anagnoson	200 W. Fourth Street, Suite 3100, Madera, CA 93637	stephanie.anagnoson@maderacounty.com
City of Los Banos	Mark Fachin	411 Madison Avenue, Los Banos, CA 93635	mark.fachin@losbanos.org
City of Mendota	Cristian Gonzalez	643 Quince Street, Mendota, CA 93640	cristian@cityofmendota.com
Grasslands GSA	Ricardo Ortega	200 W. Willmott Avenue, Los Banos, CA 93635	rortega@gwdwater.org
City of Newman	Michael Holland	1162 Main Street, PO Box 1162, Newman, CA 95360	mholland@cityofnewman.com
Farmers Water District	Jim Stilwell	4460 W. Shaw Avenue, #219, Fresno, CA 93722	Jim@bakerfarming.com
Aliso Water District	Roy Catania	10302 Avenue 7-1/2, Firebaugh, CA 93622	roy@oneilag.com
Patterson Irrigation District	Vince Lucchesi	PO Box 685, Patterson, CA 95363	vlucchesi@pattersonid.org
West Stanislaus Irrigation District	Robert Pierce	1800 E. West Stanislaus Road, Westley, CA 95387	bobby.pierce@weststanislausid.org
San Joaquin River Exchange Contractors	Jarrett Martin	1335 West I Street, Los Banos, CA 93635	jmartin@ccidwater.org

Appendix G. Delta-Mendota Subbasin Communications Plan

Delta Mendota Subbasin Groundwater Management

Sustainable Groundwater Management Act Communications Plan



ICF

Figure 9-1
Vicinity Map of Groundwater Subbasins

Prepared by:
Lisa Beutler, MWH/Stantec,
Via CA Dept. of Water Resources,
Facilitation Services Technical Assistance

June 2017

MWH Stantec

Forward: How to use this Plan

This Communication Plan provides a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. Its purpose is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. It is presented as a working public draft, and should be considered a living document that is continuously refined and updated as circumstances suggest.

Chapter 1*: Introduction and Background* provides text and information about SGMA and the Delta Mendota Subbasin that can be repurposed directly into websites or printed materials by agencies and/or entities with an interest in SGMA and how it will affect the subbasin. This section also describes the communications activities mandated by SGMA.

Chapter 2: *Communications Plan Overview* provides communications planning goals and objectives as well as the scope. This section can be used in support of project management activities.

Chapter 3: *Situation Assessment* provides some of the context for communications activities. This section can be used in developing required assessments of stakeholder issues and interests. It also informs project management activities.

Chapter 4: *Audiences and Messages* identifies key subbasin audiences and message points for specific audience segments. The goal of this chapter is to provide information that can be used by the subbasin GSAs in preparing to work with key stakeholders.

Chapter 5: *Risk Management* is the summary of a communications risk assessment that considers subbasin communications strengths and weakness and proposes on-going adjustments based on best communication management practices. This section informs project management activities and provides a context for some of the recommended communications tactics.

Chapter 6: *Tactical Approaches* offers a communications to do list with specific communications activities relevant for project phases and subbasin audiences.

Chapter 7: *Measurements and Evaluation* outlines methods to determine the effectiveness of outreach and engagement.

Chapter 8: *Roles and Responsibilities* provides a sample list of tasks and illustrates the types of communications roles and responsibilities which might be assigned. This section should be incorporated into project management plans.

Subbasin GSAs should feel free to repurpose any or all parts of the document that will assist them in meeting SGMA requirements.

This document was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program and completed by the Communication and Engagement Group of MWH/Stantec.

Delta Mendota Subbasin
Sustainable Groundwater Management Act
Communications Plan
Working Draft

Contents

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List of Acronyms and Abbreviations

Item	Description
Basin	Groundwater Basin or Subbasin
Coms Plan	Delta Mendota Subbasin, Sustainable Groundwater Management Act, Working Draft Communications Plan
CSD	Community Service District(s):
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
DAC	Disadvantaged Communities
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
IRWMP	Integrated Resource Water Management Plan
PDF	Portable Document Format
RCD	Resource Conservation District(s)
SGMA	Sustainable Groundwater Management Act
SLDMWA	San Luis Delta- Mendota Water Authority
State Board	State Water Resources Control Board

Item	Description
SA	Situation Assessment
USGS	United States Geological Survey

Revision History

Table 1. Revision History

Revision History			
Revision/Dock Title #	Date of Release	Author	Summary of Changes

INTRODUCTION AND BACKGROUND

The purpose of this Communication Plan is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. Its chapters identify key stakeholders and provide a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. The plan was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program.

1.1. SGMA Basics[1]

After decades of debate, in 2014 California lawmakers adopted SGMA. This far-reaching law seeks to bring the State's critically important groundwater basins into a sustainable regime of pumping and recharge. The change in water management laws has created new obligations for residents and water managers in the Delta-Mendota Groundwater Subbasin. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members in implementation of this law.

SGMA requires, **by June 30, 2017**, the formation of locally-controlled GSAs in many of the State's groundwater basins and subbasins (basins). A GSA is responsible for developing and implementing a **groundwater sustainability plan** (GSP). These plans assist the basins in meeting sustainability goals. The primary goal is to maintain sustainable yields without causing undesirable results.

1.1.1. <u>GSAs & GSPs</u>

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. A single local agency can decide to become a GSA, or a combination of local agencies can decide to form a GSA by using either a Joint Power Authority (JPA), a memorandum of agreement (MOA), or other legal agreement. If no agency assumes this role the GSA responsibility defaults to the County; however, the County may decline.

A GSP may be any of the following *(Water Code § 10727(b)):*

- A <u>single plan</u> covering the entire basin developed and implemented by <u>one GSA</u>.
- A <u>single plan</u> covering the entire basin developed and implemented by <u>multiple GSAs</u>.

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[1] Sections on SGMA are largely drawn, in whole or in part, from publicly available materials from the Department of Water Resources. For more see: http://www.water.ca.gov/groundwater/sgm

- Subject to Water Code Section 10727.6, multiple plans implemented by multiple GSAs and coordinated pursuant to a single coordination agreement that covers the entire basin.

If local agencies are unable to form an approved GSA and/or prepare an approved GSP in the required timeframe, then the basin or subbasin would be considered unmanaged. Unmanaged groundwater basins and subbasins are subject to State Water Resources Control Board (State Board) oversight. This is true even if the vast majority of the subbasin is covered by a plan. Should intervention occur, the State Board is authorized to recover its costs from the GSAs.

1.2. SGMA Communications and Engagement Requirements

SGMA includes specific requirements for communications and engagement by each planning phase. **Figure 1** (next page) illustrates the requirements and provides water code references. The GSP submittal guidelines also describe the outreach and engagement documentation to be submitted with the plan. **Table 2** describes the submittal requirements. A full list of codes and requirements is also provided in **Appendix 1**.

Table 2. GSP Submittal Requirements[2]

GSP Regulations Section	Requirement	Description
Article 5. Plan Contents, Sub-article 1. Administrative Information		
354.10	Notice and Communication	• Description of beneficial uses and users • List of public meetings with dates • GSP comments and responses • Decision-making process • Public engagement process • Method(s) to encouraging active involvement • Steps to inform the public on GSP implementation progress

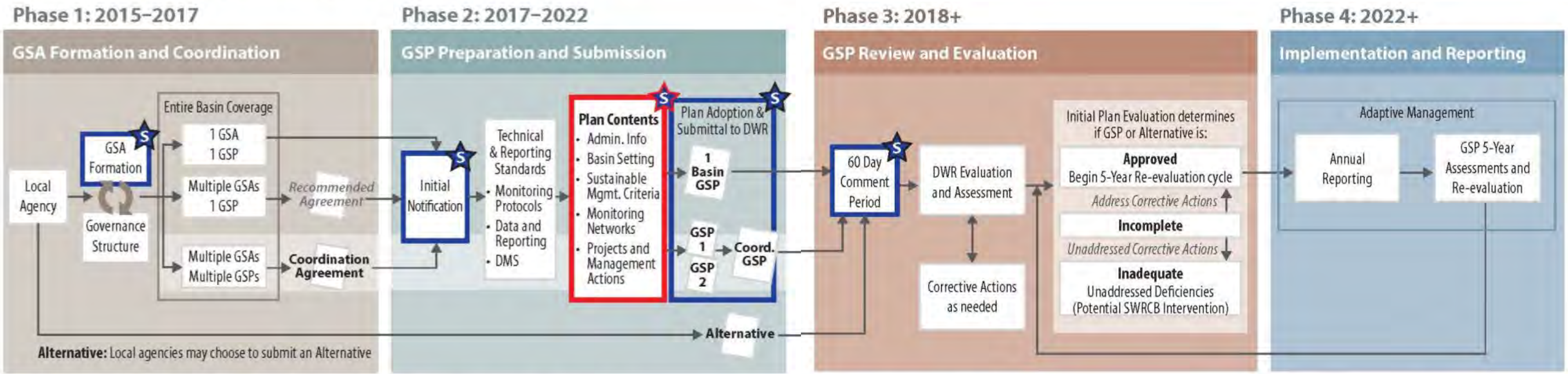
1.3. Planning Approach

While the SLDMWA is assisting with the coordination of GSP(s) development, this Communications Plan (Coms Plan) is offered for the voluntary use of all of the GSAs of the Delta-Mendota Subbasin. A full Coms Plan schedule should be developed in conjunction with the overall GSP(s) development schedule. One additional option is for the Coordination Committee of GSAs to provide overall communications guidance. This could potentially be included in a section of the Coordination Agreement.

[2] Guidance Document for the Sustainable Management of Groundwater, Preparation Checklist for GSP Submittal, Department of Water Resources, December 2016

Figure 1. Stakeholder Engagement Requirements

Stakeholder Engagement Requirements by Phase



Phase 1 Engagement Requirements

- **Establish and Maintain List of Interested Parties** §10723.4
- **GSA Formation Public Notice** §10723(b)
- **GSA Formation Public Hearing** §10723(b)
- **GSA Formation (due 6/30/17)** §10723(b)
  Notify DWR:
  - Include list of interested parties
  - Explain how parties' interests will be considered
- **Pre-GSP Development** §10727.8
  Provide a written statement describing how interested parties may participate to:
  - DWR
  - Cities within the GSA boundary
  - Counties within the GSA boundary

Phase 2 Engagement Requirements

- **GSP Initial Notification** §353.6*
- **GSP Preparation** §10727.8 and §10723.2
  - Encourage active involvement
  - Consider beneficial uses and users of groundwater when describing *Undesirable Results, Minimum Thresholds, and Projects & Actions*
- **GSP Communications Section** §354.10*
  - GSA decision-making process
  - Opportunities for engagement and how public input is used
  - How GSA encourages active involvement
  - Method of informing the public
- **Public Notice of Proposed Adoption** §10728.4
- **GSP Adoption Public Hearing** §10728.4
- **GSP Submittal** §354.10*
  - Include a summary of communications: description of beneficial uses/users, list of public meetings, comments received/responses

Phase 3 Engagement Requirements

- **60 Day Comment Period** §353.8*
  - Any person may provide comments to DWR regarding a proposed or adopted GSP via the SGMA Portal at http://sgma.water.ca.gov/portal/
  - Comments will be posted to DWR's website

Phase 4 Engagement Requirements

- **Public Notices and Meetings** §10730
  - Before amending a GSP
  - Prior to imposing or increasing a fee
- **Encourage Active Involvement** §10727.8

Engagement Requirements Applicable to ALL PHASES

- **Beneficial Uses and Users** §10723.2
  Consider interests of all beneficial uses and users of groundwater
- **Advisory Committee** §10727.8
  GSA may appoint and consult with an advisory committee
- **Public Notices and Meetings** §10730
  - Before electing to be a GSA
  - Before adopting or amending a GSP
  - Prior to imposing or increasing a fee
- **Encourage Active Involvement** §10727.8
  Encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin
- **Native American Tribes** §10720.3
  - May voluntarily agree to participate
  - See Engagement with Tribal Government Guidance Document
- **Federal Government** §10720.3
  - May voluntarily agree to participate

Stakeholder Input

Stakeholders should be informed throughout the development of Plan Content

Code References: §(#) = SGMA, §(#)* = GSP Regulations

Source: Guidance Document for Groundwater Sustainability Plan Stakeholder Communication and Engagement Department of Water Resources, June 2017

An important additional step will be establishing, in conjunction with the multiple GSAs, the roles and responsibilities for implementing the Coms Plan.

1.4. SGMA and the Delta Mendota Subbasin[3]

The Delta-Mendota Subbasin of the San Joaquin Valley Groundwater Basin is a long, relatively narrow groundwater basin that covers portions of five counties, from north to south, San Joaquin, Stanislaus, Merced, Madera and Fresno Counties (see **Figure 2**). The Delta-Mendota sub-basin is bounded on the west by the Tertiary and older marine sediments of the Coast Ranges. The northern boundary (from west to east) begins on the west by following the Stanislaus/San Joaquin County line, then deviates to the north to encapsulate all of the Del Puerto Water District before returning back to the Stanislaus/San Joaquin County line. The boundary continues east then deviates north again to encapsulate all of the West Stanislaus Irrigation District before returning back to the Stanislaus/San Joaquin County line. The boundary continues to follow the Stanislaus/San Joaquin County line east until it intersects with the San Joaquin River.

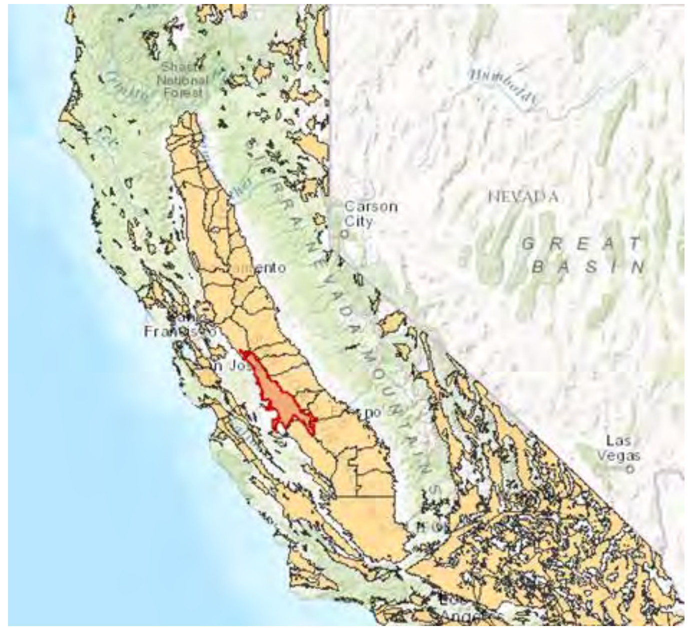


Figure 2. Delta Mendota Subbasin

The eastern boundary (from north to south) follows the San Joaquin River to within Township 11S, where it jogs eastward along the northern boundary of Columbia Canal Company and then follows the eastern boundary of Columbia Canal company until intersecting the northern boundary of the Aliso Water District. The boundary then heads east following the northern and then eastern boundary of the Aliso Water District until intersecting the Madera/Fresno County line. The boundary then heads westerly following the Madera/Fresno County line to the eastern boundary of the Farmers Water District. The boundary then heads southerly along the eastern boundary of the Farmers Water District, and continues southerly along the section line to the intersection with the northern right-of-way of the railroad. The boundary then heads east along the northern right-of-way of the railroad until intersecting with the western boundary of the Mid-Valley Water District. The boundary then heads south along the western boundary of the Mid-Valley Water District to the intersection with the northern boundary of Reclamation District 1606. The boundary then heads west and then south following the boundary of Reclamation District 1606 and James Irrigation District until its intersection with the Westlands Water District boundary.

The southern boundary (from east to west) matches the northerly boundaries of Westlands Water District legal jurisdictional boundary last revised in 2006. The boundary then

[3] Information related to the Delta Mendota subbasin is drawn directly from http://sgma.water.ca.gov/basinmod/basinrequest/preview/23.

proceeds west along the southernmost boundary of the San Luis Water District. The boundary then projects westward from this alignment until intersecting the Delta-Mendota sub-basin Western boundary described above.

1.5. Delta-Mendota Subbasin GSP Planning

The GSAs of the Delta-Mendota Subbasin intend to work together to meet Sustainable Groundwater Management Act (SGMA) requirements and prepare a Groundwater Sustainability Plan (GSP) or coordinated Sustainability Plans by June 31, 2020. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members and non-members in planning and implementation of this law and has been directly assisting a subset of the local GSA eligible agencies in organizing to accomplish required SGMA tasks. The SLDMWA has also hosted informal, information meetings with all of the subbasin GSAs.

While SLDMWA coordinated GSAs are confident in their ability to prepare a GSP for the areas under their jurisdiction, SGMA requires that an approved GSP or multiple coordinated GSPs are in place to provide sustainable management for the entire subbasin. The identified GSAs have been asked to determine how they wish to proceed in individual GSP development or a coordinated single GSP by July 2017 and whether or not they wish to participate in the Prop 1 Sustainable Groundwater Planning Grant as a joint request.

1.6. Delta Mendota Subbasin GSAs

Following are the DWR identified agencies (as of June 15, 2017).[4]

1. Aliso Water District
2. Central Delta-Mendota Region Multi-Agency GSA
3. City of Dos Palos
4. City of Firebaugh
5. City of Gustine
6. City of Los Baños
7. City of Mendota
8. City of Newman
9. City of Patterson
10. County of Madera—3
11. DM-II
12. Farmers Water District
13. Fresno County—Management Area ‘A’
14. Fresno County—Management Area ‘B’
15. Grasslands Groundwater Sustainability Agency
16. Merced County—Delta-Mendota

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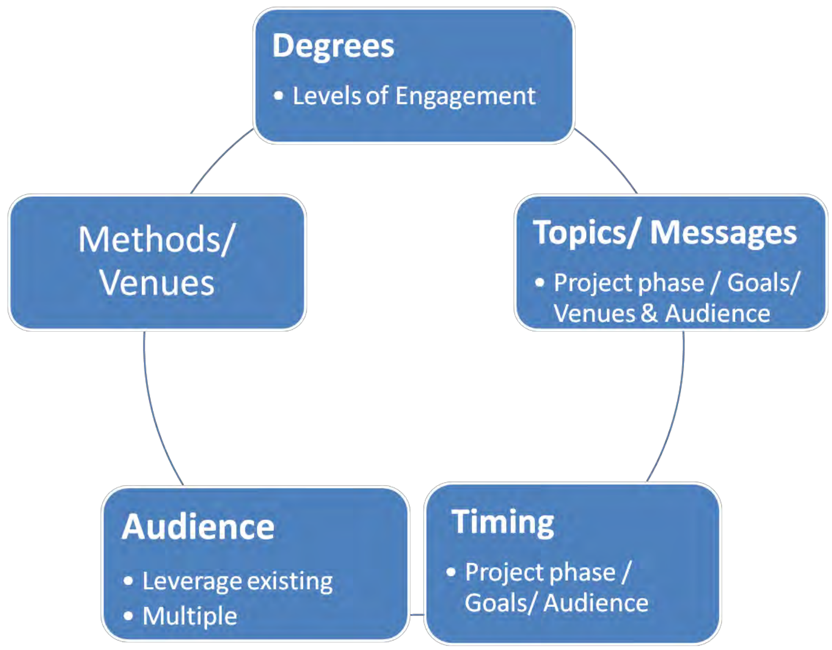
[4] See: http://sgma.water.ca.gov/portal/

17. Northwestern Delta-Mendota GSA
18. Ora Loma Water District
19. Patterson Irrigation District
20. San Joaquin River Exchange Contractors Water Authority
21. Turner Island Water District-2
22. West Stanislaus Irrigation District GSA
23. Widren Water District GSA

COMMUNICATIONS PLAN OVERVIEW

Communication is the process of transmitting ideas and information. According to the Project Management Institute, 75%-90% of a project manager's time is spent communicating. A Coms Plan provides the purpose, method, messages, timing, intensity, and audience of the communication, then describes who will do the communicating, and the frequency of the communication (see **Figure 3**.)

Figure 3. Elements of a Communications Plan



2.1. Purpose

The purpose of the Delta-Mendota Subbasin, Sustainable Groundwater Management Act, Coms Plan is to outline the information and communications needs of the project stakeholders and provide a roadmap to meet them. The Coms Plan then identifies how communications activities, processes, and procedures will be managed throughout the project life cycle.

2.2. Importance

While communications are important in every project, a well-executed communications strategy will be essential to the success of the GSP(s) development and adoption process. The financial and regulatory stakes are high and communication missteps can create project risks. Further, development of a viable GSP(s) will require an on-going collaboration among all the stakeholders, both organizational and external. The plan will be comprehensive and consider multiple variables, a range of system elements and project costs and benefits. Stakeholder input will be needed to refine GSP requirements and fully

define the water management system, and potential impacts, costs and benefits that may result in managing for sustainability.

2.3. Scope

The plan focuses on formal communication elements. Other communication channels exist on informal levels and enhance those discussed within this plan. This plan is not intended to limit, but to enhance communication practices. Open, ongoing communication between stakeholders is critical to the success of the project.

2.4. Communications Goal

Development, adoption and implementation of the GSP(s) will require basin external stakeholders, other agencies, staff, managers, and the multiple GSA Boards to evaluate choices, make decisions and commit resources.

The core communications goal is to plan for and efficiently deliver clear and succinct information:

- At the right time
- To the right people
- With a resonating message

This is done to facilitate quality decision making and build accompanying public support

2.5. Communications Objectives

The Coms Plan Objectives are to present strategies and actions that are:

- Realistic and action-oriented
- Specific and measurable
- Minimal in number (a few well delivered are better than many mediocre efforts)
- Audience relevant

2.6. Strategic Approach

Three primary communications strategies have been identified for the GSP(s) development.

1) Fully leverage the activities of existing groups. This practical approach is cost effective and respectful of the limited time that stakeholders have to participate in collaborative processes.
2) Provide targeted, communications and outreach to opinion leaders in key stakeholder segments.
3) Provide user friendly information and intermittent opportunities through existing communication channels and open houses or workshops to allow interested stakeholders (internal and external) to engage commensurate with their degree of interest.

2.7. Communications Governance, Communications Team

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[5], some form of communications governance is recommended. Several governance options for consideration are offered in Appendix 2. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. For the purpose of this document, an assumption is made that some form of governance will be identified and a communications team (which may be an individual or multiple individuals, and/or include the project consultants) is designated.

A driving consideration for this recommendation is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance is efficient and effective.

2.8. Constraints

All projects are subject to limitations and constraints as they must be within scope and adhere to budget, scheduling, and resource requirements. These constraints can be even more challenging in projects with multiple agencies as will be the case with the development and coordination of multiple GSPs.

There are also legislative, regulatory, technology, and other organizational policy requirements which must be followed as part of communications management. These limitations must be clearly understood and communicated where appropriate. While communications management is arguably one of the most important aspects of project management, it must be done in an effective and strategic manner recognizing and balancing the multiple constraints.

All project communication activities should occur within the project's approved budget, schedule, and resource allocations. The GSP(s) project managers and the leadership of the participating GSAs should have identified roles in ensuring that communication activities are performed.

To the extent possible, to support collaboration and reduce costs, GSP(s) partners should utilize standardized formats and templates as well as project file management and collaboration tools.

[5] See Appendix 1

SITUATION ASSESSMENT

3.1. *Introduction*

The challenges of asking a community to make changes in how things are done, or forging an agreement among multiple parties are often large. Prior to preparing a Coms Plan, a neutral, 3rd party facilitator conducted a stakeholder Situation Assessment (SA).

The facilitator's role was to provide an independent evaluation of potential stakeholder's interest in coordination and governance for GSA formation and GSP development and identify any barriers or concerns that would need to be addressed for the GSA formation process and GSP(s) development to be successful.

3.2. *Situation Assessments*

An SA is an information-gathering process that informs outreach, engagement and collaboration. As part of preparing the basin communication's process, it was important to know more about:

- Stakeholder Categories
- Opinion leaders
- Regulatory and political context
- Advocates and detractors
- Attitudes and knowledge
- Other elements useful to the crafting of decisions

An assessment is also a low risk approach to education and signaling a future relationship. It facilitates the community's appraisal of its needs, wants and values. A well-crafted assessment sets the stage for the parties to better understand and interpret their situation so that they can make informed decisions for actions, in the short term and for the future.

The Delta-Mendota subbasin SA included background research and interviews. Interviews were usually with individuals but in a few cases a very small group was convened. To encourage candor, the results of the input process were bundled so those interviewed were not individually identified unless they explicitly indicated they wished to share their individual response.

3.3. *Background Research*

The facilitator worked closely with the SLDMWA and DWR to identify useful documents, plans and activities that might inform the overall communications planning process.

3.4. *Interviews and Consultations*

Using information gathered during the background research and similar GSA formation efforts throughout the state, the facilitator worked with the SLDMWA to craft interview questions. The facilitator also provided some selection criteria to the SLDWMA to help identify a representative group of interview candidates. Once selected, the SLDMWA staff and facilitation team invited the interviewees to participate. In addition to full interviews,

additional calls and in person communications were conducted to acquire amplifying information. **Figure 4** provides a quick overview.

Figure 4. Interview and Consultation Quick Facts

Number of Contacts: 30

Dates of Calls and Interviews Conducted:
February to May 2017

Average Length: 1 hr.
(Shortest = 20 mins., Longest = 1.5 hrs)

Selected participants were all engaged or otherwise stakeholders in some aspect of the basin GSA development process.

A project background sheet was provided in advance of each formal interview and used again during the interviewee discussions with the facilitator. Each interview followed the same format and included 16-18 questions (depending on whether or not a follow-up question was needed).

The questions covered the following topics pertaining to the GSA formations and GSP(s) development:

1. Overarching perspectives from each key stakeholder on general groundwater conditions, GSA governance; subbasin management and associated SGMA compliance
2. Preferred methods to achieve groundwater sustainability consistent with SGMA requirements
3. The level of agreement/conflict around groundwater governance across the range of stakeholder perspectives
4. Experience with facilitated processes, outreach and engagement, and the goals for such support
5. Potential configurations of governance and formations of GSAs and GSP development

3.5. *Summary of key findings*

Interview results indicate an overall positive environment for the project and project communications; however, the effort will require interactions of a large number of parties and planning for an extremely complex system. Following are the reflections, ideas and suggestions of those contacted.

3.5.1. Related to Groundwater Sources and Trends

- *Significant observed impacts associated with Weather, Water Project Deliveries and Cropping Patterns* – Participants observed a declining

groundwater situation and were able to attribute it to drought and weather (particularly timing of seasonal rainfall and periods of prolonged, higher temperatures), conversion to permanent crops, and significant changes in access to surface water.

- *Surface & Groundwater Nexus* – As noted in comments related to access to surface water, there was a clear understanding of the surface/groundwater nexus. Many believed that any realistic solution would have to include a full assessment of the region's surface water future.

- *Extremely Complex Systems* – Many of those interviewed reported that parts of the subbasin were doing fine and could, with good management, be sustainable. They described problems as being primarily in pockets of the subbasin. They also characterized some parts of the subbasin as not being managed sustainably and indicated that they believe this would have continued had SGMA not passed. While it was generally agreed that it would have been better if SGMA was not driving the change, they felt change would not occur without something like SGMA. Several of the participants were able to describe specific locations and situations that illustrated this.

  Issues related to operations of the Bureau of Reclamation, the Delta-Mendota Canal (DMC), the Mendota Pool and restoration activities are of keen interest to all the stakeholders. Everyone was familiar with issues of subsidence and with the facts and figures represented in graphics like those in **Figure 5**, prepared by the United States Geological Survey (USGS).[6]

  Many perceived that groundwater supplies for municipal uses in some parts of the basin were at risk.

- *Historic Rights and Arrangements* – Access to surface water is based on numerous historic rights and agreements as well as more contemporary agreements. As such there is no **single** description of the status of surface water availability among the many subbasin GSAs,[7] although there is a strong understanding of the rights and arrangements that do exist.[8]

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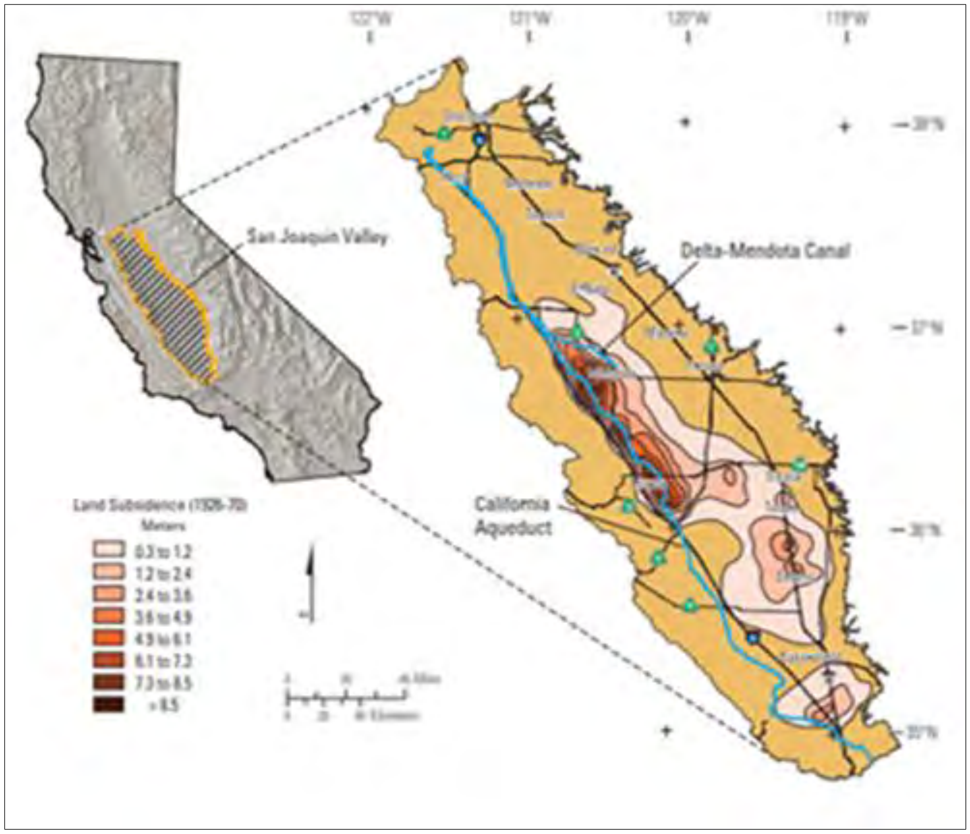
[6] U.S. Department of the Interior | U.S. Geological Survey: https://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html, Page Last Modified: Monday, 20-Mar-2017 22:39:47 EDT

[7] A full inventory of water rights and arrangements for the subbasin GSAs is recommended to be prepared as part of the GSP planning process.

[8] In 2010 there were 1,403 water rights claimed in the San Joaquin Delta watershed, the largest number of any watershed in the State. [Source: Associated Press: Original data source is State Water Resources Control Board eWRIMS, Database

Figure 5. USGS Illustration of the DMC and Subsidence



The hierarchy of water rights as well as laws related to groundwater rights will be a significant factor in GSP negotiations.

Another historical factor related to sustainability is the character of land ownership. There was a perceived difference in the values placed on sustainability by multi-generational family farms versus investor driven agriculture and/or water development.

3.5.2. <u>Related to GSA Governance; Subbasin Management and SGMA Compliance</u>

- *Numbers* - The subbasin includes numerous Water Agencies (35) and other potential GSA eligible agencies including Cities and Counties (such as Dos Palos, Firebaugh, Gustine, Los Baños, Mendota, Newman, Patterson, Fresno, Madera, Merced, San Joaquin, and Stanislaus) and Community Service Districts (CSDs) including among others Grayson, Westley, and Volta, as well as multiple Resource Conservation Districts (RCDs) that for the most part were within the general boundaries of other GSA eligible authorities (Panoche, Poso and Grasslands as an example).

  By the June 30, 2017 filing deadline, 23 eligible entities had formally filed GSA formations and met SGMA requirements for subbasin coverage.

Even with this large number of GSA entities, during the SA interviews and in a follow-up survey, most agencies indicated a preference for a reduced number of GSPs and potentially just one or two.

At the time of this assessment there was not a full understanding of all of the potential requirements of being a GSA and ultimately what might be required to prepare a compliant GSP.

Table 3. Number of Subbasin Public Water Agencies

Number of Public Water Agencies

- Merced County
- Fresno County
- Broadview WD
- Centinella WD
- Central California ID,
- Davis WD
- Del Puerto WD
- Eagle Field WD
- El Solyo WD
- Farmers WD
- Firebaugh Canal WD
- Foothill WD
- Fresno Slough WD
- Grasslands WD
- Hospital WD
- Kern Canon WD
- Laguna WD
- Mercy Springs WD
- Mustang WD
- Oak Flat WD
- Orestimba WD
- Oro Loma WD
- Pacheco WD
- Panoche WD
- Patterson WD
- Romero WD
- Salado WD
- San Luis Canal Company
- San Luis WD
- Santa Nella C.WD
- Sunflower WD
- Tranquility ID
- West Stanislaus ID
- Widren WD
- Quinto WD

At the time of this assessment participants did not fully recognize the potential number of stakeholders and/or the requirements to conduct outreach.

- *Subbasin Governance Structures* – Many individuals and entities within the subbasin have experience working in cooperative governance and related structures. For example, the SLDMWA provides leadership for an Integrated Resource Water Management Plan (IRWMP) illustrated in **Figure 6**[9] on the following page. Many of the stakeholders are also involved with Irrigated Lands Coalitions (see **Figure 7**).[10]

  Likewise, many are also involved in efforts related to the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) initiative (see **Figure 8**).

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[9] Source : San Luis & Delta-Mendota Water Authority, Westside-San Joaquin Integrated Water Resources Plan, July 2014

[10] Source: Central Valley Regional Water Resources Control Board

Existing Cooperative / Collaborative Governance Structures with Delta Mendota Subbasin Stakeholders

Figure 6. Integrated Regional Water Management Groups

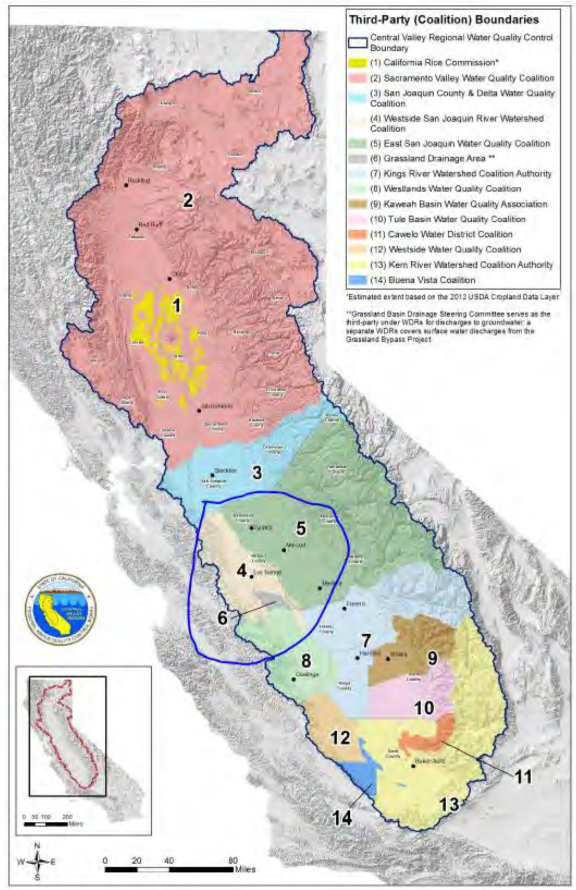


Figure 7. Irrigated Lands Coalitions

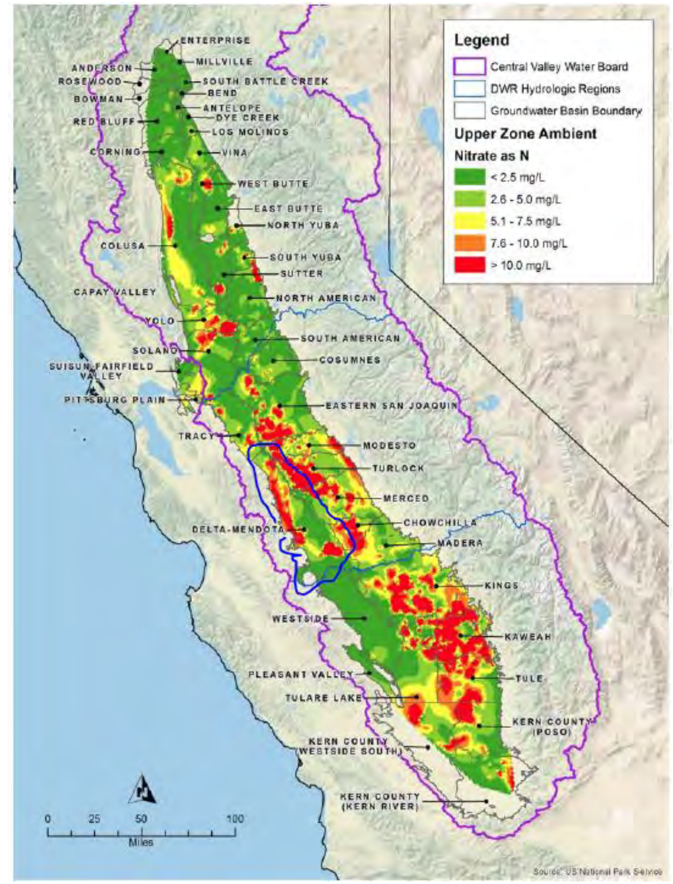


Figure 8. CV-Salts Initiative

CV-Salts was launched to develop sustainable salinity and nitrate management planning for the Central Valley. (See **Figure 8**.[11])

Finally, there are multiple arrangements in place related to surface water transfers and other previous groundwater management planning efforts.

Experience with these programs has created a capacity for collaborative planning that will be essential for GSP development. It also creates opportunities to access and leverage existing stakeholder meetings and events rather than needing to convene multiple new stakeholder processes.

3.5.3. Issues to be Addressed in Creating a Sustainability Plan

Some of the participants indicated they had an extremely good understanding of their section of the subbasin, with exact and extensive records to support their perspective. They found that making projections using historical data had been more reliable than some of the groundwater models that were in use.

In thinking about development of a GSP they felt there could be some difficulty in developing water balances due to lack of quality data for some locations. Another mild concern was the potential for disagreements about the selection of a groundwater model(s) or reconciling differences among methods.

Still another concern was the capacity of the GSAs and/or GSA members to fully participate. Some of these agencies are very lightly staffed and have varying levels of knowledge related to groundwater management. All of the participants had significant other duties prior to the passage of SGMA.

One concern, expressed after completion of the assessment, was the potential for some agencies to simply opt out of participating in the development of a GSP but still receive the benefits of the region having an approved plan without having contributed to the larger good of the subbasin.

3.5.4. Representation

The State Board lists the following as Required Interested Parties for the purpose of SGMA outreach:

- All Groundwater Users
- Holders of Overlying Rights (agriculture and domestic)
- Municipal Well Operators and Public Water Systems
- Tribes
- Counties
- Planning Departments /Land Use
- Local Landowners
- Disadvantaged communities
- Business

[11] Ibid

- Federal Government
- Environmental Uses
- Surface Water Users (if connection between surface and ground water)

All of these stakeholder categories were contacted in the interview process excepting tribes. In the case of tribes, there are no classified tribal lands in the Delta-Mendota subbasin, therefore no planning, outreach or communication needs are currently anticipated for tribes.

Due to subbasin characteristics, a primary focus of the assessment was on agricultural, disadvantaged communities (DACs) and municipal groundwater users.

- *Related to Agricultural Representation* - most respondents believed that the elected leadership of the GSA agencies would do a good job in representing agriculture and noted that many of them were growers themselves. It was also noted that farmers were busy and would be far more interested in any specifics of a GSP that would impact operations or the degree of certainty about water availability than the particulars of GSA governance.

- *Regarding DACs* - Much of the subbasin and its counties (San Joaquin, Stanislaus, Merced, and Fresno) have communities that meet the DAC definition and the region is generally considered disadvantaged. The ability of DACs to participate in GSP development was considered limited and it was thought that there would be a need for specific and direct outreach to DACs through elected leadership and via use of trusted community advocates. As part of the SA, several of those interviewed identified themselves as being able to represent a DAC perspective and one in particular was particularly concerned about the availability of Spanish language materials. As a result, Spanish language materials were included in the meeting materials of the public GSA adoption meetings and the SLDMWA provided a fluent Spanish speaker to assist with meetings.

In the past, to promote DAC identification and involvement, the Westside-San Joaquin IRWM previously conducted an extensive survey of private and public community representatives to educate and encourage understanding of the IRWM process, to help understand the issues confronted by DACs, and to

better address the needs of minority and/or low-income communities. This effort resulted in identification of DACs in the Region and an initial list of 22 projects that would benefit DACs and low-income communities. Given known constraints on this community it is recommended that more focused DAC outreach should be coordinated with the IRWM. This effort is now in progress.

- *Regarding Municipals* - The SA outreach also included interviewing Municipal Stakeholders. A significant number of the Cities are fully dependent on wells for water supply and issues related groundwater management are of grave concern. These representatives all felt that even while it would be difficult to make time to participate in GSAs and GSP development, that they must make the time. Many had also determined that they wished to form their own GSA to reflect their specific interests in any kind of broader GSP negotiation.

- *Regarding Environmental Interests* - There appeared to be a less defined stakeholder segment representing traditional, environmentally focused issues. Outreach was made to subbasin government agencies that often serve as a surrogate for these interests and an informal consultation occurred with a representative of the Planning and Conservation League to identify any known, active stakeholders. However, no specific entity or individual was identified by those contacted. A general perception was that this community would desire engagement and would designate representatives if the GSP development was thought to potentially impact existing restoration or other environmental concerns but the formation of GSAs per-se, was of less interest. The next phase of communications should include outreach to organizations such as Audubon, the Nature Conservancy and Ducks Unlimited just to ensure due diligence. These connections will be important going forward, particularly if environmental issues are identified.

- *Regarding Industrial Users* – The region includes some industrial water users. This sector has a relatively lower percent of water use compared to other subbasins users; however, representatives of the sector pointed out how essential access to water was to their industry. The interviewees also emphasized how important these industries were to the local economies. There was a stated concern about representation since there didn't appear to be a direct way to engage, particularly with multiple GSAs being formed.

- *Regarding Counties & Planning Agencies* – All of the subbasin counties have designated representatives and all are assisting with GSA coverage for areas not otherwise covered by a GSA. All of the city and county representatives had direct engagement with the planning arms of their jurisdictions, or were staff to the planning departments. These representatives, like the municipal representatives, viewed this as critical issue even as it creates new workload for the already busy entities.

3.5.5. Communications and Facilitation Preferences

Participants were asked to describe their communications preferences. Several offered specific suggestions on written materials. Most did not believe there would be a need for a high frequency of communications directly with non-GSA stakeholders.

Several suggested using regularly scheduled activities of existing groups and gatherings to share information rather than creating stand-alone events. They listed annual meetings of the water agencies as one good venue as well as meetings related to the IRWM and Irrigated Lands. Several also thought that it would be good to go to places like Farmers Markets, particularly for the disadvantaged communities, and County Fairs.

Farm Bureau representatives also indicated a willingness to support outreach efforts. The Merced Farm Bureau, in particular, has already helped to advertise public meetings related to GSA formations.

Related to facilitation there was not a broad exposure to professional facilitators among many of the stakeholders. Even so, participants consistently listed qualities such as fairness and transparency, a good understanding of the issues, and confidence as helpful facilitator strengths. There was a sense that the GSAs would not need hand holding but that facilitation could be useful for helping the stakeholders forge decisions and making what many believed would need to be compromises.

3.5.6. Success Factors, Barriers to Success

The participants were asked to describe their view on the odds for success as well as any barriers that would prevent successful completion of a GSP.

Overall, most participants expressed a medium to high likelihood for success. They noted that the carrot (grants and technical support) and stick (significant regulatory intervention) by the State creates a dynamic that is supportive to success.

Participants stated barriers related to the capacity of the GSAs to participate and ultimately agree to, and implement changes. The much diffused governance structure of multiple GSAs amplifies this dilemma as do actions beyond the control of the subbasin entities (such as climate and water deliveries).

In addition to perceived barriers, participants outlined their thoughts on opportunities and success strategies.

- *Drought* – While the drought was unwelcome it increased awareness of the need for changes. Many felt it would be easier to move forward while the topic is prominent in everyone's minds.
- *Short and Long Game* – Several suggested it will be important to have a plan that includes long and short term strategies and activities.
- *Integrated Planning* – Many of the participants emphasized the importance of integrated planning.

3.5.7. Other Comments and Advice

Many participants expressed appreciation for being contacted and invited the facilitator to contact them again if there were questions.

3.6. *Promising messages and methods*

Three primary communications strategies have already been identified for the GSP(s) development:

- Leveraging the activities of existing groups
- Providing targeted, communications and outreach to opinion leaders in key stakeholder segments
- Providing user friendly information and intermittent opportunities for a broader range of stakeholders

The same strategies aligned with the recommendations of the SA participants. These methods will allow stakeholders to engage commensurate with their degree of interest while providing sufficient information to ensure long-term success for plan development and implementation.

AUDIENCES AND MESSAGES

GSA formation and GSP(s) development, like most large planning efforts, consists of a broad range of stakeholders with differing interests and influence.

4.1. Two Core Audience Segments

This Coms Plan Anticipates two core audience segments. First is the subbasin GSA Boards and the communications among and between themselves. This audience segment is significant in size given that 23 GSAs will be working to develop a GSP(s) and each GSA has its own Board and audiences.

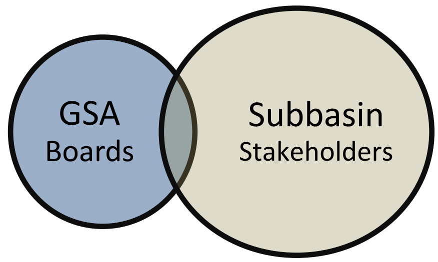


Figure 9. Two Core Audience Segments

The second audience is the subbasin stakeholders as identified in SGMA. This audience is also large. Many of the stakeholders are shared by the GSA Boards and some of the larger stakeholder segments are also represented on the GSA Boards (see **Figure 9**).

Nearly all of the communications strategies apply to both segments; however, some strategies apply to one or the other specifically and are so identified.

4.2. Communications and Change Management

The process of adopting and implementing a GSP will require significant change management. Communications planning should encompass basic change management approaches. Messages should also evolve over time and be tied to the planning process and key decision points. Then, for each audience and each major planning step, communications must do the following:

1. Describe what the actual proposed plan (change) is
2. Articulate how the change will directly impact the category of stakeholder involved
3. Outline the methods that will be used to implement the plan (change)
4. Define the costs and benefits of changing and not changing, and what future conditions will be if change does not occur
5. Consider unintended consequences and others that may also be impacted by the same change then develop a strategy to engage them
6. Offer opportunities for input and for stakeholders and others to improve the approach

The communications requirements for large changes are often underestimated. Some experts indicate that messages may need to be delivered up to 8 different times to be fully absorbed. Communications needs will also evolve as the GSP planning progresses. **Table 4** provides a sample of early communications that focus on SGMA and groundwater basics.

Table 4. Sample – Early Phase Message Elements for Subbasin Stakeholders

Element	What the Change Is	How it will affect the Stakeholder	How the change will be Implemented	Why it is a good idea
Early Phase GSP Development	• Locally governed GSAs will work together to sustainably manage ground water. • The Subbasin /Basin is required to ensure Sustainable Groundwater Management by submitting a sustainability plan by 2020. • The plan must be implemented and found to result in sustainable management by 2040.	(Unique to audience type) • Changes in the current methods of acquiring and utilizing groundwater may occur. • May affect future decisions related to crop types and decisions related to conjunctively using surface water. • May provide additional project resources to the DAC communities.	A collaborative approach is being undertaken to prepare the plan with multiple GSAs coordinating with the SLDMWA as the planning organizer.	• Sustainable and wise use of groundwater allows for the success of future generations and creates greater certainty for today's beneficial users. • Failure to act may result in negative regulatory consequences.

As part of the GSP planning process, the next phase of communications will also need to communicate the requirements for sustainability and how they are achieved in the context of the Delta-Mendota subbasin. Then, communications related to GSP specifics and adoption will require additional outreach, targeted to specific audiences.

4.3. Tied to Decision Making

Communications should also be tightly linked to decision making. For each anticipated decision, stakeholders for that decision should be identified and the following addressed.

1. Who (Is the stakeholder)
    a. An impacted party?
    b. A potential planning partner?
    c. A potential provider of services or resources?
    d. A regulator of the activity?
    (Note: Maybe more than one category.)

2. What (What is the interest of the stakeholder? How will the stakeholder be affected? What are the stakeholders' needs?)
3. Who (Who is the right messenger for the information)
4. How (How should the information be delivered? What are the best methods?)
5. When (What is the appropriate timing for the messages?)
6. Engagement and Knowledge Transfer (How do we create two-way communications?))

Table 5 illustrates some of these ideas.

Table 5. Communications Planning Questions

Who	Interest	Messenger	Delivery	Timing	Knowledge Transfer
• Impacted • Partner • Provider • Regulator	• How will decision affect? • What will stakeholder need?	• Who is a trusted information Source? • How do we ID and Partner	• What are the best delivery methods?	• When should we conduct outreach?	• What do the stakeholders know that we need to know?

4.4. *GSA Boards*

Due to the multiple subbasin GSAs, specific focus is needed on communications to keep them informed, provide consistent updates and information that the Boards can use in their own outreach, and support their decision making. Primary objectives for communications with the subbasin GSA Boards are to ensure:

- Consistent understanding of the requirements for a GSP and/or GSP coordination
- On-going access to current information
- Timely notice of any significant developments or decision points that may require changes to policies and/or require some other board action
- Confidence that the GSP(s) will be accepted by the GSA's stakeholders

Key communications activities involving the Board include;

1. Providing short and digestible pieces of information to ensure each Board member can quickly articulate to his/her constituents on key matters and remain sufficiently informed so that no decision points are surprises.
2. Provide user-friendly informational materials to be used with public audiences, and will support the Board with their own constituent outreach.
3. Utilize regular Board communications for routine updates and reserve specific Board agenda items for highly significant discussion items.

4.5. *Primary Audiences*

There are several core stakeholder groups that will require ongoing communications and tailored messaging throughout the planning process. They are:

- Agriculture
- Disadvantaged Communities
- Municipals

Other stakeholders requiring special consideration include:

- Industrial Users/ Business
- Regulators (State and Federal)
- Potential Partners
- Environmental Organizations
- Federal Agencies

While all of the stakeholder types are important to engage for development of a GSP, the first three will be most affected by any changes that might be proposed as a result of the *GSP(s)*.

The following provides an outline of key messages and activities in support of each of the audience types.

4.2.1. Agricultural

Messages about the GSP(s) development should feature the overall desirability of a sustainable management approach how the plan will contribute to management certainty and protect against regulatory oversight.

In thinking about irrigation users it is also important to remember that one size does not fit all.

4.2.2. Disadvantaged Communities

Messages developed for this sector should be tailored and specific to the community. This type of outreach is often best served by use of surrogates and trusted messengers. As identified in the SA, these messages should be aligned with activities of the IRWM, especially given the high, current dependence of many on unsustainable water sources. Messages about ways to access the increased availability of resources due to grant incentives should also be considered.

A specific outreach method to consider relates to the predominance of cells phones within the communities. According to the Pew Research Center, "over 50 percent of low-income households own a smartphone. Smartphone penetration in this demographic creates substantial opportunities for utilities to reach disadvantaged communities with software solutions like customer self-service platforms and targeted digital communications."[12]

4.2.3. Municipals

[12] Secondary Source: Water Smart. https://www.watersmart.com/rethinking-disadvantaged-community-engagement/ (accessed June 1, 2017)

Some care will be needed to address tensions related to the relative percentages of use by Municipal agencies and what constitutes highest and best beneficial uses within an agricultural region. A promising interaction with this community would involve collaboration on messaging to achieve mutually beneficial goals.

Some thought it might be possible for the municipal agencies to provide in-kind support to the GSP development process through support for project websites and mailing lists, production of meeting notices, assistance to the planning process from in-house public information professionals and offering access to physical meeting spaces.

Municipals may need assistance in making the case for the need to think at a Basin scale rather than more local terms.

4.2.4. Business and Industry Interests

Business and industry interests seek assurances about the availability of water for operations and the viability of the farming industry in the region. Messages for these audiences should focus on how the GSP(s) development will contribute to sustainability and how these audiences can participate in discussion specific to their interests.

4.2.5. Regional/Statewide Interests and Regulators

Some degree of uncertainty remains in the overall legal, legislative and regulatory environment as it relates to SGMA implementation.

It is in the interest of the subbasin stakeholders to engage state and federal agencies and regulators throughout the process. These parties may have resources to assist the subbasin and a cooperative attitude will build good will in the event that adjustments are needed to achieve SGMA compliance.

4.2.6. Potential Agency Partners

A variety of collaborations to achieve GSP(s) development goals may be possible. The GSAs should consider the potential for collaboration with non-GSA members and inter-basin (adjacent subbasin) partners, as part of plan deliberations.

4.2.7. GSP Coordinators Planning Forum

A planning forum for subbasin GSP coordinators should be established to further inform a coordination strategy. This forum would include agency representatives as well as the consultant teams and be used for the sole purpose of coordination and mutual support. It is anticipated that this body might meet on a quarterly or as needed basis. This forum would also provide a central point of contact for adjacent subbasin coordinators.

4.2.8. Environmental Community

As noted in the SA, this community will be interested in a GSP features. The focus of messaging for this group being on how the GSP(s) development will contribute to a sustainable regional water portfolio. Special effort should be made to identify specific

topics of interest. For example, as part of GSP development, a list of groundwater dependent species may be created, or impacts to wetlands may be identified. These types of lists would highlight where input from the environmental community might be needed.

4.2.9. Federal Government

Federal representatives interviewed for the assessment asked to be kept informed of subbasin SGMA activities. These agencies have a direct interest in surface water integration as well as SGMA activities that could impact wetlands restoration efforts or groundwater dependent ecosystems and species.

RISK MANAGEMENT

Risk management is the identification, assessment, and prioritization of risks (defined as *the effect of uncertainty on achieving objectives*) followed by coordinated, efficient and economical strategies and actions to minimize, monitor, and control the probability and/or impact of negative events. Strategies and actions may also be used to avert risk by leveraging strengths and opportunities.

Risks can come from uncertainty in economic factors, threats from project failures (at any phase), regulatory and legal uncertainties, natural causes and disasters (drought, flood, etc.), as well as dissention from adversaries, or events of uncertain or unpredictable circumstances. Several risk management standards have been developed. This analysis utilizes those from the Project Management Institute.

Table 6 outlines standardized risk categories and translates them to outreach risks.

Table 6. Risk Factors

RISK CATEGORY	Outreach RISK FACTORS
Technical, quality, or performance	• Realistic performance goals, scope and objectives
Project management	• Quality of outreach design • Outreach deployment and change management • Appropriate allocation of time and resources • Adequate support for Outreach in project management plans
Organizational / Internal	• Executive Sponsorship • Proper prioritization of efforts • Conflicts with other functions • Distribution of workload between organizational and consultant teams
Historical	• Past experiences with similar projects • Organizational relations with stakeholders • Policy and data adequacy • Media and stakeholder fatigue*
External	• Legal and regulatory environment • Changing priorities • Risks related to political dynamics

5.1. Technical, quality, or performance

The subbasin is fortunate to have a high level of water knowledge and skilled personnel available to assist with GSP planning. In general, stakeholder expectations for outreach and performance goals, scope and objectives are attainable. The larger concern in this category is properly communicating the scope of the GSP(s) development and the need for extensive coordination and outreach among a number of parties. Communication of SGMA

requirements for outreach as a planning requirement should be an ongoing consideration and appears to be underestimated in emphasis.

5.2. Project management

A number of positive project management factors are present for the GSP(s) development outreach. Project managers view outreach as an important planning element. The outreach design is based on best management practices and industry standards. It is not overly complicated and with technical services support from DWR and other sources, sufficient resources should be available to properly execute it. Procedures and practices are already in place that can be leveraged to achieve communication goals.

The primary concern in this category relates to GSP coordination. This type of outreach will require additional assessment as the individual GSAs will determine their own protocols for representation.

5.3. Organizational / Internal

Conflicts with other GSA member functions and/or conflicts with outreach activities by efforts that include the same stakeholders (e.g. Irrigated Lands, IRWM, and CV-Salts) should be monitored.

One additional consideration will be the distribution of workload between GSA, organizational and consultant teams. Clear roles and responsibilities must be defined and continuous interaction in place to ensure successful execution.

The GSP(s) development process will also need identified, high level spokespersons or champions. These individuals should be able to discuss subbasin planning with the media, in discussions with regulators and potentially at professional conferences.

5.4. External

The legal and regulatory environment of the GSP(s) development process is complex and evolving. Ongoing issues with surface water deliveries and changing agricultural market conditions are outside of the control of the parties. It will be important for mechanisms to be in place that allow for relatively rapid responses to changing conditions.

5.5. Historical

The primary stakeholders in this process generally view interactions and meetings as productive. There is a history of cooperation and a willingness to work together to save costs and achieve better outcomes.

TACTICAL APPROACHES

Following are specific tactical approaches that may be utilized to deliver the activities, messages, and recommendations of the previous chapters. These approaches are based on best communication practices and grounded in the public participation philosophy of the International Association for Public Participation, Public Participation Spectrum as illustrated in **Table 7**.

The Spectrum represents a philosophy that outreach should match the desired level of input from both the stakeholder and the organizational entity.

Table 7. IAP2 Public Participation Spectrum

IAP2 Public Participation Spectrum

Developed by the International Association for Public Participation

INCREASING LEVEL OF PUBLIC IMPACT

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public Participation Goal:	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public issues and concerns are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the Public:	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**
We will keep You informed.	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and issues are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example Tools:	**Example Tools:**	**Example Tools:**	**Example Tools:**	**Example Tools:**
• Fact sheets • Web Sites • Open houses	• Public comment • Focus groups • Surveys • Public meetings	• Workshops • Deliberate polling	• Citizen Advisory Committees • Consensus-building • Participatory decision-making	• Citizen juries • Ballots • Delegated decisions

Based on the assessment findings for the GSP(s) development, most stakeholders would simply like to be INFORMED unless there is a potential for significant changes that may include that stakeholder. Tactics for this group will include fact sheets, websites, open houses, briefings, and informational items placed in publications they already read.

The next largest group of stakeholders, primarily groundwater pumpers and disadvantaged communities, wish to be CONSULTED. This group will have access to all the materials

prepared as part of the informational phase. In addition they should be invited to provide comments on written materials and planning concepts and participate in focused workshops and/or briefings. They should also be invited to attend larger public meetings.

The development of some GSP features may require a higher degree of INVOLVEMENT. This would focus on engagement of a subset of stakeholders that may experience significant impacts associated with SGMA.

COLLABORATION opportunities have also been identified; however, they are of a different character than defined in the Spectrum. Collaboration in this GSP(s) development process will focus on working with partners that have mutual goals to achieve those goals together. This will more resemble a partnership than a public engagement activity.

6.1. Communications Coordination.

Each GSA is required to perform legally mandated outreach activities and the GSP submission guidelines require a minimum level of engagement.

The subbasin GSAs should coordinate outreach activities even if there is a decision to move forward with multiple GSPs. In addition to efficiency and cost savings (the GSAs can share resources) this strategy will allow for consistency in messaging and reduce confusion for stakeholders that may not know what GSA jurisdiction they are in, and/or are in multiple GSA jurisdictions. Following are suggested options for communications coordination.

1. Website
2. Meeting calendar
3. Branded informational Flyers, Templates, PowerPoint Presentations, etc.
4. Periodic newsletter
5. GSP related mailing lists
6. Descriptions of interested parties
7. Issues and interest statements for legally mandatory interested parties
8. Public workshops
9. Message calendar
10. Press releases and guest editorials
11. Speakers Bureau
12. Existing group venues
13. Outreach documentation

6.2. Tactics

6.2.1. Website

As part of the communications plan development, a list of website concepts and draft website content was prepared. The following describes the proposed approach:

a. Centralized – Establish a centralized website for the entire subbasin.

b. Individual GSAs – Posting of material to a website is part of the SGMA requirements. Those GSAs with their own webpages can link to and from the centralized site if they wish to provide their own customized information. For those GSAs without their own website, courtesy pages would be provided as an added feature of the main site. The courtesy pages would all use a single template with the same information to facilitate easy management and updates. Individual GSAs choosing to take advantage of the courtesy pages would be responsible for ensuring that information is current. The page should include a "Last Updated" box to indicate the timeliness of the information.

c. **Basic features** – A basic website framework has already been developed along with introductory information that has prepopulated each page. **Figure 10** illustrates the basic content of the site and includes:
   1. Background information
   2. Information about getting involved, including meeting information
   3. A separate link for Spanish Language materials
   4. Frequently asked questions
   5. Links to GSAs
   6. Contact information

   Should a GSA decide to not participate in the Central website, a similar structure could be utilized.

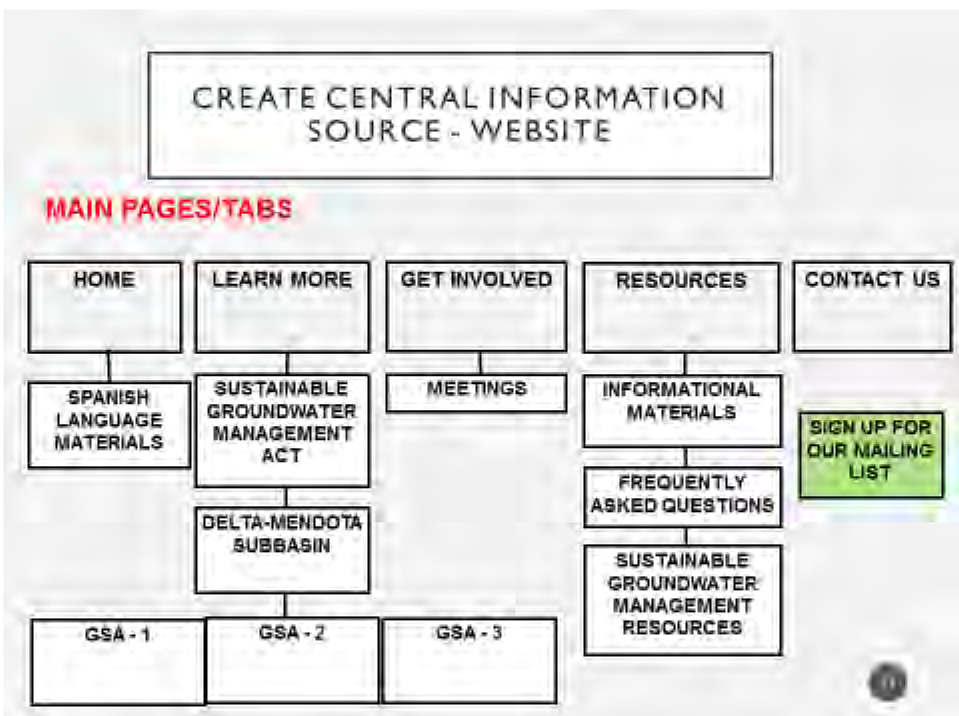


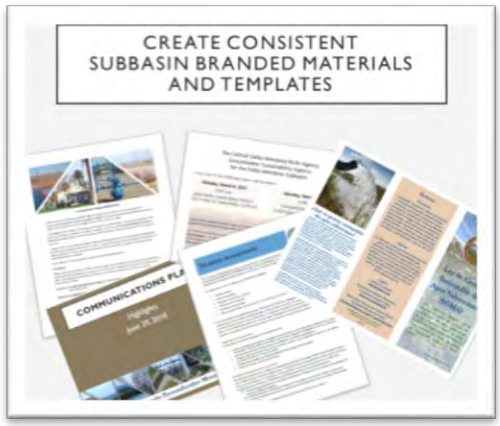
Figure 10. Website Structure

6.2.2. Meeting Calendar

A shared meeting calendar will provide a one-stop shop for stakeholders and assist in preventing meeting conflicts while creating more potential for shared activities. This calendar should include current and scheduled meetings and workshops as well as serve as the repository for agendas and meeting notes, along with copies of meeting materials and presentation.

An integrated project calendar should also be developed that links planning project milestones with communications milestones.

6.2.3. Branded Informational Flyers, Templates, PowerPoint Presentations, etc.



Subbasin level materials should have a single look and feel to create on-going consistency and visual recognition by stakeholders. Use of templates, shared presentations and flyers will create efficiencies and reinforce messaging. This communications plan incorporates some of this type of branding.

6.2.4. Periodic Newsletter

The need for regular communications cannot be overstated. One option is production of a periodic newsletter. Given the relatively short GSP(s) development process timeframe and the GSP development requirements for periodic outreach to identified stakeholders, a quarterly schedule would be realistic and achieve compliance with SGMA requirements for periodic updates to stakeholders. The newsletter should be designed so that individual GSAs can add tailored information if they choose to. For Portable Document Format (PDF) versions of the newsletter, a GSA could add a simple one or two page insert and the edition could be used as a handout or mailer. For a professional looking, email version of the newsletter, we recommend free or low cost services such as Mail Chimp or Constant Comment, which can be integrated with mailing lists.

Adding GSA specific information to an email newsletter can be done with web-links in the email to the very same PDF page prepared for the hardcopy mailer. An alternative is emailing the entire newsletter PDF as an attachment (although this format is less likely to be read than the mailer services).

6.2.5. GSP related mailing lists

Each GSA is required to develop notification lists. A central list may be utilized for GSP(s) related notifications.

6.2.6. Descriptions of Interested Parties

Each GSA is required to develop descriptions of interested parties. These lists should be updated and merged for use in the GSP(s) submittal(s). These can also be provided as background information on the website as part of constructing an administrative record. The SA in Chapter 4 provides an initial start for this documentation.

6.2.7. Issues and Interest Statements for Legally Mandatory Interested Parties

A GSP submission must include a statement of interests for listed stakeholders. As suggested earlier, this can also be included on the website.

6.2.8. Coordinated Public Workshops

SGMA requires a series of public hearings and some public workshops. Such workshops should be coordinated with other subbasin entities.

During the GSA formation process the County of Merced and a forming GSA body conducted a joint workshop to explain more about SGMA and the proposed GSA formation. Distribution of meeting flyers and notices was done concurrently, and DWR attended the event to answer questions. The GSP development process will offer similar opportunities, not only within the subbasin, but with adjacent subbasins.

6.2.9. Message Calendar

Basic messages should be associated with the planning schedule and each stage of GSP(s) development and serve as the theme for the communications materials being generated. For example, during the GSA formation period there was a need to communicate the basics of SGMA and groundwater management. During the GSP(s) initiation phase messages should focus on the basics of groundwater sustainability and the current state of the subbasin. As the GSP(s) begins to take form the specifics of the GSP(s) and what it means for each stakeholder would be the focus.

6.2.10. Press Releases and Guest Editorials

At some point in the GSP development and implementation process, it is likely that stakeholders will be asked to make changes and/or financially support a sustainability effort. It will be more productive for the GSAs and their GSP collaboration partners to frame discussions about these changes than to have others, perhaps with less knowledge, do so on their behalf. For that reason there is a need for press releases and/or guest editorials to offer the media and stakeholders accurate information offered in the context of SGMA. This type of outreach should be closely coordinated as consistency in messages is critical to stakeholder acceptance.

6.2.11. Speakers Bureau

Efforts should be made to conduct outreach at events and meetings that already occur (e.g. Farm Bureau meetings, Rotary Club, etc.). A list of knowledgeable presenters should be developed in the event an organization or other entity would like a presentation. Speakers Bureau engagements should be recorded on the planning project meeting calendar.

6.2.12. Existing Group Venues

Fully leverage the activities of existing groups.

- Maintain a roster of existing groups and typical meeting schedules with a nexus to GSP(s) development. Add the dates to the messaging calendar.
- The list of audiences, messages and existing groups should be referenced when there is a need to deploy information.
- Conduct informal outreach with the leaders of such groups to determine the best way to interact.
- Determine what communications channels these groups are using and equally leverage these, for example by placement of articles in newsletters.

6.2.13. Outreach Documentation

A central point of contact should be identified on the website and an outreach statistics inventory should be established that identifies dates, times, audiences and attendance. This information will be also be useful in conducting follow up with stakeholders as well as documenting outreach as part of GSP submittal guidelines.

6.3. Procedural and Legally Mandated Outreach

A discussion of SGMA outreach requirements was provided in Chapter 1 and a full list of requirements is contained in Appendix 1. One major feature of the requirements is a submission to DWR of the opportunities that interested parties will be given to participate in the GSP deliberations. The Situation Assessment provides an initial description that can be added to with additional outreach.

Following are the Required Interested Parties for the purpose of mandated outreach:

Table 9 provides a list of the mandated outreach and the timeframe in which is required.

Table 8. Mandated Outreach

Timeframe	Item
Prior to initiating plan development	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR.

Timeframe	Item
	2. Web posting of same information.
Prior to plan development	1. Must establish and maintain an interested persons list. 2. Must prepare a written statement describing the manner in which interested parties may participate in GSP development and implementation. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public
Prior to and with GSP submission	1. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 2. Lists of public meetings 3. Inventory of comments and summary of responses 4. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions)
90 days prior to GSP Adoption Hearing	1. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must notify cities and/or counties of geographic area 90 days in advance.
90 days or less prior to GSP Adoption Hearing	2. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Consider and review comments b. Conduct consultation within 30 days of receipt with cities or counties so requesting
GSP Adoption or Amendment	1. GSP must be adopted or amended at Public Hearing.
60 days after plan submission	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission.
Prior to adoption of fees	1. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting. 2. Public notice shall include: a. Time and place of meeting b. General explanation of matter to be considered

Timeframe	Item
	c. Statement of availability for data required to initiate or amend such fees d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance) 3. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year. 4. Includes procedural requirements per Government Code, Section 6066.
Prior to conducting a fee adoption hearing.	1. Must publish notices in a newspaper of general circulation as prescribed. 2. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 3. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.)

6.4. Items for Future Consideration

This GSP(s) Coms Plan outlines an outreach effort based on project and stakeholder needs and preferences. This document has been prepared as a working draft living document and should be updated as new information and the GSP(s) development process needs are developed.

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MEASUREMENTS & EVALUATION

A guiding principle for evaluation and measurement of the Coms Plan's success is to provide regular, unbiased reporting of progress toward achieving goals. Success may be evaluated in several ways, including process measures, outcome measures, and an annual evaluation of accomplishments. Optional evaluation measures are described below.

As part of each outreach effort debrief the following process and outcome measures will be discussed and recorded in a check sheet. The check sheets will be prepared with the goal of continuous improvement rather than criticisms.

7.2. Process Measures

Process measures track progress toward meeting the goals of the Coms Plan. These include:

- Level of attendance at outreach meetings
- Shared understanding of the overarching aims, activities, and opportunities presented by different planning approaches and project activities
- Productive dialogue among participants at meetings and events
- Sense of authentic engagement; people understand why they have been asked to participate, and feel that they can contribute meaningfully
- Timely and accurate public reporting of planning milestones
- Feedback from Coordinating Body and GSA members, regulators, stakeholders, and interested parties about the quality and availability of information materials
- Level of stakeholder interest in the GSP(s) development process information

7.3. Outcome Measures

Outcome measures track the level of success of the Coms Plan in meeting its overall goals. Some outcome measures considered for the GSP(s) development process include the following:

- Consistent participation by key stakeholders and interested parties in essential activities. Participants should have no difficulty locating the meetings, and should be informed as to when and where they will be held.
- Response from meeting participants that the engagement methods provided for a fair and balanced exchange of information.
- Feedback from interested parties that they understand how their input is used, where to track data, and what results to expect.
- The project receives quality media coverage that is accurate, complete and fair.

7.4. Mid-cycle Evaluation of Accomplishments

A mid-cycle evaluation provides an opportunity to examine the current effectiveness of the Coms Plan and provides a chance to reevaluate strategies to meet the GSP(s) development process objectives. The evaluation tasks may include:

- Preparation of an executive-level summary detailing high-level initiatives and accomplishments of the previous cycle. This evaluation should also include positive news, best practices, goals and objectives, notable changes, timelines, and priorities.
- Identifying gaps and areas for improvement.
- Highlighting how gaps and areas for improvement in the cycle has been addressed.
- Outlining process and outcome measures and their current results.

ROLES AND RESPONSIBILITIES

The GSP(s) development Coms Plan outlines numerous strategies, activities and tactics. While none are highly complex, there is a requirement for coordination and clarity regarding who will be responsible for executing the tasks.

After the planning team evaluates the timelines and priorities for each of the communications activities a recommended next step is completion of a Responsible, Accountable, Consulted, and Informed (RACI) Chart. This Chart, as displayed in **Table 10**, outlines key tasks and the assignment of roles and responsibilities for accomplishing them.

Table 9. Sample RACI Chart

Activity TYPE	SPECIFIC PRODUCT	RESPONSIBLE	ACCOUNTABLE	CONSULTED	INFORMED
Internal Staff Communications, information materials for/briefings	Draft	Person A	Person E	Person I	
	Final Draft	Person A	Person E	Person I	Project Team
List Serves, mailing lists	Customer Contacts	Person B - Person A	Person E	Person I	Project Team
	Concurrent jurisdictions	Lisa Beutler/MWH	Person G	Person I	Project Team
	Other - identified stakeholders	Person A	Person G	Person I	Project Team
Web Content and Maintenance	Draft Content and Content Refresh	Lisa Beutler/MWH/	Person G	Person H	Project Team
	Site Administration	Person A	Person G	Person H	
General public Intro Packets, Fact Sheets and Brochures	Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team
Newsletter Content	Draft	Lisa Beutler/MWH	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team

Responsible
Those who do the work to achieve the task. There is at least one person with a role of *responsible*, although others can be delegated to assist in the work required.

Accountable (also approver or final approving authority)
This is the person ultimately answerable for the correct and thorough completion of the deliverable or task, and the one who delegates the work to those responsible. <u>There **may only** be only one *accountable*</u> specified for each task or deliverable.

Consulted
Those whose opinions are sought, typically subject matter experts were people that are impacted by the activity; and with whom there is two-way communication.

Informed
Those who are kept up-to-date on progress, typically on the launch and completion of the task or deliverable. This is one way communication.

Role distinction
There is a distinction between a role and the individual assigned the task. Role is a descriptor of an associated set of tasks that could be performed by just one or many people.

In the case of the RACI Chart, the team may list as many people as is logical except for the Accountable role.

Scope of Work
Completion of the RACI Chart will also support development of any future scopes of work for consultant provided communication and outreach services.

LIST OF APPENDICES

Appendix 1. Public Outreach Requirements under SGMA

GSP Regulations

CODE	PUBLIC OUTREACH REQUIREMENT
§ 353.6. Initial Notification (a) Each Agency shall notify the Department, in writing, prior to initiating development of a Plan. The notification shall provide general information about the Agency's process for developing the Plan, including the manner in which interested parties may contact the Agency and participate in the development and implementation of the Plan. The Agency shall make the information publicly available by posting relevant information on the Agency's website.	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR. 2. Web posting of same information. **Timing**: *Prior to initiating development of a plan.*
§ 353.8. Comments (a) Any person may provide comments to the Department regarding a proposed or adopted Plan. (b) Pursuant to Water Code Section 10733.4, the Department shall establish a comment period of no less than 60 days for an adopted Plan that has been accepted by the Department for evaluation pursuant to Section 355.2. (c) In addition to the comment period required by Water Code Section 10733.4, the Department shall accept comments on an Agency's decision to develop a Plan as described in Section 353.6, including comments on elements of a proposed Plan under consideration by the Agency.	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission. 2. Parties may also comment on a GSA's (or GSAs') statements submitted under section 353.6 **Timing**: For GSP Submittal - *60 days after submission to DWR*
§ 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: (a) 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. (b) A list of public meetings at which the Plan was discussed or considered by the Agency. (c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency. (d) A communication section of the Plan that includes the following: (1) An explanation of the Agency's decision-making process. (2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.	5. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 6. Lists of public meetings 7. Inventory of comments and summary of responses 8. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions) **Timing**: For GSP Submittal – *with plan* For GSP Development – *continuous. [Note: activities should be included*

Appendix 1

CODE	PUBLIC OUTREACH REQUIREMENT
(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin. (4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.	*in the project schedule and information posted on web.]*
§ 355.2. (c) Department Review of Adopted Plan (c) The Department (DWR) shall establish a period of no less than 60 days to receive public comments on the adopted Plan, as described in Section 353.8.	1. 60 day public review period for public comment on submitted plan. **Timing**: After GSP Submittal to DWR – *60 days*
§ 355.4. & 355.10 Criteria for Plan Evaluation The basin shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act. The Department shall evaluate an adopted Plan for compliance with this requirement as follows: (b) (4) Whether the interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected by the use of groundwater in the basin, have been considered. … (10) Whether the Agency has adequately responded to comments that raise credible technical or policy issues with the Plan.	1. Required public outreach and stakeholder information is submitted, including statement of issues and interests of beneficial users. 2. Public and stakeholder comments and questions adequately addressed during planning process. **Timing**: For GSP Submittal – *with plan* For resubmittal related to corrective action *– with submittal*

California Water Code

CODE	PUBLIC OUTREACH REQUIREMENT
10720. This part shall be known, and may be cited, as the "Sustainable Groundwater Management Act." **10720.3** (a) This part applies to all groundwater basins in the state. … (c) The federal government or any federally recognized Indian tribe, appreciating the shared interest in assuring the sustainability of groundwater resources, may voluntarily agree to participate in the preparation or administration of a groundwater sustainability plan or groundwater management plan under this part through a joint powers authority or other agreement with local agencies in the basin. A participating tribe shall be eligible to participate fully in planning, financing, and management under this part, including eligibility for grants and technical assistance, if any exercise of regulatory authority, enforcement, or imposition and collection of fees is pursuant to	1. Tribes and the federal government may voluntarily participate in GSA governance and GSP development. **Timing**: *Prior to initiating development of a plan.*

Appendix 1

CODE	PUBLIC OUTREACH REQUIREMENT
the tribe's independent authority and not pursuant to authority granted to a groundwater sustainability agency under this part.	
CHAPTER 4. Establishing Groundwater Sustainability Agencies [10723 - 10724]	
10723. a) Except as provided in subdivision (c), any local agency or combination of local agencies overlying a groundwater basin may decide to become a groundwater sustainability agency for that basin. (b) Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant to Section 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin.	1. Must hold public hearing in the county or counties overlying the basin, prior to becoming a GSA **Timing**: *Prior to becoming a GSA.*
10723.2 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 of the following: (a) Holders of overlying groundwater rights, including: (1) Agricultural users. (2) Domestic well owners. (b) Municipal well operators. (c) Public water systems. (d) Local land use planning agencies. (e) Environmental users of groundwater. (f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies. (g) The federal government, including, but not limited to, the military and managers of federal lands. (h) California Native American tribes. (i) Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems. (j) Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	1. Must consider interest of all beneficial uses and users of groundwater. 2. Includes specific stakeholders as listed. **Timing**: *During development of a GSP.*
10723.4. The groundwater sustainability agency shall establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents. Any person may request, in writing, to be placed on the list of interested persons.	3. Must establish and maintain an interested persons list. 4. Any person may ask to be added to the list **Timing**: *On forming a GSA.*
10723.8. (a) Within 30 days of deciding to become or form a groundwater sustainability agency, the local agency or combination of local agencies shall inform the department of its decision and its intent to undertake sustainable groundwater management. The	1. Creates notification requirements that include: a. A list of interested parties b. An explanation of how interests will be considered

CODE	PUBLIC OUTREACH REQUIREMENT
notification shall include the following information, as applicable: … (4) A list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan.	**Timing**: *On forming a GSA & with submittal of GSP*
10727.8 (a) Prior to initiating the development of a groundwater sustainability plan, the groundwater sustainability agency shall make available to the public and the department a written statement describing the manner in which interested parties may participate in the development and implementation of the groundwater sustainability plan. The groundwater sustainability agency shall provide the written statement to the legislative body of any city, county, or city and county located within the geographic area to be covered by the plan. The groundwater sustainability agency may appoint and consult with an advisory committee consisting of interested parties for the purposes of developing and implementing a groundwater sustainability plan. The groundwater sustainability agency shall 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. If the geographic area to be covered by the plan includes a public water system regulated by the Public Utilities Commission, the groundwater sustainability agency shall provide the written statement to the commission. (b) For purposes of this section, interested parties include entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	2. Agencies preparing a GSP must prepare a written statement describing the manner in which interested parties may participate in its development and implementation. 3. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public 4. GSP entities may form an advisory committee for the GSP preparation and implementation. 5. The GSP entities are to encourage active involvement of diverse social, cultural and economic elements of the affected populations. **Timing**: *On initiating GSP*
10728.4 Public Notice of Proposed Adoption, GSP Adoption Pubic Hearing A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment. The groundwater sustainability agency shall review and consider comments from any city or county that receives notice pursuant to this section and shall consult with a city or county that requests consultation within 30 days of receipt of the notice. Nothing in this section is intended to	3. GSP must be adopted or amended at Public Hearing. 4. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Notify cities and/or counties of geographic area 90 days in advance. b. Consider and review comments

Appendix 1

CODE	PUBLIC OUTREACH REQUIREMENT
preclude an agency and a city or county from otherwise consulting or commenting regarding the adoption or amendment of a plan.	c. Conduct consultation within 30 days of receipt with cities or counties so requesting
10730 Fees. (a) A groundwater sustainability agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve. A groundwater sustainability agency shall not impose a fee pursuant to this subdivision on a de minimis extractor unless the agency has regulated the users pursuant to this part. (b) (1) Prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting, at which oral or written presentations may be made as part of the meeting. (2) Notice of the time and place of the meeting shall include a general explanation of the matter to be considered and a statement that the data required by this section is available. The notice shall be provided by publication pursuant to Section 6066 of the Government Code, by posting notice on the Internet Web site of the groundwater sustainability agency, and by mail to any interested party who files a written request with the agency for mailed notice of the meeting on new or increased fees. A written request for mailed notices shall be valid for one year from the date that the request is made and may be renewed by making a written request on or before April 1 of each year. (3) At least 20 days prior to the meeting, the groundwater sustainability agency shall make available to the public data upon which the proposed fee is based. (c) Any action by a groundwater sustainability agency to impose or increase a fee shall be taken only by ordinance or resolution. (d) (1) As an alternative method for the collection of fees imposed pursuant to this section, a groundwater sustainability agency may adopt a resolution requesting collection of the fees in the same manner as ordinary municipal ad valorem taxes. (2) A resolution described in paragraph (1) shall be adopted and furnished to the county auditor-controller and board of supervisors on or before August 1 of each year that the alternative collection of the fees is being requested. The resolution shall include a list of parcels and the amount to be collected for each parcel. (e) The power granted by this section is in addition to any powers a groundwater sustainability agency has under any other law.	Related to GSAs 5. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting. 6. Public notice shall include: a. Time and place of meeting b. General explanation of matter to be considered c. Statement of availability for data required to initiate or amend such fees d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance) 7. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year. 8. Includes procedural requirements per Government Code, Section 6066. **Timing**: *Prior to adopting fees.*

California Government Code

CODE	PUBLIC OUTREACH REQUIREMENT
6060 Whenever any law provides that publication of notice shall be made pursuant to a designated section of this article, such notice shall be published in a newspaper of general circulation for the period prescribed, the number of times, and in the manner provided in that section. As used in this article, “notice” includes official advertising, resolutions, orders, or other matter of any nature whatsoever that are required by law to be published in a newspaper of general circulation. **6066** Publication of notice pursuant to this section shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. The period of notice commences upon the first day of publication and terminates at the end of the fourteenth day, including therein the first day.	4. Must publish notices in a newspaper of general circulation as prescribed. 5. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 6. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.) **Timing**: *Prior to adopting fees*

Appendix 2. Communications Governance

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[13] some form of communications governance is recommended.

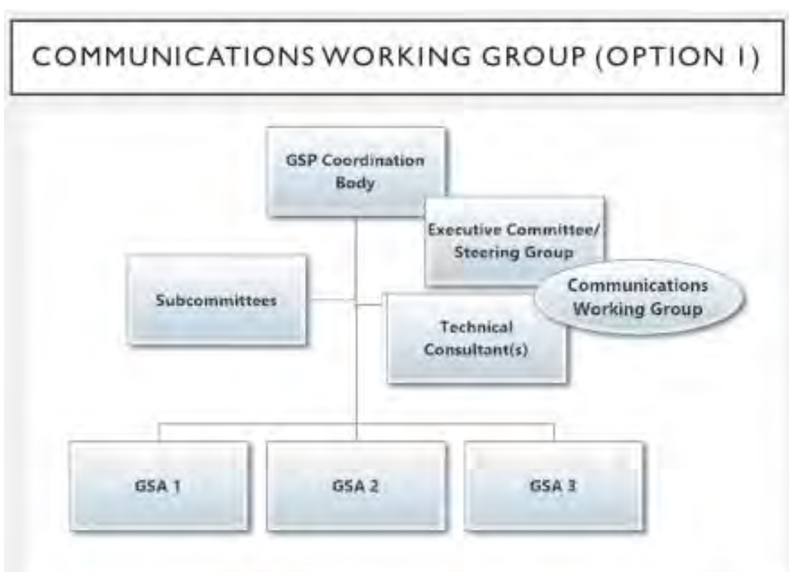
Execution of communications activities can be accomplished by an individual or multiple individuals, and/or include or be solely managed by project consultants. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. Also essential is a clear chain of command that ensures the elected representatives of GSAs are able to retain communications leadership and guidance.

A driving consideration for establishing a communications governance structure is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance to a communications team is efficient and effective.

Several governance options for consideration are offered below.

Communications Option 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based leadership function that is guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications working group that would ultimately report to the larger GSP coordinating body.



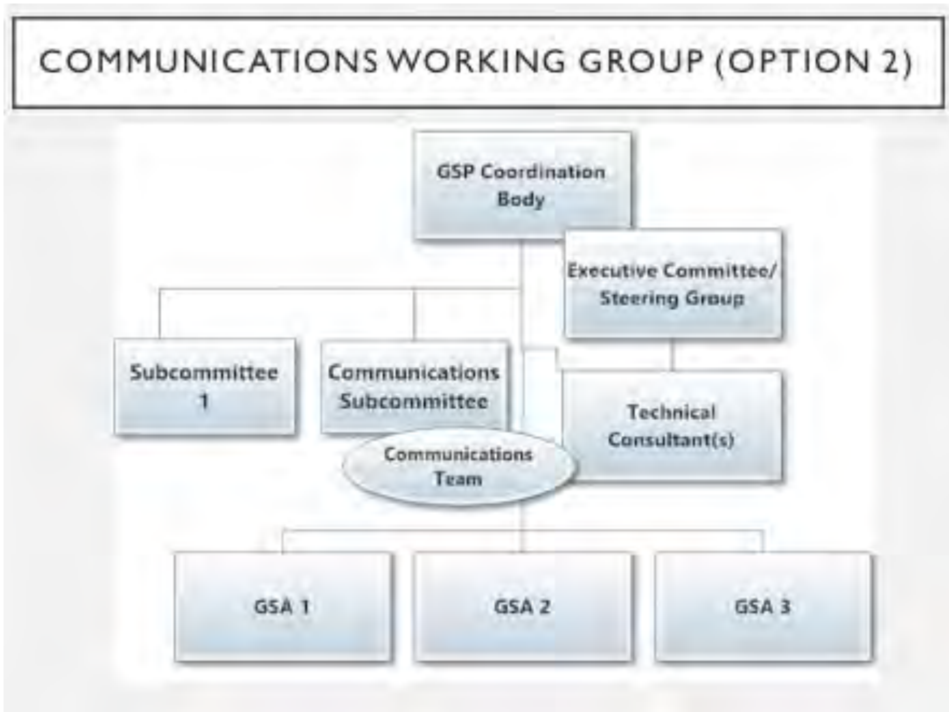
Communications Governance Option 1

Communications Option 2

[13] See Appendix 1

Appendix 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based subcommittee guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications team that is affiliated with a subcommittee and would ultimately report to the larger GSP coordinating body



Communications Governance Option 2

Appendix H. Comments and Response to Comments

Comments and Response to Public Comments

- This is a placeholder and will include all public comments received during each public hearing of the GSA's partnering in the development of this GSP

Appendix I. Hydrogeologic Conceptual Model and Groundwater Conditions for the San Joaquin River Exchange Contractors Service Area GSP

HYDROGEOLOGIC CONCEPTUAL MODEL AND GROUNDWATER CONDITIONS FOR THE SAN JOAQUIN RIVER EXCHANGE CONTRACTORS SERVICE AREA GSP

prepared for
San Joaquin River Exchange
Contractors GSA
Los Banos, California

by
Kenneth D. Schmidt & Associates
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June 2019

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TELEPHONE (559) 224-4412

June 14, 2019

Mr. Chris White, Executive Director
San Joaquin River Exchange
Contractors GSA
P. O. Box 2115
Los Banos, CA 93635

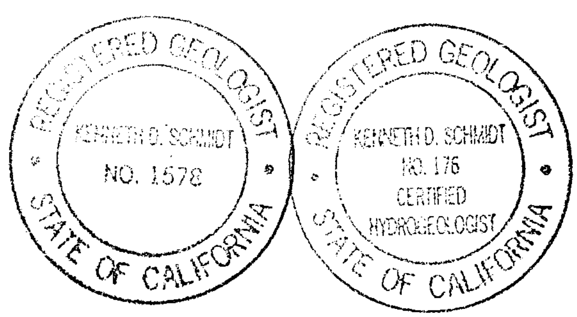
Re: Service Area GSP

Dear Chris:

Submitted herewith is our report on groundwater conditions in the SJREC Service Area GSP. We appreciate the cooperation of SJREC and CCID in providing data for this report.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist 176



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HYDROGEOLOGIC CONCEPTUAL MODEL AND GROUNDWATER CONDITIONS FOR THE SAN JOAQUIN RIVER EXCHANGE CONTRACTORS SERVICE AREA GSP

INTRODUCTION

This report is intended to satisfy Sections 354.14 (Hydrologic Conceptual Model) and Section 354.16 (Groundwater Conditions) of a Groundwater Sustainability Plan (GSP) for the San Joaquin River Exchange Contractors (SJREC) Water Authority service area. The service area has previously been divided into ten management sub-areas. Management Sub-areas A, B, C, D, E, F, G, and K are in the Central California Irrigation District (CCID). These sub-areas extend from north to south from near Crows Landing to Mendota. Sub-area I is the Firebaugh Canal Water District, Sub-area H is the San Luis Canal Co. service area, and Sub-area J is the Columbia Canal Co. service area. Also covered by this report are a number of white areas in Merced County, Madera County, and Fresno County that generally adjoin the SJRECWA service area.

SURFICIAL CHARACTERISTICS OF BASIN

Topography

Figure 1 shows topographic conditions in the basin. Overall, the land west of the San Joaquin River generally slopes to the northeast towards the San Joaquin River. The land in the Columbia Canal Co. service area slopes to the southwest, also toward the river. Major streams that pass through the area are the San Joaquin River, Los Banos Creek, San Luis Creek, and Orestimba Creek.

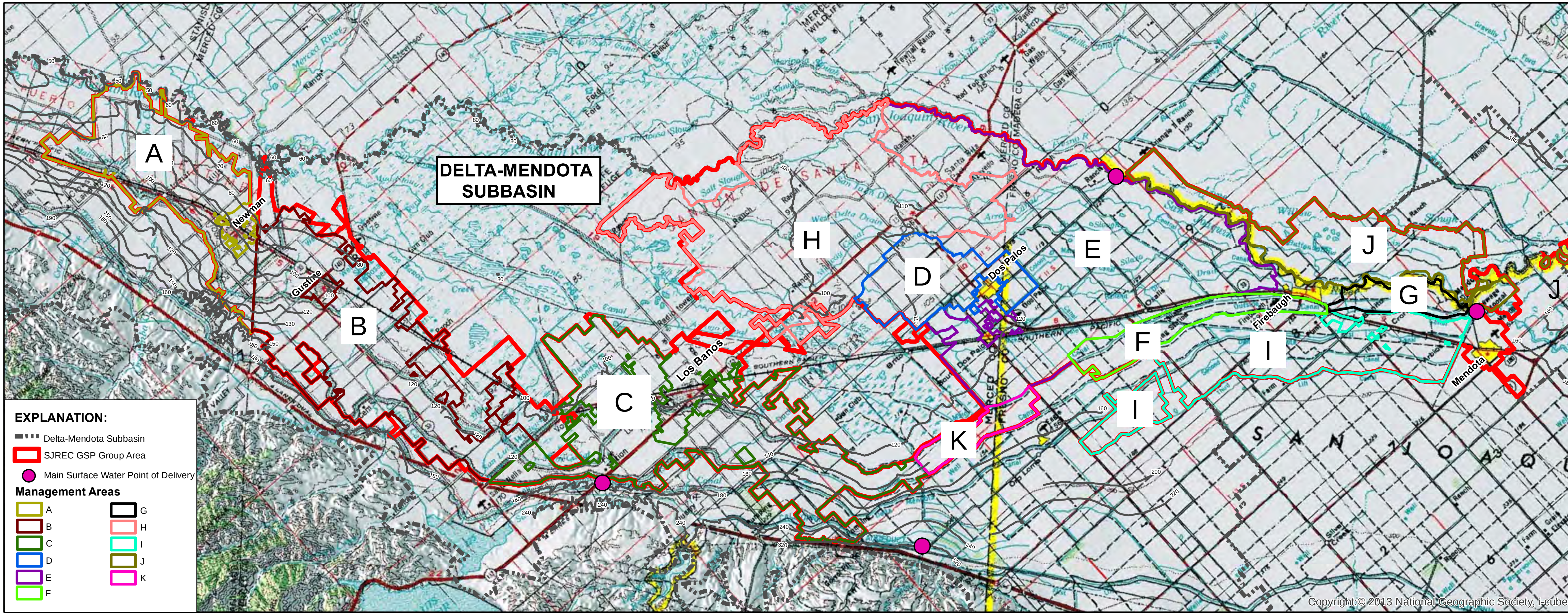

FIGURE 1 - TOPOGRAPHIC MAP OF SJREC GSP GROUP

Land surface elevations range from about 160 to 250 feet above mean sea level near the west edge of Sub-areas B and C to about 55 feet above mean sea level near the San Joaquin River and the north end of Sub-area A.

Surficial Geology

Hotchkiss and Balding (1971, Plate 1) mapped the surficial geology of the Tracy-Dos Palos Area, which includes the north part of the SJREC service area. Figure 2 shows the part of their map that covers lands in the service area. Much of the surficial deposits were mapped as flood basin deposits. These are unconsolidated clay, silt, sand, and gravel deposits on the floodplain of the San Joaquin River. Alluvial deposits are present along the southwest edge of the area, primarily along the Orestimba Creek, San Luis Creek, Los Banos Creek, and Ortigalita Creek alluvial fans. These are unconsolidated clay, silt, sand, and gravel.

Mitten, LeBlanc, and Bertoldi (1970) mapped the geomorphic features of the Madera area, which includes Sub-area J. Surficial materials in most of this sub-area (the Columbia Canal Co. service area) were mapped as flood basin deposits. However, in the east part of the area the surficial deposits were mapped as the younger alluvium.

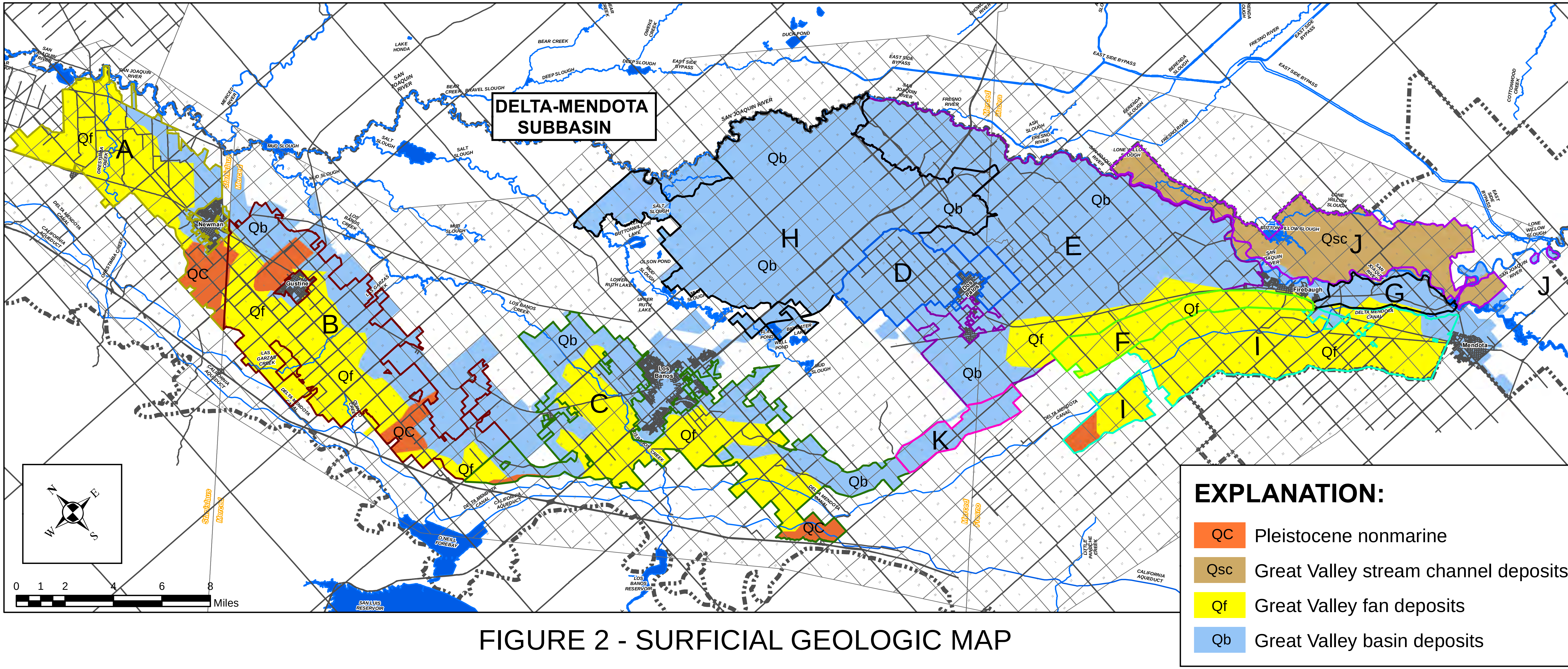

FIGURE 2 - SURFICIAL GEOLOGIC MAP

Topsoils

Harradine, et al (1956) mapped topsoils in the Mendota area, which extends southeasterly from the Merced County-Madera County line to south of Tranquillity. Soils in the northwest part (Red Top area) were mapped as "Soils of the Valley Basin". These include the Merced, Temple, Rossi, and Traver soils series. The Merced, Tempe, and Rossi soils are fine textured and poorly drained, whereas the Traver soils are coarse textured. Soils farther to the southwest, including near Dos Palos, west of Firebaugh, and west of Mendota were mapped as "Soils of the Valley Basin". These include the Williams, Oxalis, Lethen, and Levis soil series. These soils are fine-textured with moderate to strong amounts of alkali and usually have high amounts of gypsum. Most of the rest of the topsoils, except for alluvial fans of the major westside streams, were classified as "Soils of the Recent Alluvial Fans and River Flood Plains". These include Panoche, Panhill, and Columbia Soils. The Panoche and Panhill soils have a wide range of texture and calcareous profiles. The Columbia soils occupy the recent floodplain along or near the San Joaquin River and are more permeable than the other two soils.

Ulrich and Stromberg (1962) provided a soil survey for the Madera Area, which includes Sub-area J. Topsoils of the Traver-Chino Association are predominant in this sub-area, except near the San

Joaquin River, north of Mendota, where soils of the Columbia-Temple Association are predominant. The Traver soils are medium to coarse textured. They have slightly more clay in the subsoil than in the surface soil and are generally strongly affected by salts and alkali. The Chino soils have slightly more clay in a moderately calcareous subsoil. Concentrations of salts and alkali vary from slight to strong. Soils of the Columbia-Temple Association have imperfect to poor natural drainage. The Columbia soils are non-calcareous and coarse textured. The Temple soils are farther from the river and have a medium to fine texture, and a strongly calcareous subsoil. In many places they are slightly saline.

Figure 3 shows the major types of topsoils in the SJREC GSP Group Area. For the part of the area on the west side of the San Joaquin River, U.S. Soils Conservation Service reports on soils in the Newman, Los Banos, and Mendota areas were used. For Subarea J, the report on soils in the Madera area was used.

For this evaluation, KDSA grouped the soil textures into three groups: Coarse-grained (generally sand or loamy sand, clay or silty clay, and intermediate (i.e. sandy clay). This map indicates that the coarsest topsoils are either to the east near the San Joaquin River, or to the west along alluvial fans such as along Los Banos Creek. The finest grained topsoils were

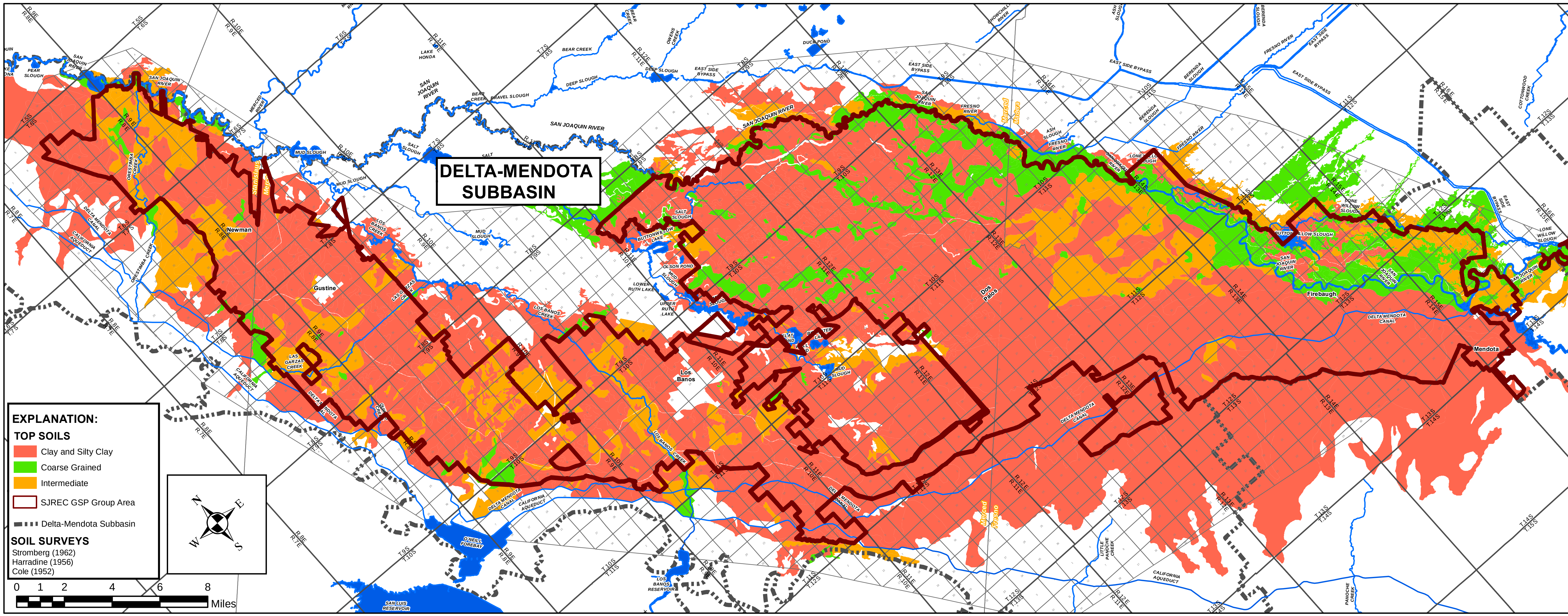

FIGURE 3 - TOPSOILS

along much of the rest of the area, except Stanislaus County, where intermediate materials are more extensive.

Surface Water Bodies

Figure 4 shows the location of surface water bodies in the SJREC GSP Group Area. Major streams on the west side are Orestimba Creek, San Luis Creek, Los Banos Creek, and Garzas Creek. Dams have been built in San Luis Creek and Los Banos Creek. Los Banos Creek joins the San Joaquin River near or north of the north boundary of the San Luis National Wildlife Refuge (NWR). The San Joaquin River passes through the area, and divides Madera County from Fresno County. Major reservoirs are the San Luis Reservoir and O'Neill Forebay and Los Banos Creek Detention Reservoir. Major canals in the area include the California Aqueduct, the Delta-Mendota Canal (DMC), Arroyo Canal, and the CCID's Main, Outside, and Poso Canals. The San Luis Drain, located east of Los Banos, was designed to carry subsurface drainage flows, which formerly were discharged to the Kesterson Reservoir. The main canals in the Columbia Canal Co. service area are the Columbia Canal, the Ridge Ditch, and Lone Willow Slough. The Mendota Pool extends both east along the San Joaquin River and south along the Fresno Slough. The Chowchilla Bypass extends to the north from the river upstream of the pool.

Figure 4 also shows locations of a number of regulating res-

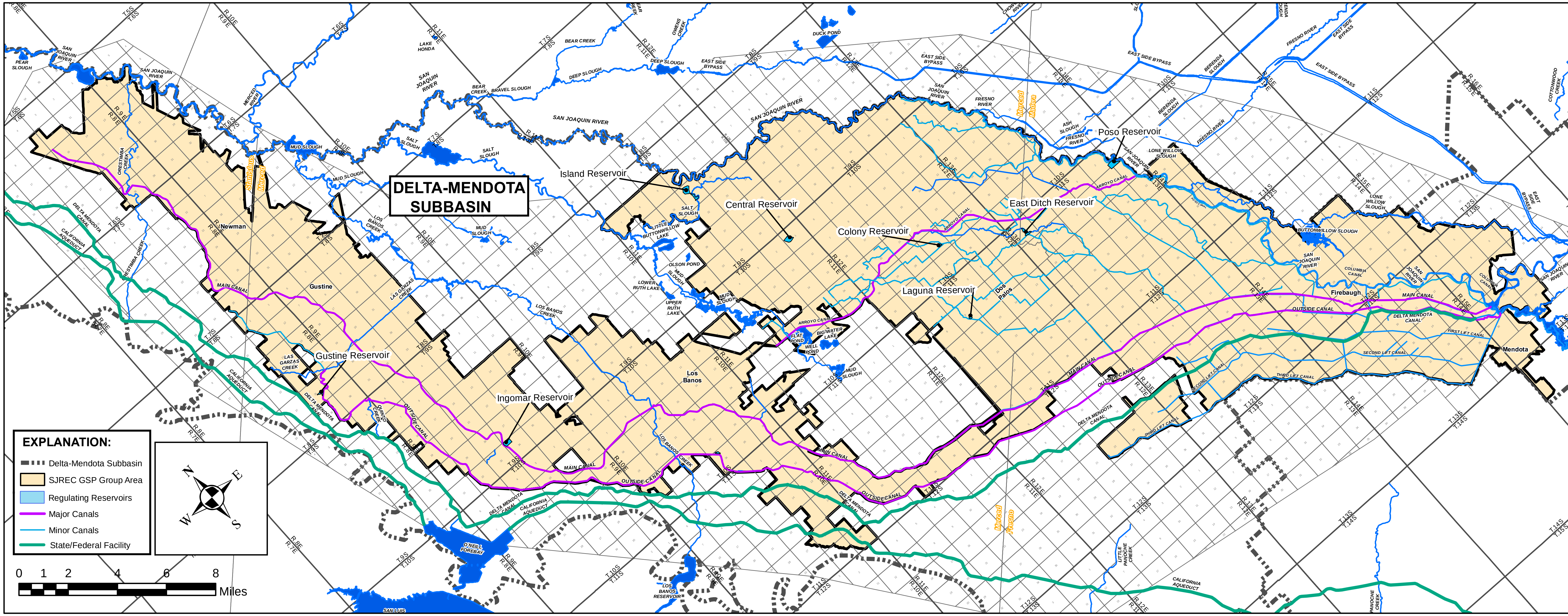

FIGURE 4 - SURFACE WATER BODIES

ervoirs in the SJREC GSP Group Area.

SUBSURFACE GEOLOGIC CONDITIONS

Hotchkiss and Balding (1971) described the geology, hydrology, and water quality of the Tracy-Dos Palos Area, which includes the north part of the SJREC GSP Group Area that is west of the San Joaquin River. Davis and Poland (1957) described groundwater conditions in the Mendota-Huron Area, which includes the rest of the area west of the San Joaquin River and south of Dos Palos. Mitten, LeBlanc, and Bertoldi (1970) described these features in the Madera area, which includes Sub-area J. In addition, Kenneth D. Schmidt & Associates (KDSA, 1997a) provided a report for the CCID on groundwater conditions in the area between Mendota and Crows Landing. KDSA (1997b) provided another report focusing on groundwater flows in the SJREC service area. These reports provide significant information on subsurface geologic conditions that was used in this report.

Regional Geologic and Structural Setting

The SJREC GSP Group Area is within the San Joaquin Valley, which is a topographic and structural trough bounded on the east by the Sierra Nevada fault block and on the west by the folded and faulted Coast Ranges. Both mountain blocks have contributed to marine and continental deposits in the Valley. In the west-central part of the valley, more than 12,000 feet of sediments are present. Groundwater is present in alluvial deposits that dip slightly toward the trough of the valley (the San Joaquin River), from both the west and east sides.

Lateral Basin Boundaries

Figure 1 shows the boundaries of the relevant parts of the Delta-Mendota Sub-basin and the SJREC GSP Group Area. The SJREC GSP Group boundaries include the north end of the CCID service area on the north side, the San Joaquin River and the east edge of the Columbia Canal Co. service area on the east side. The west and south edges of the CCID service area comprise the west and south boundaries.

Definable Bottom of the Basin

Figure 5 shows the definable bottom of the basin beneath the SJREC GSP Group Area. Historically, the U.S. Geological Survey (Page, 1973) used an electrical conductivity of 3,000 micromhos per centimeter at 25°C to delineate the regional base of the fresh groundwater in the San Joaquin Valley. The underlying groundwater is termed "connate water" and is of higher salinity. Page indicated that the base of the fresh groundwater ranged from about 600 to 1,200 feet deep in most of the SJREC GSA service area. As part of this

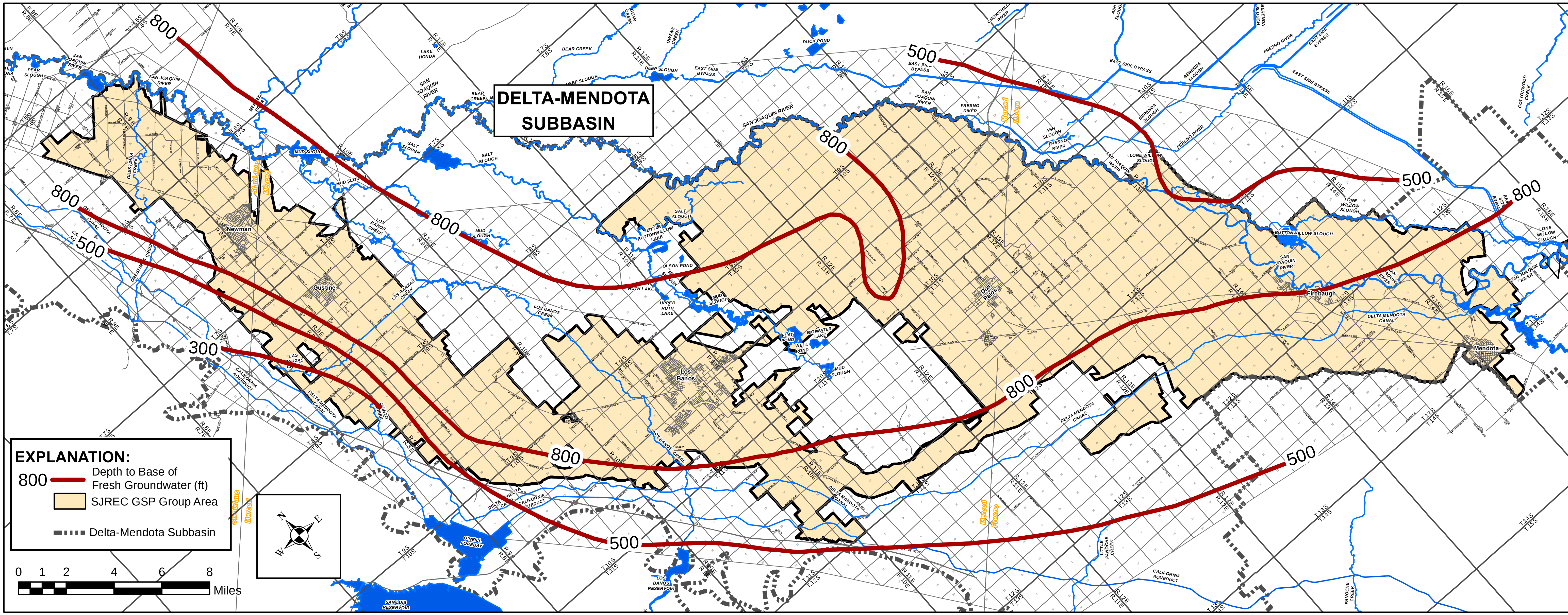

FIGURE 5 - DEFINABLE BOTTOM OF BASIN

evaluation, electric logs for a number of deep holes were obtained from the California Division of Oil, Gas, & Geothermal Resources and interpreted, to determine in more detail the bottom of the basin.

Sub-area A

The bottom of the basin ranges from about 800 to 1,160 feet deep in the area between Crows Landing and Newman, and deepens to the south. The under-lying deposits are either predominantly clay or contain brackish groundwater.

Sub-area B

The bottom of the basin ranges from less than 500 to about 800 feet deep in the area between Newman and Santa Nella. The shallowest bottom is generally to the west near I-5.

Sub-area C

The bottom of the basin between Santa Nella and the boundary between T11S and 12S ranges from about 550 to 800 feet deep and generally is deeper to the east.

Sub-area D

The bottom of the basin near Dos Palos ranges from about 750 to 970 feet deep and is deeper to the southeast.

Sub-area E

The bottom of the basin in the area generally between Dos Palos and Firebaugh ranges from about 650 to 1,000 feet deep, and is generally deepest in the area northeast and southeast of Dos Palos.

Sub-area F

The bottom of the basin ranges from less than 500 to about 800 feet deep in this sub-area. The shallowest bottom is near Firebaugh and the northwest corner of the sub-area.

Sub-area G

The bottom of the basin ranges from 600 to 700 feet deep in the CCID Headgate area, between Firebaugh and Mendota on the west side of the San Joaquin River.

Sub-area H

The bottom of the basin in the San Luis Canal Co. service area ranges from about 750 to 1,040 feet deep and generally is the deepest to the northeast.

Sub-area I

For the area in the FCWD service area, the bottom of the basin ranges from about 700 feet near Firebaugh and Mendota to about 730 feet near the southwest edge of the sub-area.

Sub-area J

The bottom of the basin in the Columbia Canal Co, service area ranges from about 680 feet deep near Mendota to about 1,150 feet deep near the north end of the sub-area. The bottom of the basin generally exceeds 1,000 feet in depth north of Firebaugh.

Sub-area K

The bottom of the basin ranges from about 700 to 800 feet deep in this sub-area.

Formation Names

Hotchkiss and Balding (1971) divided the unconsolidated deposits in the Tracy-Dos Palos area (west of the San Joaquin River) into flood basin deposits (normally less than 50 feet thick), Quaternary alluvium (usually less than 200 feet thick), and the Tulare Formation (up to almost 1,000 feet thick). The Tulare Formation has an upper, thinner section which is above the Corcoran Clay, and a thicker, lower section below the clay. The Corcoran Clay is a regional confining bed, which divides the groundwater into an upper aquifer and lower aquifer. Deposits in most of the west part of the SJREC GSP Group Area are generally tan in color and are termed the Diablo Range deposits. Deposits to the east are brown, gray, or white in color and are termed the Sierra deposits. These deposits are shown on a number of subsurface geologic cross sections that are presented later in this report.

Mitten, LeBlanc, and Bertoldi (1970) divided the unconsolidated deposits in the Madera Area (east of the San Joaquin River) into the younger alluvium (normally less than about 50 feet thick), the Quaternary older alluvium less than 1,000 feet thick, and the Tertiary Quaternary continental deposits (1,000 to 2,000 feet thick). The Corcoran Clay is present beneath Subarea J, and the predominant deposits in this sub-area are generally termed the Sierra deposits.

Confining Beds

There are two confining beds that are important beneath part of the SJREC GSP Group Area. These are the A-Clay and Corcoran Clay (also termed the E-Clay by Croft, 1969). The extent of the A-Clay has only been mapped in the part of the SJREC GSA near Mendota. Figure 6 shows the depth to the top of and the extent of the A-Clay near Mendota, taken from KDSA (2013). This clay is located primarily in a relatively narrow band along the valley trough. The A-Clay is important, as it acts to enable shallow groundwater to develop in the overlying deposits, and also acts as a confining bed for groundwater in this underlying strata. The top of the A-Clay is usually less than 80 feet deep. Groundwater above the A-clay can be in direct hydraulic communication with streamflow

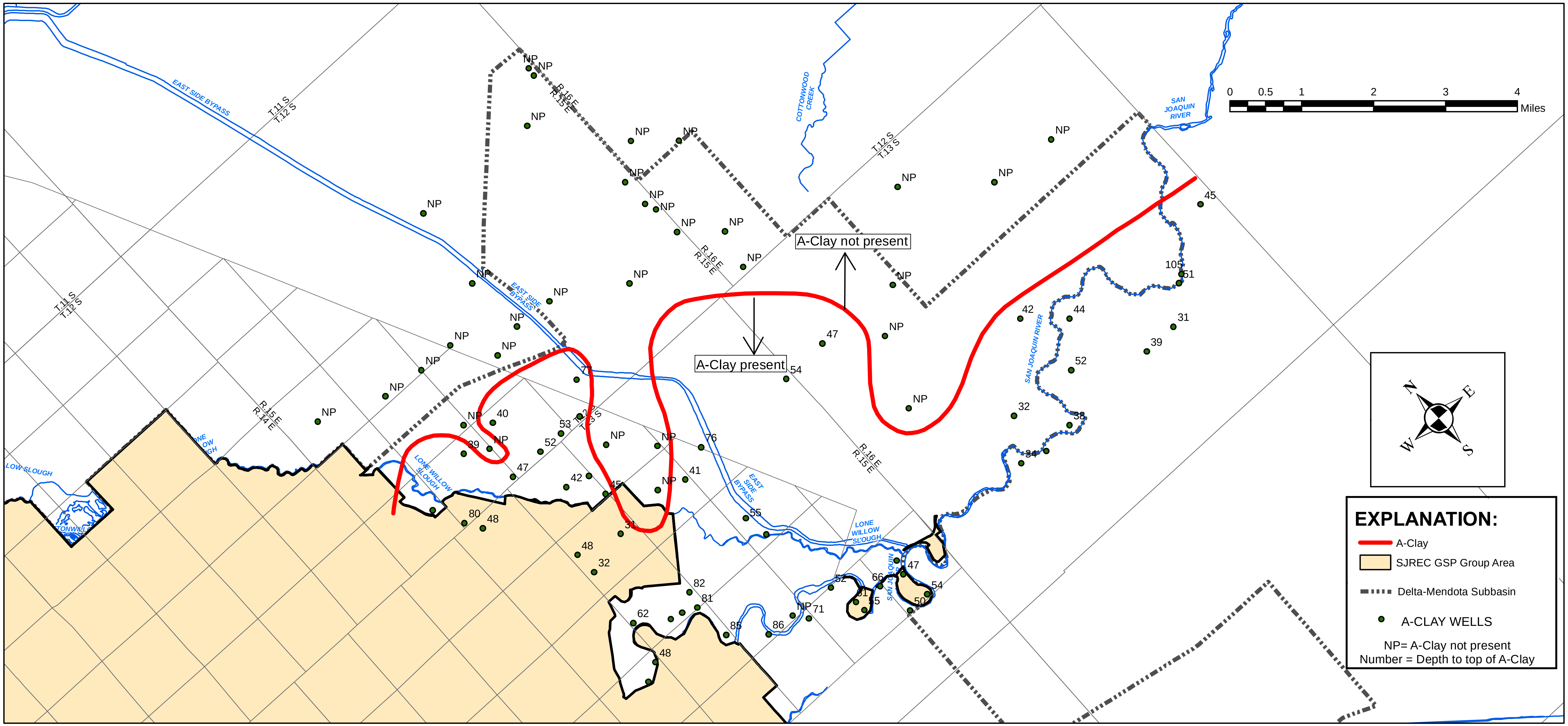

FIGURE 6 - EXTENT AND DEPTH TO TOP OF A-CLAY

in the San Joaquin River. In the area along the west side of the Fresno Slough branch of the Mendota Pool, the Mendota Pool Group (MPG) operates a series of shallow water supply wells tapping strata above the A-Clay.

The Corcoran Clay is indicated to be the most important confining bed in the Delta-Mendota Sub-basin. Figure 7 shows the depth to the top of the Corcoran Clay, which was mapped by KDSA (1997a). Historically, this clay has been used to divide the groundwater system in the San Joaquin Valley into an upper aquifer (above the clay) and lower aquifer (below the clay). The Corcoran Clay underlies most of the SJREC GSP Group Area, except for a small area along the west boundary of the CCID. The Corcoran Clay has been deformed since its deposition. The top of the clay is shallowest (about 50 feet deep) near Santa Nella. North of Fresno County, the top of the clay is deepest near Newman, Gustine, and Los Banos, where the depth exceeds 250 feet. The depth to the top of the Corcoran Clay is commonly about 200 feet near the San Joaquin River in the area north of Fresno County. The top of the clay deepens to the south in the SJREC GSP Group Area, and ranges from about 400 to 450 feet deep near Mendota. In most of the Fresno County, the top of the clay is generally deeper to the south and west.

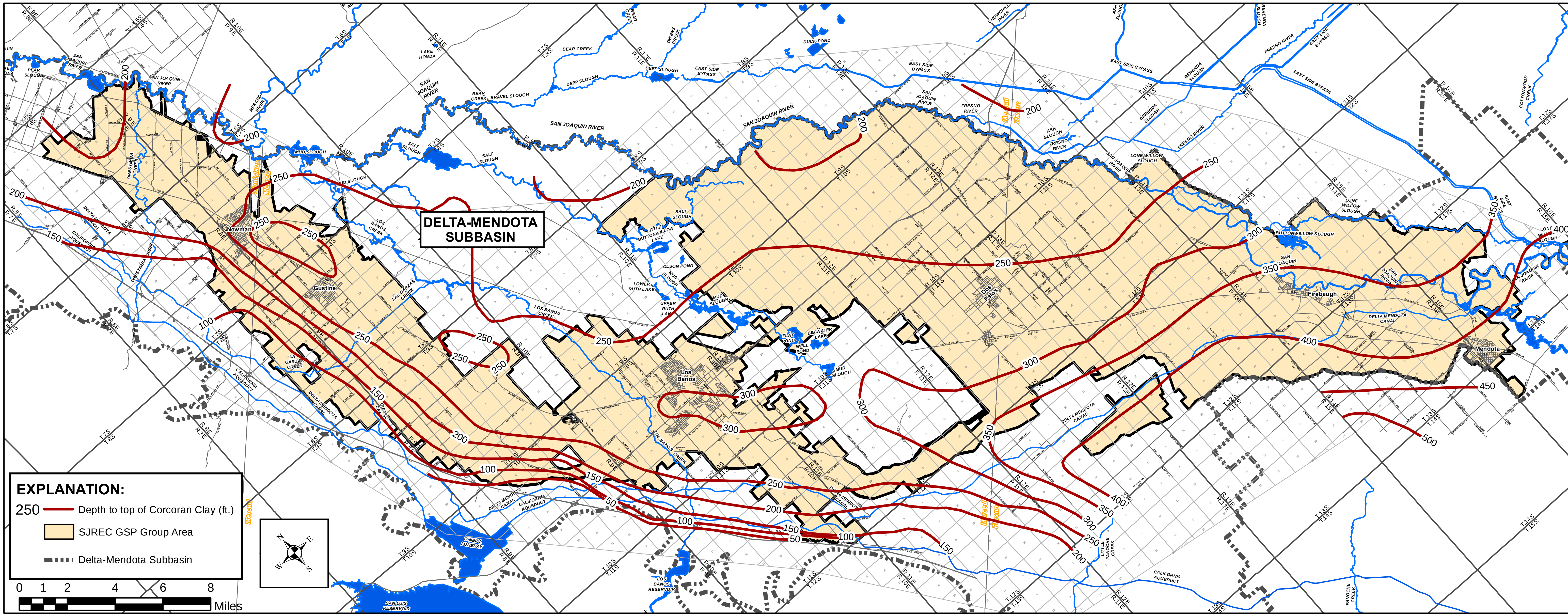

FIGURE 7 - DEPTH TO TOP OF CORCORAN CLAY

The depth to the top of the Corcoran Clay in the Red Top-El Nido area was shown in Figure 8 of KDSA (2013). The top of the Corcoran Clay is shallowest in the northeast part of that area and deepest to the south. The depth ranges from about 160 feet near Chamberlain Road and Combs Road, to more than 300 feet near Avenue 10 and Road 6.

Figure 8 shows the thickness of the Corcoran Clay in the SJREC GSP Group Area. The clay is less than 20 feet thick in the area northwest of Newman, and over 80 feet thick northeast of Newman. The clay averages about 60 feet thick near Mendota and much of the San Joaquin River. The Corcoran Clay is thickest in two areas. The clay is more than 120 feet thick northwest of Volta and south of Dos Palos near the Delta-Mendota Canal.

Subsurface Geologic Cross Sections

Figure 9 shows the locations of subsurface geologic cross sections that are discussed in this report. Some of these sections were reproduced or modified from previous U.S. Geological Survey studies. Regional Cross Sections A-A′, C-C′, D-D′, and E-E′ are from Hotchkiss and Balding (1971), and Cross Section B-B′ is from Miller, Green, and Davis (1971). KDSA (1997a) developed a number of local cross sections. Two of these (F-F′ and G-G′) were in one of the major areas of past pumping into the DMC near

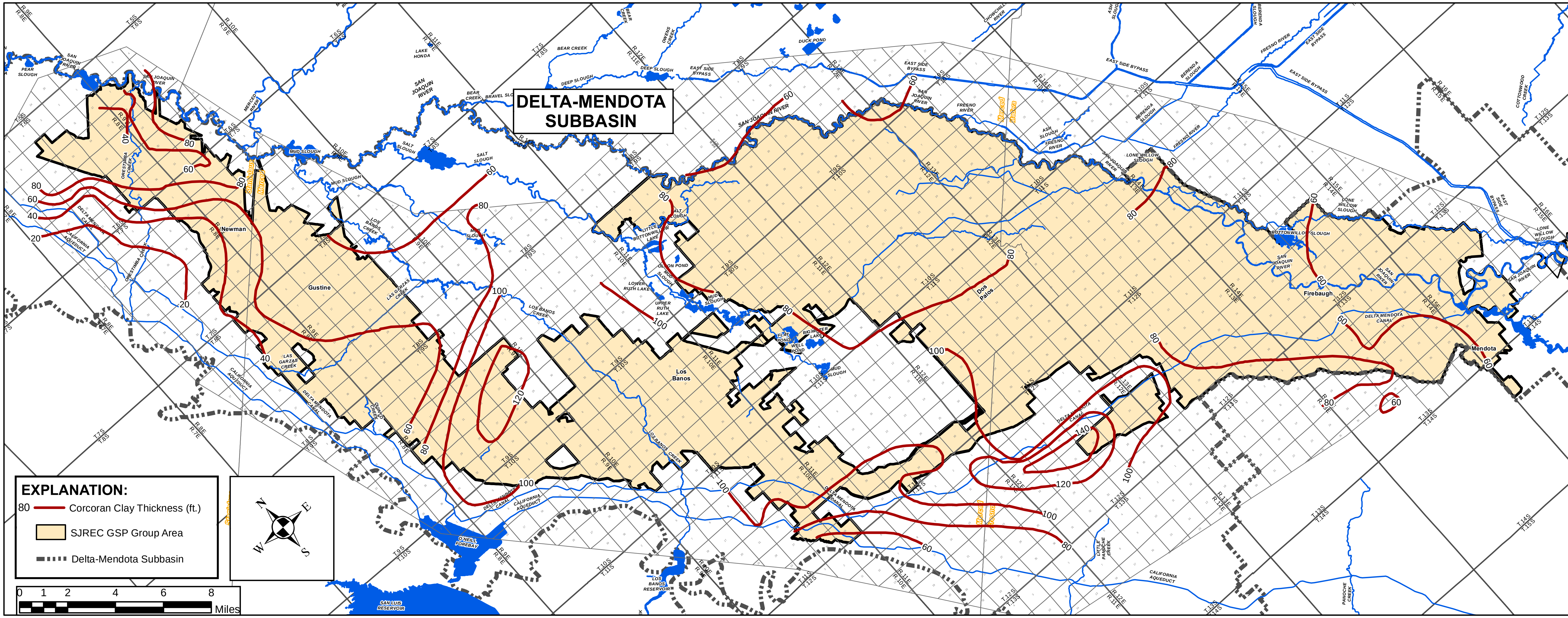

FIGURE 8 - CONTOURS OF THICKNESS OF THE CORCORAN CLAY

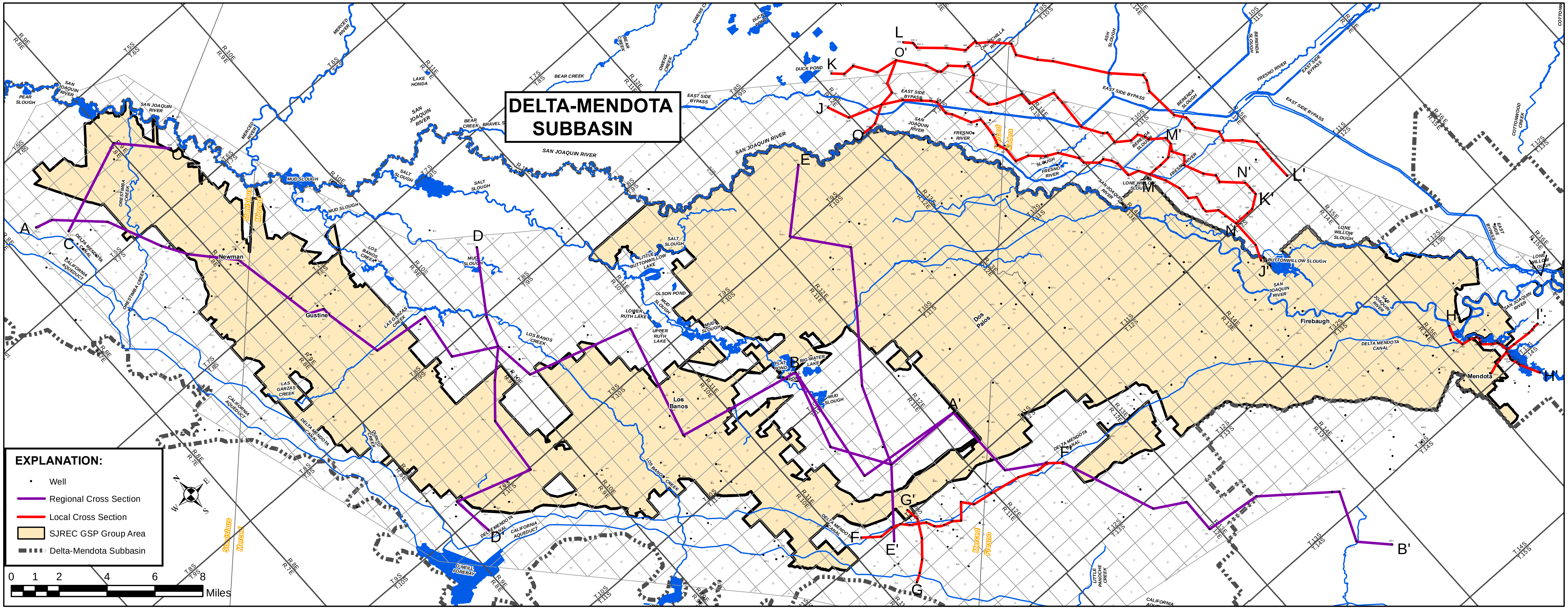

FIGURE 9 - LOCATION OF SUBSURFACE GEOLOGIC CROSS SECTIONS

Russell Avenue, and two others (H-H′ and I-I′) were in the Mendota Pool area. In addition to these sections, a number of other local cross sections were previously developed by KDSA as part of cooperative studies between the CCID and the Cities of Los Banos, Gustine, and Newman. As part of the Sack Dam-Red Top area subsidence evaluation, KDSA (2013) developed a number of local subsurface geologic cross sections in that area which is east of and adjacent to Sub-area E. Some or parts of these are used in this report. References to reports on these evaluations are provided at the end of this report.

Regional

Cross Section A-A' (Figure 10) extends from near Crows Landing, through Newman, Gustine, and Los Banos, to a point southwest of Dos Palos. This cross section extends along the length of the northern and central parts of the CCID. An average of about 100 feet of alluvial deposits are present above the Tulare Formation along this section. The Tulare Formation comprises the Coast Range derived deposits in both the upper and lower aquifers. The vertical extent of the Corcoran Clay and the base of the Tulare Formation are shown. In general, the Corcoran Clay and the base of the Tulare Formation are deeper to the south along this section. The base of the lower aquifer ranges from

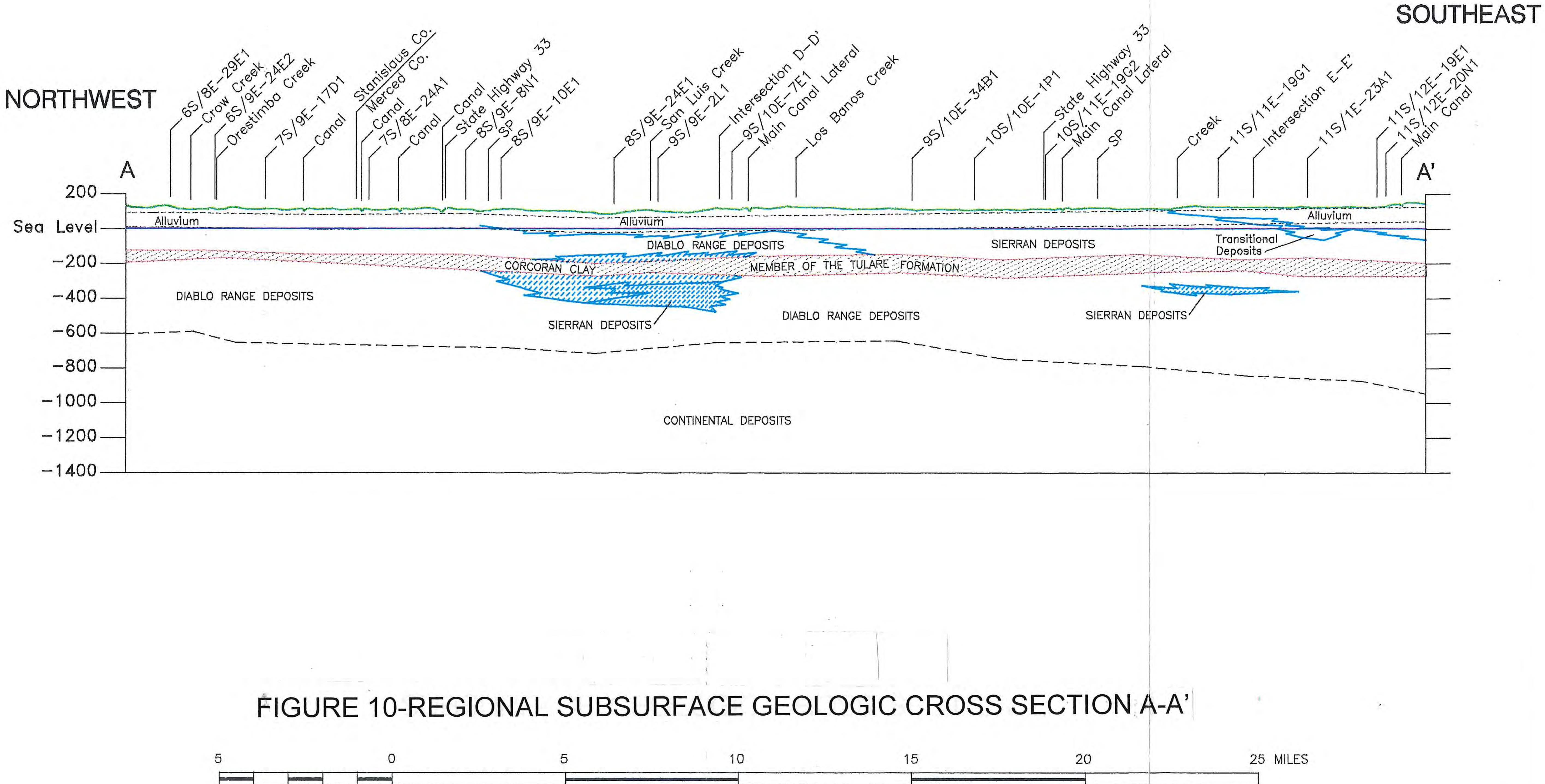

FIGURE 10-REGIONAL SUBSURFACE GEOLOGIC CROSS SECTION A-A'

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about 700 feet deep near the north end of this section to about 900 to 1,000 feet deep near the south end. The base of the lower aquifer generally corresponds to the base of permeable fresh water-producing deposits in this area. In general, groundwater in the deposits below the Tulare Formation in this area has total dissolved solids concentrations exceeding 2,000 mg/l, and has historically been considered unusable.

Cross Section B-B' (Figure 11) extends from east of Los Banos south to near the southwest corner of the study area, south-southwest of Mendota. This section is based primarily on electric logs, which are shown on the section. The Corcoran Clay clearly deepens to the south along this section. The base of the Tulare Formation (the base of the lower aquifer in this area) ranges from about 900 to 1,000 feet deep near the north end of the section to almost 1,600 feet deep south-southwest of Mendota.

Cross Section C-C' (Figure 12) extends from west to east through Crows Landing. The top of the Corcoran Clay averages about 200 feet thick and the clay dips to the east along this section. The Tulare Formation (also termed the Diablo or Coast Range deposits) is about 600 feet thick. Less than 70 feet of alluvial or flood basin deposits are above the Tulare Formation along this section. Some water supply wells tap both the shallow

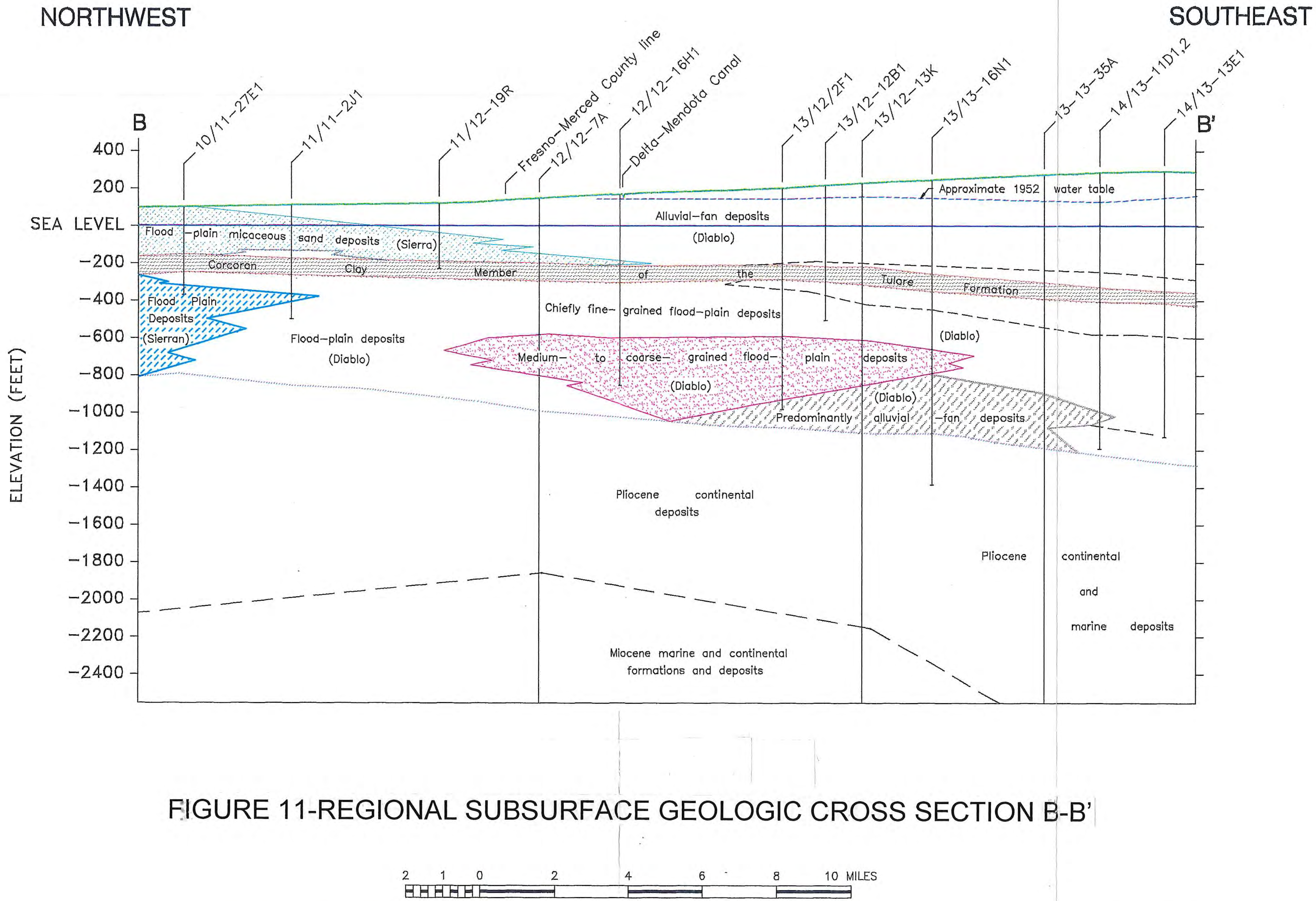

FIGURE 11-REGIONAL SUBSURFACE GEOLOGIC CROSS SECTION B-B'

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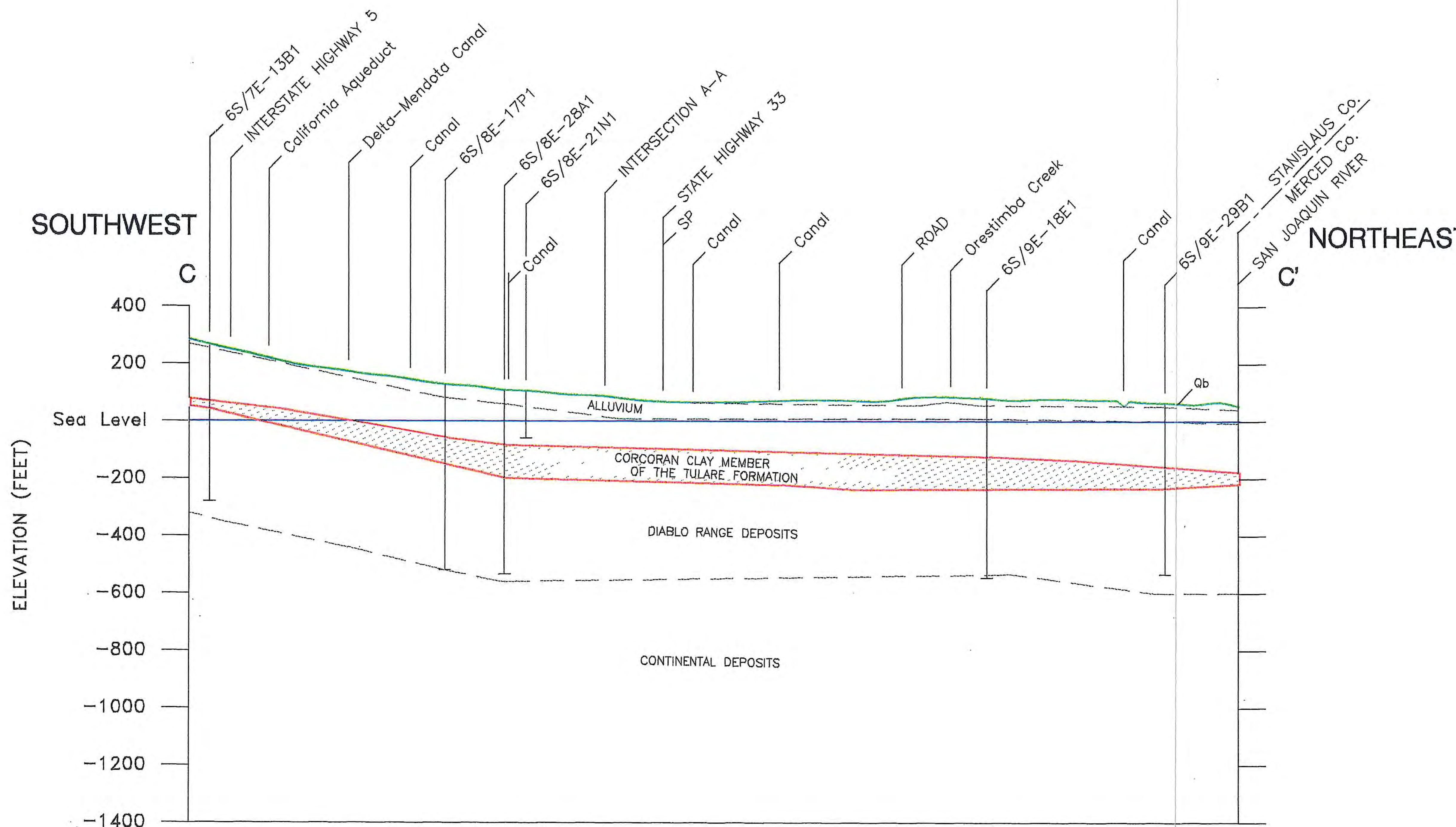
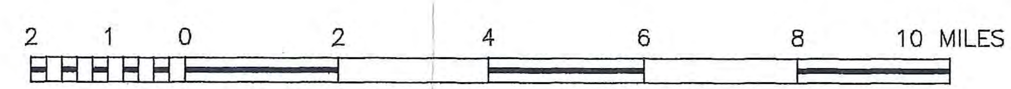


FIGURE 12-REGIONAL SUBSURFACE GEOLOGIC CROSS SECTION C-C'



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deposits and the Tulare Formation.

Cross Section D-D' (Figure 13) extends from near the O'Neill Forebay on the southwest to the northeast to a point east-southeast of Gustine. The Corcoran Clay crops out at the land surface and the top of the clay is about 200 feet deep to the east near the San Joaquin River along this section. The Tulare Formation (Diablo Range deposits) is about 600 feet thick along this section. Beneath most of the area along this section east of the Main Canal, coarse-grained deposits derived from the Sierra Nevada are present below the Corcoran Clay. Beneath the east half of the section, the Sierran deposits are present both above and below the Corcoran Clay. The Sierran deposits generally thicken to the east, toward the San Joaquin River. These deposits were formed when the depositional axis of the valley (the valley trough) was much farther west than at present.

Cross Section E-E' (Figure 14) extends from the southwest to the northeast, between Los Banos and Dos Palos. This section clearly illustrates the dip of the Corcoran Clay, from very shallow depth near Interstate 5, to near maximum depth near the Santa Fe Grade. The deposits of the Tulare Formation and the Sierran deposits are also thickest near or southwest of the Santa Fe Grade. Sierran deposits are present both above and below

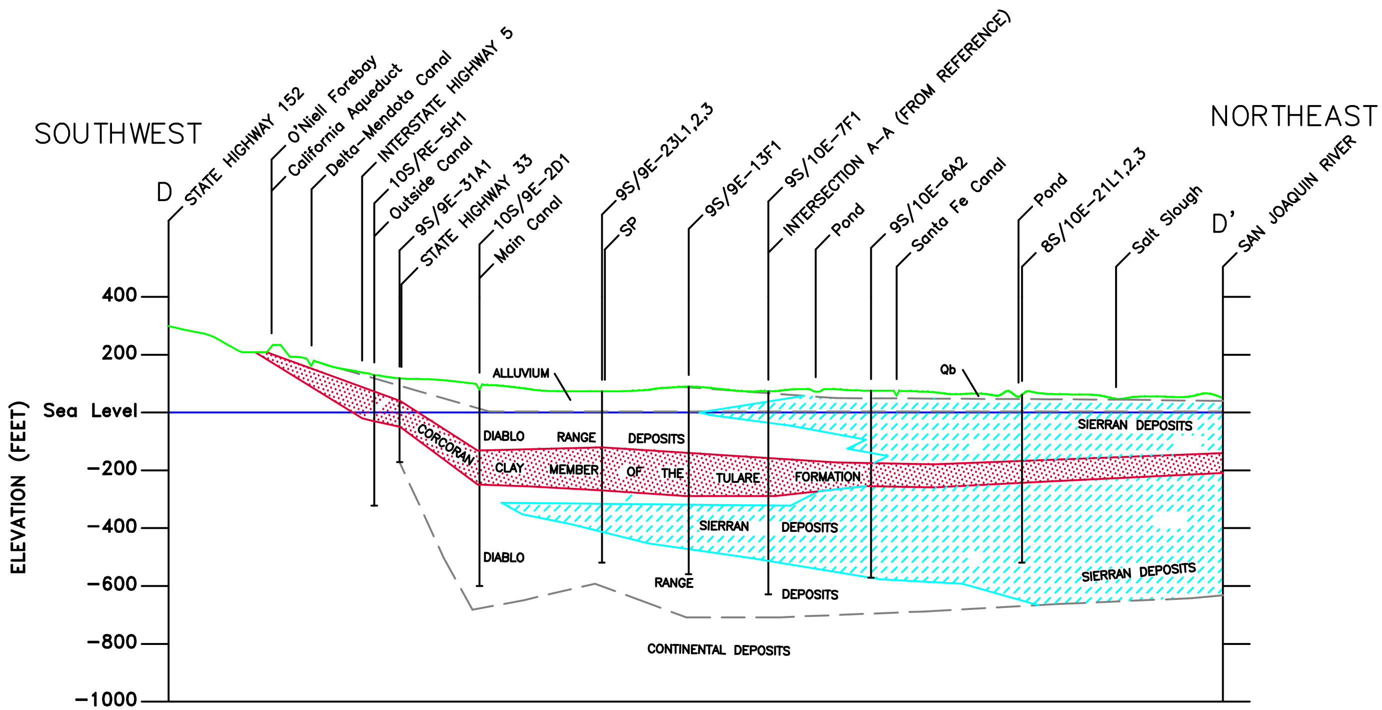

FIGURE No. 13

SUBSURFACE GEOLOGIC CROSS SECTION D-D'

2 1 0 2 4 6 8 10 MILES

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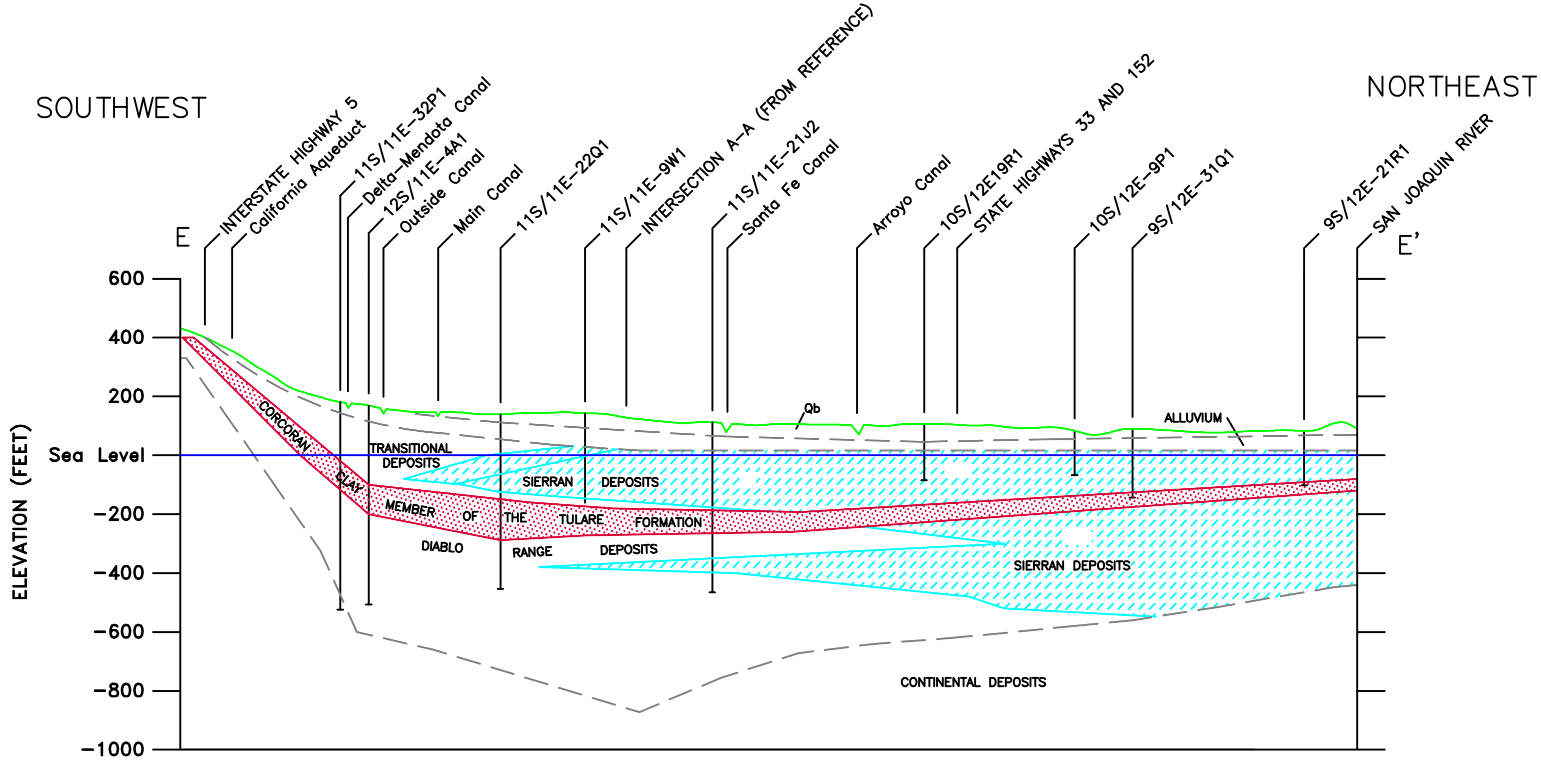

FIGURE No. 14

SUBSURFACE GEOLOGIC CROSS SECTION E–E'

2 1 0 2 4 6 8 10 MILES

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the Corcoran Clay beneath most of this section, except west of the Outside Canal. These deposits are thickest to the east near the San Joaquin River.

DMC Pumping Area

Concerns have been expressed about the impacts of pumping from a concentrated group of wells into the Delta-Mendota Canal. Thus KDSA developed two cross sections in this area. Cross Section F-F' (Figure 15) extends from a point about one mile northeast of the Dos Amigos Pumping Plant along the Delta-Mendota Canal to the east-southeast, to near Russell Avenue. The Corcoran Clay generally deepens to the southeast along this section. Although the Corcoran Clay is less than 50 feet thick along part of the section, it is usually about 80 to 100 feet thick. The perforated intervals of a number of water supply wells are shown along this section. Many of the supply wells are perforated exclusively in the lower aquifer and sealed opposite the upper aquifer, and generally range in depth from about 600 to 1,000 feet. The deeper supply wells are generally to the southeast near Russell Avenue.

Cross Section G-G' (Figure 16) extends from near Eagle Field Road and I-5 to the northeast to near the Outside Canal. Wells along this section range from about 300 to 900 feet in depth.

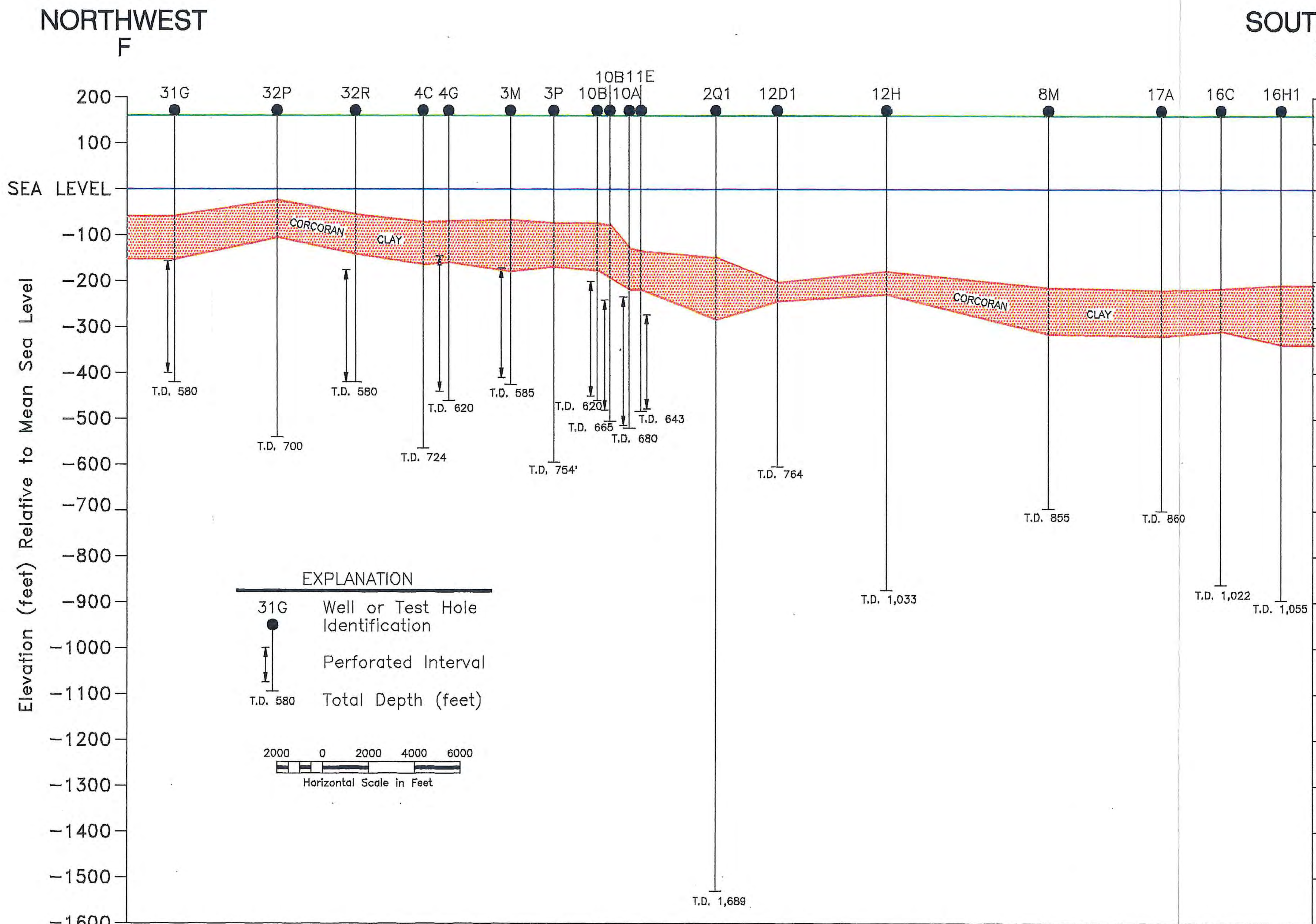

FIGURE 15-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION F-F'

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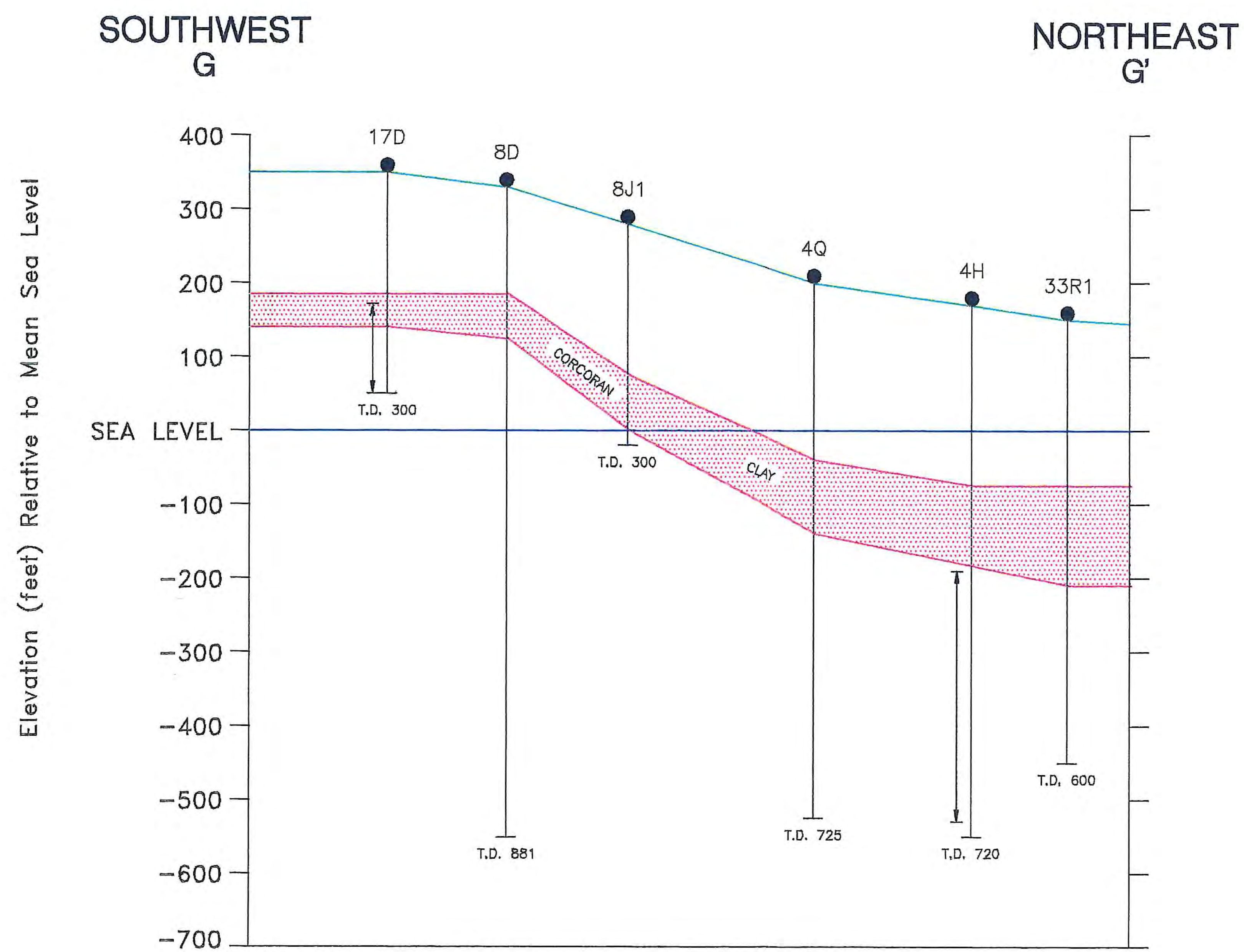

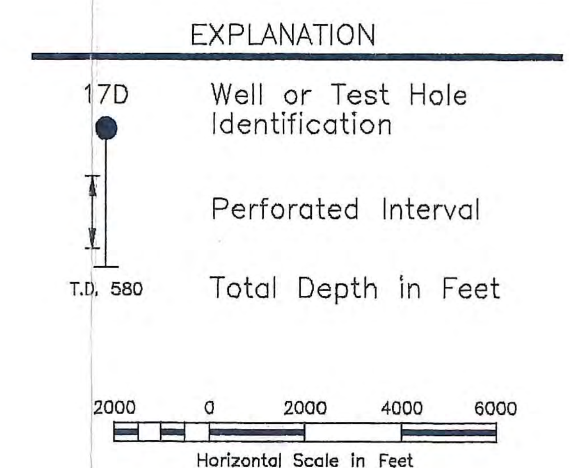

FIGURE 16-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION G-G'

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This section clearly illustrates the dip and thickening of the Corcoran Clay to the northeast in this area. The top of the clay is about 180 feet deep near the southwest end of the section and over 220 feet deep near the northeast end. The clay thickens significantly, from about 40 feet to the southwest to 130 feet to the northeast.

Mendota Pool Area

The Mendota Pool Area has been another area of a large amount of pumping from a dense network of wells. KDSA (1997) developed two local subsurface geologic sections in this area. Section H-H' (Figure 17) extends from north of the Mendota Dam, south along the Mendota Pool to near Whites Bridge Road. Electric logs are not available for most wells along this section, and thus the section is based primarily on drillers logs. Experience indicates that fine-grained flood-basin deposits are locally more than 100 feet thick in some places in the Mendota-Tranquillity area. Regional maps of another locally important confining bed (the A-clay), which is part of the flood-basin deposits, are available only for the area south of Mendota. Normally this clay is present only near the trough of the valley. The A-clay has been important historically in this area, because much of the land east of the Fresno Slough has been in a U.S. Bureau of Reclamation contract area, where water-supply wells aren't permitted to tap

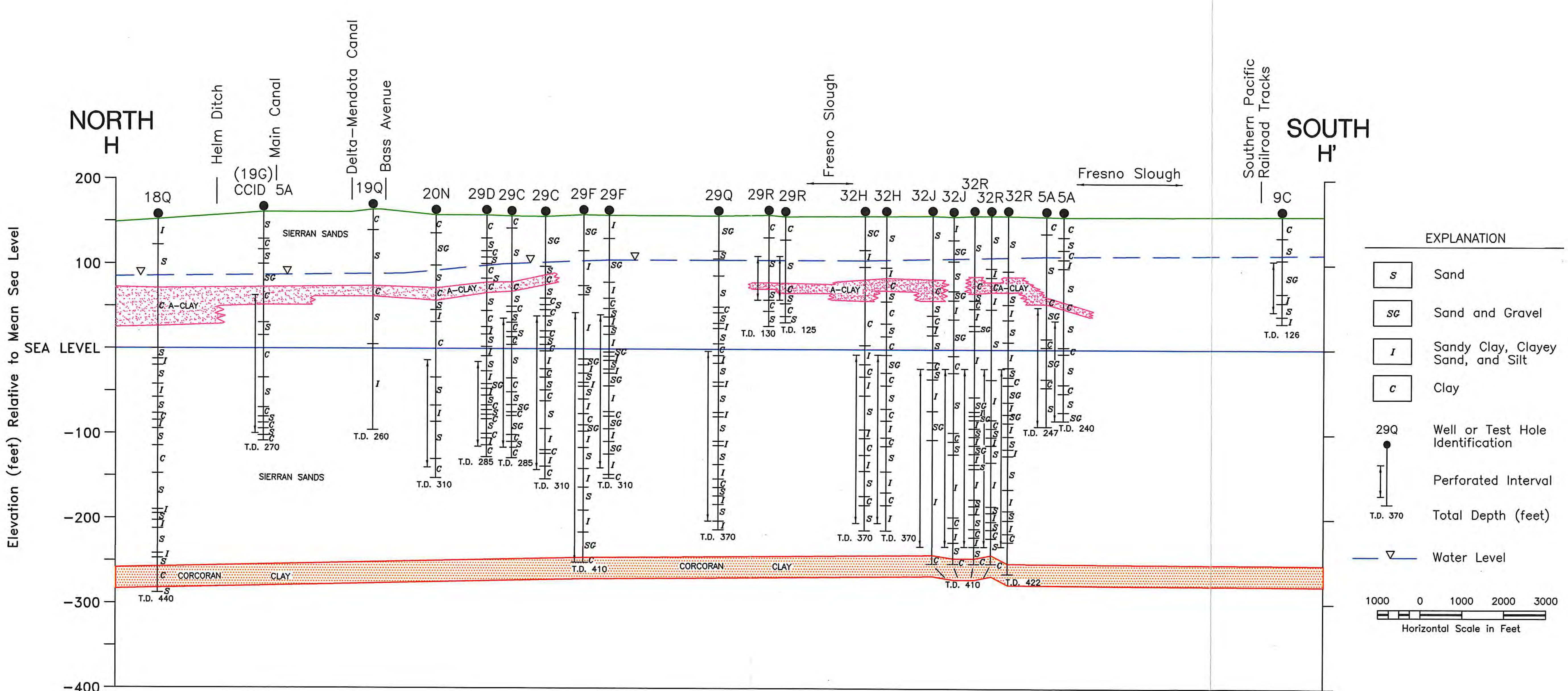

FIGURE 17-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION H-H'

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MENDOTA POOL AREA

groundwater above the A-clay. The A-clay is continuous beneath much of this section. The two locations where this clay is not shown may be due to a lack of identification of the clay on the drillers logs. The top of the clay is commonly about 80 feet deep along this section. The A-clay is normally from about 10 to 30 feet thick, however beneath the north end of the section the thickness appears to increase substantially. The top of the Corcoran Clay is about 400 to 420 feet deep along this section. Only one test well was drilled deep enough along this section to apparently reach the bottom of this clay. This section shows some shallow wells in two areas where pumping of groundwater above the A-clay was commenced in the 1990's (Etchengoinberry Ranch and Five Star Ranch). Although not specifically indicated on this map, coarse-grained Sierran deposits predominate between the A-clay and Corcoran Clay, and historically comprised the major aquifer tapped by wells in the Mendota area. Higher salinity groundwater is present below the Corcoran Clay in most of this area. Some Sierran sands are also present above the A-clay and below the Corcoran Clay.

Cross Section I-I' (Figure 18) extends from near the Mendota Airport to the east, through the Mendota Pool, to a point about one-half mile west of San Mateo Avenue. In contrast to the pre-

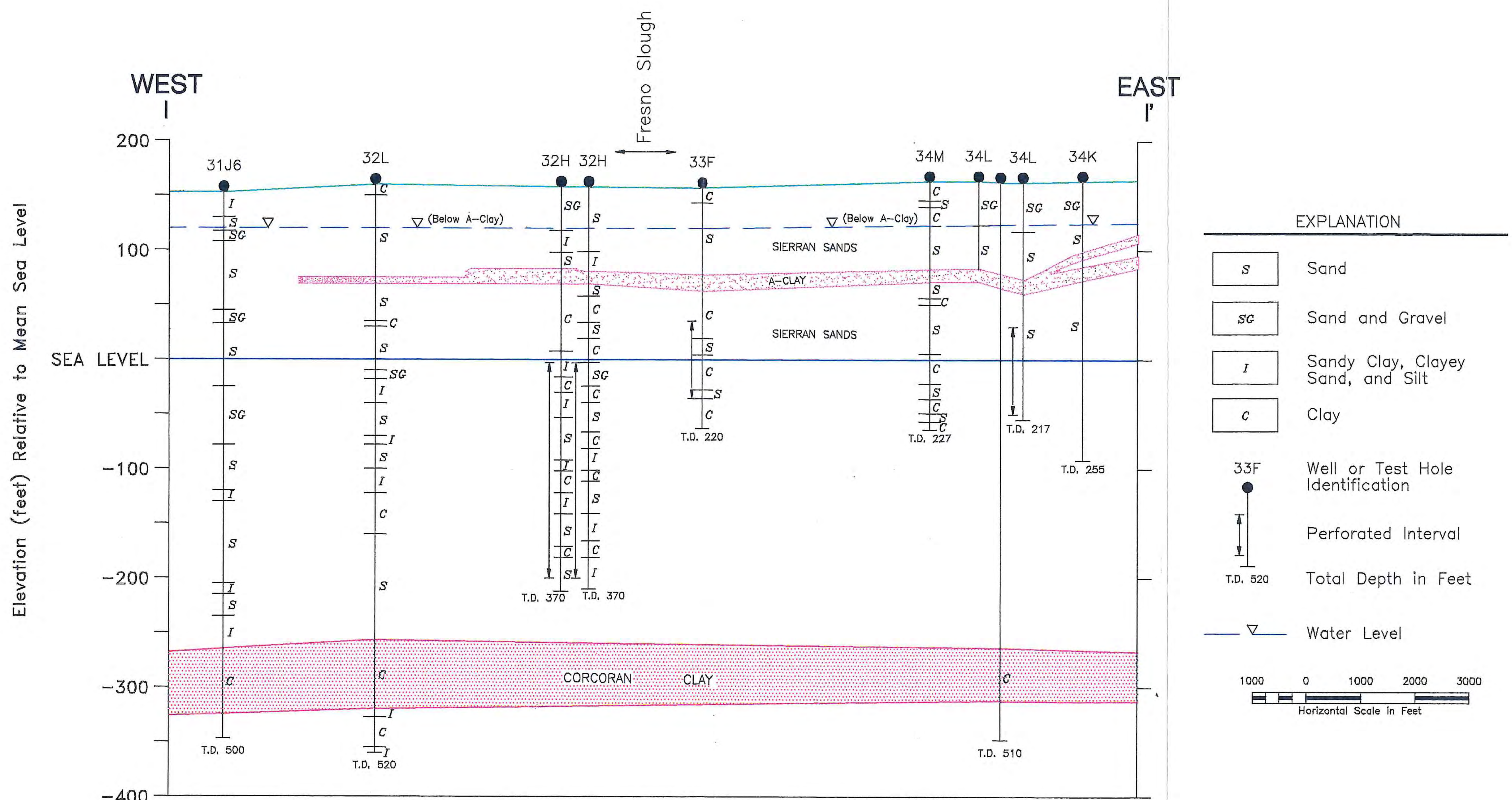

FIGURE 18-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION I-I'

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MENDOTA POOL AREA

vious section, electric logs and/or geologic logs are available for most of the wells along this section. Numerous monitor wells have been drilled at the Spreckels Sugar Co. factory in this area, to tap strata above or below the A-clay. Geologic and electric logs for these wells and geologic logs for several deep soil borings provide substantial information on the location of the A-clay in this area. The A-clay has been identified along much of this section, particularly in the area east of the Fresno Slough. The top of this clay ranges from about 60 to 90 feet deep. Near the east edge of the section, the A-clay bifurcates into two layers, which is a common trend. Three wells or test wells along this section penetrated the Corcoran Clay. The top of the clay is about 420 feet deep along this section, and the clay is about 50 to 60 feet thick.

Sack Dam-Red Top Area

As part of a subsidence evaluation in the Sack Dam-Red Top Area, KDSA developed six local subsurface geologic cross sections, and some or parts of these are reproduced herein. Three of the cross sections (J-J′, K-K′, and L-L′) are oriented from the north-northwest to the south-southeast. The other three cross sections (M-M′, N-N′, and O-O′) are oriented from the west-southwest to the east-northeast.

Cross Section J-J′ (Figure 19) extends from near Roosevelt Road, west of Indiana Road to the southeast to near Avenue 10 and Road 6. The part of this section north of Avenue 22 is generally near the Eastside Bypass. The section is generally parallel to the San Joaquin River and an average of about a mile and a half northeast of the river. The Corcoran Clay thickens to the northwest and southeast along this section. The thickness ranges from about 35 feet between Avenues 17 and 18 to about 100 feet near the north end of the section. The top of the clay is about 210 feet deep near the north end and about 305 feet deep near the south end. Fine to intermediate textured deposits are prevalent above the Corcoran Clay along much of the section, except near Jefferson Road near Avenue 17, and south of Avenue 11½. Coarse-grained strata below the water level and above the Corcoran Clay are generally uncommon along this section, except near the south end. Some thick, extensive clay layers are present below the Corcoran Clay along this section, including one below a depth of about 800 to 850 feet. North of Washington Road, such layers are predominant. Another such layer is present beneath the part of this section south of Avenue 16½ at an average depth of about 600 to 650 feet. In terms of land subsidence, both the Corcoran Clay and deeper clays are important because of their aggregate thickness. Coarse-grained strata

FIGURE 19-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION J-J'

are common along the part of this section south of Washington Road, below the Corcoran Clay and above a depth of about 550 to 650 feet.

Cross Section K-K′ (Figure 20) extends from Chamberlain Road west of Lone Tree Road on the north to near Avenue 12 and Road 7 on the south. This section is an average of about a mile and a half northeast of Cross Section A-A′. The Corcoran Clay ranges from about 60 feet thick to about 100 feet thick along the section. The top of the Corcoran Clay is about 180 feet deep at the north end of the section and 290 feet deep near the south end. Coarse-grained strata below the water level and above the Corcoran Clay are more common south of Jefferson Road than along Cross Section A-A′. These coarse-grained strata are usually present along the part of the section south of Avenue 17½. Within the uppermost 50 feet, sands are common between Avenues 17 and 18, between Avenues 14 and 15, and south of Avenue 13. A relatively thick extensive clay layer is indicated to be present beneath a depth of about 800 to 850 feet along this section. Fine-grained deposits are predominant below the Corcoran Clay along the part of the section north of Jefferson Road. Intermediate textured deposits (such as sandy clay) are predominant below the Corcoran Clay along much of rest of the section.

FIGURE 20-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION K-K'

Coarse-grained strata in the lower aquifer are primarily above a depth of about 600 650 feet along this section.

Cross Section L-L′ (Figure 21) extends from near Roosevelt Road west of Flanagan Road to the south near Avenue 12 and Road 9. The part of this section south of Avenue 20 is generally near the Eastside Bypass, and the section is an average of about two miles northeast of Section B-B′. The Corcoran Clay ranges from about 50 to 80 feet thick and thickness to the north and south along this section. The top of this clay ranges from about 170 feet deep near the north end to about 270 feet deep near the south end of the section. Fine-grained of intermediate textured deposits above the Corcoran Clay are predominant along the parts of the section west of Highway 59 and between Avenues 16 and 18. Clay strata are predominant both above and below the Corcoran clay along much of the part of the section north of Avenue 19. Clay or intermediate textured deposits are predominant in the lower aquifer along much of the section. Sand strata in the lower aquifer are usually present above a depth of about 650 feet.

Cross Section M-M′ (Figure 22) extends from near Avenue 16 and the realigned Fresno River to the east-northeast to near Avenue 17½ and Road 9. The Corcoran Clay ranges from about 40 to 60 feet thick along the section. The top of the Corcoran Clay

FIGURE 21-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION L-L'

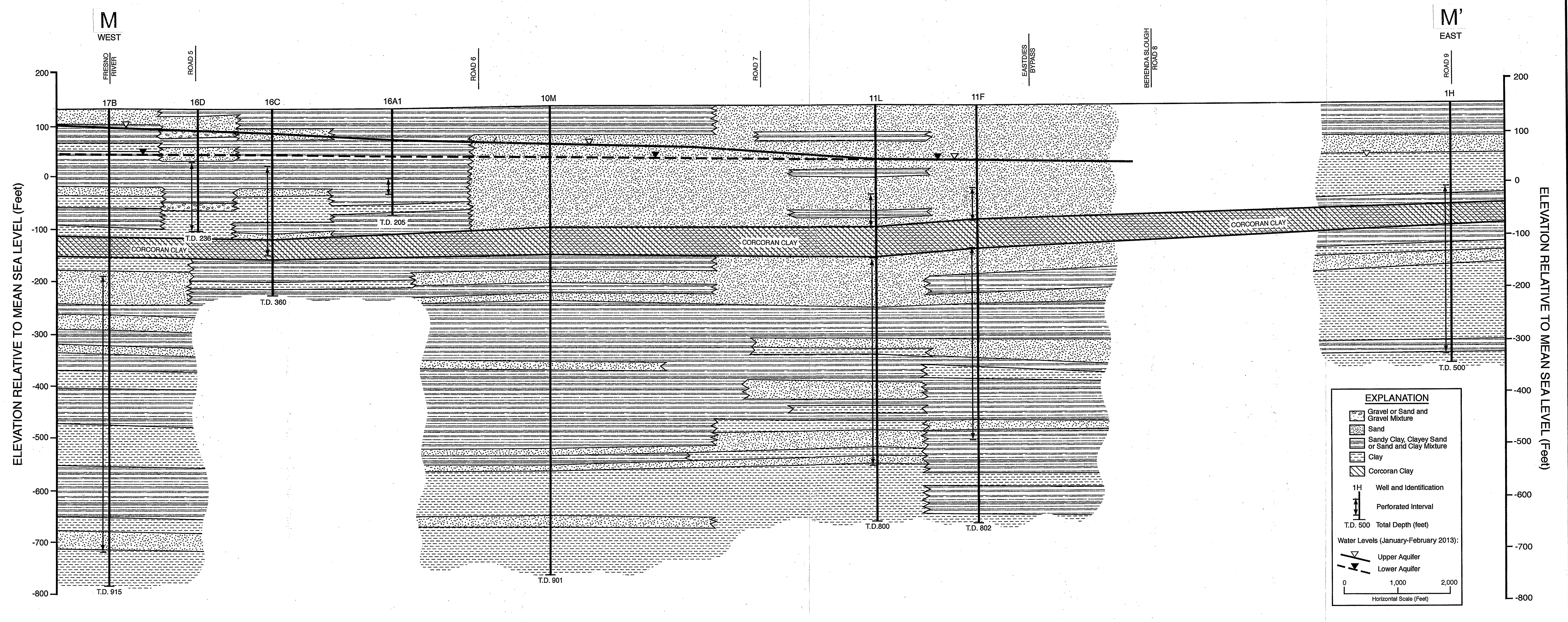


FIGURE 22-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION M-M'

ranges from about 240 feet deep near the west end of the section to 195 feet deep near the east end. Sand strata are predominant above the Corcoran Clay between Roads 6 and 8 along the section. A substantial thickness of intermediate textured or clay deposits are present above the Corcoran Clay in the parts of the section west of road 6 and east of Road 8. Clay and intermediate textured deposits are predominant below the Corcoran clay along the section. Some sand strata are usually present in the lower aquifer above a depth from about 800 feet along the section, where logs for deep wells or test holes are available. The thickest sands in the lower aquifer are generally within about 100 feet of the base of the Corcoran Clay.

Cross Section N-N′ (Figure 23) extends from near Avenue 12 and Road 6 to the northeast to near Avenue 14 and Road 9. The Corcoran Clay ranges from about 40 feet thick near the east end of the section to almost 70 feet thick near the west end. Sand is predominant in the upper aquifer along this section between Roads 6½ and 8. Productive sands are also present in the upper aquifer between Roads 8 and 9 along this section. Clay and intermediate textured deposits are predominant in the lower aquifer along this section, particularly below a depth of about 550 feet. Water producing sand or gravel are common in the lower aquifer within about 150 feet of the base of the Corcoran Clay.

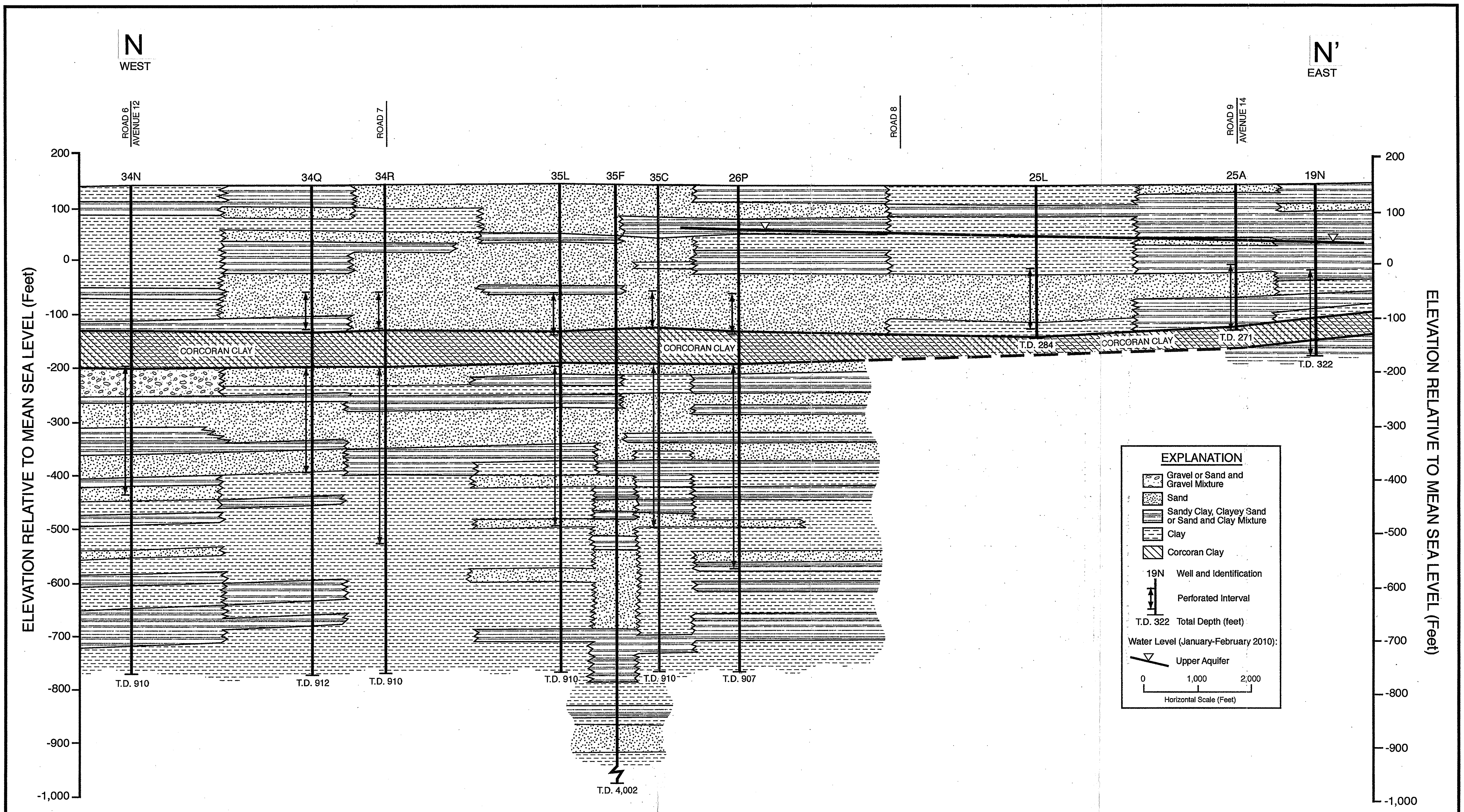


FIGURE 23-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION N-N'

Cross Section O-O′ (Figure 24) extends from near Indiana Road and the San Joaquin River to the northeast near Roosevelt Road, west of Flanagan Road. The Corcoran clay generally thickens to the northeast along this section, from about 55 feet to 85 feet. The top of this clay is about 200 feet deep near the southwest end and about 160 feet deep near the northeast end. Clay layers are predominant both above and below the Corcoran Clay along the part of the section east of Newhall Road. More sand layers are present both above and below the Corcoran Clay along the part of the section west of Newhall Road. Most of the sand layers are indicated to be above a depth of about 600 feet along this section.

GROUNDWATER USE AND WELL DATA

Primary Uses of Each Aquifer

The primary use of the upper and lower aquifers is irrigation and public supply. Secondary uses of these aquifers are for private domestic and industrial.

Depths of Water Supply Wells

Figure 7 is a good indication of the maximum depths of most supply wells in the SJREC GSA, as they tap strata above the Corcoran Clay. The depths of most upper aquifer supply wells generally range from about 100 to 300 feet, although some near the DMC

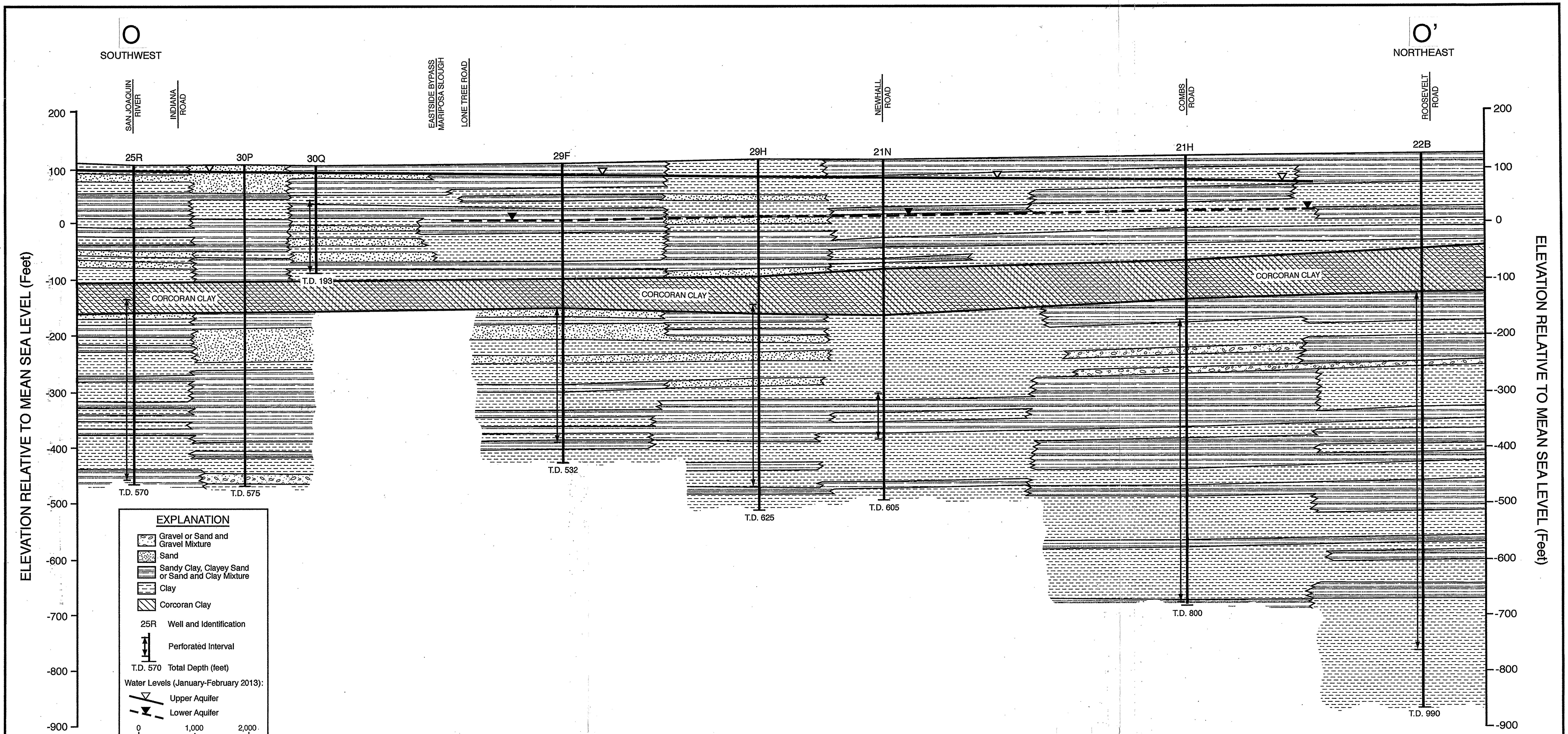


FIGURE 24-LOCAL SUBSURFACE GEOLOGIC CROSS SECTION 0-O'

in the south part of the area are more than 400 feet deep. As for maximum depths of wells tapping the lower aquifer, Figure 5 is relevant. Thus the maximum depths of these wells range from about 500 to 800 feet (the bottom of the basin). There are few water supply wells that are more than 600 feet in depth in the SJREC GSP Group Area.

WATER LEVELS

Water-level Elevations and Direction of Groundwater Flow

Above the A-Clay Near Mendota

In the SJREC GSP Group Area, the only place where water-level maps are available for above the A-clay is near Mendota. Figure 25 shows water-level elevations and the direction of groundwater flow above the A-clay for December 2012-January 2013, modified from the 2012 MPG pumping program report by Luhdorff & Scalmanini and KDSA (2013). Historical maps indicate that a recharge ridge has been present beneath the San Joaquin River and the easterly branch of the Mendota Pool. Groundwater from the north side of this ridge has moved northward and into Madera County. There is no known pumpage from wells tapping strata above the A-clay north of the San Joaquin River. The water levels above the A-clay are important because they are shallower then water levels in strata

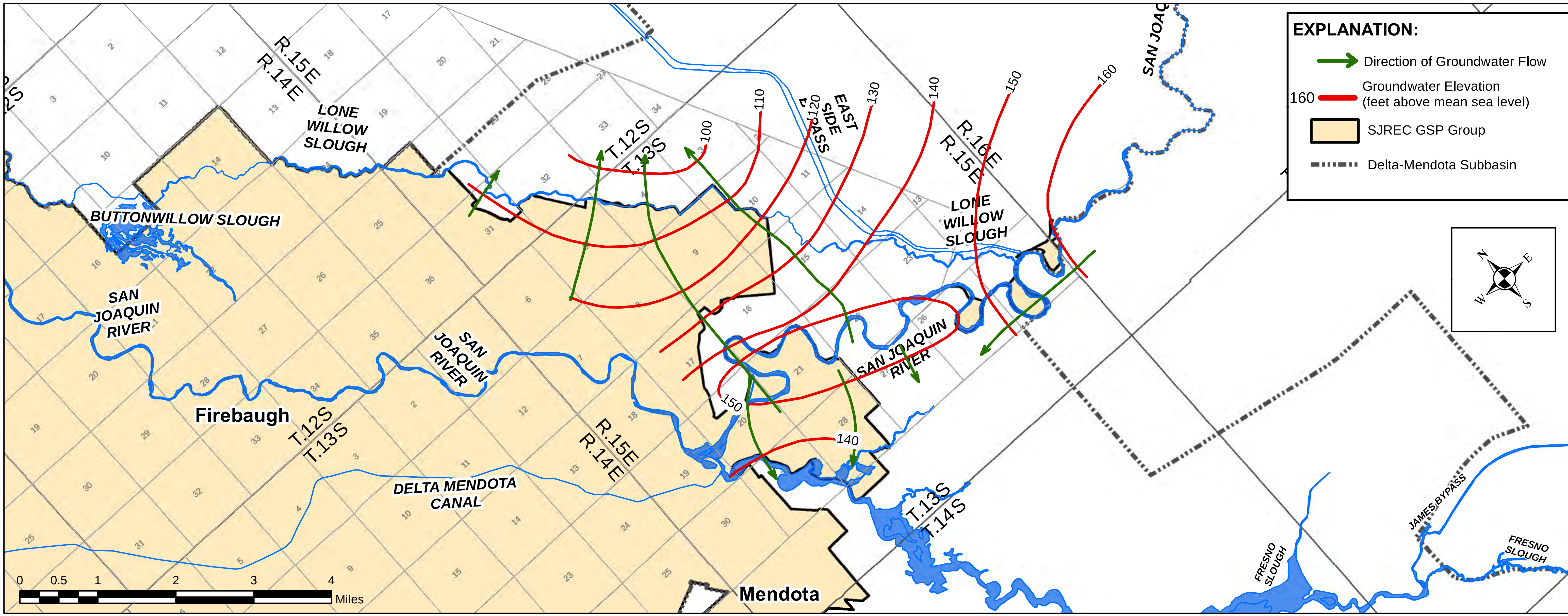


FIGURE 25- WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW ABOVE THE A-CLAY (DECEMBER 2012- JANUARY 2013)

beneath this clay. These shallower water levels limit the amount of storage space for recharging and storing groundwater in areas underlain by the A-clay.

Water-level hydrographs for shallow observation wells near the river in the area east of San Mateo Road indicate a significant response to streamflow in the river. During streamflow, water levels in strata above the A-clay rise, and during periods of no streamflow they fall. Because water is normally present in the Mendota Pool, water levels in shallow wells have been more stable in this reach, compared to farther east. In general, water levels in wells tapping strata above the A-clay have been relatively stable over the long-term, rising during and following periods of streamflow in the San Joaquin River, and falling during the intervening periods.

Upper Aquifer

Figure 26 shows water-level elevations and the direction of groundwater flow for the upper aquifer for February 2015. The coverage for this map has been expanded to the east in the Red Top-El Nido Area, because of concerns about land subsidence in that area. Overall, the directions of groundwater flow in February 2015 were similar to those shown on the previous map for Spring 1986 and 2006, which were representative of periods of

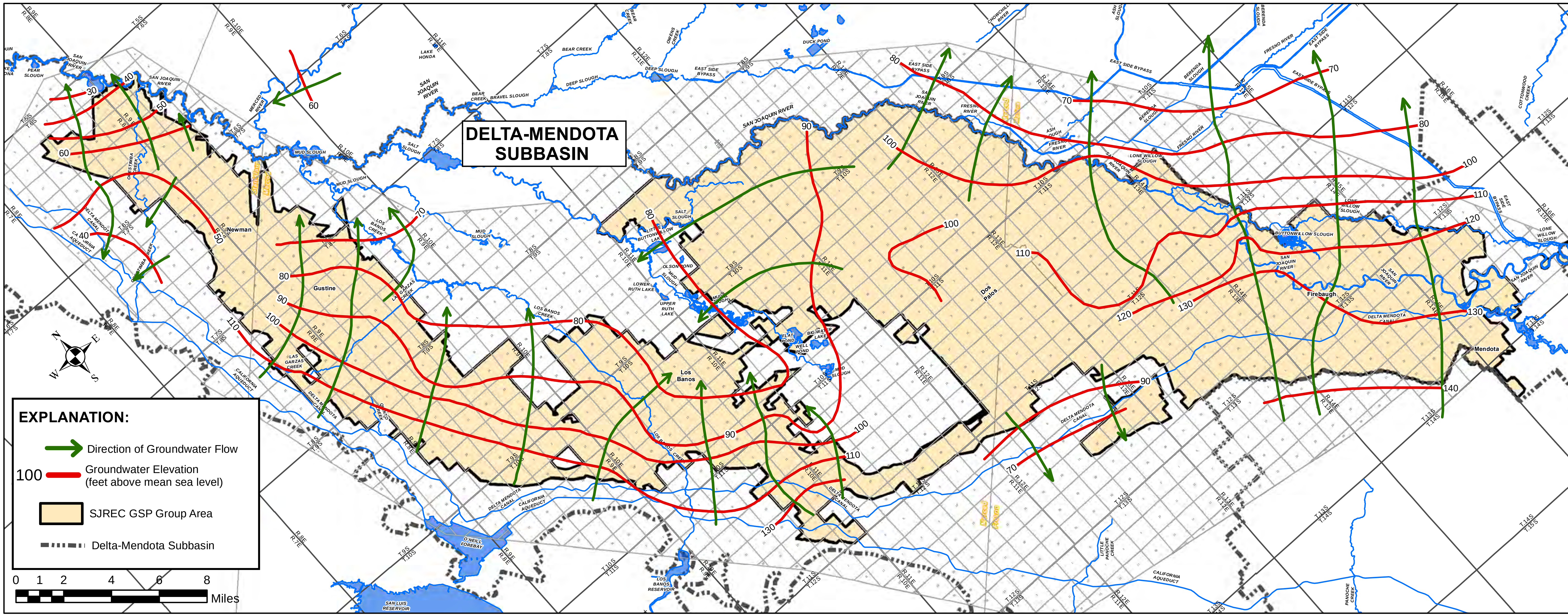


FIGURE 26 - WATER LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR UPPER AQUIFER (SPRING 2015)

abundant surface water supplies in most of the area. In 1986 and Spring 2006 there was a groundwater divide east of Dos Palos. South of Highway 152, groundwater was flowing northeast and into Madera County. North of Highway 152, groundwater was moving northerly and toward the San Joaquin River from both sides of the river. Water levels in Spring 2013 are generally representative of a dry period. South of Chamberlain Road, groundwater in the upper aquifer was flowing into Madera and Merced Counties. North of this road, groundwater was generally flowing toward the San Joaquin River from both sides of the river.

Lower Aquifer

In most parts of the SJREC service area, few wells tap strata only below the Corcoran Clay. However, there are a number of wells that tap strata both above and below the Corcoran Clay, particularly in the area west of Newman and near Management Area J. These wells are termed composite wells. Water levels in these wells generally are significantly lower than those in nearby wells that tap only the upper aquifer. The water levels in these composite wells normally are similar to water levels in wells that tap strata only below the Corcoran Clay, such as in the Panoche and Westlands Water Districts. For this reason, water-level measurements for selected composite wells have been used, in addition to measurements for wells tapping only the lower aquifer, to prepare water-level elevation maps for the lower aquifer. Because of recent concerns about land subsidence in the Red Top-El Nido area, significantly improved water-level maps are available east of the Exchange Contractors service area in this area for Spring 2015.

The Fall 1981 water-level elevation and direction of groundwater flow maps prepared by KDSA (1997) for the lower aquifer indicated a number of features which weren't previously well known. First, a groundwater divide was present in the area between Mendota and a point near the San Joaquin River northeast of Los Banos. The divide extended through Sub-area E. Groundwater northeast of this divide was moving to the northeast and into the Madera area. Southwest of this divide, groundwater was moving southwest and out of the CCID toward the Panoche Water District. The groundwater flow directions in Fall 1981 were primarily toward pumping depressions due to pumping of groundwater from below the Corcoran Clay in the Madera area, and in the Panoche Water District and the Westlands Water District. There has been little pumping of water from the lower aquifer in Subareas E and G, due to high salinity. Beneath and adjacent to the groundwater divide, there has been significant downward flow of groundwater from the upper aquifer through the Corcoran Clay. This has provided a significant source of recharge to groundwater in the lower aquifer. Northwest of the Stanislaus-Merced County line, groundwater in the lower aquifer was indicated to flow upward into the upper aquifer. This was the only known part of the SJREC service area where there was upward flow of groundwater from the lower to the upper aquifer.

Figure 27 shows water-level elevations and directions of groundwater flow for the lower aquifer in part of the SJREC GSP Group Area in Spring 2015. This map was also extended into the Red Top area because of concerns about land subsidence. The most extensive coverage was for the Westlands W.D. and in the Red Top area. In the Red Top area, water-level elevations ranged from 14 to 28 feet above mean sea level, and the direction of groundwater flow was to the northeast. In the Westlands W.D. area, water-level elevations ranged from 20 feet to 50 feet below mean sea level and the direction of groundwater flow was to the south. In the Panoche W.D., water-level elevations ranged from about 10 to 20 feet below mean sea level and the direction of groundwater flow was to the southwest. North and west of Newman, water-level elevations ranged from about 40 to 50 feet above mean sea level. The direction of groundwater flow was primarily to the east. Groundwater flow directions were the same as in Fall 1981 and Spring 1993. That is, groundwater flowed away from the divide toward pumping depressions in the Madera Area and in the Panoche

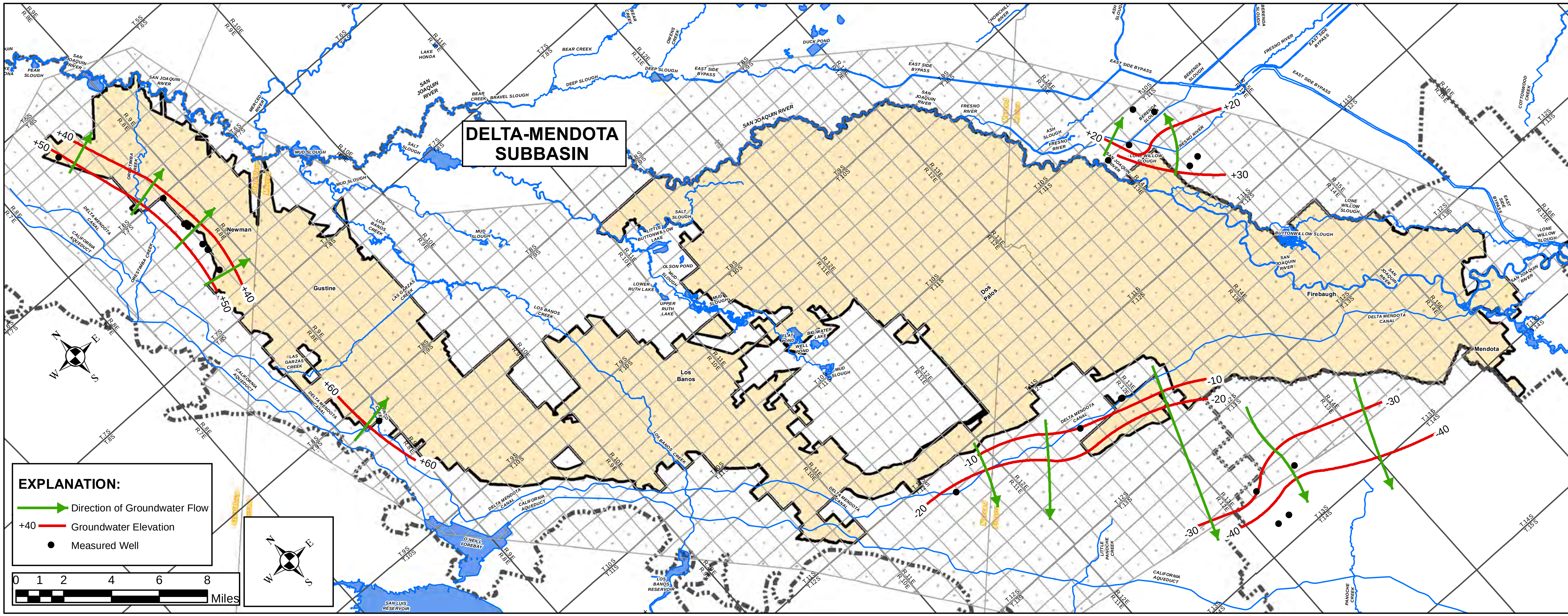


FIGURE 27 - WATER-LEVEL ELEVATIONS AND DIRECTIONS OF GROUNDWATER FLOW FOR LOWER AQUIFER (SPRING 2015)

and Westlands Water Districts. In general, water-level elevations in the lower aquifer in the Westlands Water District were significantly lower in Spring 2015 than in Fall 1981.

Water-Level Trends

KDSA (2014) provided updated water-level hydrographs for the SJREC service are a through early 2013. As part of the present evaluation, a number of these previously prepared water-level hydrographs were updated through early 2017.

Figure 28 shows the locations of wells with updated water-level hydrographs, which are provided in Appendix A of this report. An effort was undertaken to determine the depths and perforated intervals for many of the wells with hydrographs. Such information, where available, is provided on the hydrographs. Measurements for shallow wells (i.e., from about 10 to 20 feet deep) were purposely excluded from this evaluation, so that water-level changes in the water-producing deposits that are tapped by water supply wells could be evaluated. In order to evaluate the long-term water-level changes, a period of average hydrologic conditions is normally used. The period 1962-89 was considered representative for the 1997 evaluation. Subsequently, the period 1962 to 2005 was evaluated by KDSA (2008). For the KDSA 2014 report, the period 1962-2013 was evaluated. The water-level hydrograph evalua-

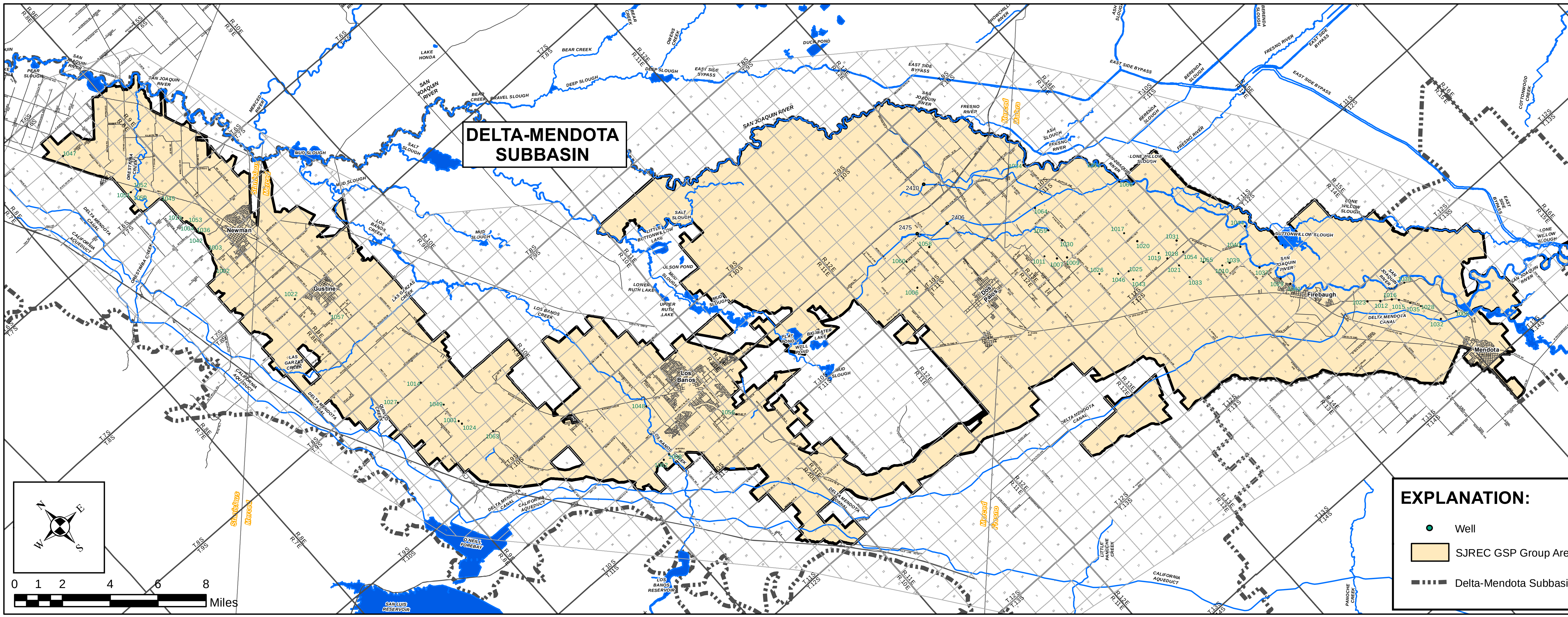


FIGURE 28 - LOCATIONS OF WELLS WITH LONG-TERM WATER LEVEL HYDROGRAPHS

tion for the SJREC service area was divided into the sub-areas which had previously been delineated. Most of the water-level hydrographs extend back to at least 1970, and many extend back to at least 1960. In interpreting trends in the hydrographs, individual measurements were not given as much weight as the preponderance of measurements for a particular well. This helps to eliminate errors and other factors that produce atypical results. The cited trends are considered applicable to most of the wells in each sub-area evaluated, however, they don't apply to every single well. The perforated intervals or total depths of the measured wells and an available map showing the depth to the top of and thickness of the Corcoran Clay (KDSA, 1997b) were used to divide the water-level measurements into the upper aquifer (above this clay) and the lower aquifer (below this clay). A number of measured wells tap both aquifers, and are termed composite wells. Water-level hydrographs for composite wells are more difficult to interpret, compared to those for other wells. Thus most of the interpretation of water-level trends was based on measurements for wells that are known to tap either the upper or lower aquifer.

Water-level fluctuations in confined aquifers are generally much greater than those in unconfined aquifers. Based on water-level depths and fluctuations shown on the hydrographs, the lower aquifer appears to be confined throughout the study area. Although the upper aquifer is generally considered to be unconfined over much of the study area, there is confinement in some locations. One example is near the San Joaquin River at Mendota, where fine-grained flood-basin deposits (the A-clay) are present at shallow depth. In this area, groundwater in deposits between about 100 and 250 feet in depth is normally confined, whereas the top of the Corcoran Clay is about 450 feet deep, or well below these deposits. The confinement in the upper aquifer is generally most pronounced near the trough of the valley, where shallow confining layers are present and groundwater levels are shallow.

Sub-Area A

This is the northernmost sub-area in the Exchange Contractors service area, comprising the Crows Landing-Newman area. Water-level hydrographs for 28 wells with construction records indicated no long-term change in water level in this sub-area through 1995. About 80 percent of these wells tapped strata only above the Corcoran Clay. Hydrographs for 12 wells with construction records indicated long-term water-level rises prior to about 1989. About two-thirds of these wells tapped strata below the Corcoran Clay.

Water-level hydrographs in this sub-area were updated through Spring 2019. An example of a hydrograph for an upper aquifer well (T6S/R8E-22A1) is provided in Figure 29. This is for CCID Well No. 2, or SGMA Well 1002. Since the mid 1960's, depth to water in this well has usually ranged from about 25 to 55 feet. The water level fell during the 1987-93 drought, and then recovered by the late 1990's. During 2012-16, the water level fell to more than 80 feet deep. However, by early Summer 2019, the water level had recovered to 47 feet deep. The overall long-term trend after the late 1980's has been one of relatively stable water levels in both aquifers in this sub-area. There was little indication of the previous rising water levels for wells tapping the lower aquifer.

Sub-Area B

This area primarily comprises the Gustine area and lands farther south. The Gustine Drainage District formerly operated a number of drainage wells to lower shallow water levels in this sub-area. However, most of these are inactive due to numerous tile drainage systems that have been installed to control shallow groundwater. Water-level hydrographs for 25 wells with construction records that were evaluated in 1997 indicated no long-term change in water level. About 85 percent of these wells tapped strata above the Corcoran Clay. Hydrographs for 11 wells with construction records indicated long-term rises (prior to about 1989). About two-thirds of these wells tapped strata above the Corcoran Clay.

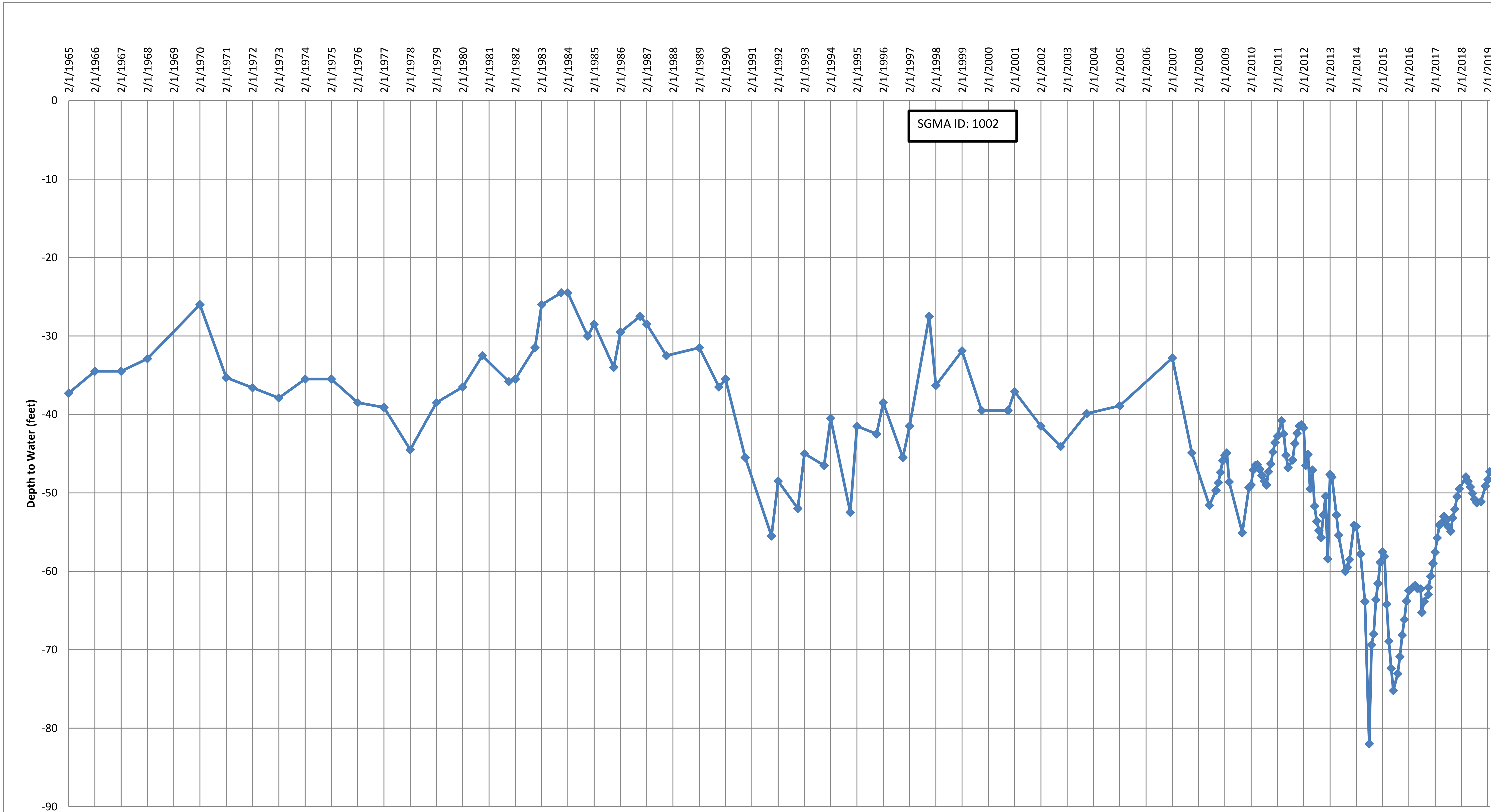


FIGURE 29 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA A

Hydrographs for two wells with construction records indicated long-term declines, and both of these wells tapped strata above the Corcoran Clay.

As part of the KDSA (2008) evaluation, water-level hydrographs for 19 wells in this sub-area were updated through 2006. Essentially the same trends were indicated as for the previous evaluation. Water levels in eight of these wells became so shallow during the 1990's, that they couldn't rise any further and began flowing. Most of these wells were in the area east of Gustine, and this situation was apparently exacerbated by the abandonment of the former drainage wells. Figure 30 is considered a representative water-level hydrograph for this sub-area. Well T9S/R9E-5R1 is CCID Well No. 14, or SGMA Well 1014. From 1965 to 2011, water levels were relatively stable. During 2012-16, water levels temporarily fell to the deepest levels of record (up to 35 feet deep). However, by Spring 2019, the water level had recovered to less than 8 feet deep.

Sub-Area C

This area includes the Volta-Los Banos area and lands to the south. Most wells in this area tap the upper aquifer, due to either limited water production capacity or poor quality groundwater in the lower aquifer. The CCID has one well in the Los Banos area that taps groundwater below the Corcoran Clay. This

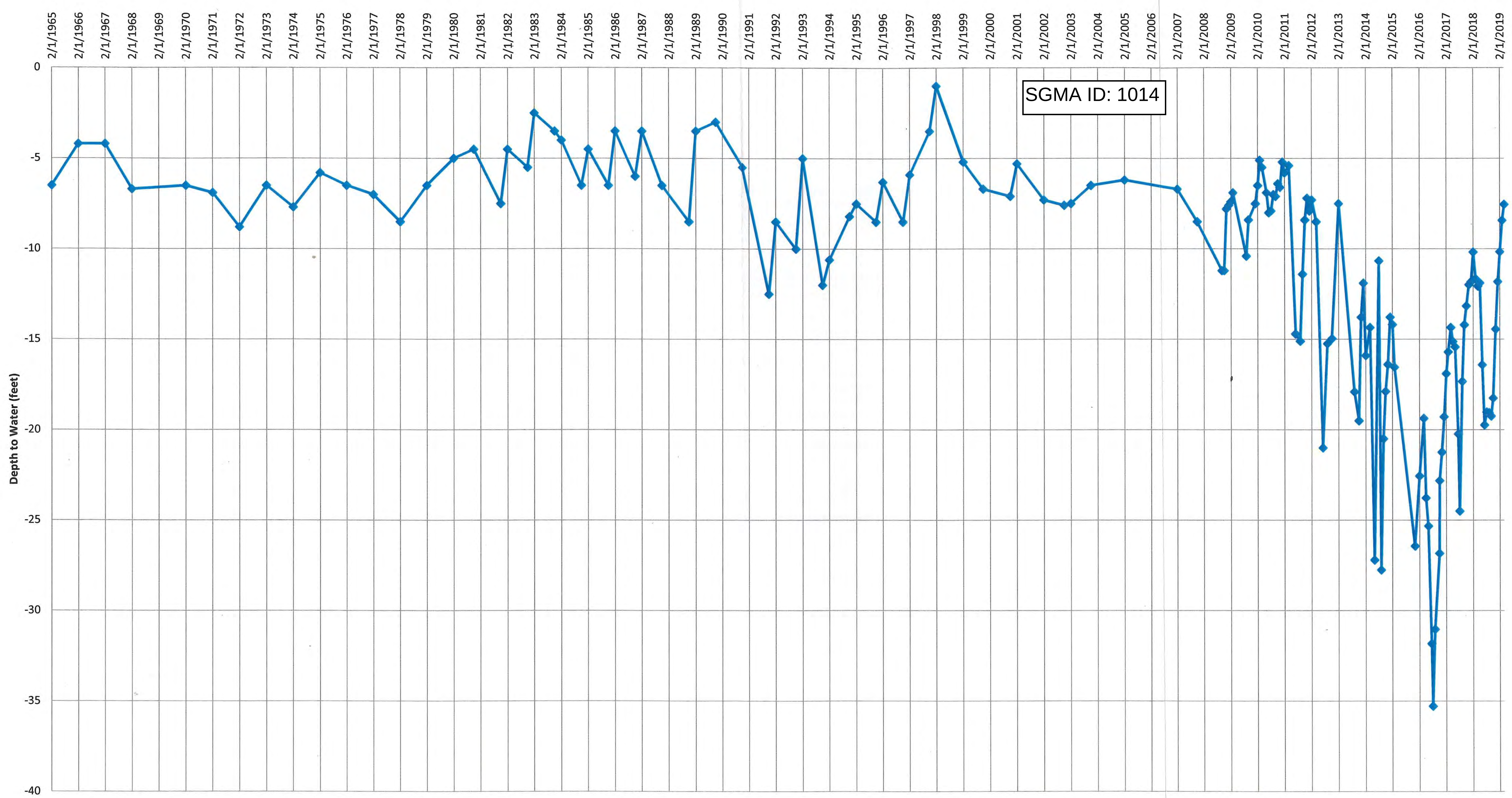


FIGURE 30- REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA B

well was installed to enable additional pumpage and not influence existing supply wells in the vicinity. Water-level hydrographs for 15 wells with construction records evaluated in 1997 indicated long-term water-levels rises (prior to about 1989). About 70 percent of these wells tapped strata above the Corcoran Clay. Hydrographs for nine wells with construction records indicated no long-term change. Almost all of these wells tapped strata above the Corcoran Clay.

As part of the KDSA (2008) evaluation, water-level hydrographs for 15 wells in this sub-area were updated through the mid-2000's. There was less evidence of rising water levels compared to the previous evaluation, and more evidence of stable water levels through the mid-2000's. Figure 31 is an updated water-level hydrograph for Well T11S/R10E-24N1 or CCID Well No. 8A (SGMA Well 1008), which is considered representative for this sub-area. Over the long-term, water levels have been relatively constant, rising during wet periods and falling during dry periods (1989-94, 2008-09, and 2013-16). Prior to 2008, the deepest water level was less than 40 feet deep. During 2008-10 the water levels temporarily fell to more than 50 feet deep and then fully recovered by Spring 2011. During 2013-16, the water level temporarily fell to more than 65 feet deep. However, by Summer 2017, the water level had recovered to a depth of 30 feet. Several ap-

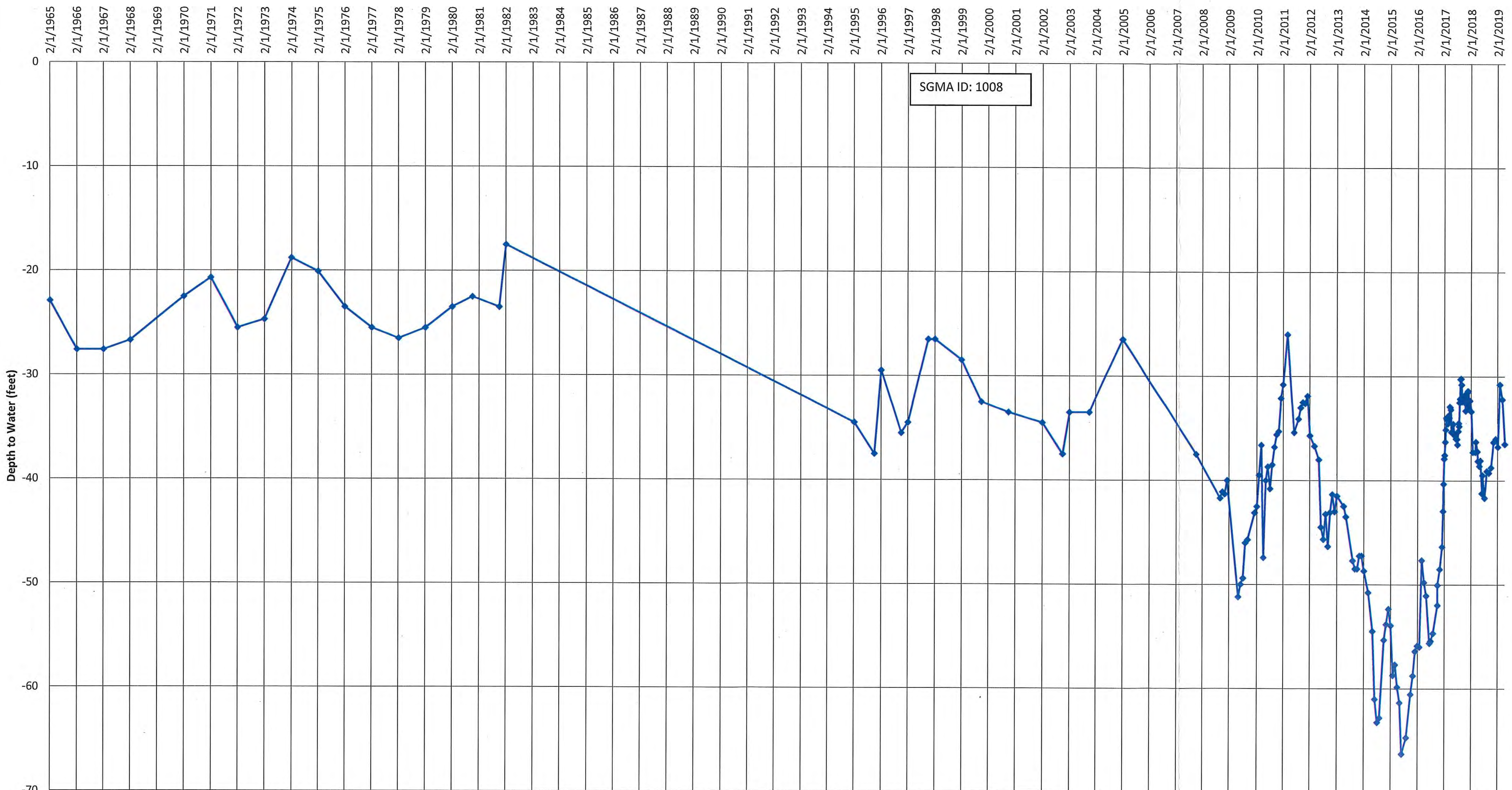


FIGURE 31 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA C

parently composite wells in the area south of Los Banos had rising water levels prior to the early 1980's, and declining water levels thereafter. These trends appear to be for the lower aquifer, and may be due to pumping of lower aquifer wells in the Panoche Water District. Although water levels in some wells in the sub-area temporarily declined during the 1976-77, and 1987-93, and 2013-16 droughts, they have been relatively stable over the long term.

Sub-Areas D & E

These sub-areas include the area in and around Dos Palos. All of the hydrographs originally prepared for these sub-areas are for wells that tap strata above the Corcoran Clay. Groundwater below the Corcoran Clay is indicated to be of poor quality in much of this area, and has seldom been used for water supply. For the 1997 evaluation, water-level hydrographs for 14 wells with construction records indicated no long-term change in water level through 1995. Hydrographs for four wells with construction records indicated long-term rising water levels through 1995.

As part of the KDSA (2008) evaluation, water-level hydrographs for 28 wells were updated through the mid-2000's. Two of those wells appear to tap the lower aquifer. The overall trend was one of constant water levels in both aquifers, and water-level rises were no longer apparent.

Figure 32 is an updated water-level hydrograph for CCID Well No. 6 or SGMA Well No. 1006, which is considered representative of Sub-area D. Overall water levels have been stable, and have temporarily fallen during droughts (1976, 2009, and 2014-16). In summer 2017, the water level was about 20 feet deep. However, by Spring 2019, the water level had recovered to a depth of less than five feet. Figure 33 is an updated water-level hydrograph for CCID Well No. 11 or SGMA Well 1011, which is considered representative for Sub-area E. Prior to 2013, no overall long-term water-level change was indicated. There was a temporary water-level decline in 1994, but the water level quickly recovered. Prior to 2013, the deepest water level was about 17 feet deep. During 2013-16 the water level temporarily fell to more than 27 feet deep. However, by Spring 2019 the water level had recovered to about 8 feet deep.

Sub-Areas F, I, & K

Sub-area I comprises the Firebaugh Canal Water District and Sub-area F is an adjacent part of the CCID known as the Camp 13 Drainage District. Sub-area K is another similar area. These areas have subsurface drainage problems, and tile drains are extensive. Because of their proximity, overall similarity, and general lack of groundwater pumping, these three sub-areas were combined for evaluation. Water-level hydrographs for six wells

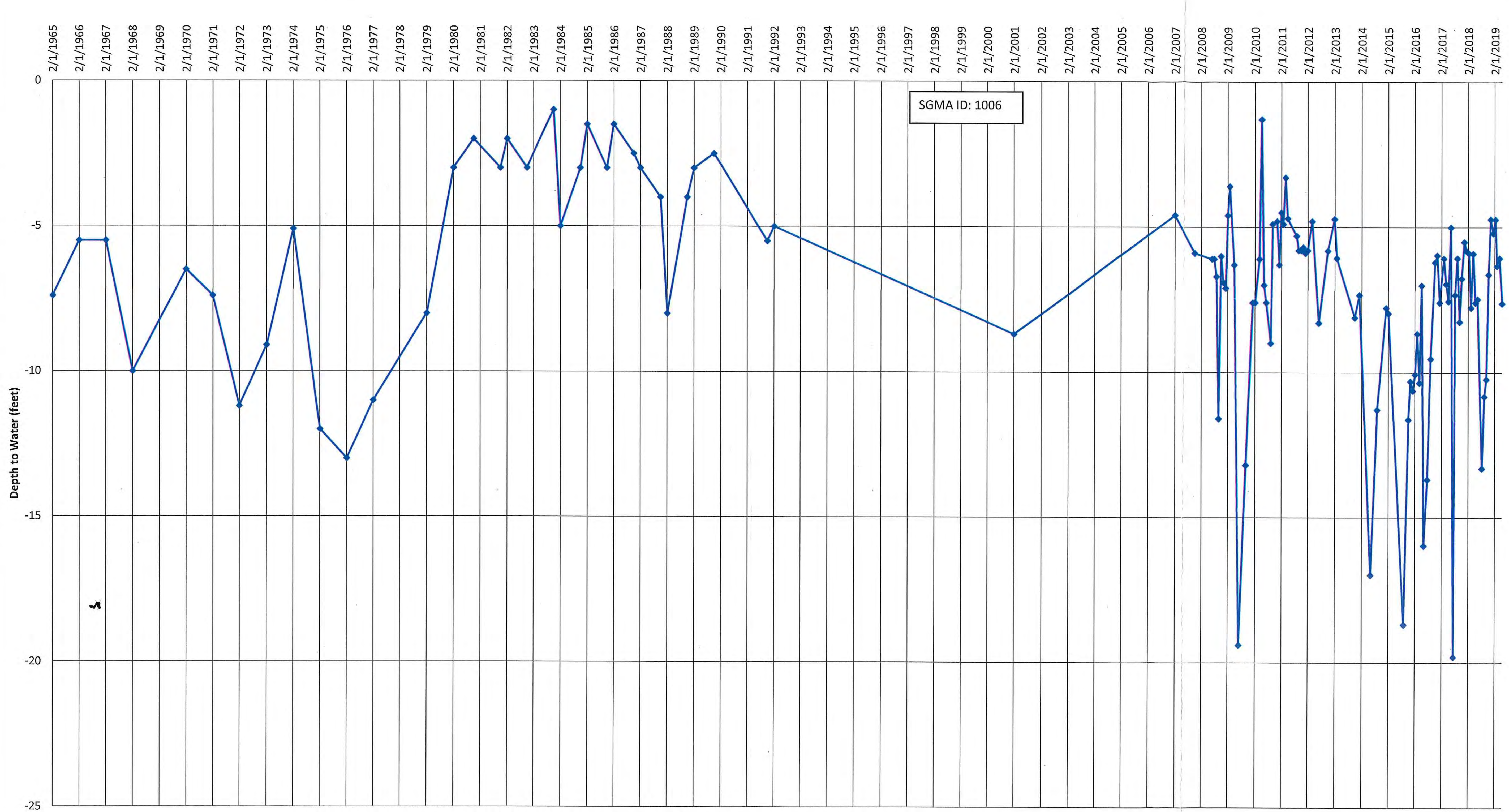


FIGURE 32 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA D

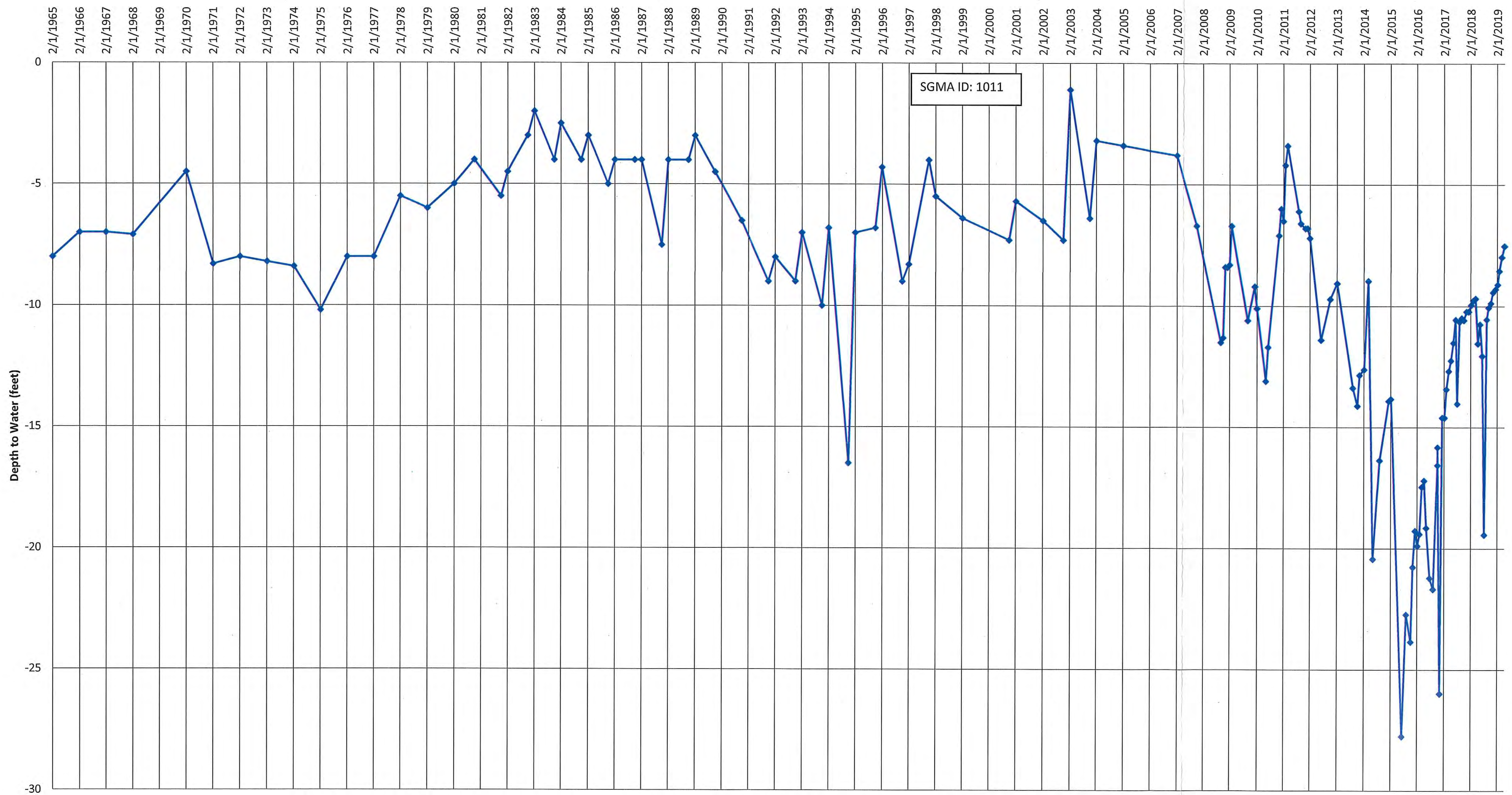


FIGURE 33 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA E

with construction records were available for the 1997 evaluation, and all showed long-term rises. The majority of these wells tapped strata above the Corcoran Clay.

Depth to water prior to 2014 was usually between about five and 20 feet. During the recent drought, the water-level fell to more than 75 feet, then recovered. Figure 34 is considered a representation of a hydrograph for an upper aquifer well near the sub-area.

Sub-Area G

This sub-area is generally west of the San Joaquin River and between Mendota and Firebaugh. All of the hydrographs prepared for this area are for wells that tap strata above the Corcoran Clay. Groundwater below the Corcoran Clay is indicated to be of poor quality in most of this area. Water-level hydrographs for about three-fourths of the wells evaluated in 1997 showed long-term rises, whereas the remainder showed no long-term change in water level (prior to about 1989). However, a pronounced trend was that in the early 1990's, water levels in a number of wells were either near the deepest or the deepest of record. For the KDSA (2008) evaluation, water-level hydrographs for 10 wells were updated through the mid-2000's. There was little or no evidence of water-level rises after 1989, and overall there was a stability in water levels. The A-clay (a shallow confining bed) in part of this sub-area confines groundwater in the upper aquifer.

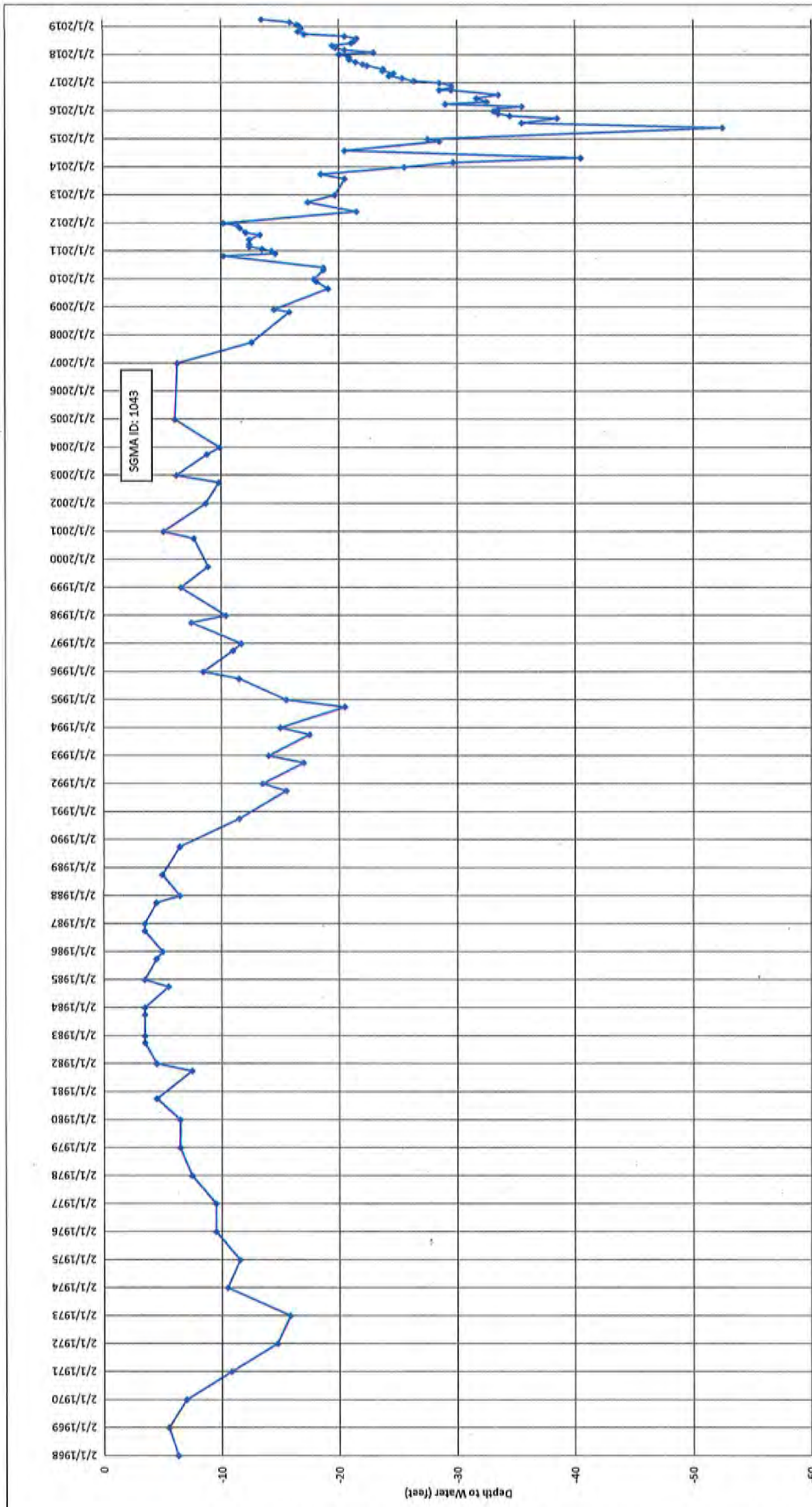


FIGURE 34 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREAS F, I, & K

There were significant water-level declines during drought periods, such as 1987 to 1993, in many wells. Figure 35 is an updated water-level hydrograph for Well CCID Well No. 5A, or SGMA 1005, which is considered representative for this sub-area. The water level in this well temporarily fell to about 55 feet deep during the 1993-94 drought, and then recovered by early 1999. During 2013-16, the water level again temporarily fell, and was about 55 feet deep in Summer 2015. However, by Spring 2019, the water level had recovered to a depth of about 18 feet. Over the long-term, water levels in this subarea were relatively stable prior to 1991. However, water levels after 1990 were deeper by an average of about 20 to 25 feet. Part of this is attributed to pumping by the Mendota Pool Group and other private wells in the Headgate Area, starting in the early 1990's.

Sub-Area H

This sub-area comprises the San Luis Canal Company (SLCC) service area. Water-level trends in this area weren't evaluated by KDSA (1997). Almost all wells in this area tap the upper aquifer. As part of the KDSA (2008) evaluation, water-level hydrographs were prepared by CCID for 17 wells, which records extending from 1959 to the mid-2000's. These hydrographs showed relatively constant water levels during this period. Water levels in some wells temporarily declined during the 1987-93 drought, but subsequently recovered. Updated water-level hydrographs by the

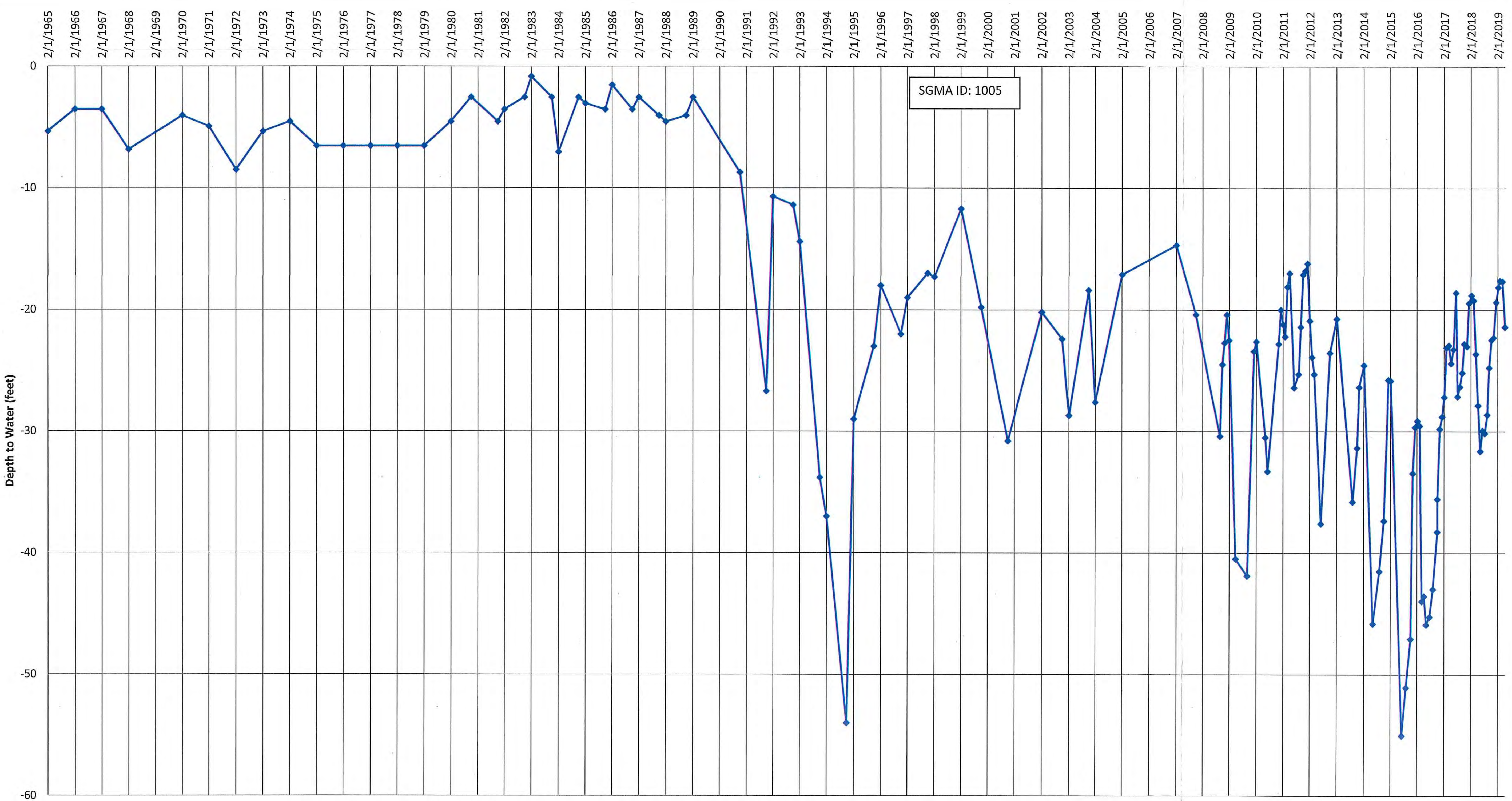


FIGURE 35 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA G

SLCC show no indication of groundwater overdraft in this area. Figure 36 is an updated water-level hydrograph for Well T9S/R12E-32N1 or SGMA Well 2759, which is considered representative for this sub-area. The water level in this well temporarily fell to a depth of about 32 feet during the 1976-77 drought, then quickly recovered. The water level in this well temporarily fell during 2006 and 2008 to between 20 and 23 feet deep, and then recovered. Water levels in this well have been stable over the long term through early 2013.

Sub-Area J

This sub-area comprises the Columbia Canal Co. service area. Irrigation wells in this area primarily tap the upper aquifer, although some deeper wells also tap the upper part of the lower aquifer. Water-level trends in this sub-area were also not evaluated by KDSA (1997). As part of the KDSA (2008) evaluation, water-level hydrographs, extending from the early 1950's to the mid-2000's were prepared for ten wells. Water-level hydrographs, extending from the late 1970's or 1980 to the mid-2000's, were also prepared for 19 other wells. Most of the hydrographs extending back to the 1950's showed water-level declines. Water levels in a number of these wells declined significantly during

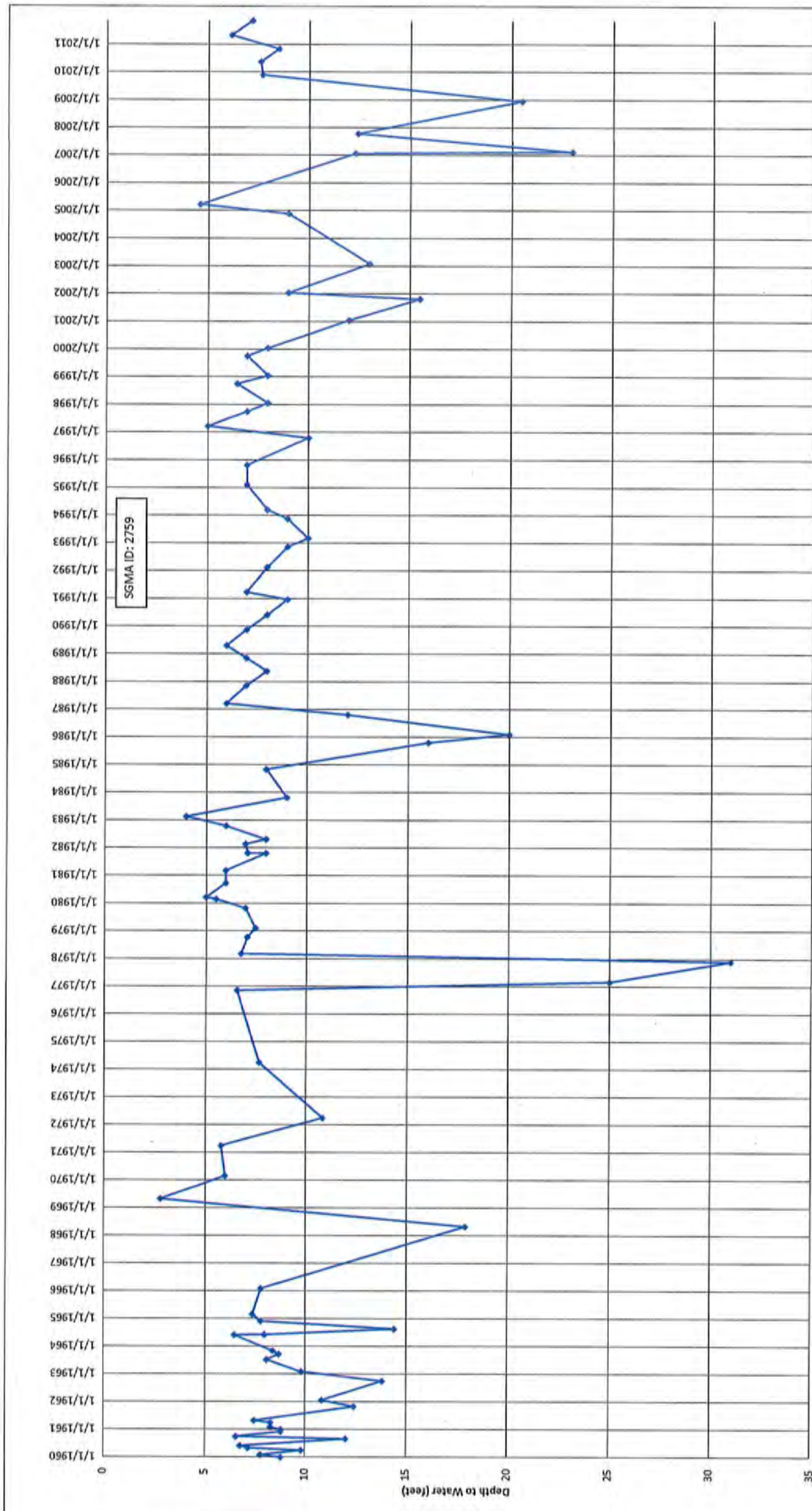


FIGURE 36 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA H

the 1970's and during the 1987-93 drought, but then subsequently partially recovered. Water-level hydrographs for wells that extended from the late 1970's or 1980 appeared to indicate more stable water levels, however many indicated slight water-level declines, particularly after about 1989. This was believed to be partly due to increased pumping in areas east of the Columbia Canal Co. service area, and some was due to MPG pumping near the San Joaquin River.

Figure 37 is a water-level hydrograph for SGMA Well 3199, which is considered representative for this sub-area. The water level in this well was relatively stable from 1980 to 1990. The water level temporarily declined during the 1991-94 drought, during 2002-2003, and during 2014-15. The water levels in this well averaged about five feet lower after 1990 and through 2008. The water level hadn't fully recovered by Spring 2017. Overall, the water level fell about seven feet between Spring 2008 and Spring 2017, or an average of about 0.8 foot per year. In summary, slightly declining water levels have been the predominant trend in Sub-area J, and part of these declines are due to pumping in adjoining areas outside of the sub-area. CCC has completed their canal lining conservation projects, which have substantially reduced pumpage in their service area since 2017.

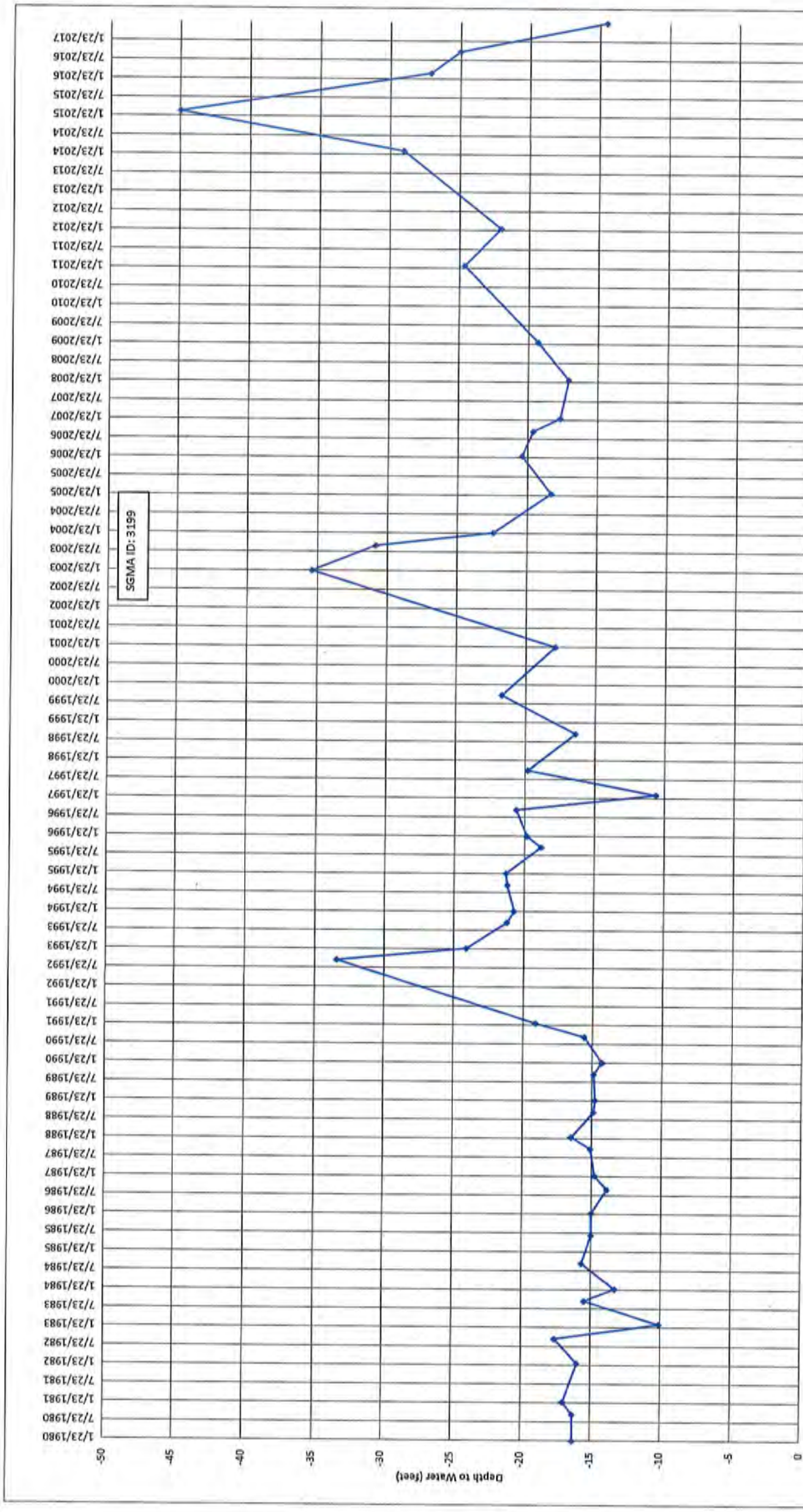


FIGURE 37 - REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN SUB-AREA J

Vertical Head Differences

Vertical head gradients between the upper and lower aquifers can be determined by dividing the difference in water level or hydraulic heads between the aquifers by the thickness of the Corcoran Clay. To determine vertical head differences, water-level elevation maps for the upper and lower aquifers were compared and the differences contoured. Such maps were prepared for Fall 1986 and Spring 1992 and showed similar results. Figure 6 of KDSA (1997b) showed head difference contours for Spring 1992. Water levels in strata below the Corcoran Clay were lower than those in strata above the Corcoran Clay throughout the area, except for a small area northeast of Newman. Head differences ranged from about 20 feet near Newman and the east edge of the north part of the Grassland Water District, north of Highway 152, to about 140 feet near the southwest edge of Area I and in the Hamburg Farms area. The head difference was about 40 feet south of Gustine, near Dos Palos, and in Area J. The head difference was about 80 feet southwest of Los Banos and near the boundary between Areas F and I. Thus overall, the head difference increased toward the southwest in the GSA.

Beneath almost all of the SJREC GSP Area there has been downward flow of groundwater through the Corcoran Clay. Vertical head differences have apparently been relatively the same during wet periods and droughts, except in some local areas, such as the Mendota Pool and Hamburg Farms areas. These head differences can be used along with the map showing the thickness of the Corcoran Clay to determine the vertical head gradients between the upper and lower aquifers in the service areas.

SOURCES OF GROUNDWATER RECHARGE

Figure 38 shows potential recharge areas, excluding groundwater flows, in the area. The major sources of recharge to groundwater above the A-Clay are seepage of water from the San Joaquin River and Mendota Pool, and deep percolation from irrigated lands. The major sources of recharge to the upper aquifer are lateral groundwater inflow, seepage from streamflow, seepage from conveyance facilities, deep percolation from irrigated areas not underlain by the A-clay, and downward flow of groundwater through the A-Clay. Lateral groundwater flows are shown on the previous water-level maps. In the area north of Washington Road, there is also recharge from upward flow through the Corcoran Clay. The major sources of recharge to the lower aquifer are downward flow through the Corcoran Clay and lateral ground water inflow.

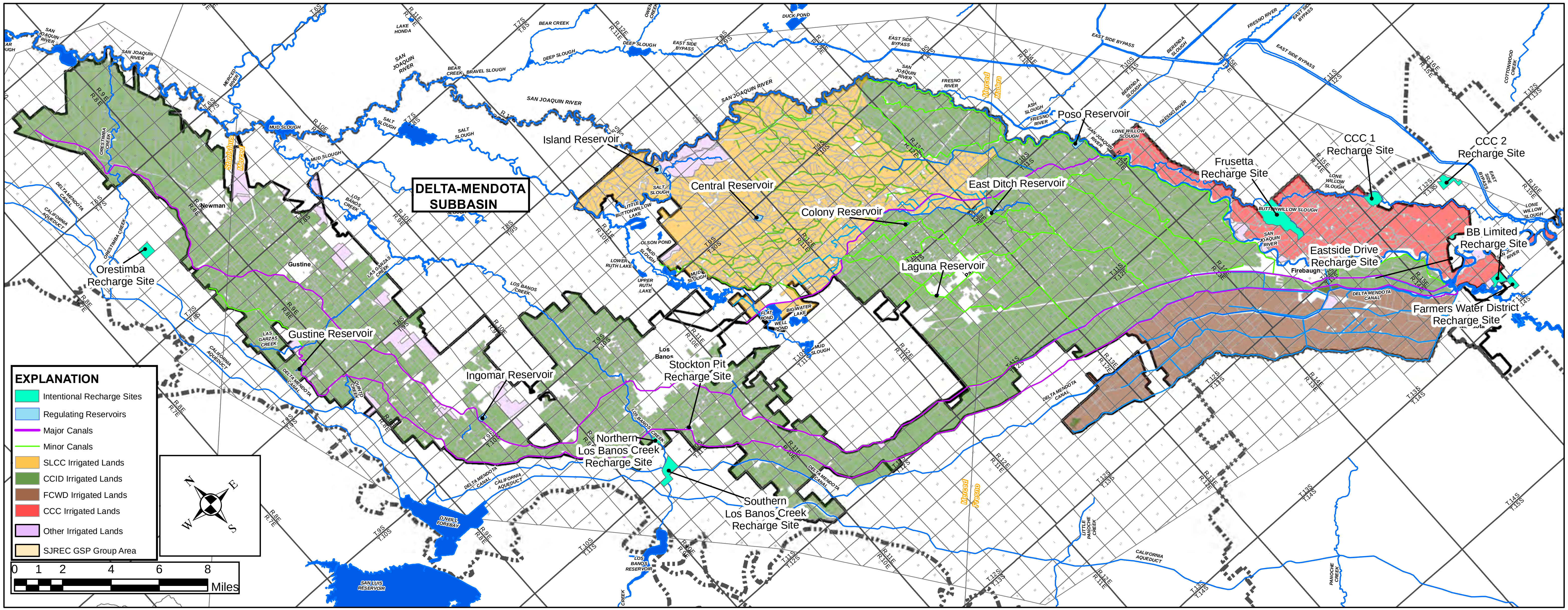


FIGURE 38 - POTENTIAL GROUNDWATER RECHARGE AREAS

Intentional recharge sites are shown in Figure 37. Included are Los Banos Creek sites, the Stockton Pit, the Orestimba Creek site, Columbia Canal Co. 1 and 2 sites, the Frusetta site, the B&B Ltd site, and the Farmers Water District site.

SOURCES OF GROUNDWATER DISCHARGE

Figure 39 shows locations of potential sources of discharge. Locations of active supply wells and drainage wells in and near the SJREC GSA are shown. For groundwater above the A-Clay, the major sources of discharge are pumpage (only in the Mendota area), downward flow of groundwater through the A-Clay, lateral groundwater outflow, flow to tile drainage systems, and direct evaporation. The major sources of groundwater discharge for the upper aquifer are well pumping, lateral groundwater outflow, and downward flow of groundwater through the Corcoran Clay. The major sources of discharge for the lower aquifer are well pumpage and lateral groundwater outflow.

AQUIFER CHARACTERISTICS

Specific capacities and aquifer transmissivities for the Exchange Contractors service area were discussed in detail by KDSA (1997a). Figure 25 of KDSA (1997a) showed specific capacities for a number of wells, as of the mid-1990's. Figure 12 of the

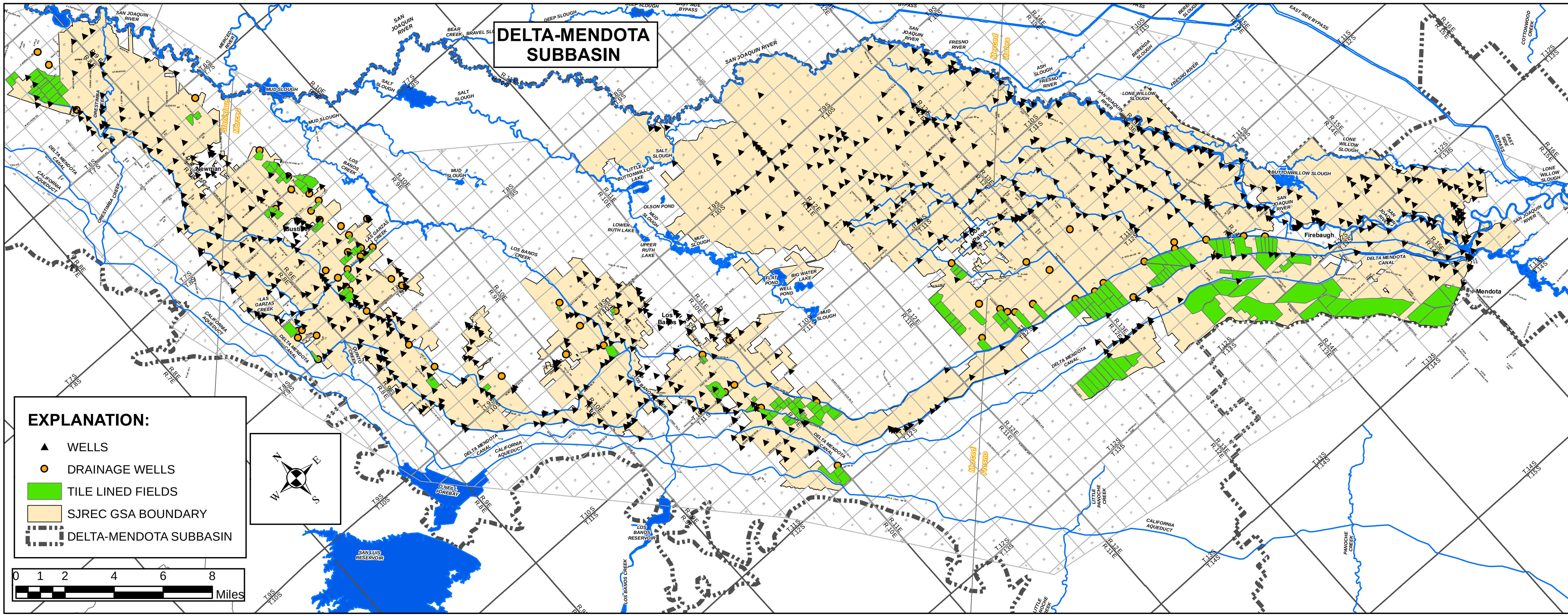


FIGURE 39 - POTENTIAL GROUNDWATER DISCHARGE AREAS

KDSA (2008) report was an updated map of specific capacities for CCID and other wells in the service area. In general, the same pattern was evident as from the previous map. Figure 40 of this report is an updated specific capacity map for 2012, and the same general patterns are evident. Almost all of these values are for wells tapping the upper aquifer, except for the area west of Crows Landing and Newman, where many tests are for composite wells. The highest specific capacities are in the south part of Sub-area B, and in Sub-areas C, G, and J. Highly permeable Sierran sands are tapped by most large-capacity water supply wells in Sub-areas G and J. High permeable deposits are also present in the Santa Nella-Volta-Los Banos area. Along the west side of the study area, higher specific capacities were common for wells located within major alluvial fans (i.e. San Luis Creek, Los Banos Creek, and Orestimba Creek.

Table 1 shows the range in specific capacities and the average specific capacity in each township and range in the SJREC GSP Group Area. Specific capacities of wells ranged from as low as 10 gpm per foot of drawdown to as high as over 170 gpm per foot. The average specific capacity of supply wells in the SJREC GSP Group Area for which records are available is about 70 gpm per foot.

Aquifer Tests Prior to 1996

The results of aquifer tests that were available in or near

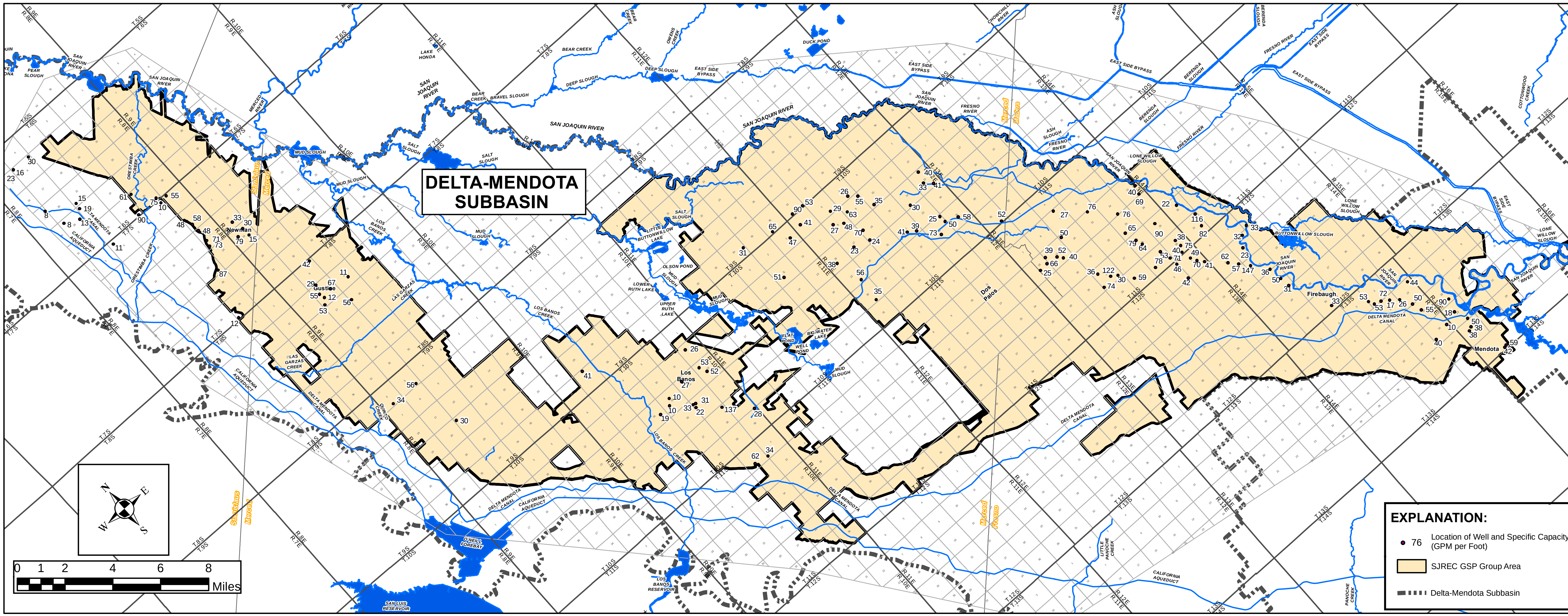


FIGURE 40 - DISTRIBUTION OF SPECIFIC CAPACITIES (2012)

TABLE 1- SPECIFIC CAPACITIES

	Specific Capacity (gpm/ft)	
Township/Range	Range	Average
T6S/R8E	61-90	75
T7S/R8E	48-87	64
T9S/R9E	30-56	40
T10S/R10E	10-176	55
T10S/R11E	-	77
T11S/R10E	34-137	84
T11S/R11E	138-171	155
T11S/R12E	58-108	83
T9S/R13E	-	68
T10S/R13E	78-103	90
T11S/R13E	25-122	63
T12S/R13E	41-79	54
T11S/R14E	22-130	87
T12S/R14E	23-147	59
T13S/R14E	10-77	42
T13S/R15E	18-160	100
City of Gustine	12-67	41
Gustine Drainage District	11-56	41
City of Los Banos	10-53	32
City of Newman	15-79	46

the SJREC Area prior to 1996 are summarized in Table 2. Seven aquifer tests had been conducted for wells tapping the upper aquifer. One of these tested wells was between Gustine and Santa Nella. Four wells that were tested near Mendota tapped strata between the C-Clay and the Corcoran Clay. The C-clay is a local confining bed between the A-clay and Corcoran Clay. Leaky aquifer tests were conducted at two sites near Mendota, which allowed determination of the vertical hydraulic conductivity of the A-clay and the storage coefficient for strata confined below the A-clay. Two other aquifer tests were conducted near Mendota on shallow wells tapping unconfined strata above the A-clay (Luhdorff & Scalmanini, 1993).

Transmissivities of strata above the A-clay near Mendota ranged from 140,000 to 280,000 per foot and averaged 210,000 gpd per foot (Luhdorff & Scalmanini, 1993). These values are for highly permeable Sierran sands. Transmissivities of strata below the A-clay and above the Corcoran Clay near Mendota ranged from about 60,000 to 260,000 gpd per foot, and averaged 120,000 gpd per foot.

The two leaky aquifer tests near Mendota both indicated a vertical hydraulic conductivity of the A-clay of 0.024 gpd per square foot. Storage coefficients for strata below the A-clay and above the Corcoran Clay ranged from $7x10^{-4}$ to $1x10^{-3}$. Prior

TABLE 2-RESULTS OF AQUIFER TESTS PRIOR TO 1996

Well No.	Date	Perforated IntervaL (feet)	Pumping Rate (gpm)	Static Level (feet)	Pumping Level (feet)	Drawdown (feet)	Specific Capacity (gpd/ft)	Transmissivity (gpd/ft)
T9S/R9E-5R1	10/67	-	-	-	-	-	58.6	83,000
T13S/R14E-24M	12/88-1/89	112-244	2,210	28.9	84.1	55.2	39	260,000
T13S/R15E-29D	4/93	50-100	630	36.0	56.4	20.4	30.9	-
T13S/R15E-29F	4/93	50-80	297	34.0	53.1	19.1	19.1	139,000
T13S/R15E-30B	9/90	180-290	770	71.3	91.9	20.6	37.5	88,000
	3/90	170-290	1,025	61.2	81.8	20.6	49.8	108,000
T13S/R15E-32M	11/88	140-260	530	37.9	46.9	9.0	59	59,000
T13S/R15E-34J1	4/81	120-216	2,000	-	-	-	-	77,000
T14S/R15E-9B	4/93	50-100	627	-	-	-	-	283,000

Results for 5R1 from Hotchkiss and Balding (1971). Results from 24M1, 30B, and 32M from files of Kenneth D. Schmidt and Associates. Results for 29D, 29F, and from Luhdorff & Scalmanini (1993) to the KDSA (1997b) evaluation, no aquifer tests were known to have been conducted to determine the vertical hydraulic conductivity of the Corcoran Clay in or near the SJREC GSA.

Results of 1996-97 Aquifer Tests

Because of the lack of previous aquifer tests in large parts of the Exchange Contractors service area, an extensive aquifer testing program was undertaken in late 1996 and early 1997. Fifteen aquifer tests were conducted between October 17, 1996 and February 6, 1997. Eleven of the pumped wells from these tests were CCID wells, and the remainder were private irrigation wells. Most of these wells were selected to provide data along the western and eastern edges of the service area, for use in groundwater inflow and outflow calculations. In general, 24-hour pumping periods were used, and several other wells in the vicinity were used as observation wells, where possible. In addition to these tests, a one-week long Leaky Aquifer Test was done in January 1997 on a well tapping strata below the Corcoran Clay. Details and graphical plots for these tests were provided by KDSA (1997b).

Twenty-four Hour Tests

The primary purpose of these tests was to provide actual transmissivity values in specific areas and to provide better conversion factors between specific capacities and aquifer transmissivities for use in other areas. In many cases observation wells either didn't tap exactly the same strata as the pumped well, or were too distant to have a drawdown useful for determing aquifer transmissivity. The corrected recovery measurements for the pumped well itself usually provide the most reliable determinations of aquifer transmissivity.

Table 3 summarizes the results of these tests. Nine of these tested wells only tapped the upper aquifer, and six others were composite wells that tapped both aquifers. Specific capacities of the tested wells ranged from 17 to 271 gpm per foot. Aquifer transmissivities ranged from about 32,000 to 500,000 gpd per foot. Transmissivities at three test sites ranged from about 400,000 to 500,000 per foot. One of these was for CCID Well No. 23A, or SGMA Well 1023, which taps highly permeable Sierran sands northwest of Mendota. The two others were CCID Wells No. 3 (SGMA Well 1003) and 51 (SGMA Well 1051), which are composite wells in the Crows Landing-Newman area. Transmissivities ranged from 37,000 to 59,000 gpd per foot at four sites: CCID Wells No. 5A (SGMA Well 1005) and 44 (SGMA Well 1044), north of Mendota, Well T12S/R15E-32B (SGMA Well 2988), a composite well east of Firebaugh, and Well T11S/R14E-19L (SGMA Well 2313), northwest of Firebaugh.

TABLE 3-RESULTS OF 1996-97 AQUIFER TESTS

Well No.	SGMA I.D.	Date	Perforated Interval feet)	Specific Capacity (feet)	Transmissivity (gpd/ft) Drawdown	Transmissivity (gpd/ft) Recovery
CCID 5A	1005	10/17/96	100-260	23	65,000	54,000
CCID 23A	1023	10/21/96	90-180	140	500,000	446,000
CCID 44	1044	10/23/96	100-280	26	75,000	58,000
CCID 41	1041	10/28/96	86-236	30	-	78,000
CCID 8A	1008	11/4/96	75-220	95	-	168,000
CCID 27A	1027	11/4/96	160-280	28	79,000	69,000
CCID 2	1002	11/6/96	90-337	55	193,000	143,000
CCID 3*	1003	11/6/96	85-355	271	400,000	-
CCID 13*	1013	12/4/96	100-415	50	192,000	172,000
CCID 45	1045	12/11/96	120-270	48	207,000	-
CCID 51	1051	12/11/96	87-477	44	388,000	440,000
T12S/R15E-32B*	-	12/17/96	210-510	17	42,000	32,000
T13S/R15E-3N*	-	1/8/97	190-430	30	97,000	77,000
T12S/R15E-10K*	-	1/30/97	210-534	54	135,000	112,000
T11S/R14E-19L	-	2/6/97	160-320	19	43,000	32,000

*Composite Well

A conversion factor of 1,500 that has been commonly used for unconfined aquifers in the San Joaquin Valley to multiply times the specific capacity to estimate transmissivity. For confined aquifers, a factor of 2,000 has been commonly used. Comparison of the specific capacity and transmissivity values for the 24-hour aquifer tests indicated a range in values from about 1,800 to 4,700, and an average of 2,850 for this factor. This higher value than commonly used is probably partly due to low to moderate well efficiencies. The effect of a lower well efficiency is to make the specific capacity smaller relative to the transmissivity (thus making the conversion factor larger). The commonly used conversion factors for unconfined aquifers were developed by the U.S. Geological Survey based on data for wells in the eastern part of the valley, many of which were open-bottomed wells at that time. Such wells have no gravel pack and often have no perforations, and are highly efficient. Gravel packed wells normally have a lower efficiency than the open-bottomed wells, due to head losses associated with the gravel and perforations. Using the average specific capacity in the SJREC GSP Group Area of about 70 gpm per foot, the average transmissivity would be about 200,000 gpd per foot. This value reflects two major factors. First is the high lateral hydraulic conductivity of the Sierran sands in the east part of the area. Second, many of the wells pump tested, particularly along the west part of the area north of Los Banos, were intentionally drilled in more favorable areas (located in major alluvial fans). These factors must be carefully evaluated when utilizing transmissivity values to determine groundwater flows in other parts of the area.

Leaky Aquifer Test

A one-week long Leaky Aquifer Test was conducted during January 13-20, 1997, along the Delta-Mendota Canal in the Hamburg Farms area. The main purposes of the Leaky Aquifer Test were to determine the transmissivity of the lower aquifer and the vertical hydraulic conductivity of the Corcoran Clay. The test site was located between Hamburg and Bennett Roads, southwest of Dos Palos about two miles northwest of the Fresno-County-Merced County line. This area was selected because drillers logs and electric logs are available for many test holes and wells in this area, and almost all wells were sealed opposite the Corcoran Clay. Also, numerous wells of relatively similar depth and perforated interval are located in relatively close proximity. The Corcoran Clay is indicated to be about 110 feet thick in this area. The DMC pumpers wells in this area pump water from below the Corcoran Clay. Except for the test, there was no significant pumpage from wells in this vicinity during Winter 1996-97. Because of this, January 1997 was an ideal time to conduct a Leaky Aquifer Test.

The pumped well was perforated from 360 to 680 feet in depth. Three nearby supply wells were used as observation wells during the test. These wells were perforated opposite similar intervals as the pumped well. A total of 34,056,400 gallons was pumped during the test and the average pumping rate was 3,406 gpm.

Theis (log-log) drawdown plots for the closest observation wells indicated no deviation from the type curve (no leakage) during the test. Based on drawdown measurements for this test, a transmissivity of 160,000 gpd per foot and storage coefficient of 0.001 were indicated to be the best values. The vertical hydraulic conductivity of the Corcoran Clay was indicated to be less than 0.001 gpd per square foot. Corrected recovery plots for these wells indicated an average transmissivity of about 140,000 gpd per foot.

The relatively low value for the vertical hydraulic conductivity of the Corcoran Clay indicated at this test site is not believed to be typical of the entire SJREC GSP Group Area for two reasons. First the clay is much thicker and more well developed at the test site than in most other parts of the area. Secondly, there were no known composite wells in the vicinity of the test site. In some parts of the area where groundwater is pumped from the lower aquifer, composite wells are present that tap both the upper and lower aquifers. Where annular seals are not present opposite the Corcoran Clay, such wells effectively allow more movement of groundwater through the Corcoran Clay.

Specific Yields

Some of the best estimates of specific yield in the SJREC GSA were provided by Davis, et al (1959) in U.S. Geological Survey Water-Supply Paper 1469. Four geographic areas considered in that report are covered by the GSP area. The northernmost part (in T7S and T8S) are in the Tracy-Patterson area, generally in Stanislaus County. The southern part is in Group I of the Mendota/Huron Area. Much of the area in Merced County is in Group 1 and 2 of the Los Banos Area. The remaining part of the GSP area (Management Area J) is primarily in the San Joaquin River area of Madera County. Specific yields were provided by Davis, et al (1959) for three depth intervals (10 to 50 feet, 50 to 100 feet, and 100 to 200 feet) and for the combined intervals. Considering the depth to the top of the Corcoran Clay, the specific yields for the combined intervals are reasonable to use to evaluate unconfined groundwater in the SJREC GSA.

A combined average specific yield of 13.5 percent was indicated for the part of the GSP in T7S and T8S. The average specific yield in Group 1 of the Los Banos Area (the western part) was 10.5 percent and in Group 2 of the Los Banos area (the eastern part) was 12.0 percent. The average combined specific yield in Group I of the Mendota-Huron area (Fresno County) was 9 percent. This was the lowest average specific yield in the GSP, and is primarily due to finer grained Coast Range deposits in this part of the GSP. Lastly the average specific yield in the Madera County part of the GSP was 14.7 percent, the highest of all values for the GSP. This reflects the predominance of Sierran sands in the subsurface of this part of the SJREC GSP Area.

Table 4 shows specific yields by management subarea. Values ranged from 9 percent in Subarea I to 14.7 percent in Sub-area J. The other values for the rest of the sub-areas range from 10.5 percent in Subarea C to 13.3 percent in Sub-areas A, B, and G.

CHANGES IN GROUNDWATER IN STORAGE

The most accurate method to estimate changes in groundwater storage is to evaluate water-level trends and specific yields for the upper aquifer (above the Corcoran Clay). Specific yields were discussed in the previous section of this report. The hydrologic base period used for this evaluation is 2003-12. The water-level trends for this period that were evaluated were for Spring 2004 and Spring 2013. The acreages of the management areas are as follows:

Management Area	Acres	Management Area	Acres
A	20,227	G	3,734
B	33,486	H	47,336
C	34,508	I	23,794
D	10,392	J	17,062
E	54,633	K	3,578
F	6,740		

TABLE 4- SPECIFIC YIELDS FOR UPPER AQUIFER
IN MANAGEMENT SUBAREAS OF SJREC GSA

Sub-Area	Specific Yield (percent)
A	13.3
B	13.3
C	10.5
D	12.2
E	12.2
F	11.5
G	13.3
H	12.2
I	9.0
J	14.7
K	11.0

Specific yields were derived from data presented in U.S. Geological Survey Water-Supply Paper 1469 by Davis et al (1959)

Water-level hydrographs covering this base period have been prepared for a number of CCID wells in Management Areas A, B, D, E and G and were presented in the 2017 CCID pumping program report by KDSA (2018). In Area A, records were available for six wells, in Area B records were available for three wells, in Area D records were available for 15 wells, and in Area G records were available for eight wells. In the remaining areas, representative water-level hydrographs presented earlier in this report were used.

Based on this information, the following average water-level changes occurred between Spring 2003 and Spring 2013.

Management Area	Water-Level Change (ft/yr)	Management Area	Water-Level Change (ft/yr)
A	-0.6	G	-0.3
B	-0.1	H	0
C	-0.8	I	0
D	-0.7	J	-0.5
E	-0.7	K	-0.6
F	0		

Following are the average annual groundwater storage changes by management area between Spring 2003 and Spring 2013.

Management Area	Change in Storage (AF/yr)	Management Area	Change in Storage (AF/yr)
A	-1,600	G	-150
B	-450	H	0
C	-3,050	I	0
D	-850	J	-1,300
E	-4,600	K	0
F	0		

The combined average decrease in storage, or the groundwater overdraft, between Spring 2003 and Spring 2013 was 11,950 acre-feet per year. The period selected (2003-12) was to comply with the DWR SGMA requirement to use a recent base period for the water budget. It should be noted that this period was slightly below average in terms of average surface water supplies to the CVP Contractors west of the SJREC GSA. Overall, the small storage decreases indicate little overdraft in the service area. Figure 41 shows the average annual changes in storage in the management areas for 2003-12.

LAND SURFACE SUBSIDENCE

The land surface can irreversibly subside when water levels in confined aquifers decline and interbedded fine-grained confining beds are compacted. Subsidence begins when the water surface in the aquifer falls below a certain threshold level. The rate of subsidence depends on how far water levels fall below that level, how long they remain there, and the characteristics of the sediments. Grain size is the most important sediment characteristic (Meade, 1968). Observations in the San Joaquin Valley indicate that subsidence began when water levels dropped more than about 100 feet below the earliest measured levels. Subsidence due to pumping from above the Corcoran Clay has been demonstrated to be reversible at two Mendota area compaction recorders. That is, compaction occurs during seasonal pumping periods, and then the

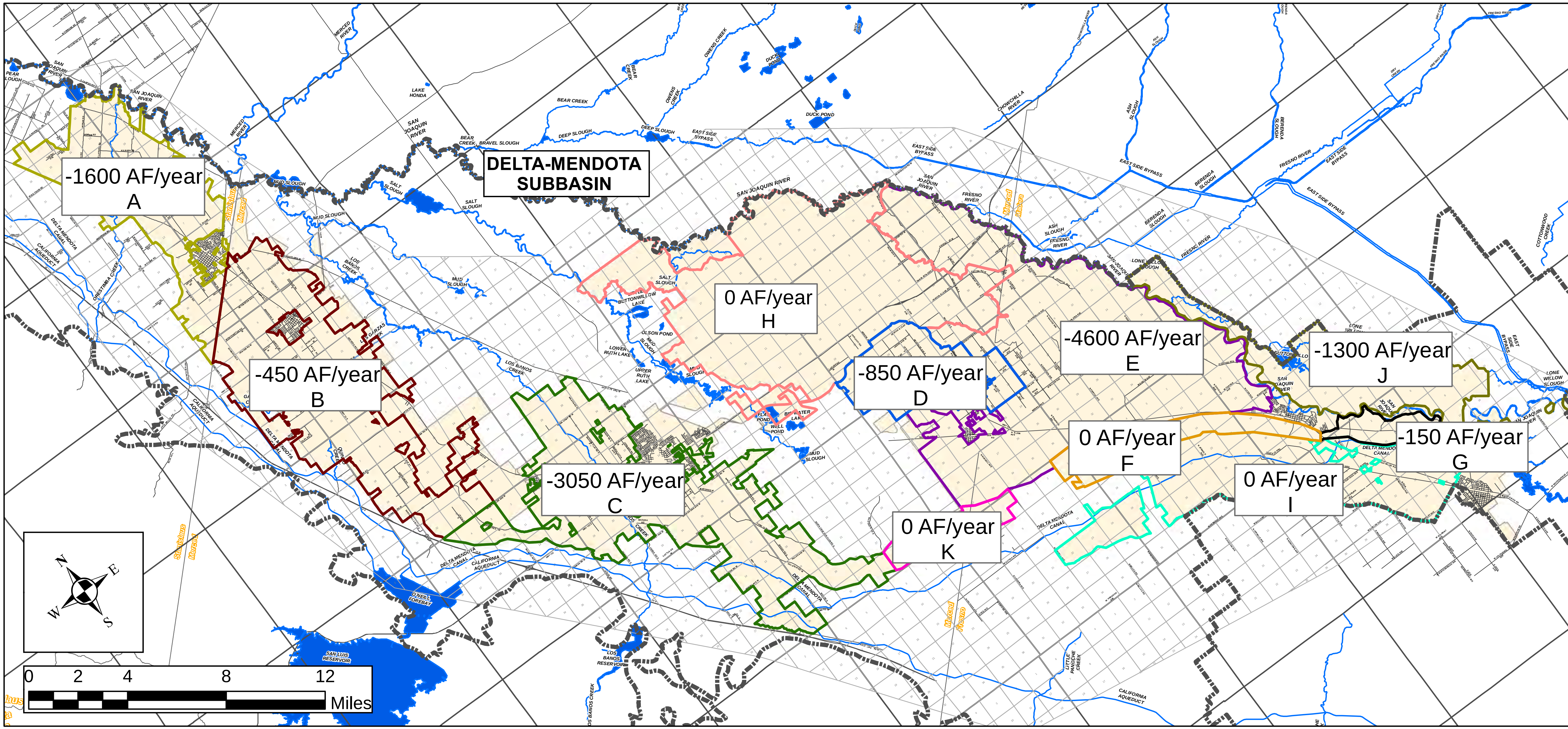


FIGURE 41 - AVERAGE ANNUAL CHANGE IN GROUNDWATER STORAGE FOR UPPER AQUIFER FROM 2003-2012

land surface rebounds during subsequent non-pumping periods. Subsidence was measured extensively in the part of the SJREC GSA south of Los Banos by the U.S. Geological Survey for many decades. The total land subsidence between 1926 and 1972 (taken from U.S. Geological Survey Professional Paper 437-I by Ireland, Poland, and Riley, 1984) ranged from one to 12 feet in the part of the GSA south of Los Banos.

From 1972 until about 2010, much less information was available on land subsidence than for the previous decades. This was because once water from the San Luis Canal (California Aqueduct) became available, it was thought that the subsequent decrease in pumpage would essentially eliminate overdraft and land subsidence. However, by the drought of the early 1990's, it had become apparent that subsidence was continuing. Some information has been available for the settling of some canals and other features. The Delta-Mendota Canal and CCID Outside Canal have required extensive repairs due to subsidence, and the repair or replacements of Mendota Dam and Sack Dam are being considered. Figure 42 shows present land subsidence monitoring sites in the area, including compaction recorders and GPS sites, DMC land surface points, and SJRRP land surface points. Figure 43 shows land subsidence along the CCID Outside Canal from 1960 to 2017 between the head of the Canal near Mendota Dam to Highway 152. The total subsidence was about four feet near the head of the canal, near and north of Nees Avenue, and near the county line.

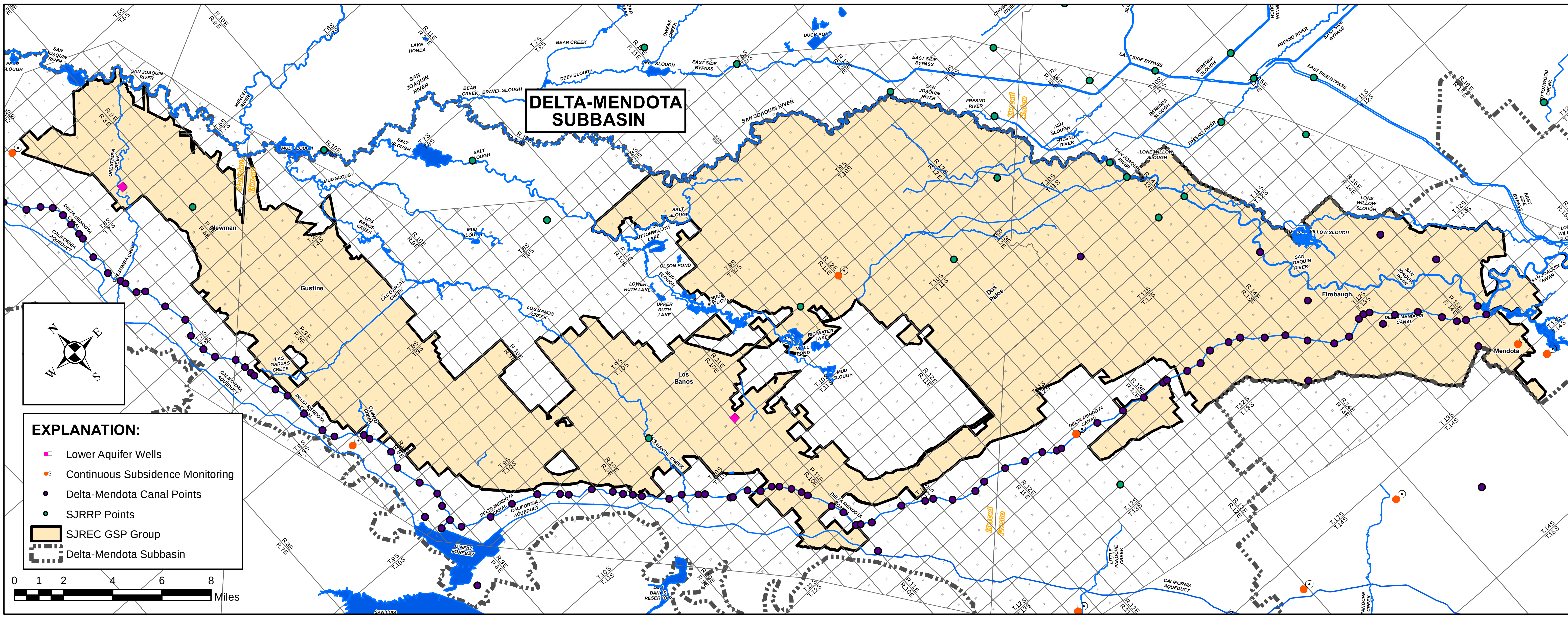
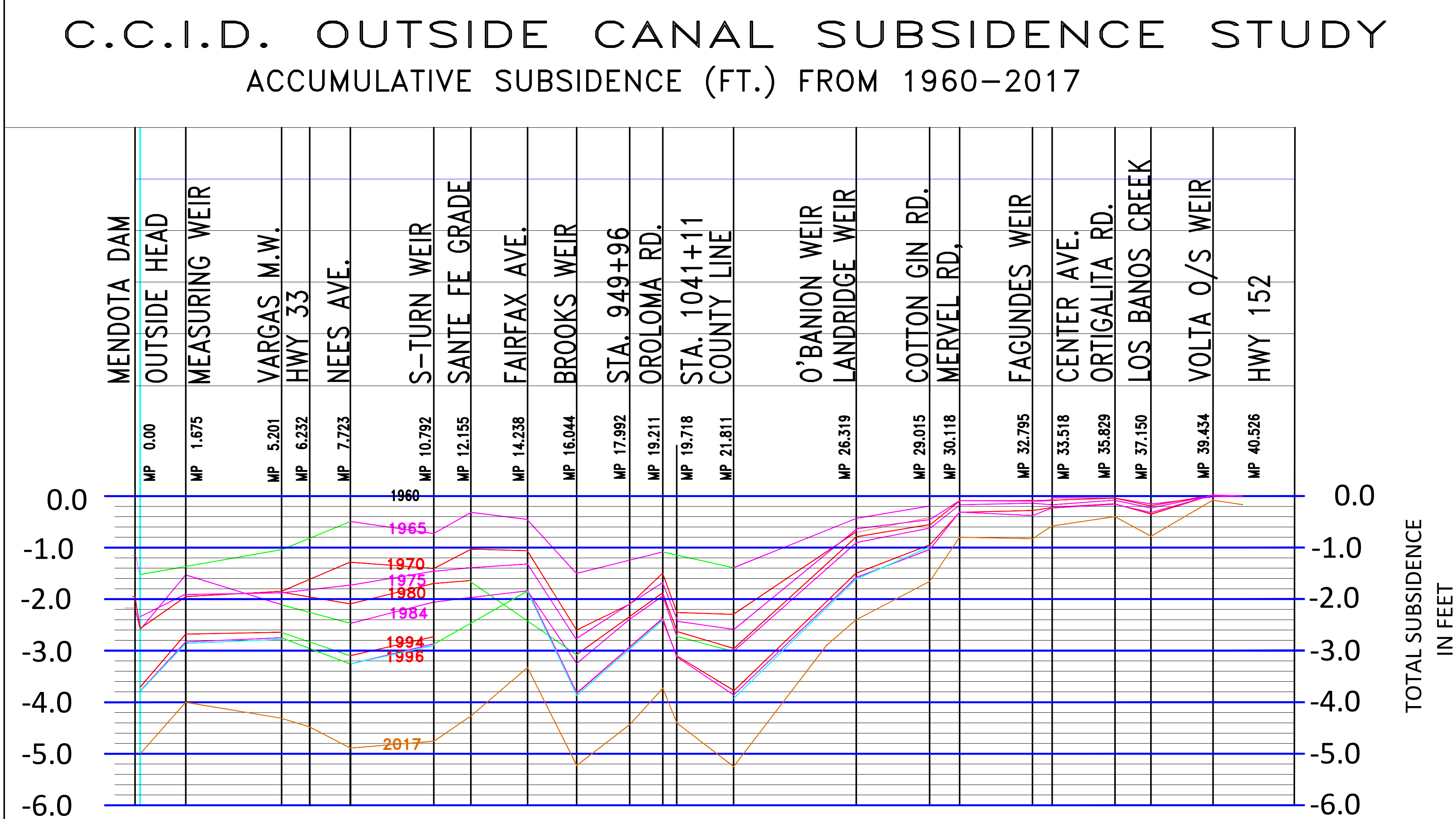


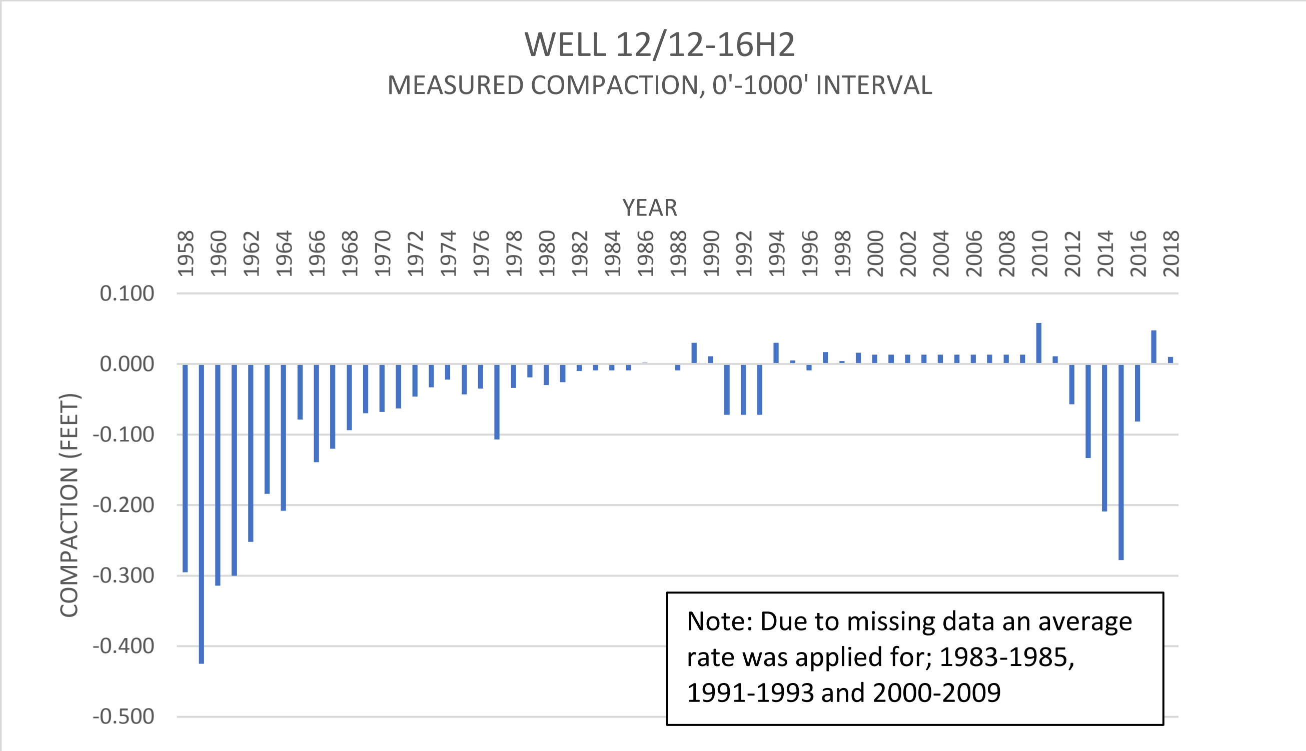
FIGURE 42 - SUBSIDENCE MONITORING POINTS



BASED ON 1960 M&L ENGINEERING ELEVATION DATA
12/1960 TO 1/1996 IS BASED ON WATER LEVEL MEASURED FROM BENCHMARK
TO THE WATER SURFACE OF THE CANAL
A GREEN LINE CONNECTS MILEPOSTS ON EACH SIDE OF A MILEPOST THAT HAD NO DATA
BEDROCK ENGINEERING LAND SURFACE SURVEY 2017

FIGURE 43 - BENCHMARK ELEVATIONS ALONG OUTSIDE CANAL (1960-2017)

There have been adequate water-level declines to cause subsidence in the Crows Landing-Newman area. The partial submergence of Anderson Road Bridge over the Main Canal indicates that there has been at least a foot of subsidence just south of Orestimba Creek. A number of recorders were installed in the San Joaquin Valley several decades ago, to allow the rates and amounts of compaction of strata at different depth intervals to be evaluated. One of these recorders (Russell Avenue or Ora Loma) is in the area (T12S/R12E-16H or SGMA ID's 10255, 10256, and 10257). Annual rates of compaction of the deposits between the ground surface and 1,000 feet near Russell Avenue and the DMC are shown on Figure 44. Since 1975, compaction and subsidence rates were relatively low, except during drought periods (1976-77, 1990-93, and 2012-15). Compaction rates declined after deliveries from the San Luis Canal/California Aqueduct began in 1968 and pumpage from outside the SJREC GSP Group was subsequently reduced. Near Russell Avenue, 93 percent of the measured compaction during 1958-82 was in strata below the top of the Corcoran Clay. Water-level hydrographs are shown for well 16H5 (perforated from 670 and 712 feet) and 16H6 (perforated from 770 and 909 feet). Figure 44 indicates that water levels do not need to be drawn down below historic lows, for compaction to resume. Data for 1987-92 are incomplete, because by this time, much of the subsidence and compaction monitoring had been discontinued. The compaction in the depth interval above the Corcoran Clay has not been monitored at this recorder since 1982.


WELL 12/12-16H2
MEASURED COMPACTION, 0'-1000' INTERVAL
YEAR
COMPACTION (FEET)
Note: Due to missing data an average rate was applied for; 1983-1985, 1991-1993 and 2000-2009

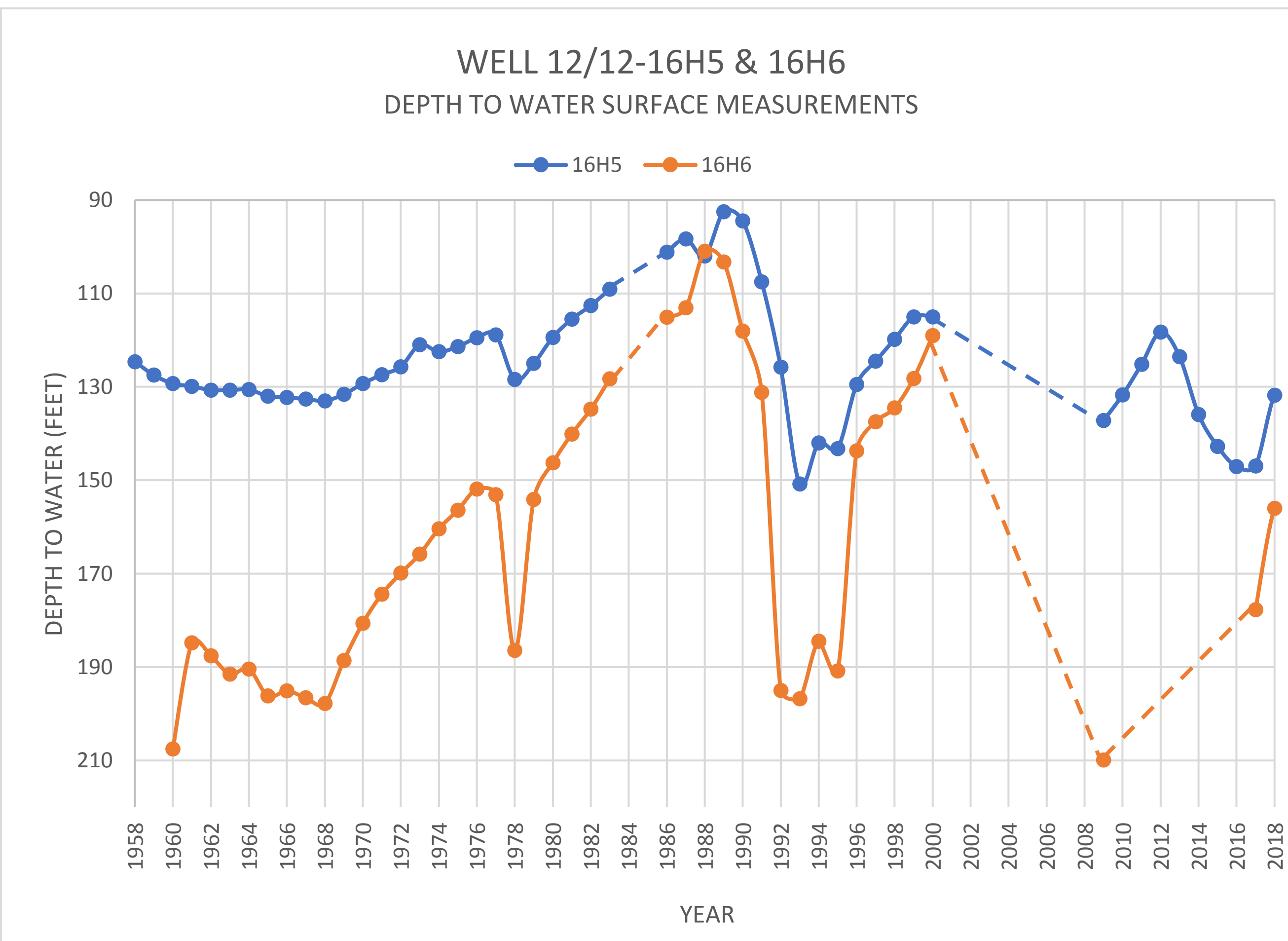

WELL 12/12-16H5 & 16H6
DEPTH TO WATER SURFACE MEASUREMENTS
16H5
16H6
DEPTH TO WATER (FEET)
YEAR

Figure 45 shows land subsidence along the Delta Mendota Canal between the head of the canal and Check 21 (Mile Post 116.48). The greatest subsidence (about 0.5 to 0.6 feet) was near Check 6, between Checks 7 and 11, near Check 14, and between Checks 17 and 19.

Highway 152 Transect

Periodic surveys of land surface elevations have been done along Highway 152. Figure 46 shows land surface subsidence along this section between 1972 and 2017. The maximum subsidence (about 9.1 feet) occurred near the Eastside Bypass. In the area west of Turner Island Road, most of the subsidence apparently occurred after 1988. In contrast, along the east part of the transect, significant subsidence occurred before 1988. This is because irrigation wells tapping the lower aquifer were generally installed earlier in this area.

Sack Dam-Red Top Area

The Sack Dam-Red Top Area was near the north edge of historical land subsidence studies in the San Joaquin Valley by the U.S. Geological Survey. More recent subsidence monitoring has been undertaken in parts of the valley during the past eight years, due to the reoccurrence of land subsidence.

A number of land surface elevation surveys have been done in this area since 2008. Data for 2008 and 2010 were used to prepare a contour map (Figure 47). Land subsidence during this period

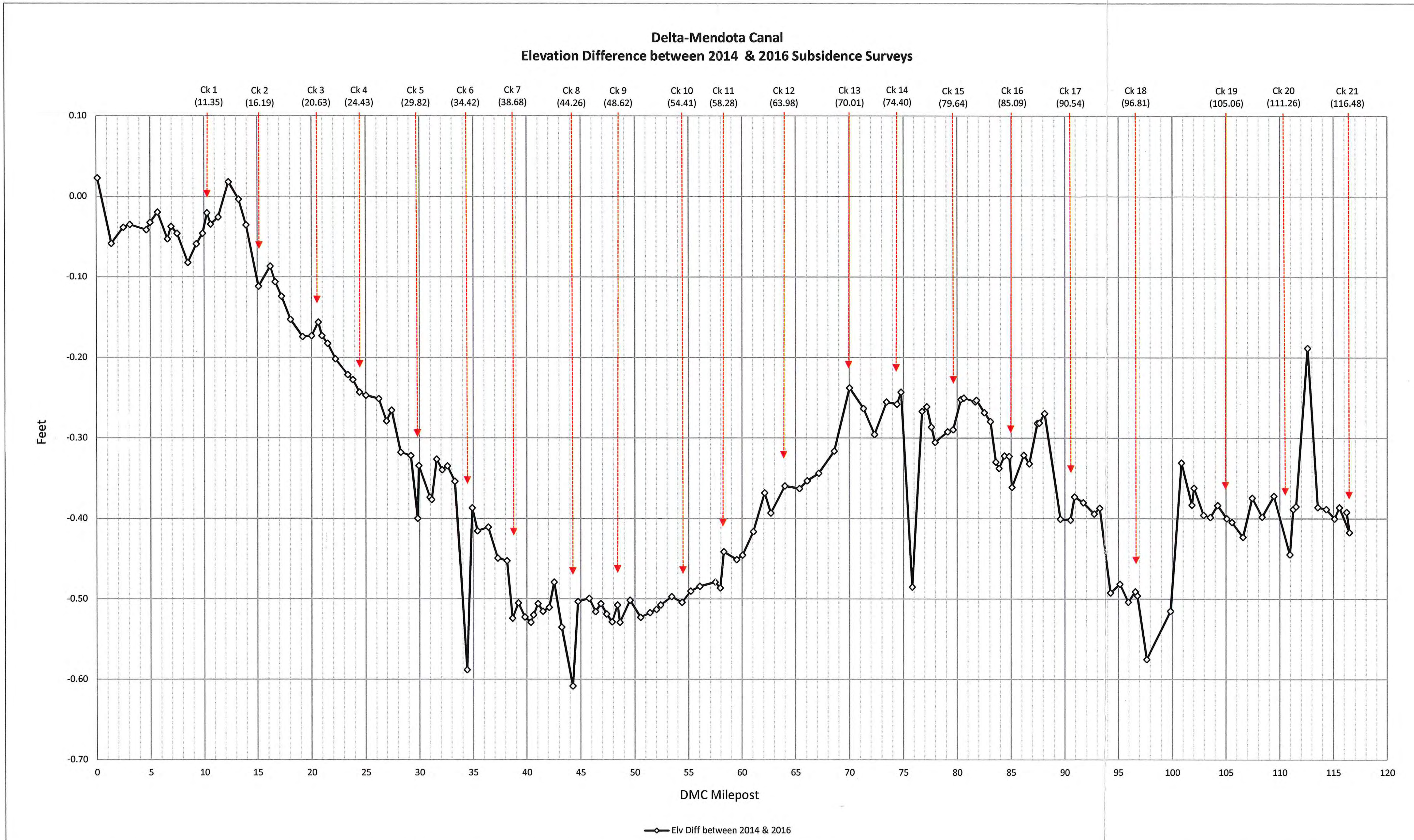
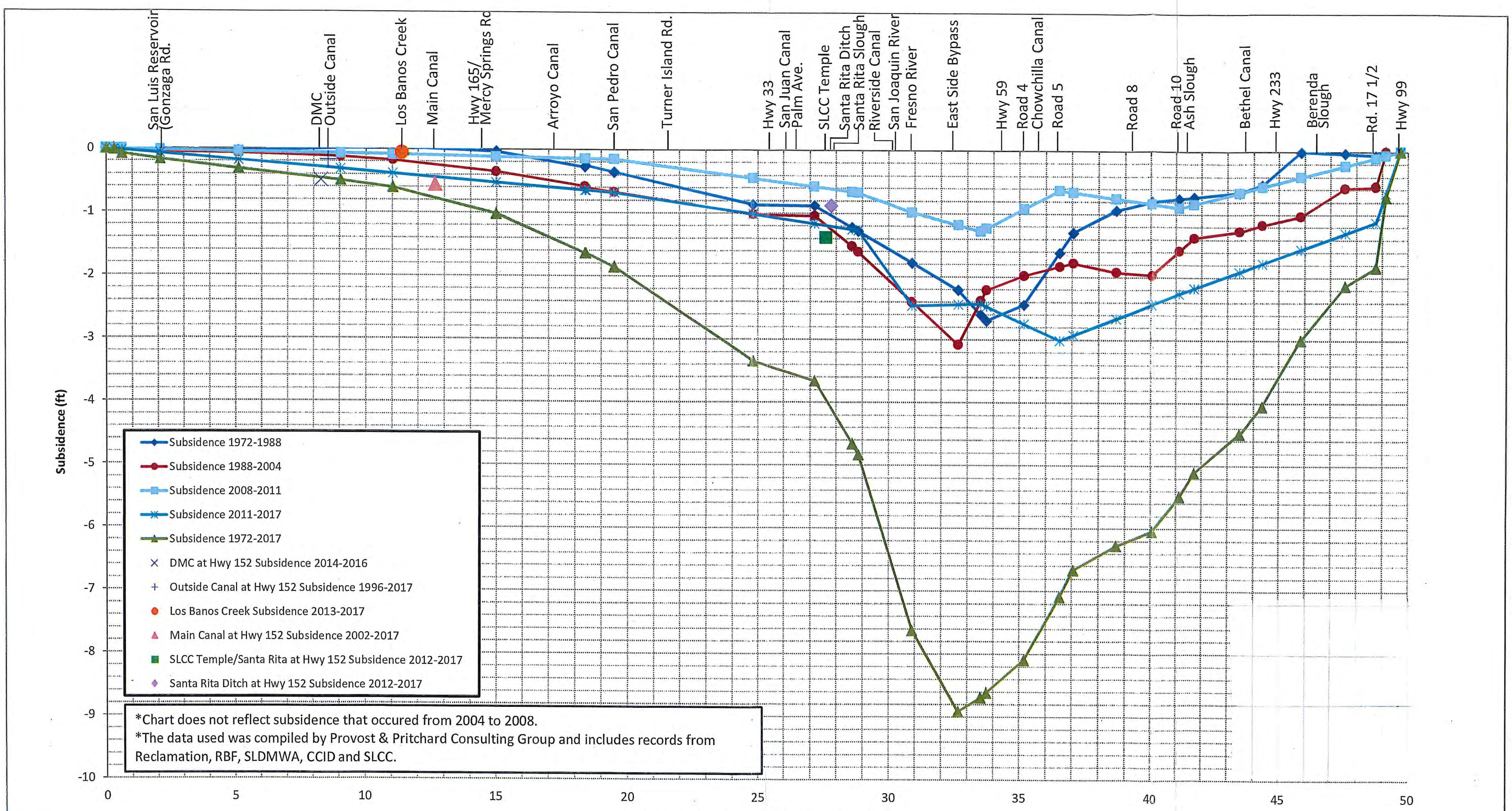
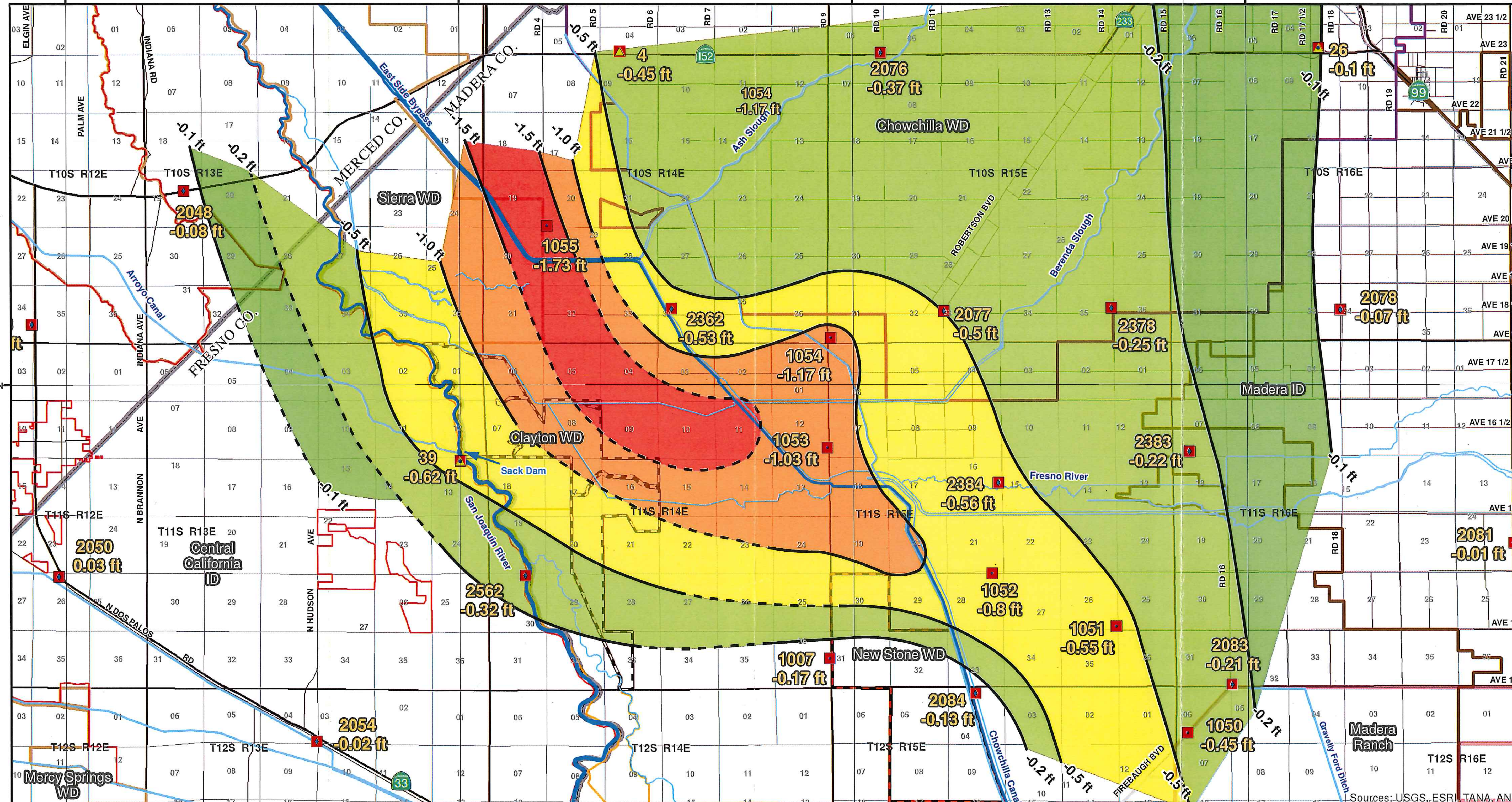


FIGURE 45-LAND SUBSIDENCE ALONG DELTA-MENDOTA CANAL (2014-16)



Source:
Elevation change computed from report geodetic surveys along Highway 152 from Caltrans, edtied by Bureau of Reclamation.

FIGURE 46- HISTORICAL LAND SUBSIDENCE
ALONG HIGHWAY 152 TRANSECT



0 4,500 9,000 Feet

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

In Association with Kenneth D. Schmidt & Associates

Legend

- County
- Township/Range
- Major Canal / Slough / River

Elevation Change (Feet)

- -0.1 to -0.2
- -0.2 to -0.5
- -0.5 to -1.0
- -1.0 to -1.5
- -1.5

*Points Surveyed 06-29-2010
Labeled By Change In Elevation (ft) Since 2008

- AT Point
- Primary Control Pt
- Primary/AT Point
- Secondary Control Pt

2008 to 2010 Change in Elevation of Ground Surface from TO19 Preliminary Subsidence Map

*Data from RBF Consulting Co. Map for California Flood Safe July 13, 2010

Date: August 27, 2012

FIGURE 47-LAND SUBSIDENCE IN RED TOP-EL NIDO AREA (2008-10)

exceeded 1.5 feet along a northwest-southeast trending area passing through the north end of the Triangle T Ranch (north of Avenue 16), and extending to the northwest (including Vlot Farms). Land subsidence exceeded 1.0 foot during 2008-10 southwest of the Eastside Bypass, between Avenues 14 and 21. Land subsidence west of the San Joaquin River was indicated to usually be less than half a foot, except near Sack Dam (0.62 foot). Land subsidence during this period exceeded half a foot over a fairly large area east of the river, extending south to Avenue 12 and north to past Highway 152. Much of the greatest subsidence was in the western part of the Chowchilla W.D., west of the Madera I.D., and in other undistricted areas east of the San Joaquin River. Surface water supplies in these areas have been limited, particularly during drought periods, and thus groundwater has been heavily used.

An agreement was developed between the landowners east of the San Joaquin River and the CCID and SLCC (west of the river) to undertake a program to decrease subsidence in the Sack Dam-Red Top area. Measures undertaken include:

1. Provision of surface water to part of the area, to reduce lower aquifer pumpage.

2. Constructing new shallow wells to tap groundwater above the Corcoran Clay. Pumping of this water isn't prone to subsidence.
3. Implementation of intentional recharge projects to recharge the upper aquifer and make its yield more sustainable.
4. Avoiding constructing new deep wells tapping the lower aquifer, and not pumping existing lower aquifer wells, to the extent possible.

Recent land subsidence surveys indicate that the program has been highly successful.

Figure 48 shows land subsidence in and near the SJREC GSP Group Area for December 2013-2017. This map indicates that subsidence exceeded about 0.5 foot during this period in a large area. This area extended to within about five miles of Merced on the north, to near Chowchilla and Madera on the east, to near San Joaquin on the south, and to near Dos Palos and Firebaugh on the southwest. Subsidence rates ranging from about 1.5 feet were primarily in the Sack Dam-Red Top area and to the southeast.

GROUNDWATER QUALITY

The chemical quality of the groundwater along the west part of the GSP area is influenced by the chemical quality of west-

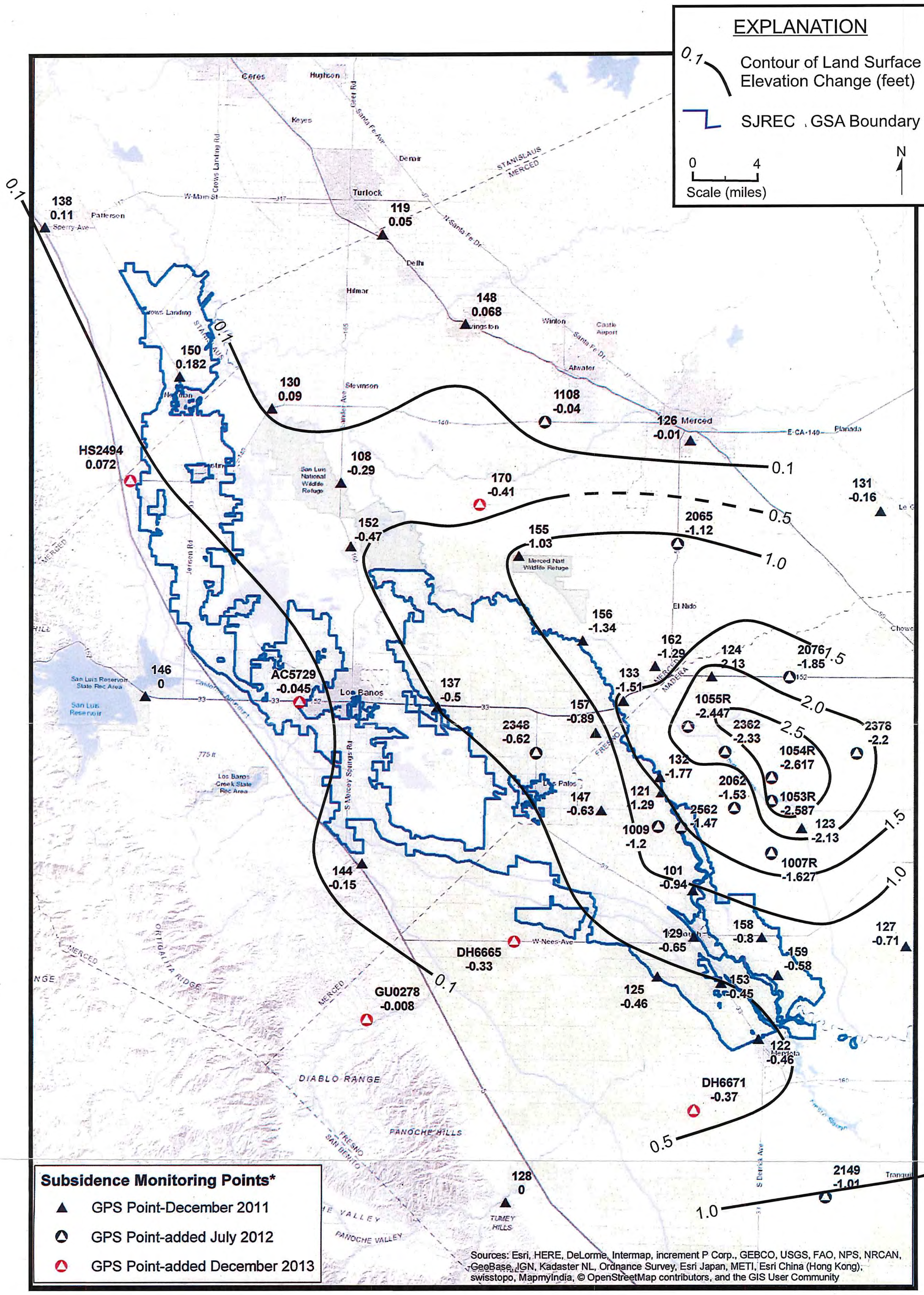


FIGURE 48- CHANGE IN GROUND SURFACE ELEVATIONS (FEET) FOR 12/13-12/17

side streams. Davis (1961) showed that the chemical quality of water for the west-side streams can be closely correlated with the geologic units in their respective drainage basins. Streams that drain basins that are chiefly underlain by sedimentary rocks of Cretaceous age and by the Franciscan Formation generally contain a high proportion of bicarbonate. The water from west-side streams in much of the area north of Los Banos is mostly bicarbonate in character. Streams that drain basins that are underlain by Tertiary marine formations contain a high proportion of sulfate and/or chloride. The dominant cations in most of the west side streams are calcium and sodium. Where serpentinized rocks are exposed, the streamflows have high magnesium concentrations. The quality of the groundwater along parts of the east edge of the GSP area is influenced by seepage from the San Joaquin River and the Eastside Bypass. This water is of low salinity and bicarbonate is the major anion. Because DMC water has been used for irrigation for many decades, the quality of this water has influenced groundwater quality in the upper aquifer throughout the service area. The DMC water has a much higher salinity than that of the San Joaquin River, and irrigation with the DMC water has contributed to an increased salinity of groundwater in the upper aquifer.

Upper Aquifer

Hotchkiss and Balding (1971) compared the quality of groundwater in the upper aquifer to that of streams in the Tracy-Dos Palos area. They indicated that the bicarbonate-type groundwater bodies were recharged by the streams that had the largest drainage basins, namely, Del Puerto, Orestimba, San Luis, and Los Banos Creeks. The TDS concentrations in groundwater of the bicarbonate type often ranged from about 400 to 600 mg/l, and increased in the downgradient direction, from west to east, in the late 1960's.

The concentrations of TDS ranged from about 1,200 mg/l to the west to around 700 mg/l towards the San Joaquin River in the late 1960's. There are areas of sulfate-type groundwater in the central and southern parts of the Tracy-Dos Palos area. Sulfur springs are present on Crow and Orestimba Creeks, indicative of sulfate-bearing deposits in the watershed that are probably responsible for the type of groundwater in the area.

There is chloride-type groundwater in parts of the Grassland Water District, east of Gustine and around Dos Palos. Sodium chloride type groundwater extends from near Mendota northward to Dos Palos. TDS concentrations in the chloride-type groundwater in the Grassland Water District ranged from 500 to around 13,000 mg/l in the 1960's.

There are transitional types of water (bicarbonate-sulfate and sulfate-bicarbonate) such as near Gustine, and these represent mixtures of water from various sources. In the vicinity of Los Banos, most of the transitional type groundwater is sulfate-chloride and bicarbonate-sulfate, but near the San Joaquin River it is chloride-bicarbonate in type. The TDS concentrations in the transitional type groundwater ranged from about 400 to 4,200 mg/l in the 1960's.

Good quality groundwater is present in the upper aquifer near Mendota and to the east, where recharge from the San Joaquin River, Eastside Bypass, and Mendota Pool are significant.

Electrical Conductivity

KDSA (1997b), as part of studies for the CCID, mapped electrical conductivities and boron concentrations in the upper aquifer, based on analyses for the 1990's. Figure 29 of KDSA (1997) showed electrical conductivities for the upper aquifer, which is reproduced herein as Figure 49. Groundwater with electrical conductivities of less than 1,200 micromhos per centimeter at 20°C was present in areas recharged by the larger westside streams, from Los Banos Creek to near Crows Landing. Relatively low electrical conductivities were also found along the east side

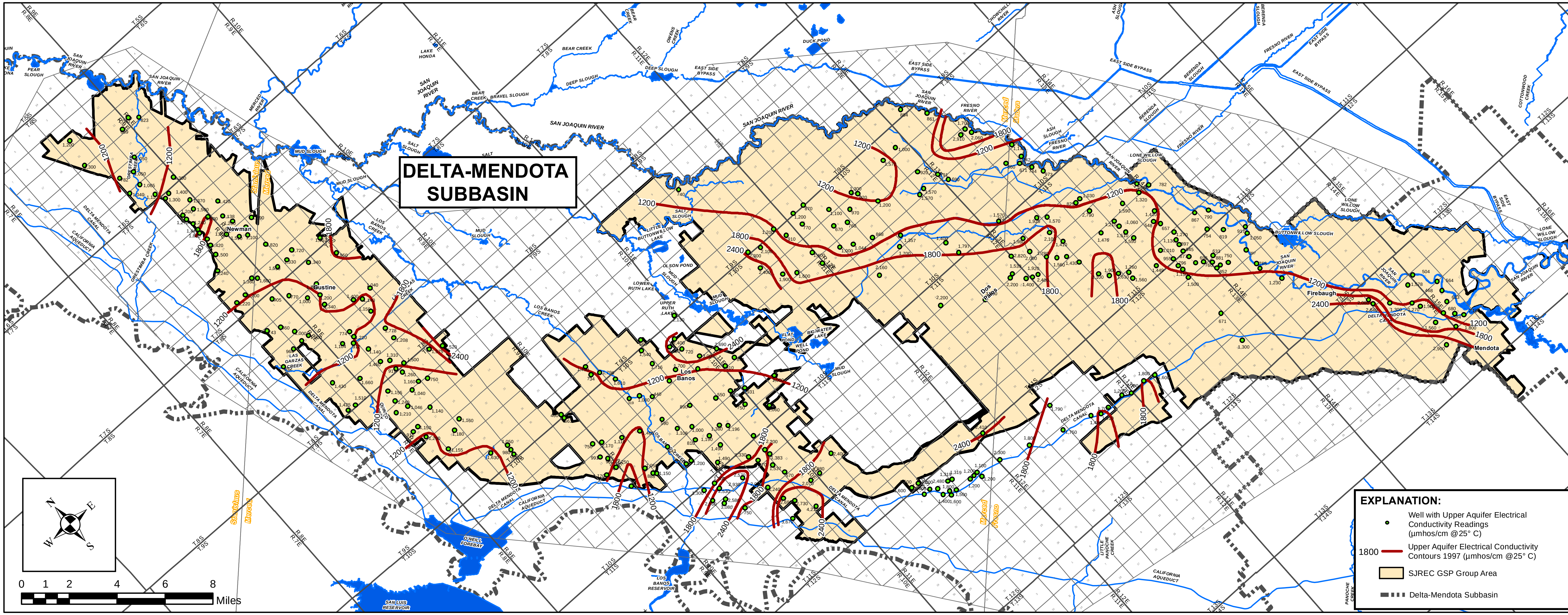


FIGURE 49 - ELECTRICAL CONDUCTIVITIES FOR WELLS TAPPING THE UPPER AQUIFER (1997)

of the area near the San Joaquin River, from south of Highway 152 to near Mendota.

An exception to the pattern of low groundwater salinity to the east, was an area of high electrical conductivity in the center of T10S/R13E. A zone of relatively shallow brackish water is indicated by interpretation of many electric logs in this area. The area of brackish water appears to underlie a large part of the San Luis Canal Co. area, and virtually all water supply wells in this area are completed above a depth of about 250 feet, above the brackish water zone.

Electrical conductivities greater than 1,800 micromhos were in 1) areas recharged by creeks south of Los Banos Creek, 2) an area of poor quality groundwater southwest of Mendota, 3) at the downslope ends of westside alluvial fans in T8S/R9E and T9S/R9E, and 4) in an area northeast of Los Banos. These are believed to have been due to historical evaporation of shallow groundwater in those areas.

Intermediate electrical conductivities (1,200 to 1,800 micromhos) were associated with the smaller westside drainages and in an area adjacent to the area of low electrical conductivity groundwater near the San Joaquin River.

As part of the KDSA (2008, Figure 19) evaluation, an updated map was prepared to show the distribution of electrical conductivity in the upper aquifer for the mid-2000's in parts of the Exchange Contractors service area where recent data were available. In the KDSA (1997b) report, electrical conductivity contours for 1,200, 1,800, and 2,400 micromhos were shown for the 1990's. These same contours are shown for the mid-2000's, where data were available. Substantial data were available for the area between Dos Palos and Mendota, in the Crows Landing and Newman areas, and in the Los Banos area. Overall, these contours were generally similar to those for the 1990's.

A substantial amount of information on electrical conductivities of well water is available for the New Columbia Ranch in Sub-area J. Electrical conductivities exceeded 1,200 micromhos per centimeter in water from several wells in an area primarily north of the extension of Avenue 5 and Avenue 8. These moderate to high electrical conductivities were present in a southeasterly trending lobe east of the Buttonwillow Slough. Water from four wells in this area had electrical conductivities ranging from 1,710 to 1,860 micromhos in 2001. Another localized area of high salinity was indicated to the southeast. The lowest electrical conductivities (less than 600 micromhos) near the Eastside Bypass (Chowchilla Canal Bypass). Seepage from the Bypass is indicated to be an important source of recharge in Sub-area J.

The electrical conductivities for well water increased substantially to the southwest in the Sub-area H. The highest electrical conductivities were in water from three wells and ranged from 2,073 to 2,351 micromhos in July 2004. A localized area of high electrical conductivity (exceeding 1,200 micromhos) was present north of Hutchins Road and west of San Juan Road. The lowest electrical conductivities (less than 900 micromhos) were near the Santa Rita Slough and in the area south of Roosbury Road, and in a localized area north of Highway 152 and west of San Juan Road.

The electrical conductivity map for the area south of Sub-area H was generally consistent with that for the mid-1990's (Figure 29 of KDSA, 1997). However, a noticeable trend was for a number of the mid-2000's contours to be slightly northeast or downgradient of the contours for the mid-1990's. In the Mendota-Firebaugh area, the mid-2000's contours for 1,200, 1,800, and 2,400 micromhos averaged about a half mile east of those for the mid-1990's. This was consistent with observations from groundwater monitoring near Mendota, and with observations in the western part of Sub-area J, where TDS concentrations and electrical conductivities have increased during the past decade. The northeasterly migration of high salinity groundwater in the upper aquifer was due to the increased northeasterly water-level slope, which has been caused by decreased pumpage and subsurface irrigation drainage from the San Luis Unit of the CVP and by water-level declines in western Madera County, particularly in irrigated areas without surface water supplies.

Figure 50 is an updated electrical conductivity map for part of the SJREC GSA for 2012. A substantial amount of additional data has become available in the Sack Dam-Red Top area. In that area, electrical conductivities were usually much lower for groundwater in the lower aquifer than in the upper aquifer. Also, electrical conductivities of groundwater in the upper aquifer generally decreased to the northeast. South of Avenue 18-1/2, electrical conductivities for the upper aquifer exceeded 4,000 micromhos to the southwest, nearby the San Joaquin River.
The lowest electrical conductivities in this area (less than 500 micomhos) were to the east near the Eastside Bypass. In parts of the SJREC GSA where data were available, the same trends were generally present as in the mid 2000's.

KDSA (2006) reported on a more detailed evaluation of groundwater quality for the upper aquifer in Sub-areas F and I. Figure 6 of KDSA (2006) showed electrical conductivity of water from wells tapping the upper aquifer in the 1990's. This figure is reproduced in this report as Figure 51. Electrical conductivity of groundwater in the upper aquifer changed laterally over relatively short distances near Firebaugh. Values increased from 1,500 to 6,000 micromhos over a distance of about a mile. This area was upgradient of the San Joaquin River. Northeasterly

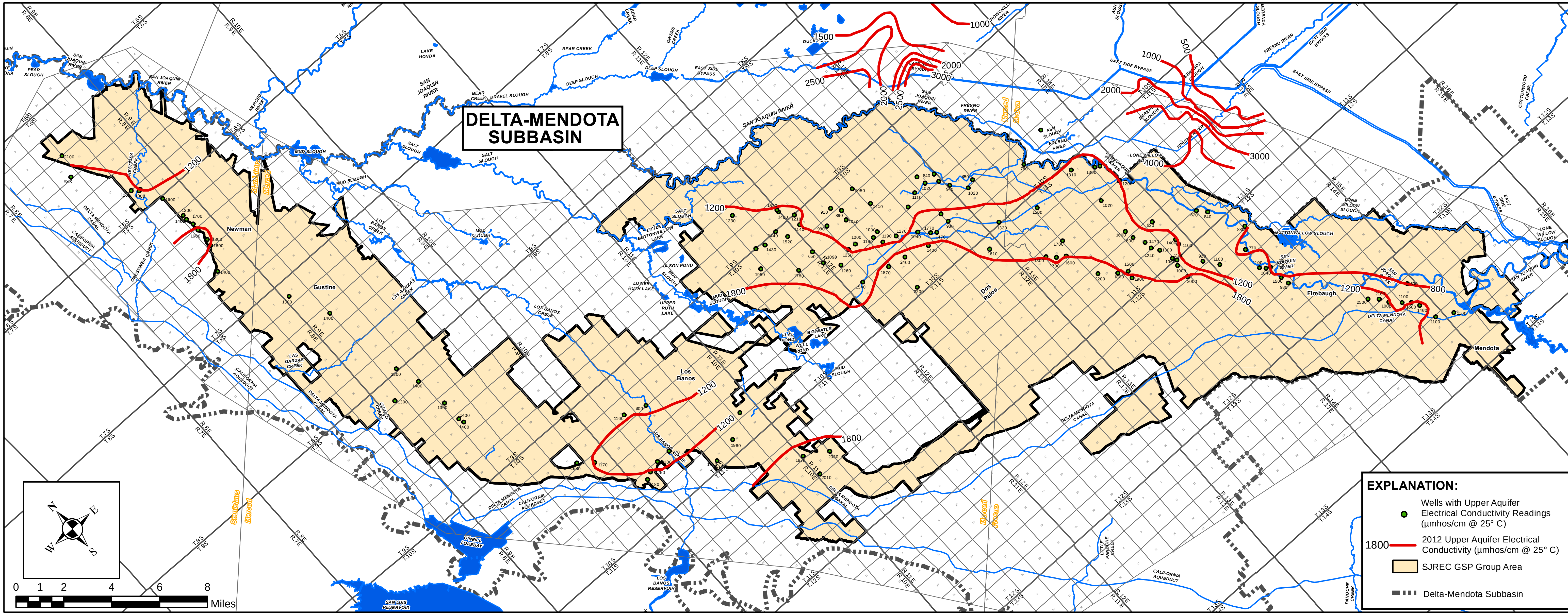


FIGURE 50 - ELECTRICAL CONDUCTIVITIES FOR WELLS TAPPING THE UPPER AQUIFER IN 2012

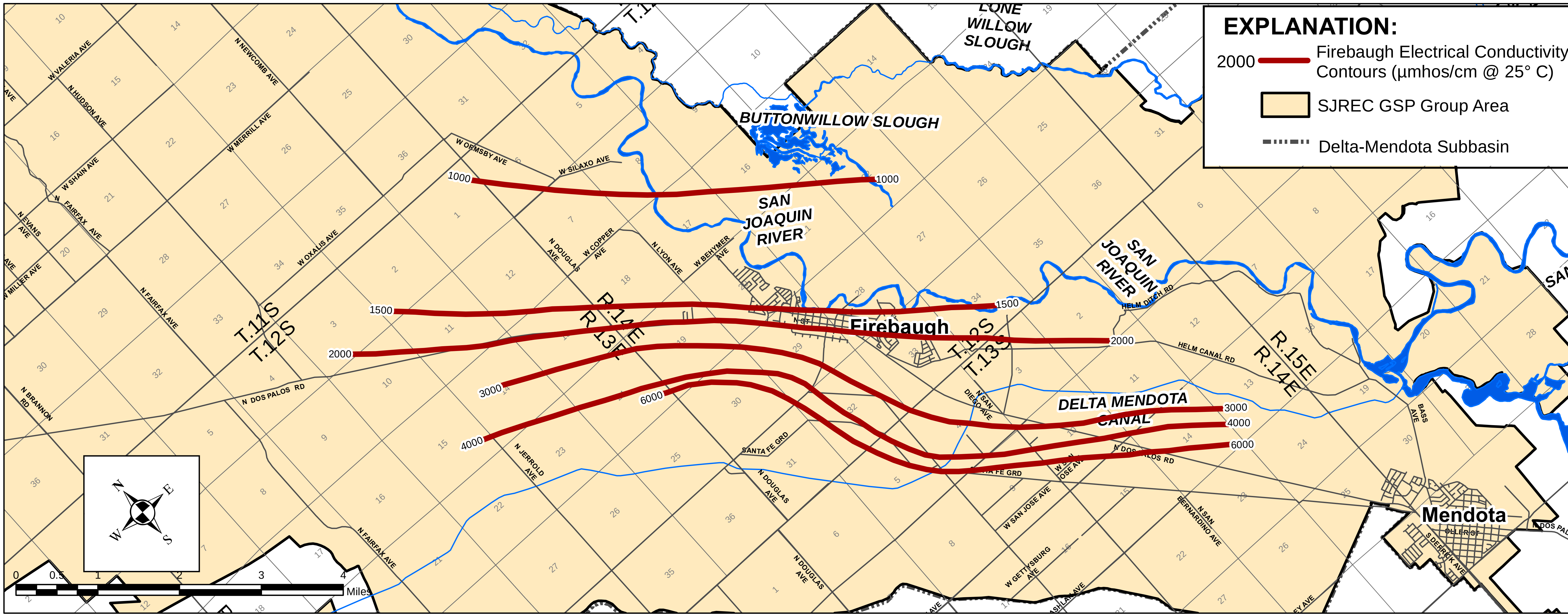


FIGURE 51- ELECTRICAL CONDUCTIVITY OF WATER FROM WELLS TAPPING UPER AQUIFER IN FIREBAUGH AREA IN THE 1990's

movement of high TDS groundwater in the upper aquifer has been occurring in this area for decades, due to decreased pumpage and irrigation drainage in the San Luis Unit of the CVP and by lowered water levels in western Madera County. A groundwater pumping and transfer program is being developed in the area northwest of Firebaugh by the Exchange Contractors to intercept the poor quality groundwater and beneficially use it through mixing with better quality surface water.

Time Trends. The CCID prepared updated hydrographs for District pumpage and electrical conductivity for four parts of the District. For CCID wells in the Mendota-Firebaugh area, electrical conductivities have generally increased since 1959. Rates of increase in electrical conductivity have generally been greater during periods of heavy pumping, compared to periods of little pumpage. More high salinity groundwater inflow from west of the wells appears to be induced during periods of heavy pumping, and there is more downward leakage of shallow high TDS groundwater. For the area between Firebaugh and Dos Palos, a similar pattern has been evident since 1959. For the Los Banos area, historical data for the CCID wells are limited, but no large changes in electrical conductivity are indicated. For the Gustine-Newman area, electrical conductivities in water from several wells, have increased since 1968, but the increases appears to be less than in the Firebaugh-Mendota area. Part of these increases is likely due to downward flow of poor quality shallow groundwater, particularly when water levels are significantly lowered in the underlying strata.

Boron

KDSA (1997b, Figure 30) also mapped boron in wells tapping the upper aquifer in the 1990's. Along the east part of the Exchange Contractors service area and south of Highway 152, boron concentrations were usually less than 0.5 mg/l. This is consistent with groundwater recharge in these areas from east side streams, which contain low boron concentrations. The lowest boron concentrations (less than 0.1 mg/l) in the upper aquifer were in T10S and T11S.

The distribution of boron concentrations in groundwater recharged by westside streams is more complex. The lowest boron concentrations in the groundwater to the west were associated with recharge from the larger westside streams, such as Orestimba, Los Banos, Garzas, and Quinto Creeks. Groundwater in some parts of this area contained more than 2.5 mg/l of boron. The second was in parts of T8S/R9E and T9S/R9E, northeast of Los Banos. These high concentrations were probably due to historic evaporation of shallow groundwater at the downslope end of the alluvial fan. Shallow groundwater southwest of Mendota also contained high boron concentrations. This is in the area where high salinity groundwater has been present for many decades.

As part of the KDSA (2008) evaluation, boron analyses of well water for 2004-05 were obtained and plotted. These values generally agreed well with the values for the 1990's. In general, higher boron concentrations in the mid-1990's corresponded to higher electric conductivities, as in the 1990's.

Lower Aquifer

The chemical quality of the groundwater in the lower aquifer in the much of the service area is less well known that of the upper aquifer, due to the overall small number of wells tapping the lower aquifer. In general, for the area north of Los Banos, in much of the western part of the rest of the CCID, and in the Red Top-El Nido area, TDS concentrations in groundwater below the Corcoran Clay are less than those in groundwater above the Corcoran Clay. However, experience in Dos Palos, the SLCC service area, Firebaugh, and Mendota indicates that higher TDS groundwater is present below the Corcoran Clay in those areas. High concentrations of hydrogen sulfide, iron, and manganese are present in the lower aquifer in some areas, particularly where reducing conditions are present.

Groundwater Quality Degradation

There are generally four types of groundwater quality problems that are important in the SJREC GSP. The first type comprise naturally occurring chemical constituents. Some of the most important in the SJREC GSP are nitrate, arsenic, hexavalent chromium, selenium, total dissolved solids (TDS), sulfate, chloride, and boron. Iron, manganese, and hydrogen sulfide concentrations are also important in some deeper groundwater under reduced conditions. For some of the deeper groundwater, high pH's and sodium adsorption ratios are a problem for irrigation use.

Most of these constituents are important in terms of developing new public supply wells to meet the Title 22 standards for public water supplies. The way those are normally handled is by conducting test well or pilot hole programs, whereby vertical trends in groundwater quality are determined. In this manner, either good quality groundwater is found and tapped by a suitable designed well, or the groundwater may be treated for specific constituents, if necessary. The SGMA program doesn't need to be directly involved with such programs. However, the data obtained are usually in the public record and can be periodically accessed and reviewed. Guidelines for the development of individual private domestic wells or irrigation wells in problem areas could be developed from this information.

The second type is termed a plume or point source contamination problem. Plumes by definition are usually long and narrow. Many of these fall under the jurisdiction of the Regional Water Quality Control Board. Numerous sites have Waste Discharge Requirements that are periodically updated. These are all in the public record and can be accessed through Regional Board websites and their offices in Sacramento and Fresno. It is recommended that the SGMA process not be directly involved in this process. If desired, the SJREC GSA could provide input to the Regional Board through the normal public process.

The third type is associated with nonpoint sources. The most important of these would be crop irrigation, including the use of fertilizers, soil amendments, water treatment chemicals, and increases in groundwater salinity due to concentration of salts by evapotranspiration. The Regional Board has an Irrigated Lands program. There is no reason for the SGMA process to directly get involved with that program, unless measures are proposed that would affect the SGMA program.

The fourth type is termed hydrogeologic modification. The most important one of these is the northeasterly migration of poor quality groundwater in the Dos Palos-Mendota area. The poor quality groundwater has been present in the upper aquifer, some distance west of the San Joaquin River. Northeasterly movement of this water has largely resulted from subsurface drainage and decreased pumpage in the CVP area west of the river and development of a large depression cone in Madera County east of the San Joaquin River. Historically, prior to large-scale pumping of groundwater, this poor quality groundwater would have been moved towards the San Joaquin River, and either discharged into the river or have been consumed by evapotranspiration of phreatophytes. This type of groundwater quality problem appears to be under the purview of the SGMA process.

Sustainable Management Criteria For Degraded Groundwater Quality

There are areas of relatively high salinity groundwater in the upper aquifer above the Corcoran Clay that extend from near Tranquillity to the south to near Red Top on the north. Much of this shallow groundwater is beneath agricultural drainage problem areas, where shallow groundwater has required the installation of subsurface tile drains. Much of the saltiest groundwater is indicated to be above the A-clay, a local confining bed that averages about 70 feet in depth. Evidence indicates that tile drains have intercepted most of this shallow groundwater. However, moderate to high salinity groundwater extends from below a depth of about 70 feet to near the top of the Corcoran Clay, except to the east near the San Joaquin River. This water can be pumped and mixed with canal water for beneficial use.

KDSA (2006) reported on a detailed evaluation of groundwater quality for the upper aquifer in Management Sub-areas F and I. Figure 6 of KDSA (2006) showed electrical conductivity of water from wells tapping the upper aquifer in the 1990's. That figure is reproduced in this report as Figure 51. Electrical conductivity of groundwater in the upper aquifer changed laterally over relatively short distances near Firebaugh. Values increased to the southwest from 1,500 to 6,000 micromhos over a distance of about a mile. This area was indicated to be upgradient of the San Joaquin River.

Northeasterly movement of high TDS groundwater in the upper aquifer has been occurring in this area for decades. A groundwater pumping and transfer program (GP/WT) was developed in the area southwest of Firebaugh by the Exchange Contractors to intercept the poor quality groundwater and beneficially use it through mixing with better quality surface water. The FCWD manages this program.

It has been proposed to eventually pump as much as 20,000 acre-feet per year from 20 interceptor wells located between Mendota and Fairfax Avenue. These wells are to be located between the CCID Main Canal and the DMC. The pumping was proposed to largely occur during eight months of the year. The top of the Corcoran Clay is at an average depth of about 350 feet in this area. Two pilot wells (Snyder and Del Rey) were installed and pumped for an extended period to obtain information for an environmental assessment study. Presently, there are seven wells in the program. Water samples are collected from the pumped wells on an annual basis for determination of electrical conductivity and boron. Downgradient wells that are monitored include CCID wells in the Poso Well Field.

The objective of the GP/WT project is to intercept as much of the moderate to high salinity groundwater that is moving to the northeast in the area above the Corcoran Clay as is feasible. Groundwater quality monitoring has been conducted for both the pumped wells and a number of CCID wells to the northeast. These results would be reviewed and evaluated about every three years.

INTERCONNECTED SURFACE AND GROUNDWATER SYSTEMS IN THE SJREC GSA

There are several areas in the SJREC GSA where the shallow groundwater is indicated to be in direct hydraulic continuity with streamflow. The only place where this situation is known to occur is along some reaches of the San Joaquin River. For many decades there were few shallow observation wells or monitor wells near the river in or near the SJREC GSA. Some of the only ones were north of the river at the New Columbia Ranch and near the former County of Fresno Mendota Landfill. Once the San Joaquin River Restoration Project became operative, a number of shallow monitor wells were installed for Reclamation along the river between Gravelly Ford and Stevinson.

Besides this information, another factor to be considered is the direction of groundwater flow in the upper aquifer. Where water-level elevation maps indicate flow towards the river from both sides, this is also usually an indication of a direct hydraulic communication, at least along reaches where the river is flowing. Upper aquifer water-level elevation maps for the area south of Highway 152 do not indicate flow toward the river from the east. Only general water-level elevation maps are available for the upper aquifer east of the river and north of Highway 152. However it appears that there is direct hydraulic communication between streamflow in the river for the reach north of Sub-area H. Water-level elevation maps for the upper aquifer are available south of the Merced River near Stevinson, and a westerly direction of flow toward the San Joaquin River is indicated. The same situation pertains farther north, in the west parts of the Turlock and Modesto Irrigation Districts.

Available data indicate that in some river reaches this direct hydraulic communication is present all or most of the time. An example is beneath the east branch of the Mendota Pool. In contrast, along other reaches, the direct hydraulic communication is only present during and following significant flows in the river. An example of this is east of the Mendota Pool, during periods when the river hasn't flowed continuously for many years.

KDSA evaluated water-level hydrographs for SJR Restoration Program shallow monitor wells near the river, and compared these to nearby river channel elevations (usually determined within 100 to 200 feet of the wells). Reclamation has identified six river reaches between the head of the Chowchilla Bypass and Hills Ferry Road. Reach 2B is located between the Chowchilla Bifurcation Structure and Mendota Dam. Water-level measurements for shallow monitor wells near the river indicate that for the part of this reach east of San Mateo Road, the shallow groundwater is in hydraulic connection with the river streamflow only near or slightly following periods of streamflow in this reach. At those times, groundwater levels near the river are above the river channel. In contrast, during periods of no streamflow, groundwater levels are below the stream channel, and no hydraulic connection exists. The part of the reach west of San Mateo Road coincides with the easterly or San Joaquin river branch of the Mendota Pool. Along this part of the reach, there is a hydraulic connection between the shallow groundwater and the water in the Mendota Pool. Shallow groundwater levels in this part of the reach are generally above the channel or bottom of the pool.

Reach 3 extends from Mendota Dam to Sack Dam. There is generally always streamflow along this reach, as the SLCC obtaining DMC water released from Mendota Dam that flows into the Sack Dam in a low flow channel. Water-level records were compared to the stream channel elevations at 14 sites along the reach. Groundwater levels were always above the nearby river channel, and thus the shallow groundwater was in hydraulic connection with streamflow in the river.

Reach 4A extends from Sack Dam to the Sand Slough Bypass. Water-level records and stream channel elevations at six locations along this reach were examined. Records indicate that within about two miles downstream of Sack Dam, groundwater levels are normally above the nearby channel elevation. Thus along this part of the reach, the shallow groundwater may be in hydraulic connection with flow in the river. Records at sites more than two miles downstream of Sack Dam to about a mile and a half downstream of the Highway 152 crossing of the river indicate shallow groundwater levels below the channel elevation. There is normally no streamflow in the river along this part of the reach, except for river releases or flood flows. Thus in this part of the reach, there is no hydraulic connection between shallow groundwater and flow in the river, except during periods of streamflow. For the third part of the reach, extending downstream to the Sand Slough Bypass, shallow groundwater levels are above the nearly channel elevation, and the shallow groundwater is in hydraulic connection with streamflow.

Reach 4B extends from the Sand Slough Control Structure downstream to the Mariposa Bypass. Records for seven sites along this reach were examined. At all of these sites, the shallow groundwater was above the nearby channel elevation, and thus the shallow groundwater was in hydraulic connection with flow in the river.

No shallow water-level records were available for Reach 4B2, which extends from the Mariposa Bypass to the Eastside Bypass.

Reach 5 extends from the Eastside Bypass to Hills Ferry Road. Records were examined for two sites near Fremont Ford. Shallow groundwater levels were above the nearly channel elevations. Thus the shallow groundwater was in hydraulic communication with streamflow in the river.

Figure 52 shows locations of interconnected groundwater and surface water bodies in or adjacent to the SJREC GSP, based on the foregoing information. The only relevant surface water body is the San Joaquin River.

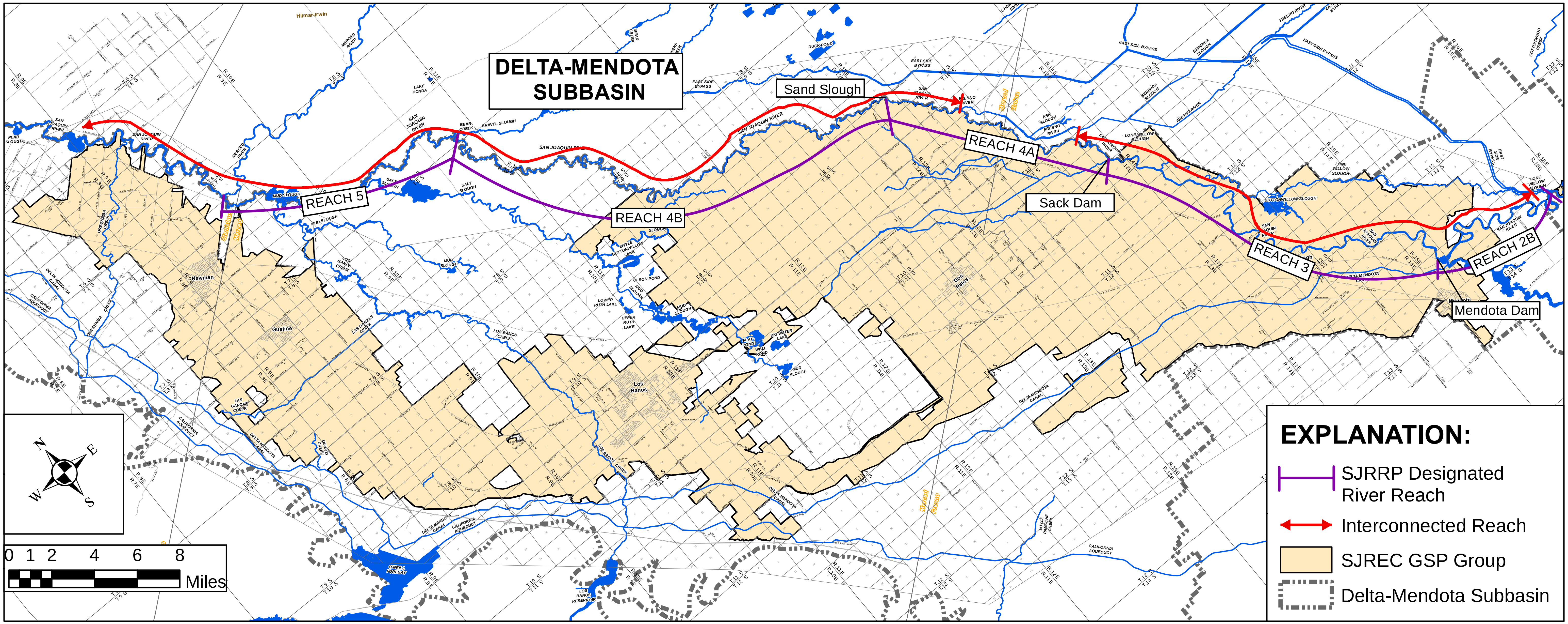


FIGURE 52 - INTERCONNECTED GROUNDWATER AND SURFACE WATER

KNOWN GROUNDWATER CONTAMINATION SITES

Figure 53 shows known contamination sites that were taken from the Regional Water Quality Control Board Geotracker website. Included are leaking underground storage tank (LUST) cleanup sites where groundwater was locally contaminated, and one Department of Toxic Substances Control (DTSC) cleanup site north of Los Banos. Other cleanup sites are for landfills or other types of sources that have affected groundwater. Overall, the groundwater contamination within these sites is indicated to be localized, and only in the shallow groundwater.

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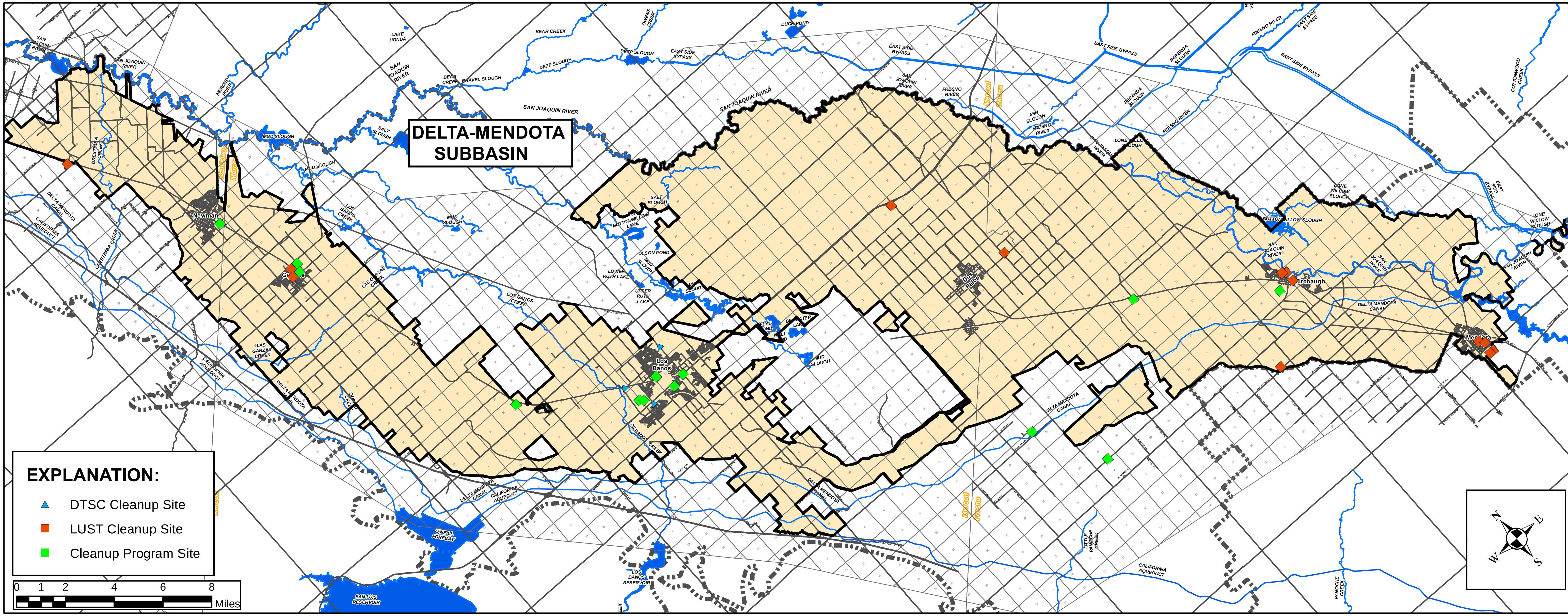

FIGURE 53 - KNOWN GROUNDWATER CONTAMINATION SITES

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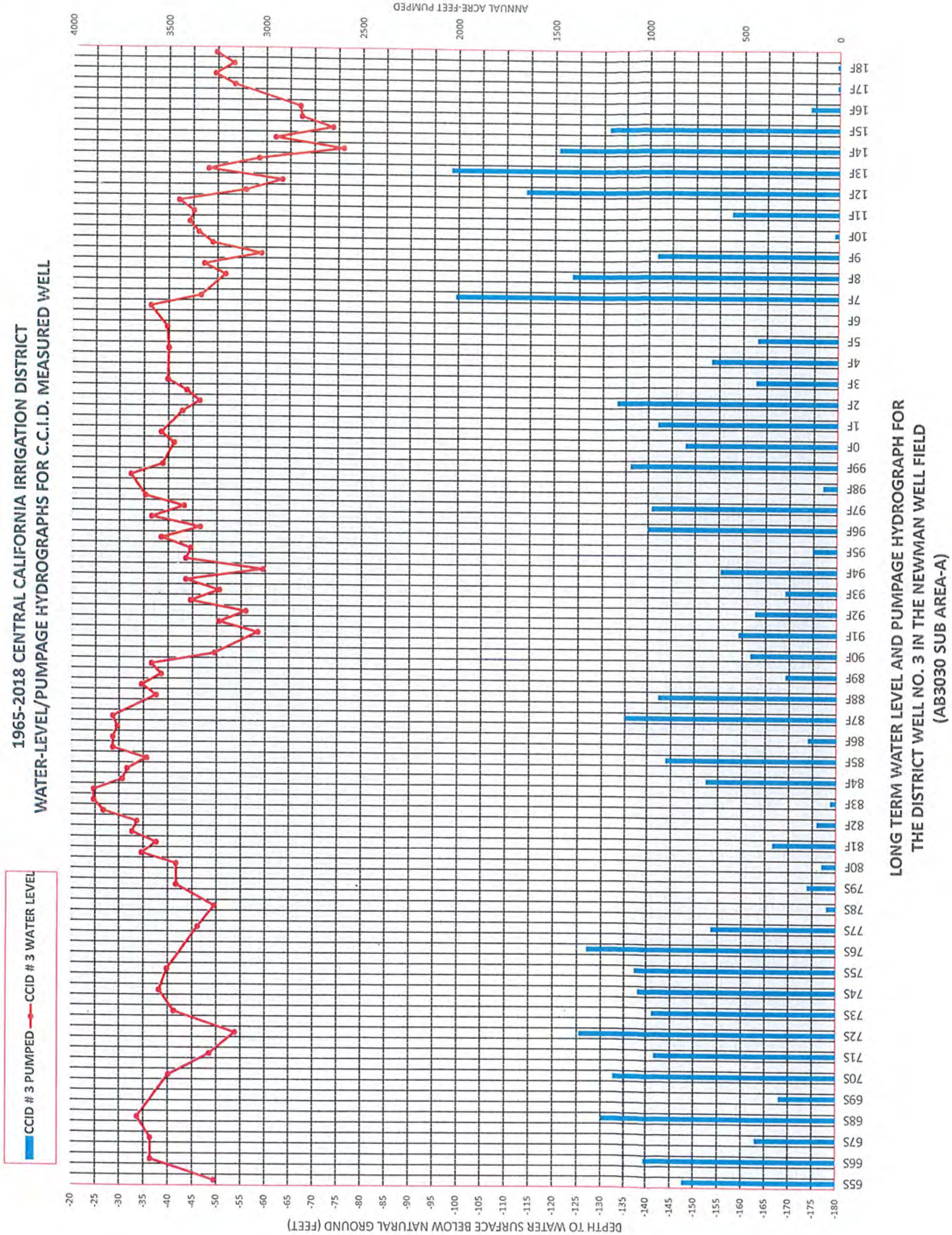
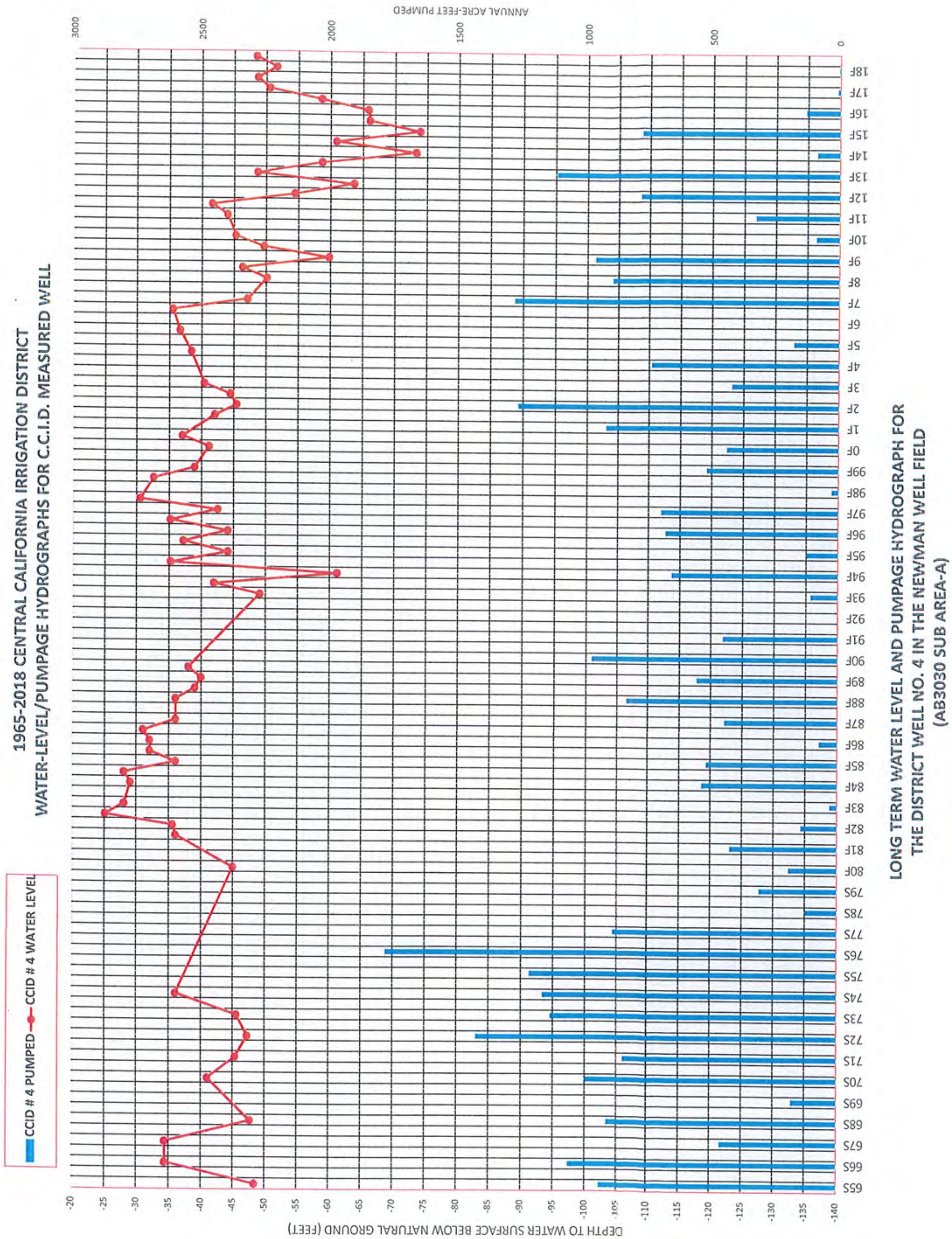
APPENDIX A

WATER-LEVEL HYDROGRAPHS


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 3 PUMPED
CCID # 3 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 3 IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)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WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 4 PUMPED
CCID # 4 WATER LEVEL
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 4 IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
65S
66S
67S
68S
69S
70S
71S
72S
73S
74S
75S
76S
77S
78S
79S
80F
81F
82F
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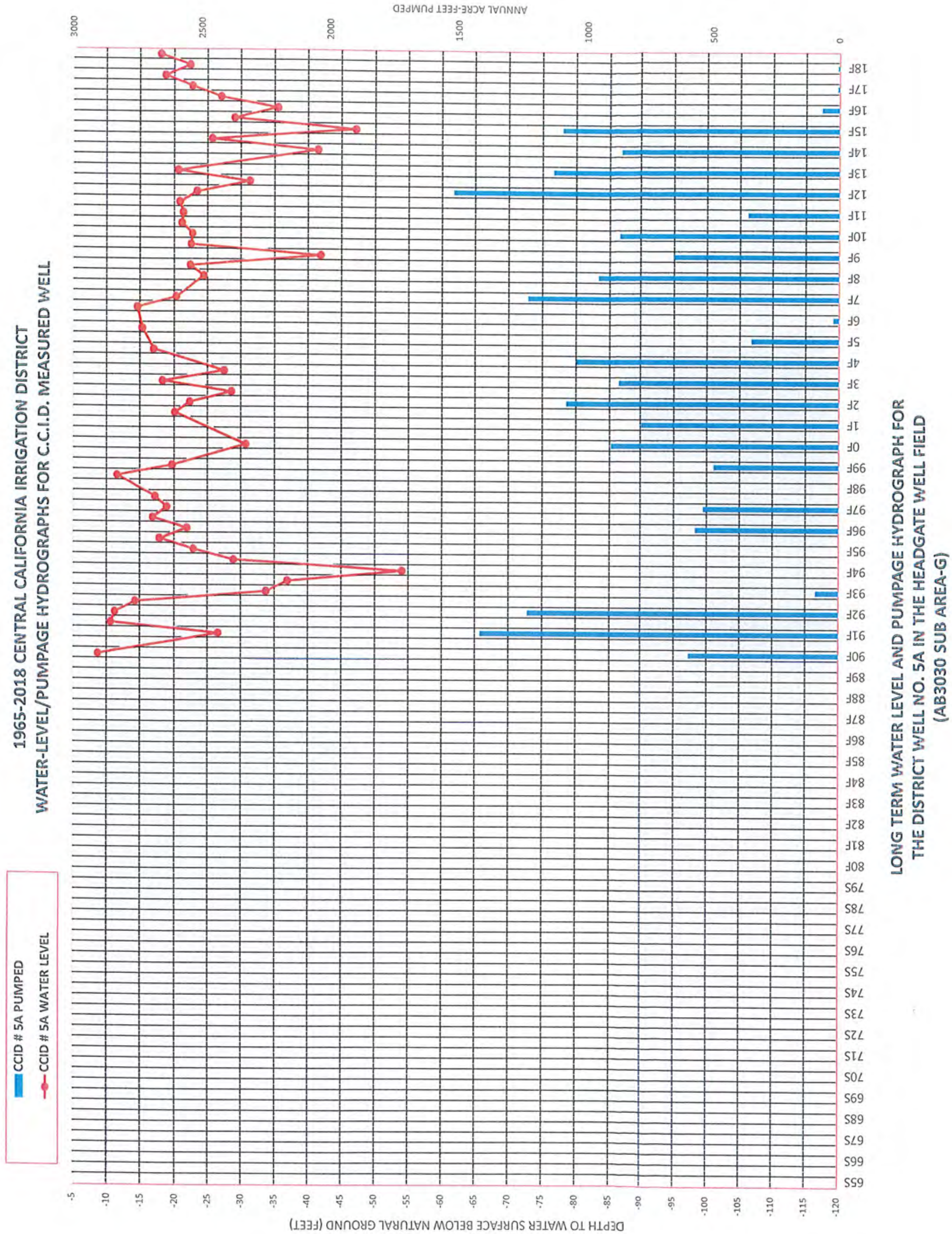
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WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
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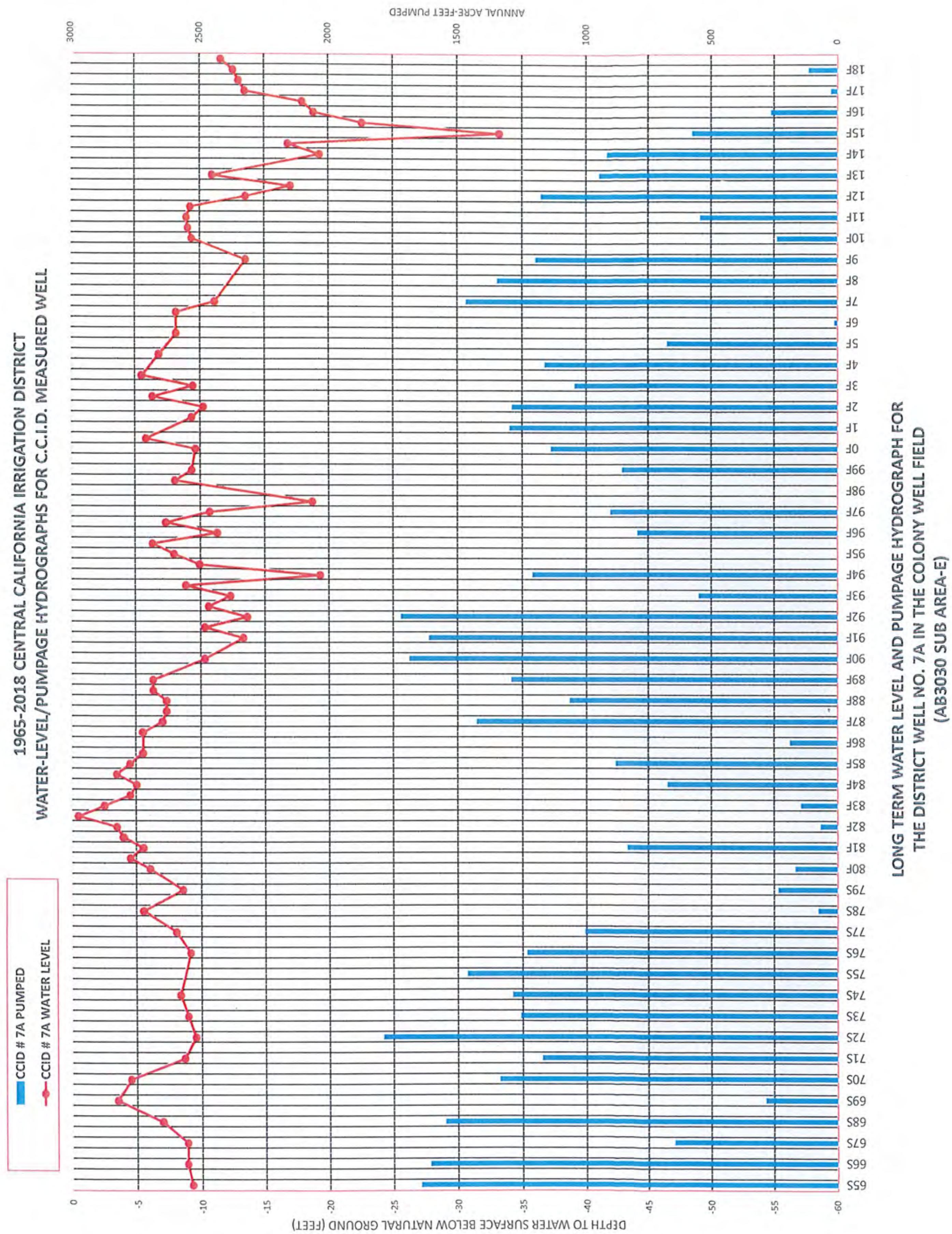
CCID # 5A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 5A IN THE HEADGATE WELL FIELD
(AB3030 SUB AREA-G)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
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CCID # 7A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
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69S
70S
71S
72S
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75S
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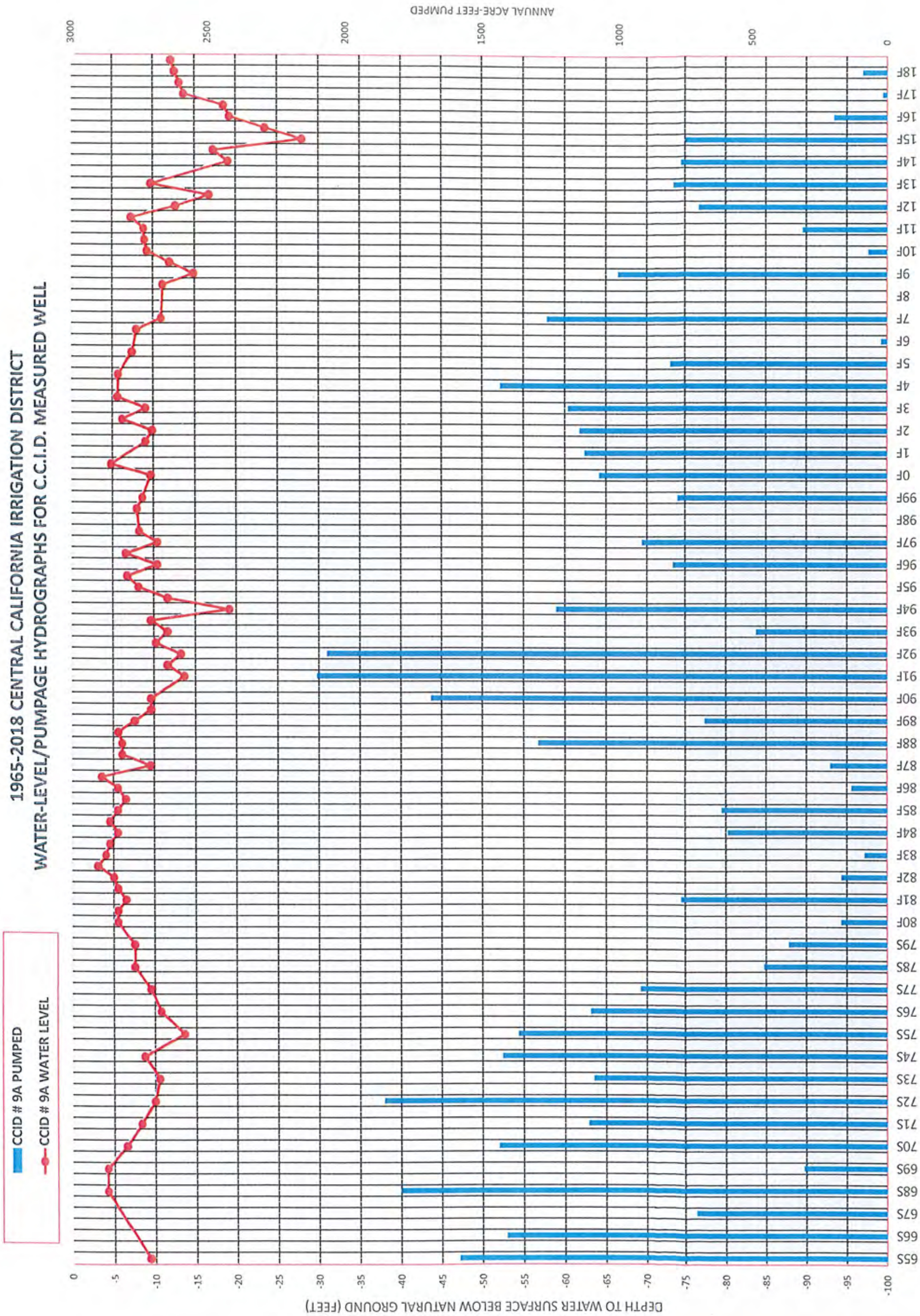
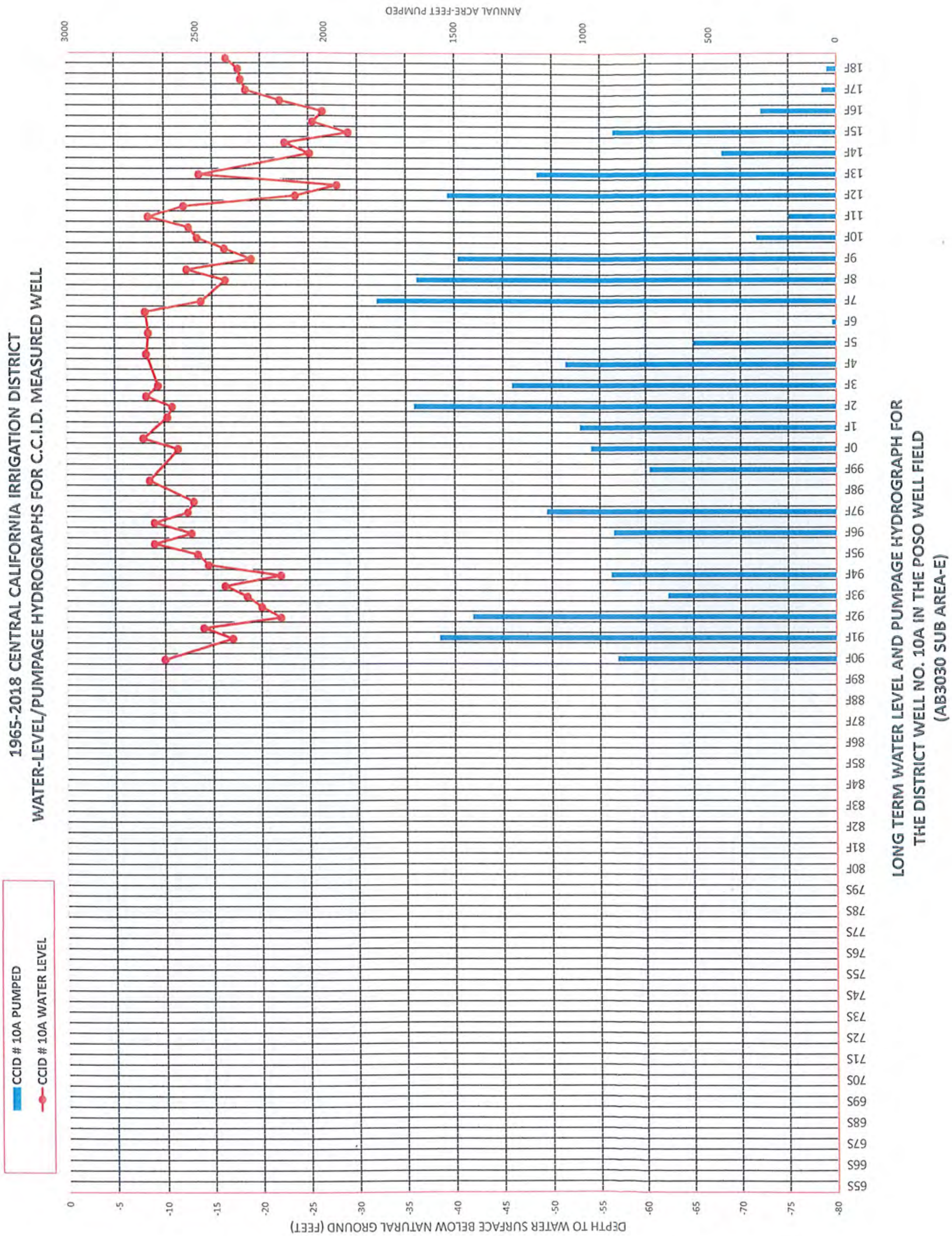
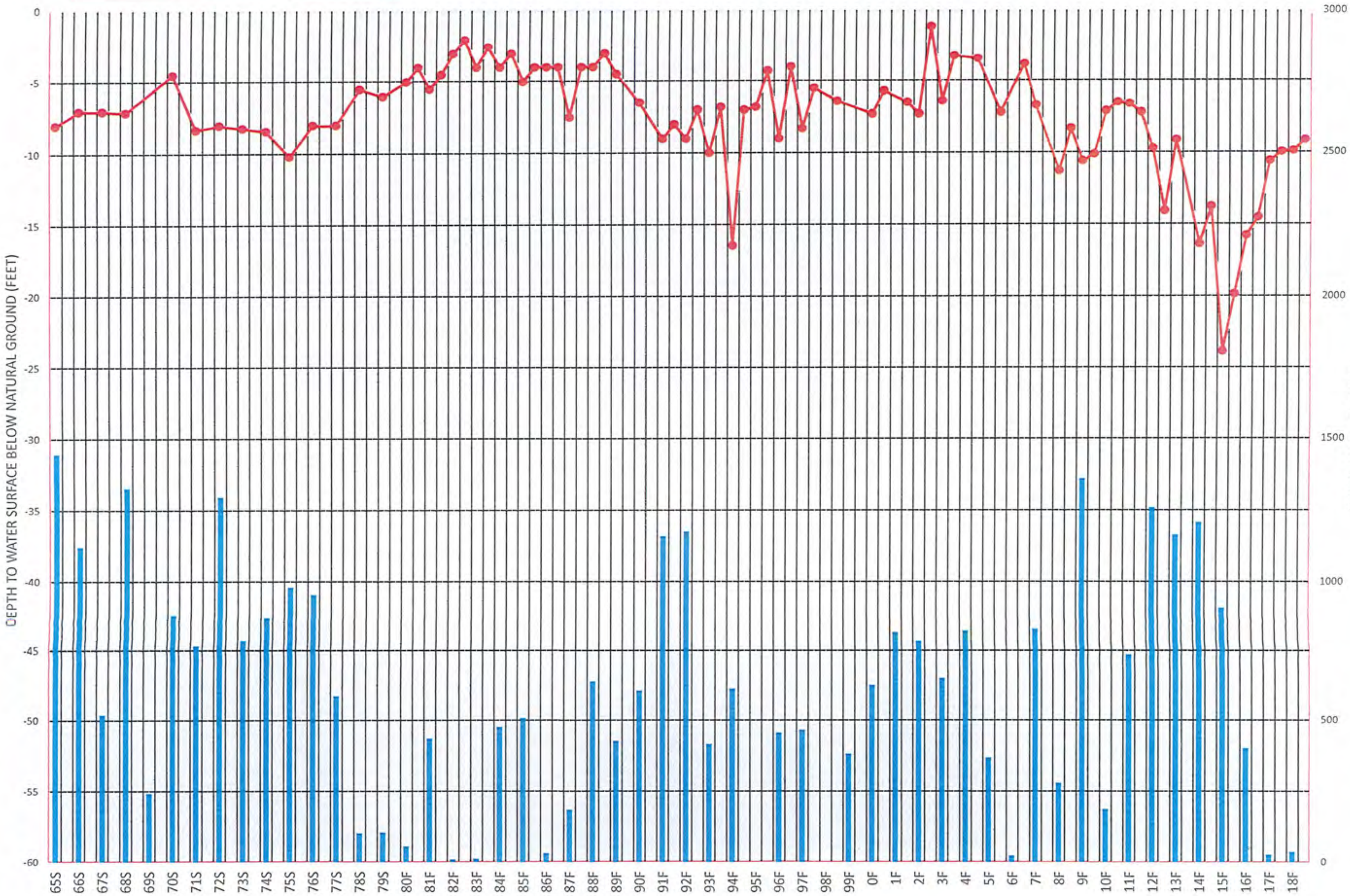
18F
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 7A IN THE COLONY WELL FIELD
(AB3030 SUB AREA-E)



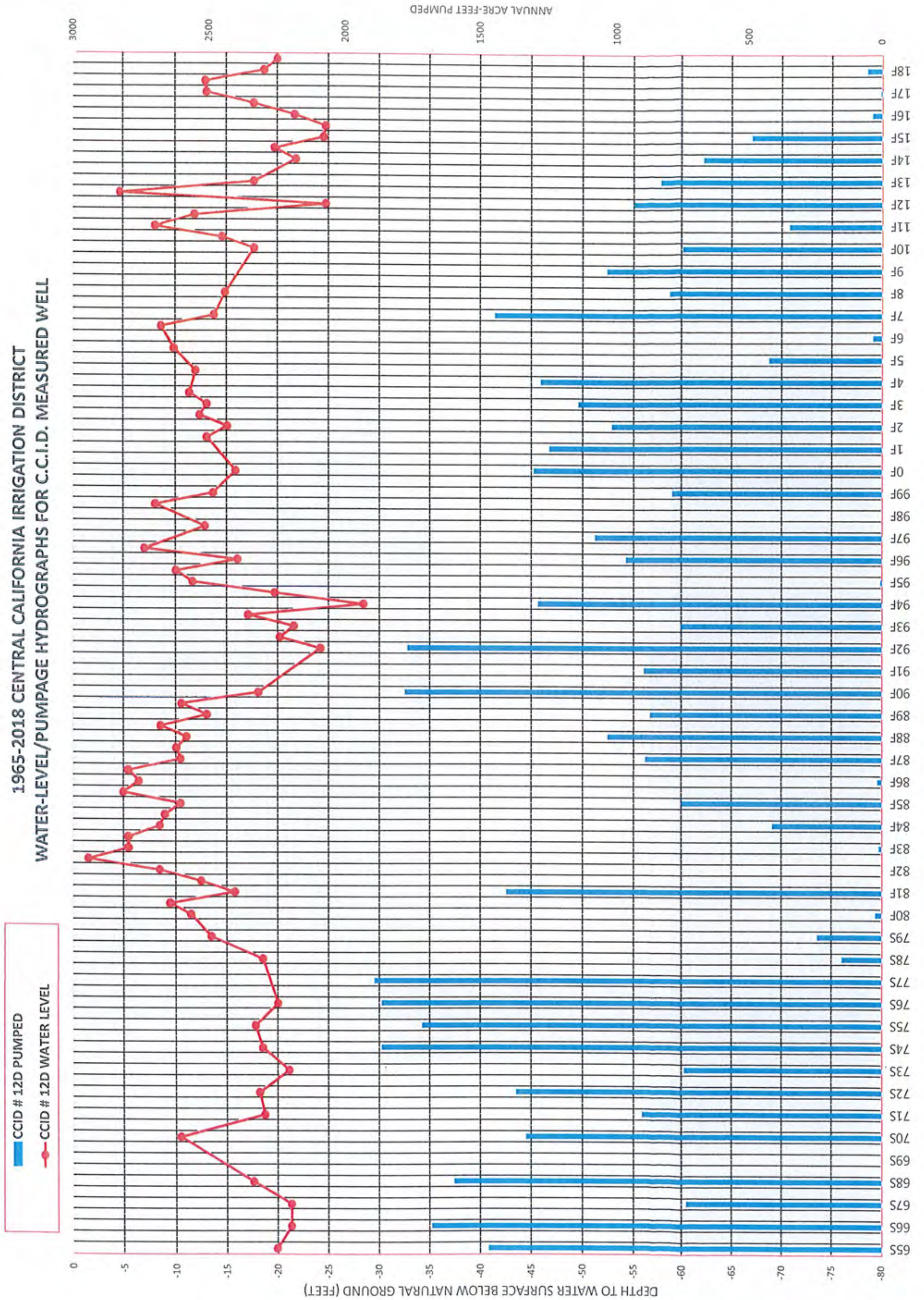
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR THE DISTRICT WELL NO. 9A IN THE COLONY WELL FIELD (AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 10A PUMPED
CCID # 10A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 10A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)

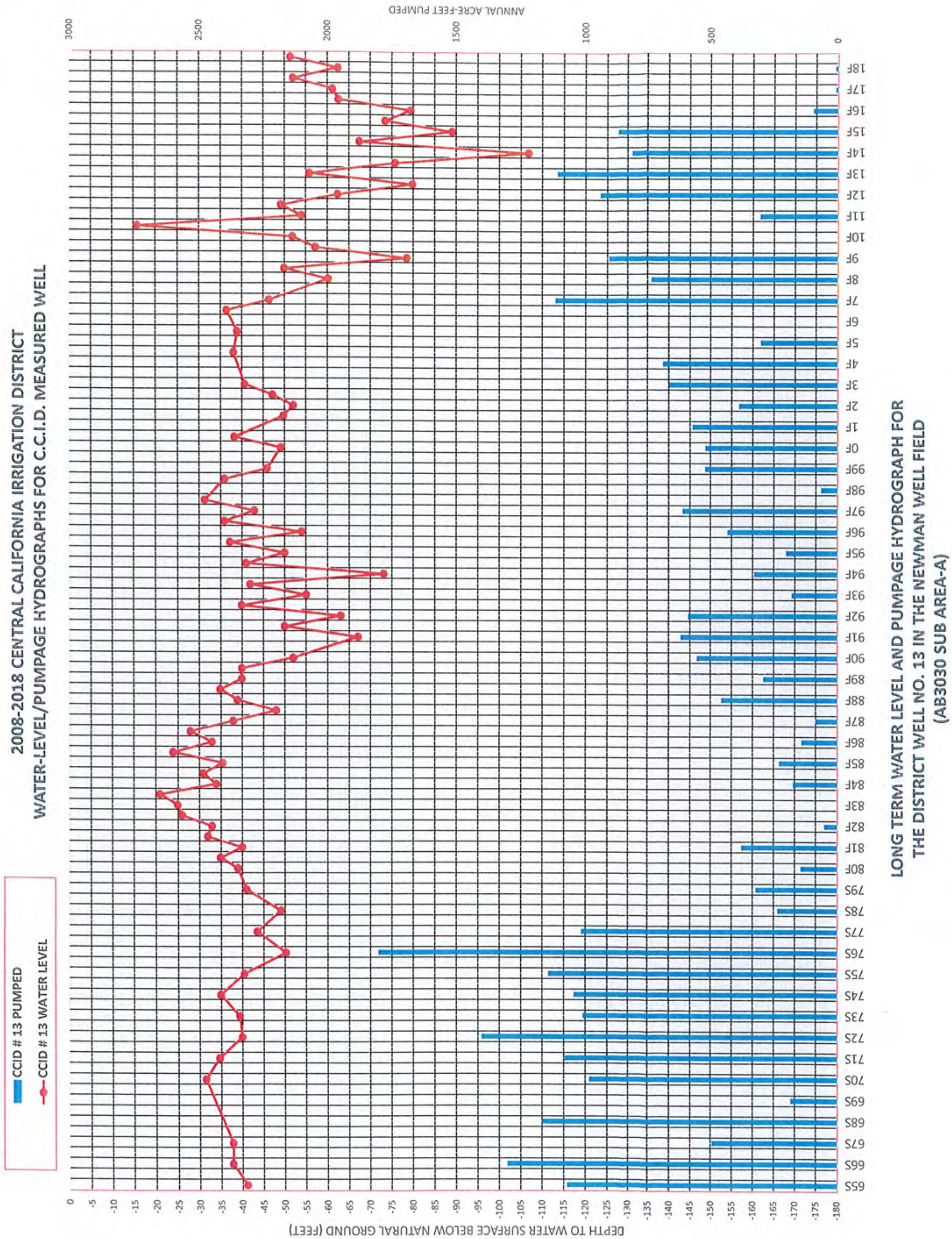
1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

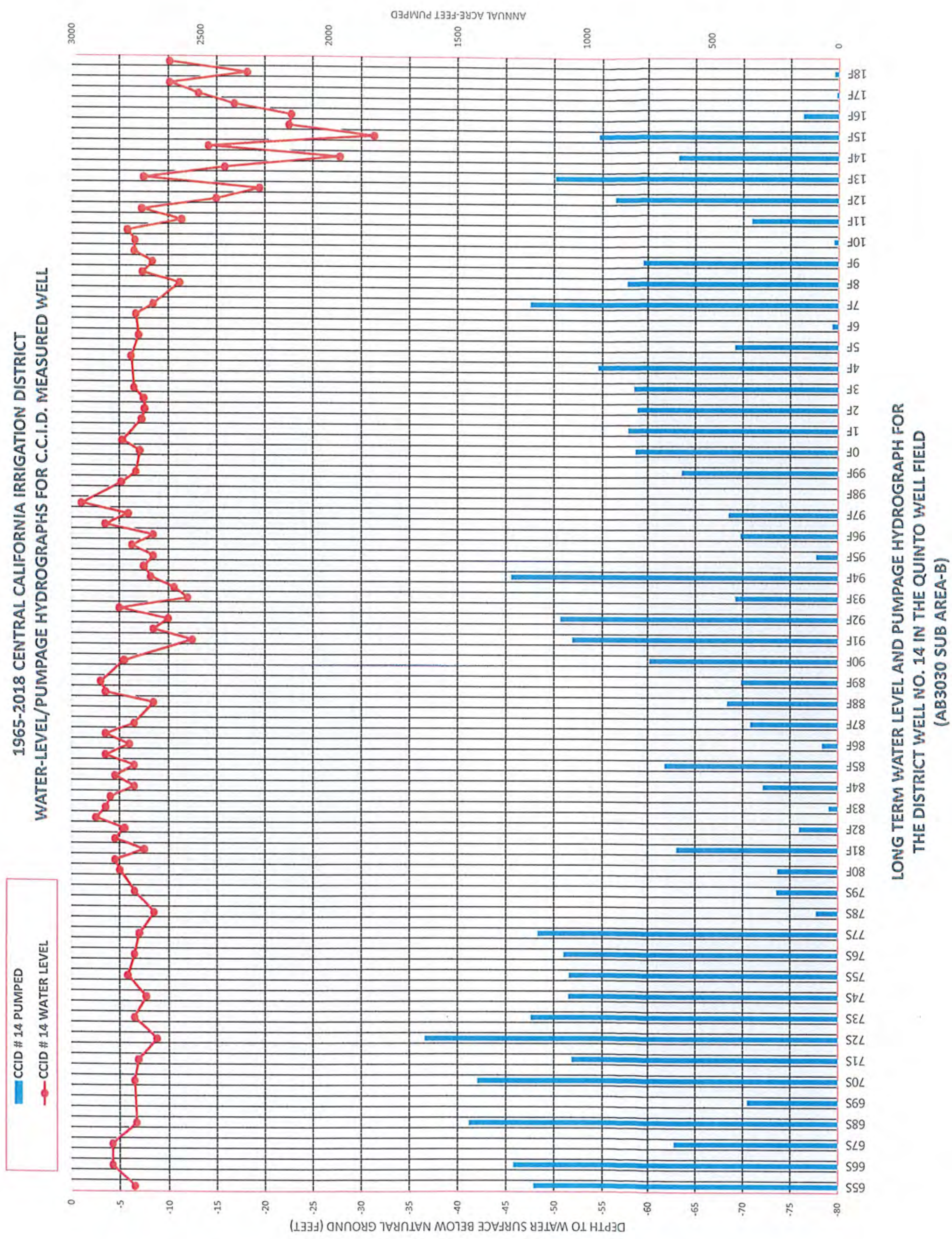


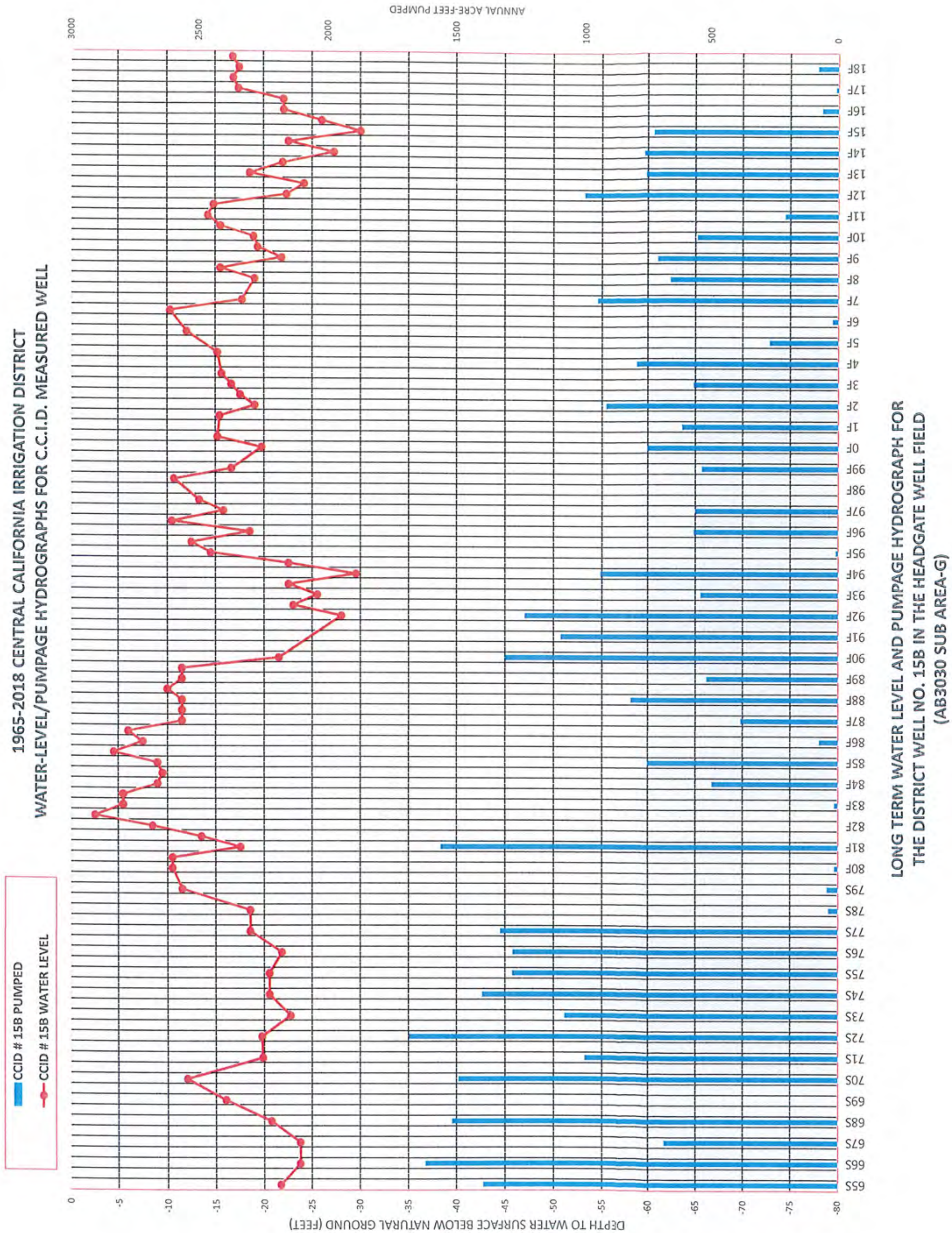
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 11A IN THE COLONY WELL FIELD
(AB3030 SUB AREA-E)



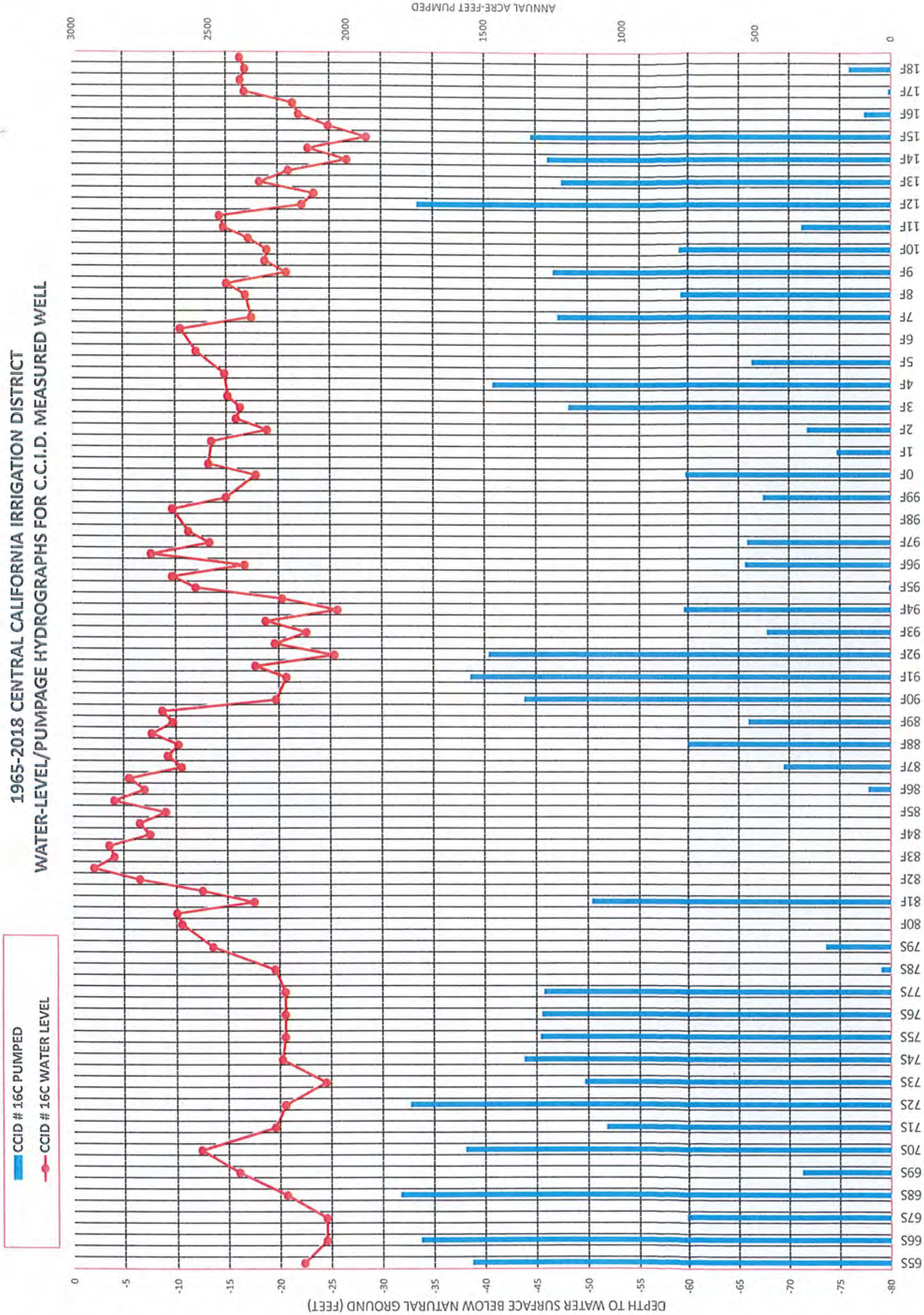
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR THE DISTRICT WELL NO. 12D IN THE HEADGATE WELL FIELD (AB3030 SUB AREA-G)


2008-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 13 PUMPED
CCID # 13 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 13 IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)

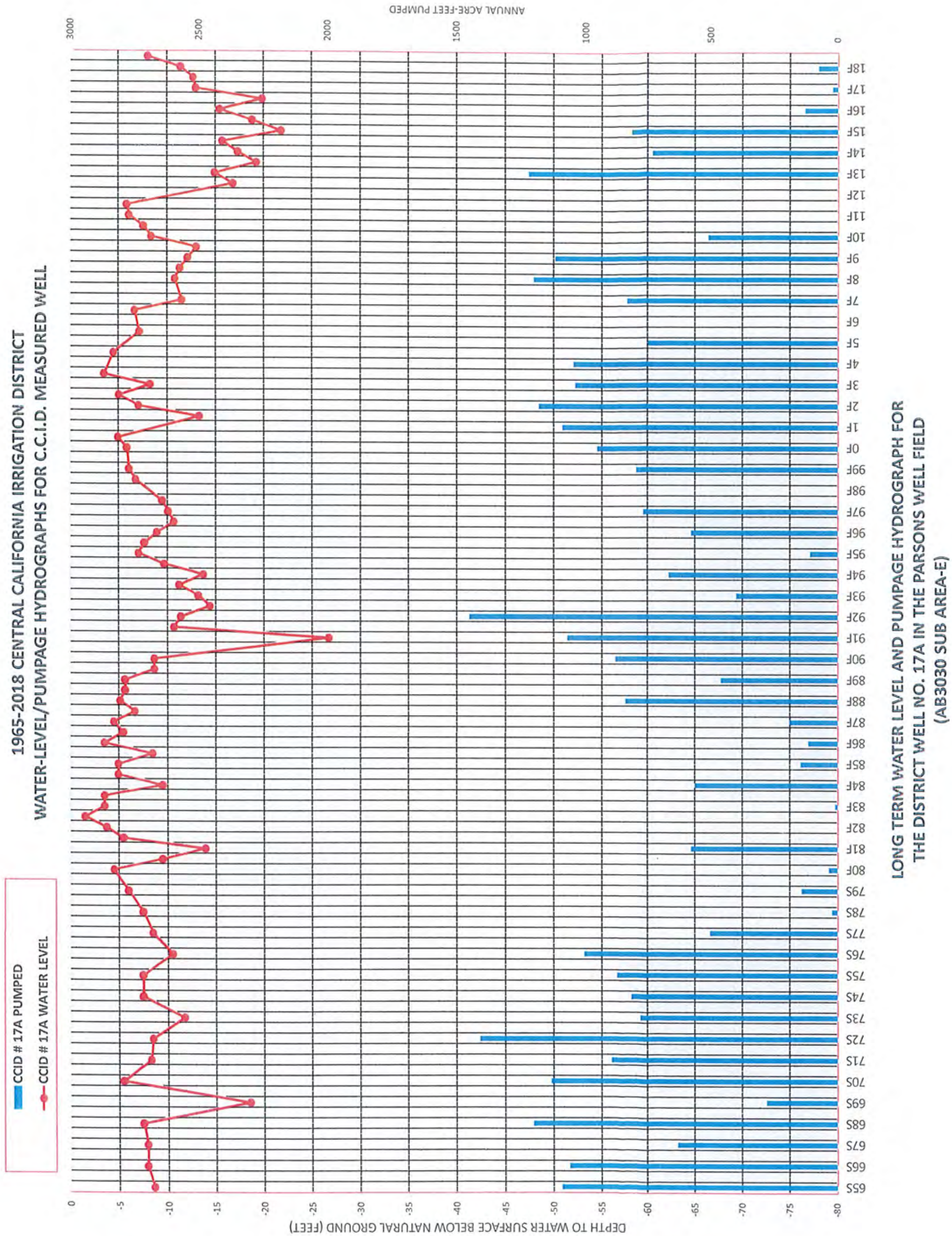

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 14 PUMPED
CCID # 14 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 14 IN THE QUINTO WELL FIELD
(AB3030 SUB AREA-B)

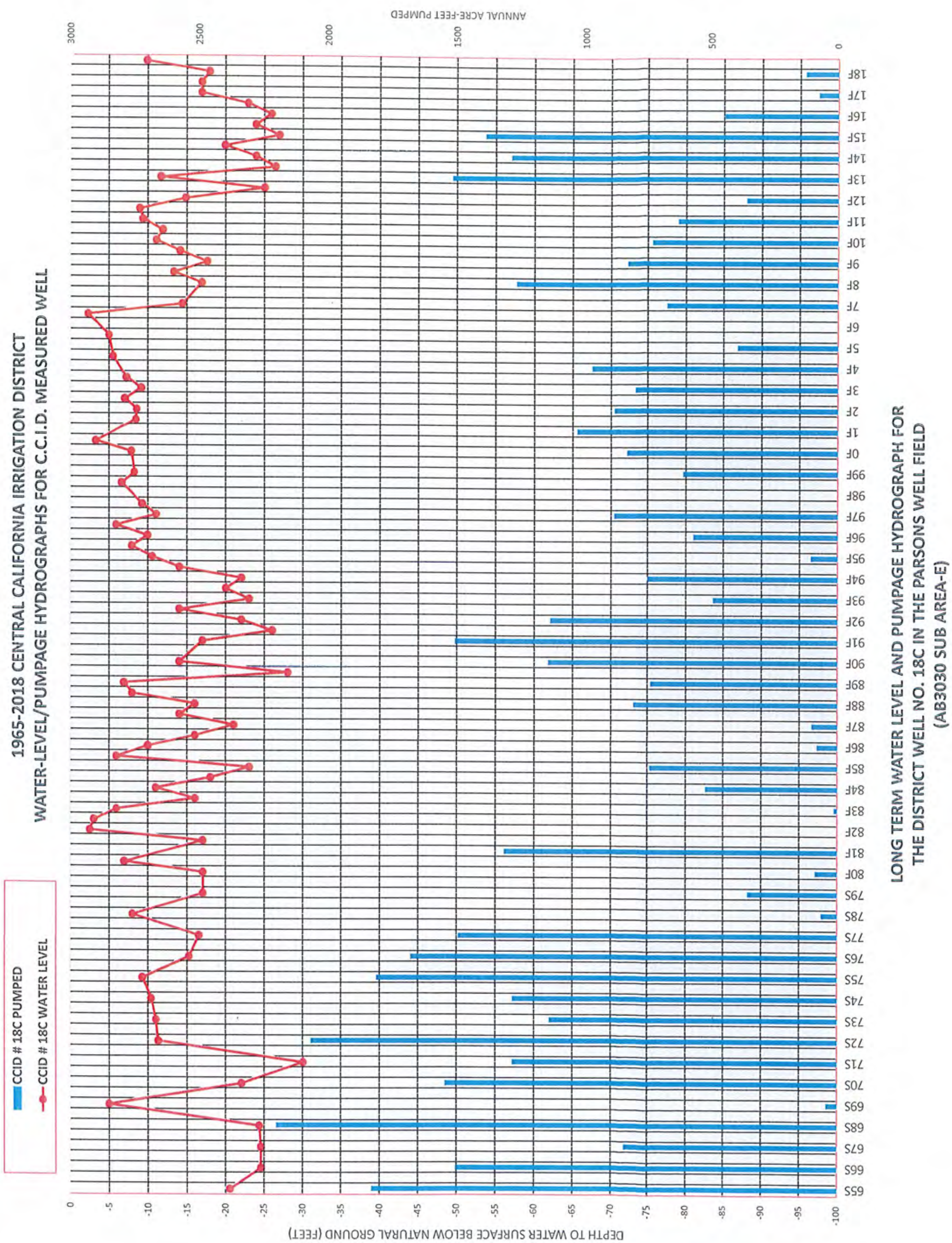

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 15B PUMPED
CCID # 15B WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 15B IN THE HEADGATE WELL FIELD
(AB3030 SUB AREA-G)

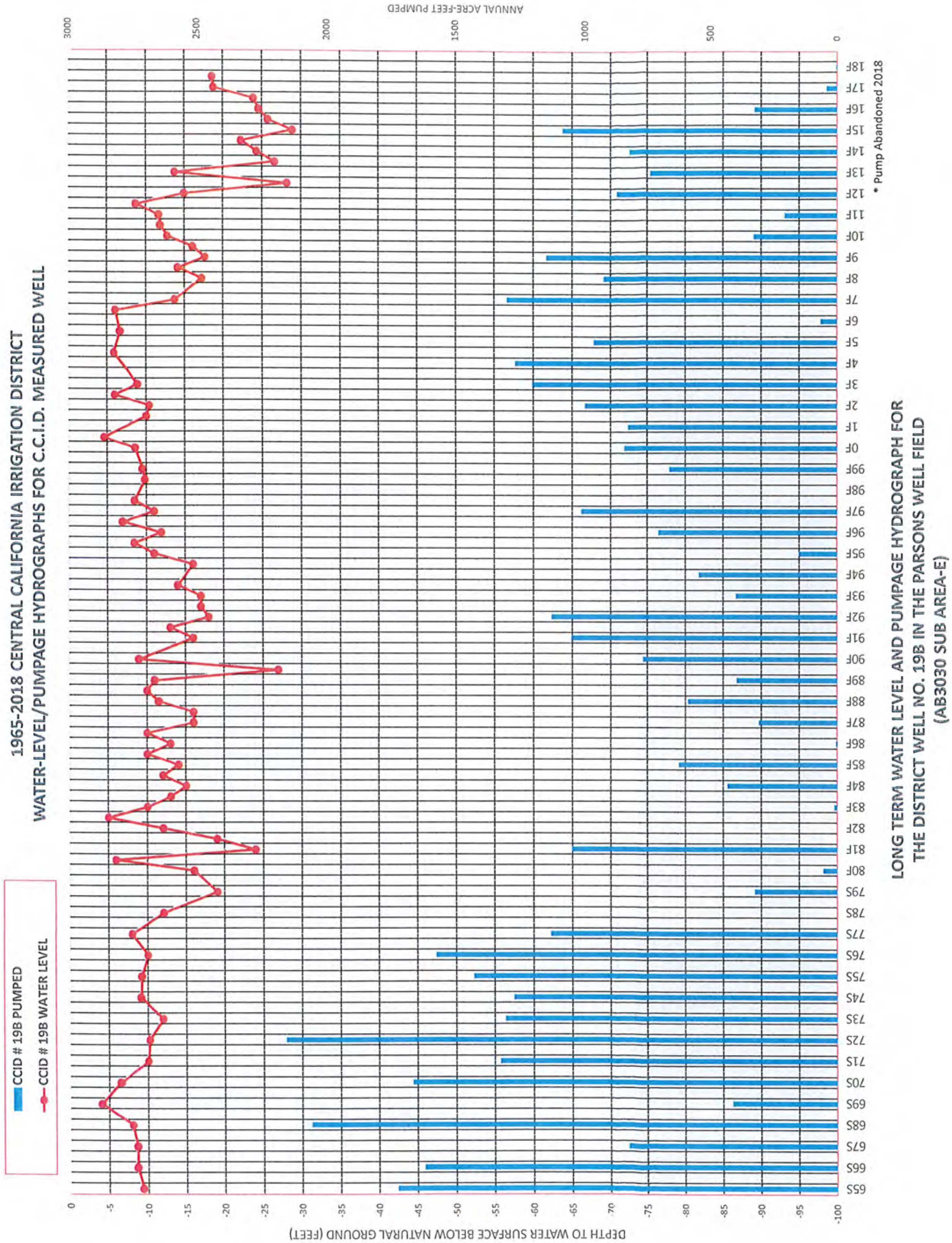
1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

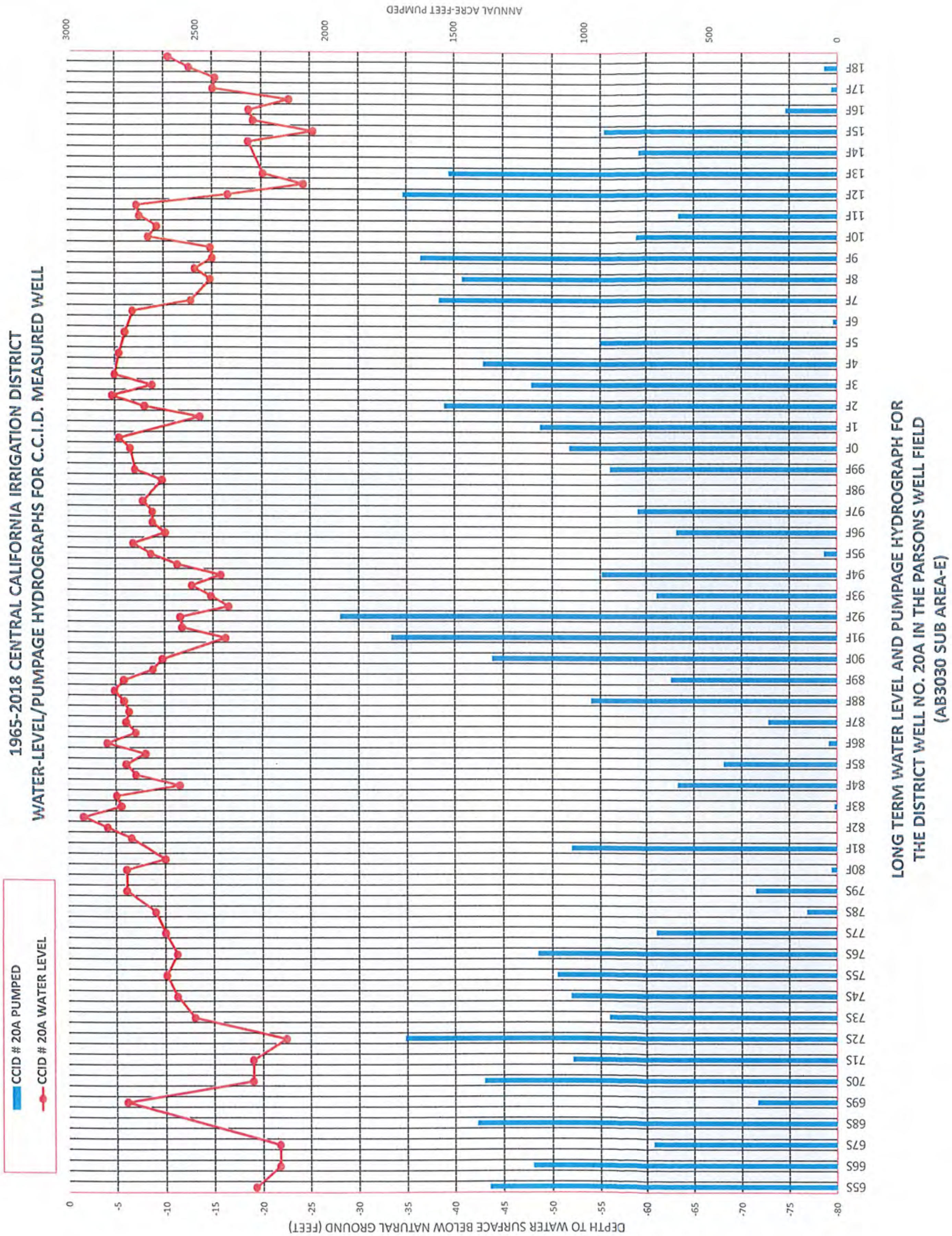


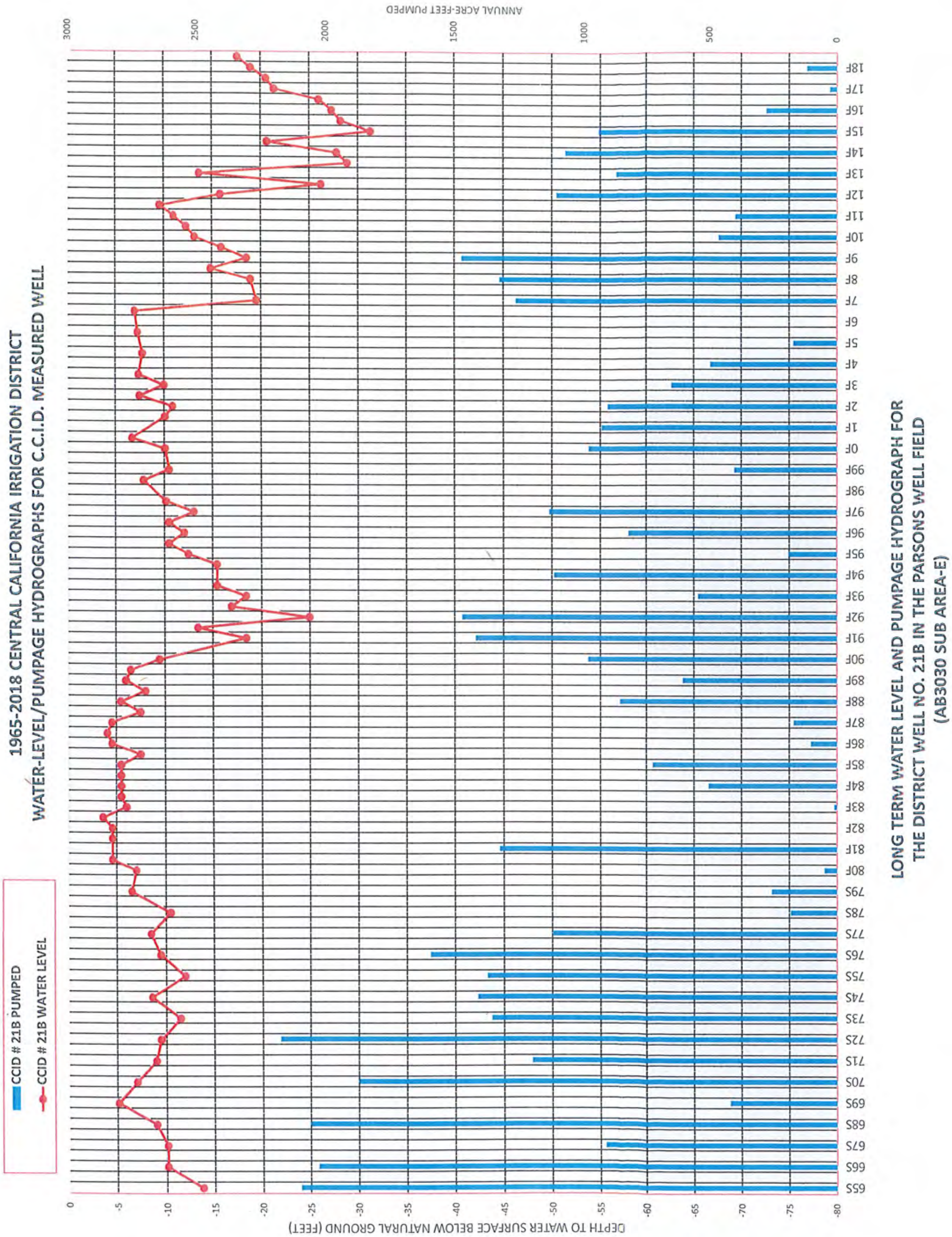
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 16C IN THE HEADGATE WELL FIELD
(AB3030 SUB AREA-G)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 17A PUMPED
CCID # 17A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 17A IN THE PARSONS WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 18C PUMPED
CCID # 18C WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 18C IN THE PARSONS WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 19B PUMPED
CCID # 19B WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
* Pump Abandoned 2018
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 19B IN THE PARSONS WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 20A PUMPED
CCID # 20A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
65S
66S
67S
68S
69S
70S
71S
72S
73S
74S
75S
76S
77S
78S
79S
80F
81F
82F
83F
84F
85F
86F
87F
88F
89F
90F
91F
92F
93F
94F
95F
96F
97F
98F
99F
0F
1F
2F
3F
4F
5F
6F
7F
8F
9F
10F
11F
12F
13F
14F
15F
16F
17F
18F
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 20A IN THE PARSONS WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 21B PUMPED
CCID # 21B WATER LEVEL
ANNUAL ACRE-FEET PUMPED
3000
2500
2000
1500
1000
500
0
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
65S
66S
67S
68S
69S
70S
71S
72S
73S
74S
75S
76S
77S
78S
79S
80F
81F
82F
83F
84F
85F
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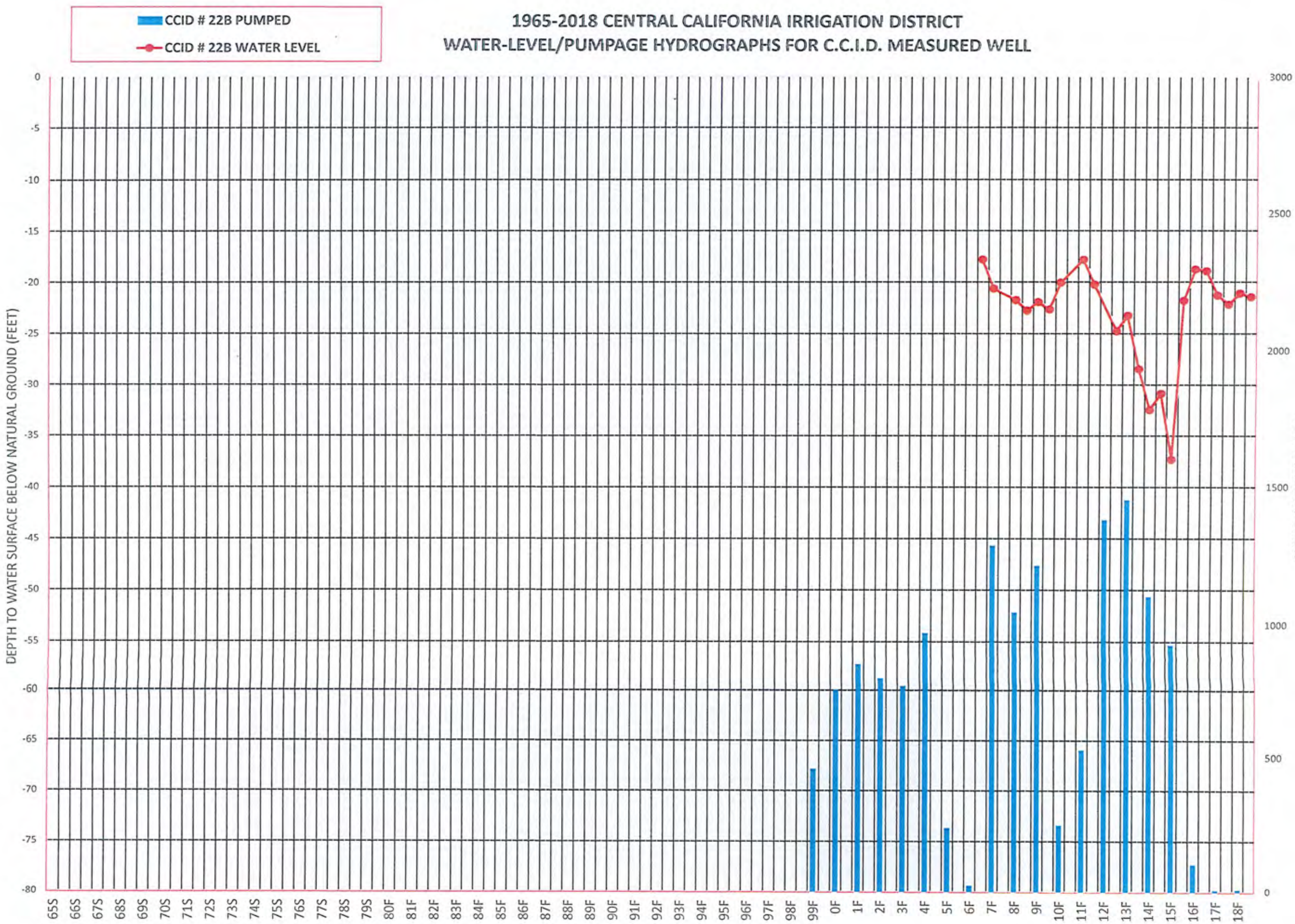
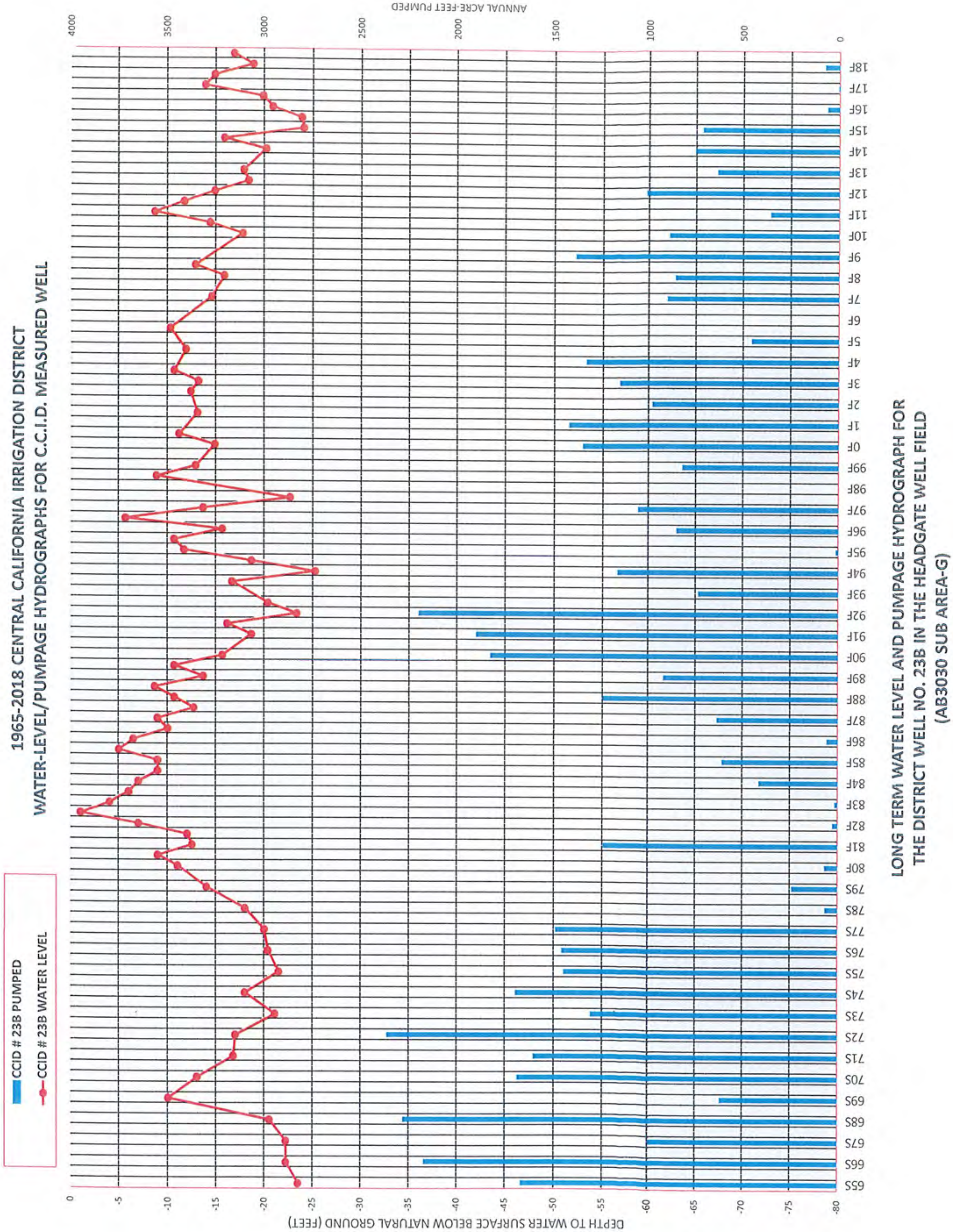
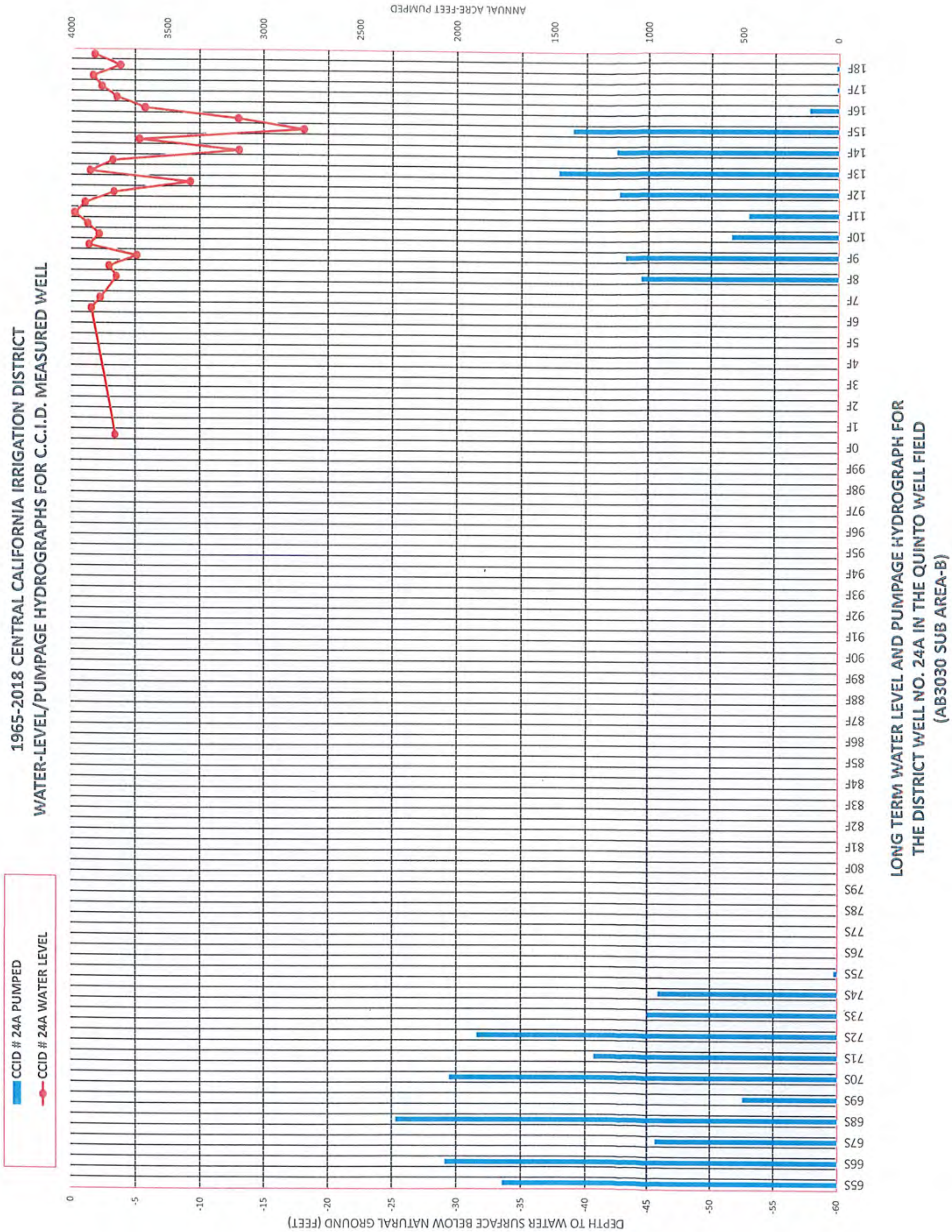
93F
94F
95F
96F
97F
98F
99F
0F
1F
2F
3F
4F
5F
6F
7F
8F
9F
10F
11F
12F
13F
14F
15F
16F
17F
18F
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 21B IN THE PARSONS WELL FIELD
(AB3030 SUB AREA-E)

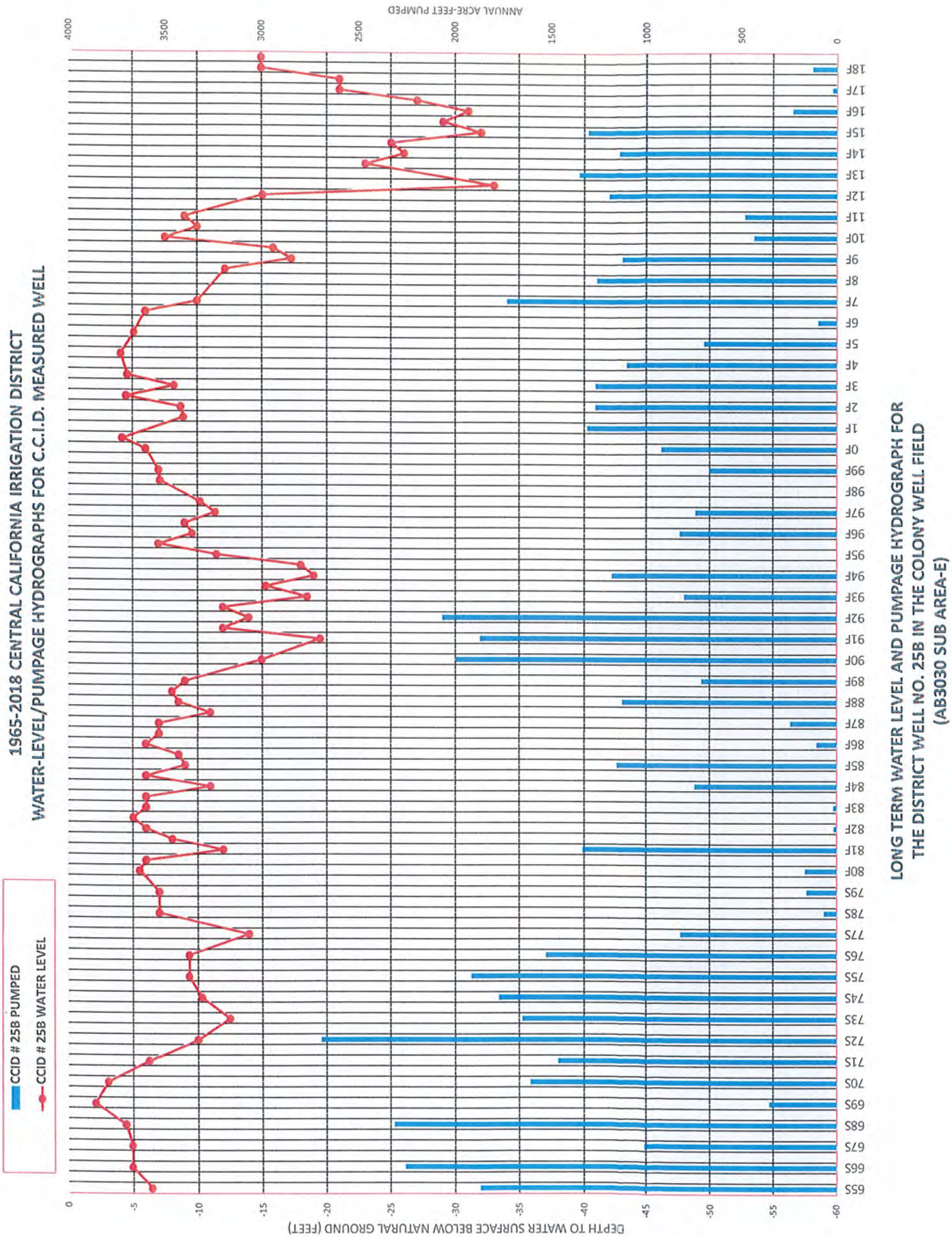
1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

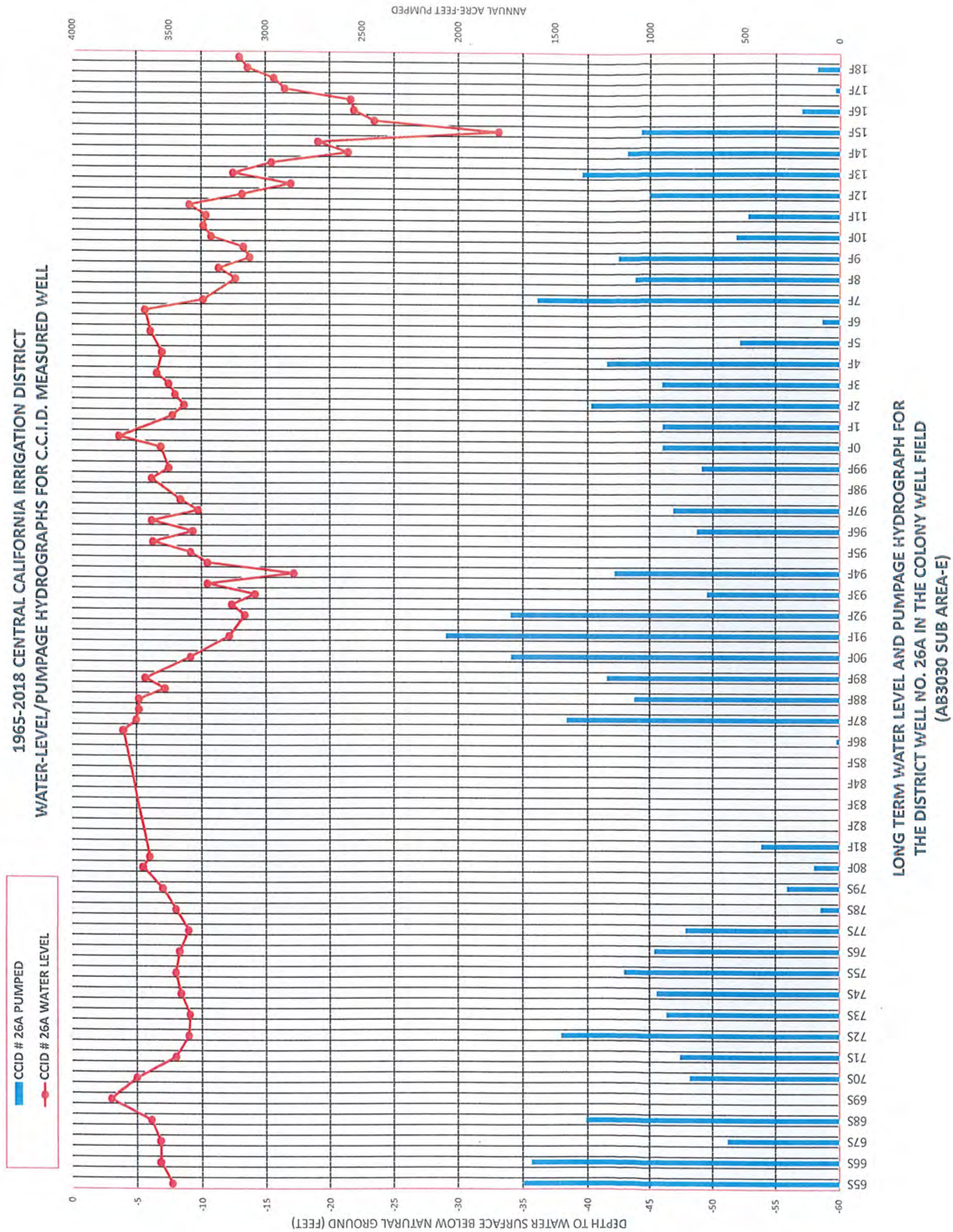


LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 22B IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-B)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 23B PUMPED
CCID # 23B WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 23B IN THE HEADGATE WELL FIELD
(AB3030 SUB AREA-G)

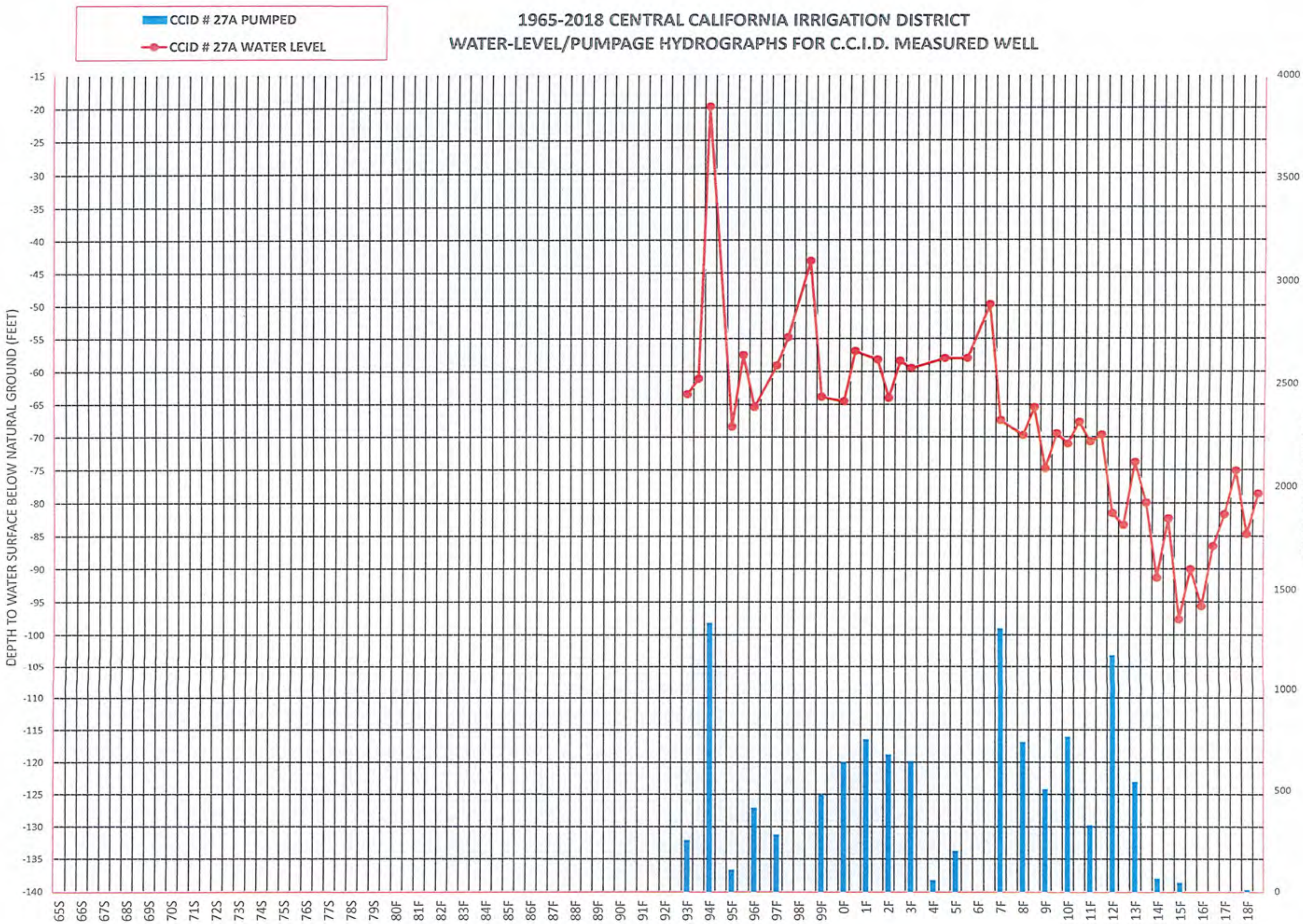

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 24A PUMPED
CCID # 24A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 24A IN THE QUINTO WELL FIELD
(AB3030 SUB AREA-B)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 25B PUMPED
CCID # 25B WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 25B IN THE COLONY WELL FIELD
(AB3030 SUB AREA-E)

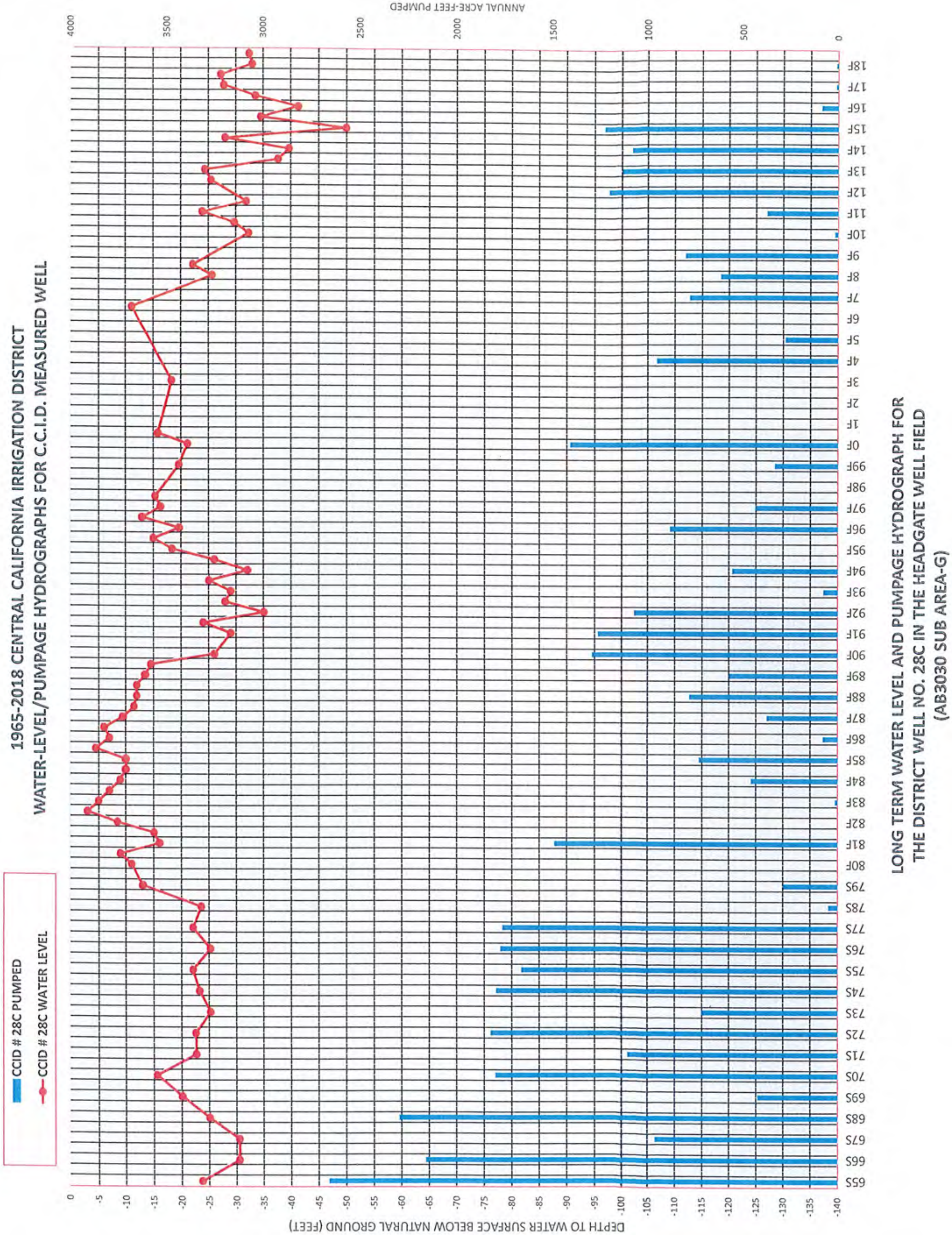


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 26A PUMPED
CCID # 26A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 26A IN THE COLONY WELL FIELD
(AB3030 SUB AREA-E)

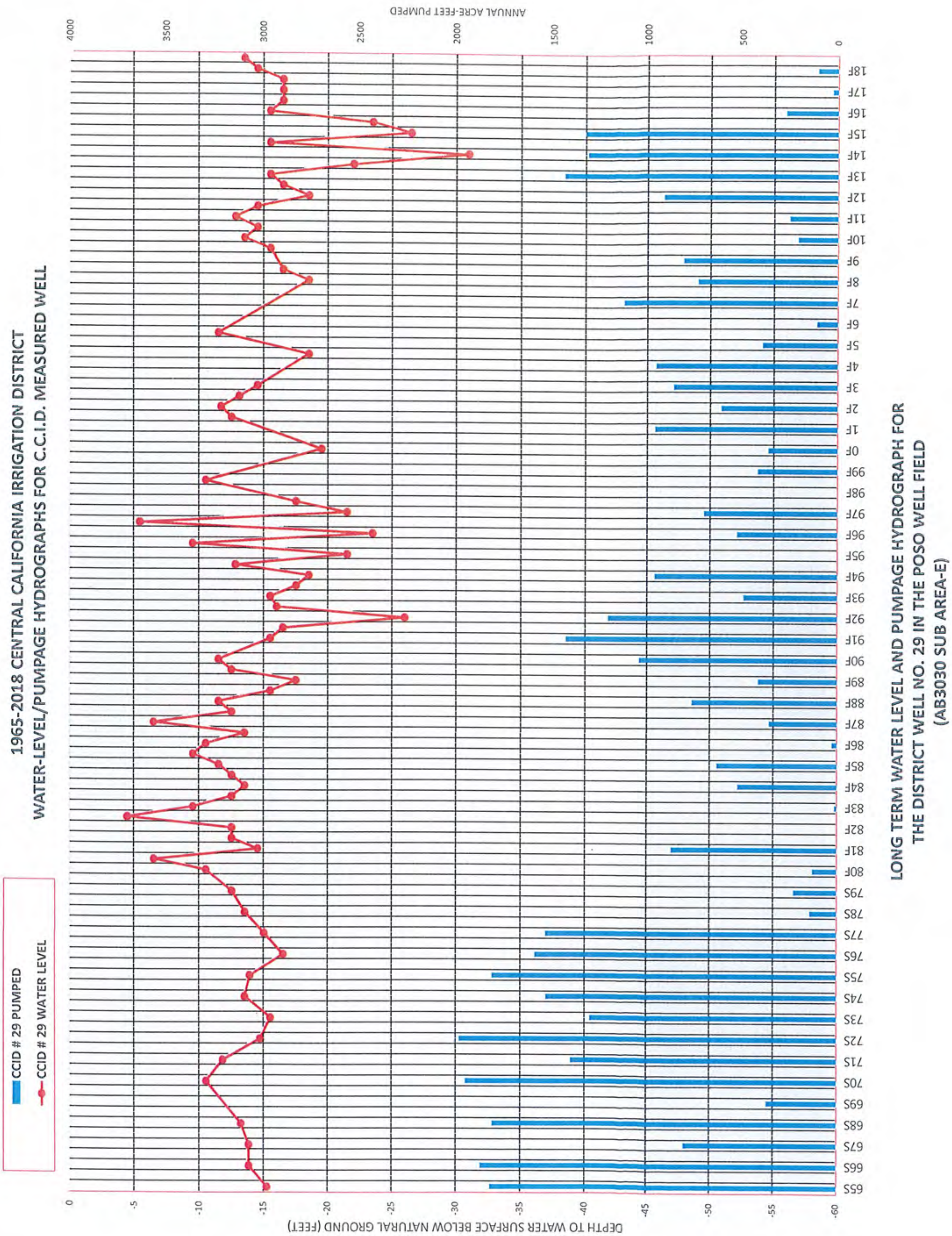
1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

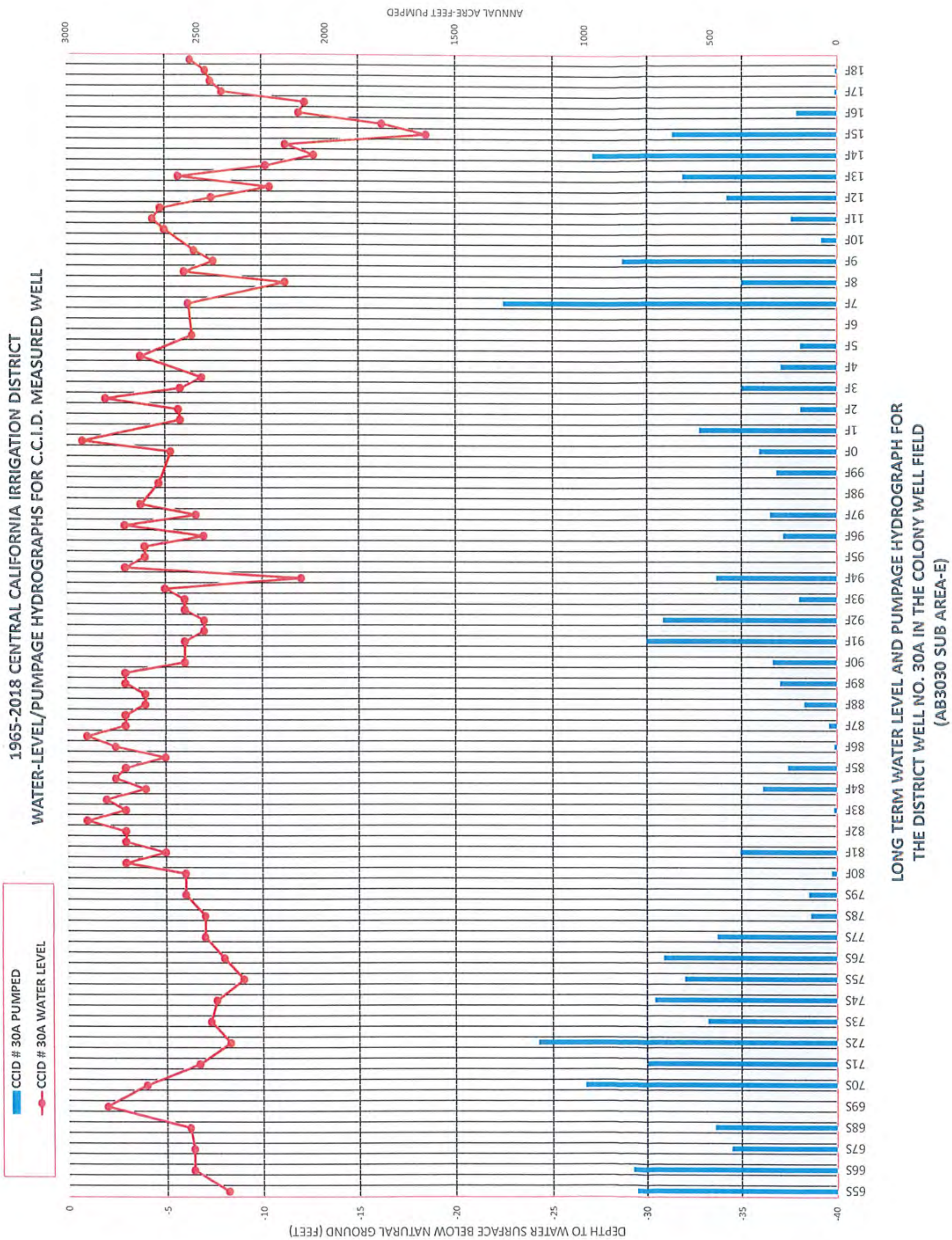


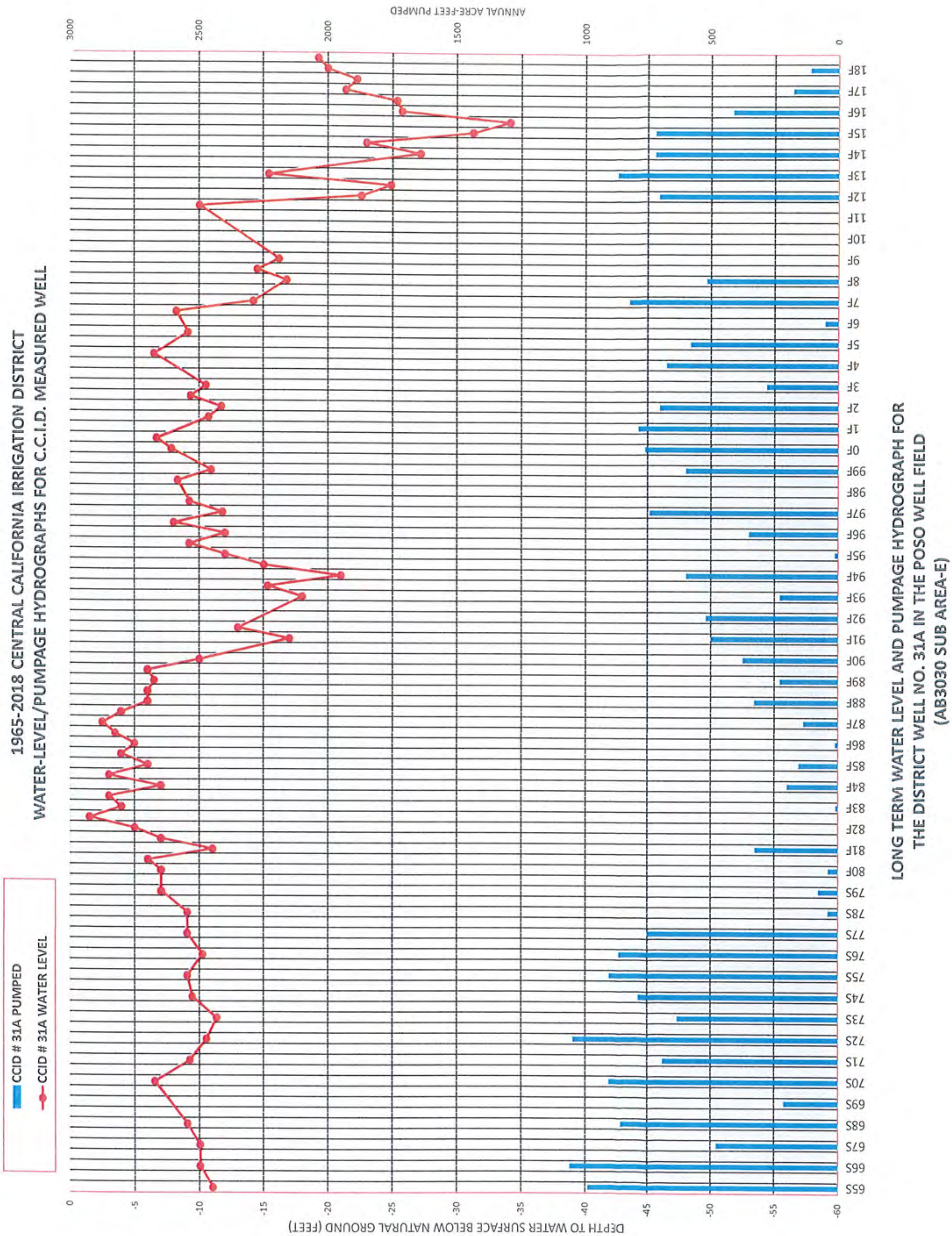
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR THE DISTRICT WELL NO. 27A IN THE QUINTO WELL FIELD (AB3030 SUB AREA-B)



1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 28C PUMPED
CCID # 28C WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 28C IN THE HEADGATE WELL FIELD
(AB3030 SUB AREA-G)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 29 PUMPED
CCID # 29 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
65S 66S 67S 68S 69S 70S 71S 72S 73S 74S 75S 76S 77S 78S 79S 80F 81F 82F 83F 84F 85F 86F 87F 88F 89F 90F 91F 92F 93F 94F 95F 96F 97F 98F 99F 0F 1F 2F 3F 4F 5F 6F 7F 8F 9F 10F 11F 12F 13F 14F 15F 16F 17F 18F
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 29 IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 30A PUMPED
CCID # 30A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 30A IN THE COLONY WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 31A PUMPED
CCID # 31A WATER LEVEL
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 31A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)
ANNUAL ACRE-FEET PUMPED
3000
2500
2000
1500
1000
500
0
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
65S
66S
67S
68S
69S
70S
71S
72S
73S
74S
75S
76S
77S
78S
79S
80F
81F
82F
83F
84F
85F
86F
87F
88F
89F
90F
91F
92F
93F
94F
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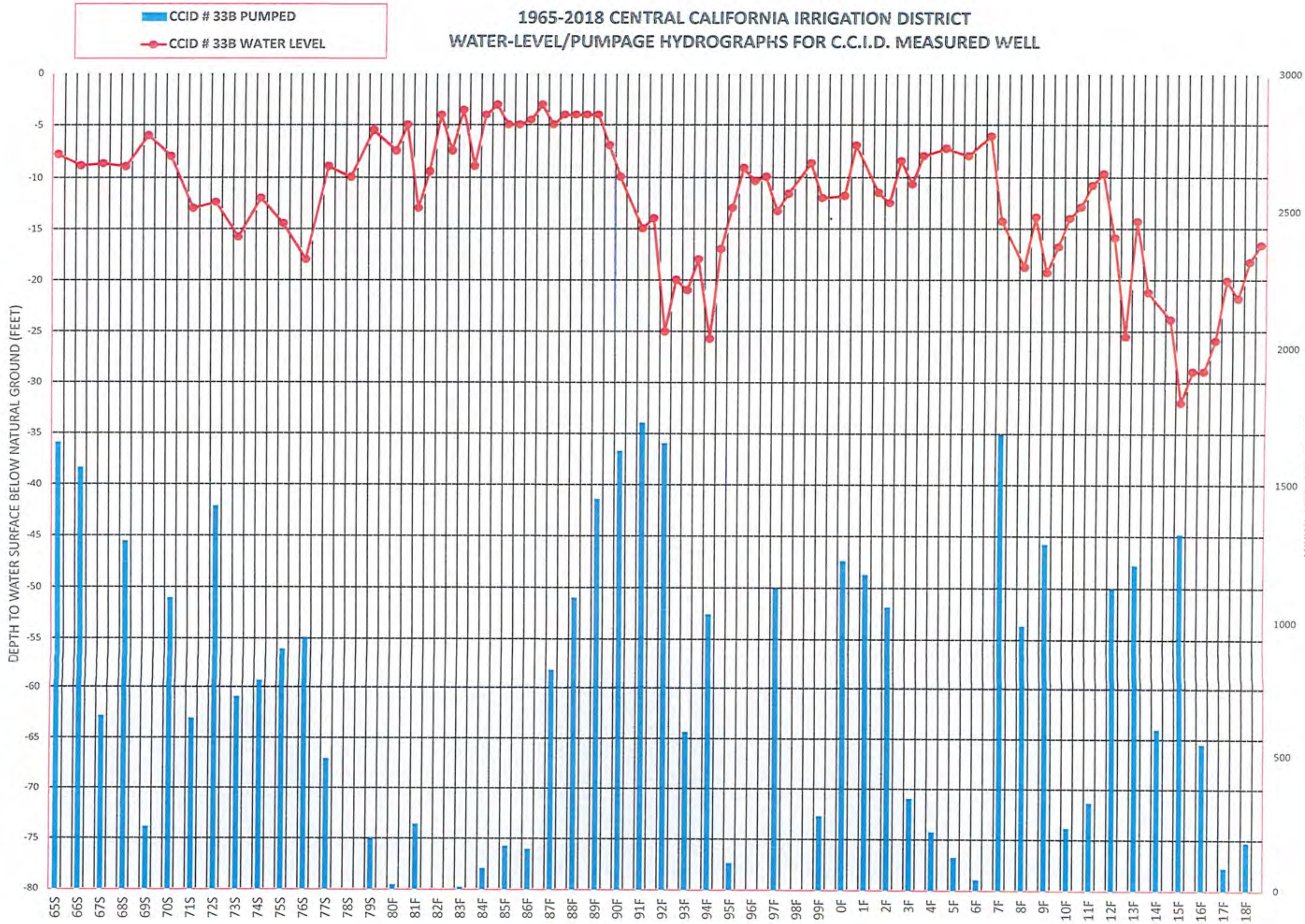
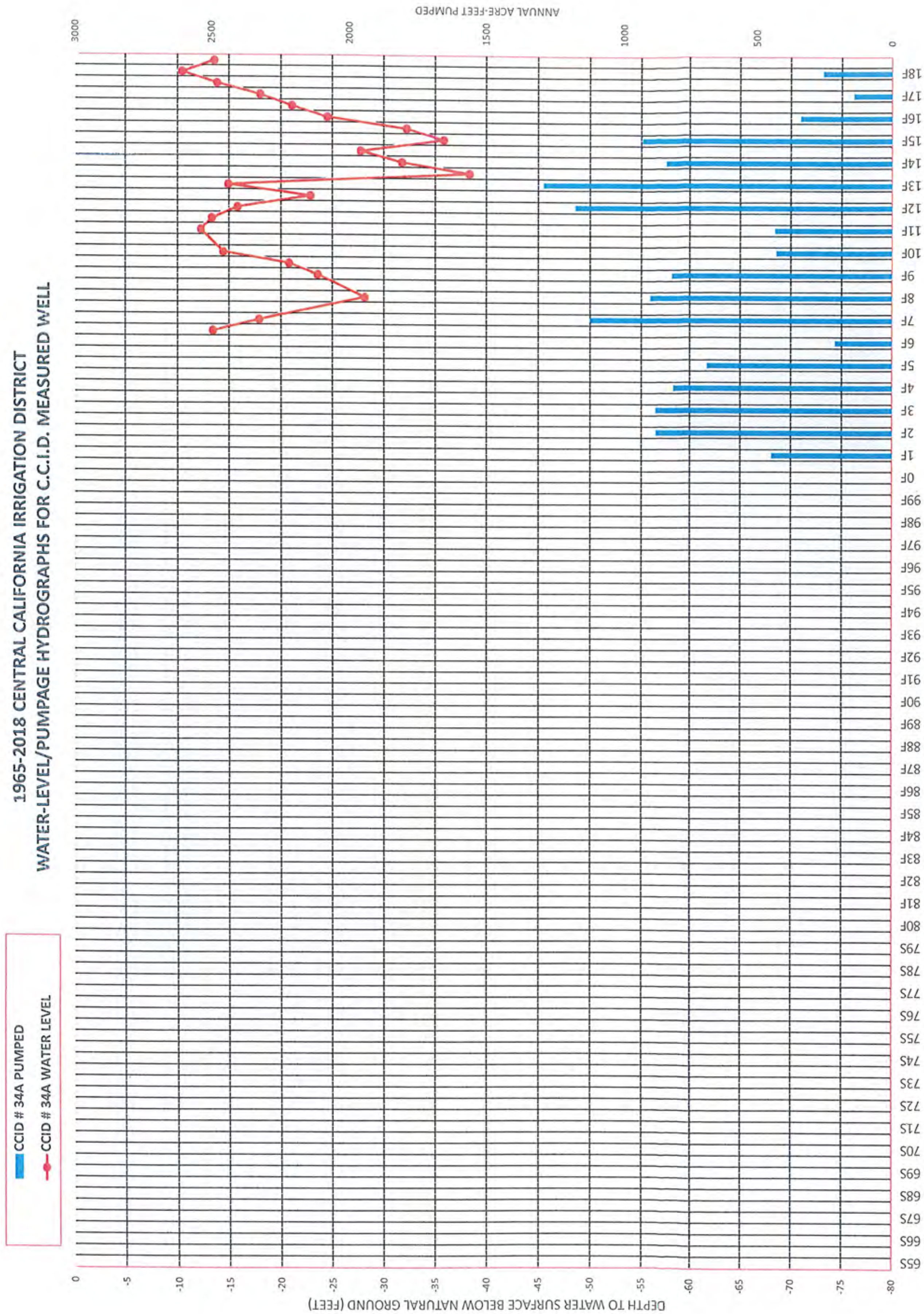
96F
97F
98F
99F
0F
1F
2F
3F
4F
5F
6F
7F
8F
9F
10F
11F
12F
13F
14F
15F
16F
17F
18F

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

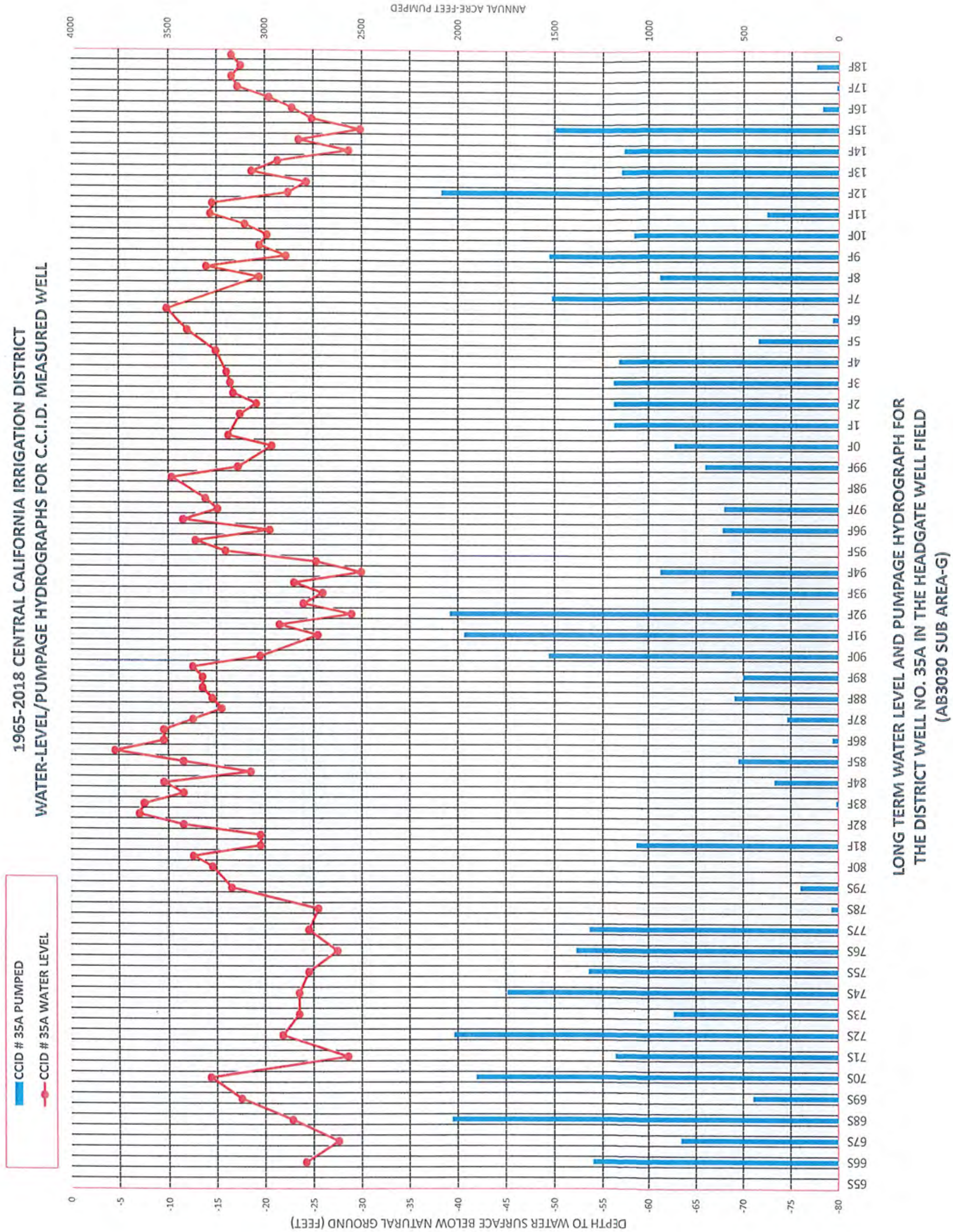


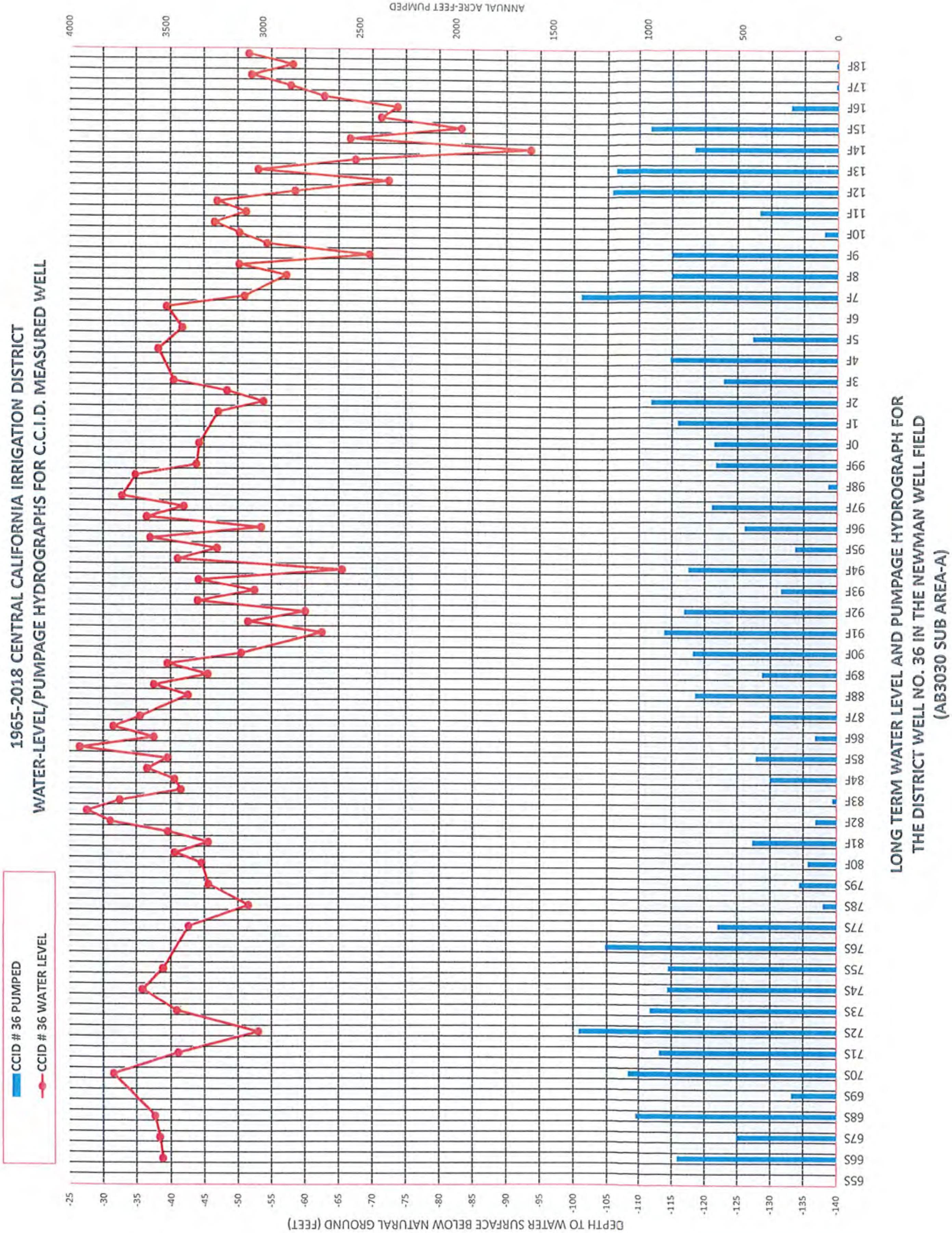
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 33B IN THE PARSONS WELL FIELD
(AB3030 SUB AREA-E)

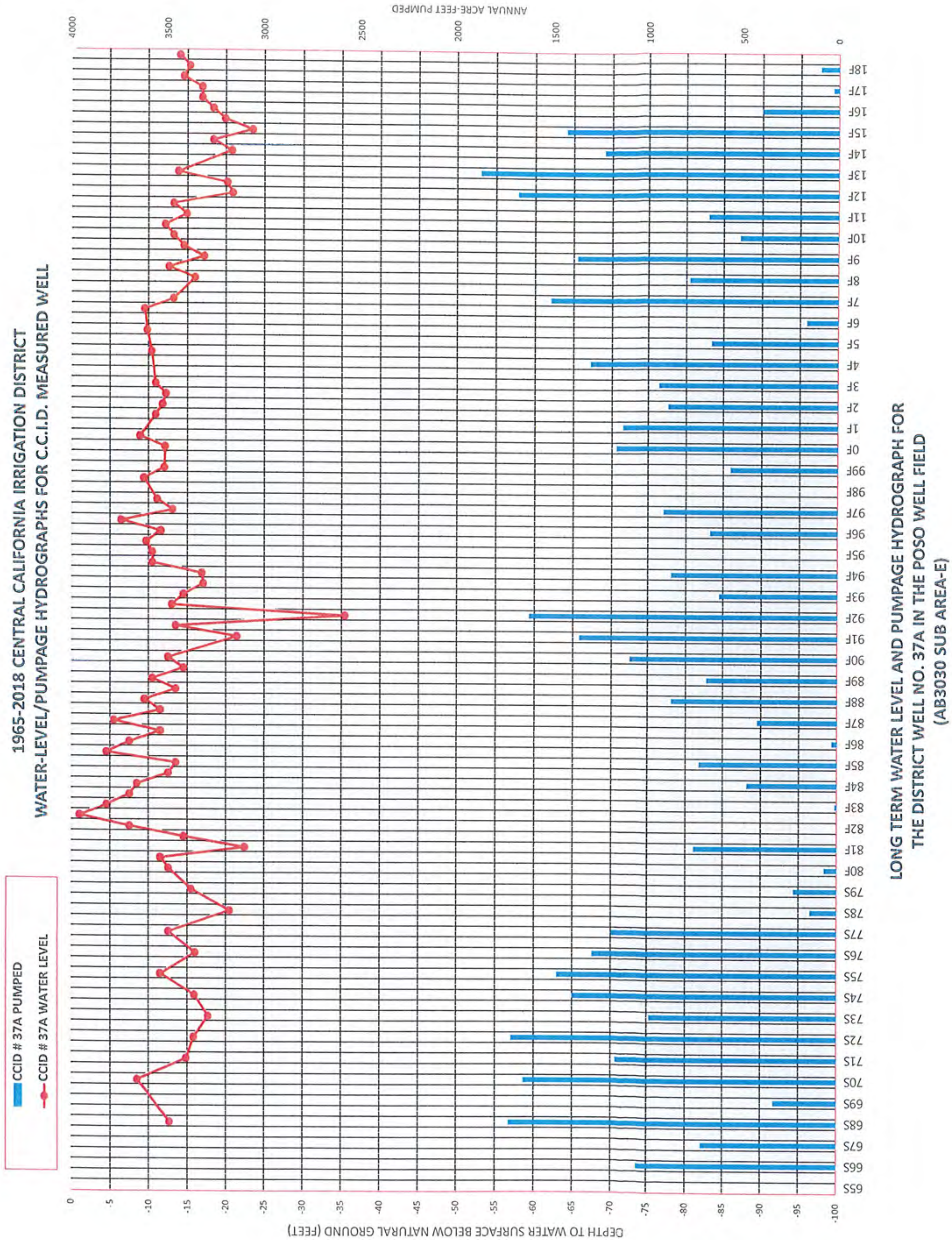
1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

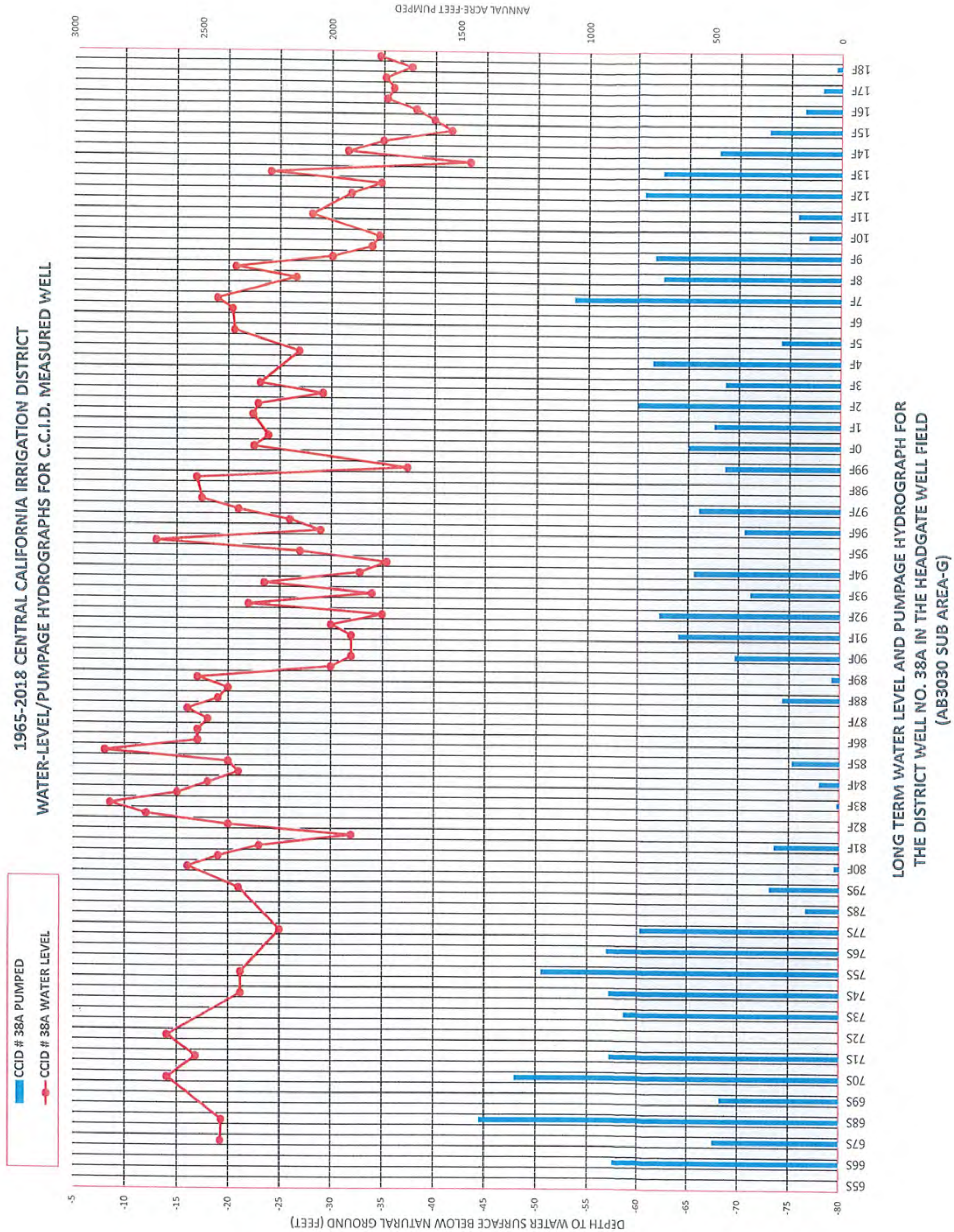


LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR THE DISTRICT WELL NO. 34A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 35A PUMPED
CCID # 35A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 35A IN THE HEADGATE WELL FIELD
(AB3030 SUB AREA-G)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 36 PUMPED
CCID # 36 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 36 IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 37A PUMPED
CCID # 37A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 37A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 38A PUMPED
CCID # 38A WATER LEVEL
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 38A IN THE HEADGATE WELL FIELD
(AB3030 SUB AREA-G)
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
3000
2500
2000
1500
1000
500
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
65S
66S
67S
68S
69S
70S
71S
72S
73S
74S
75S
76S
77S
78S
79S
80F
81F
82F
83F
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86F
87F
88F
89F
90F
91F
92F
93F
94F
95F
96F
97F
98F
99F
0F
1F
2F
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6F
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11F
12F
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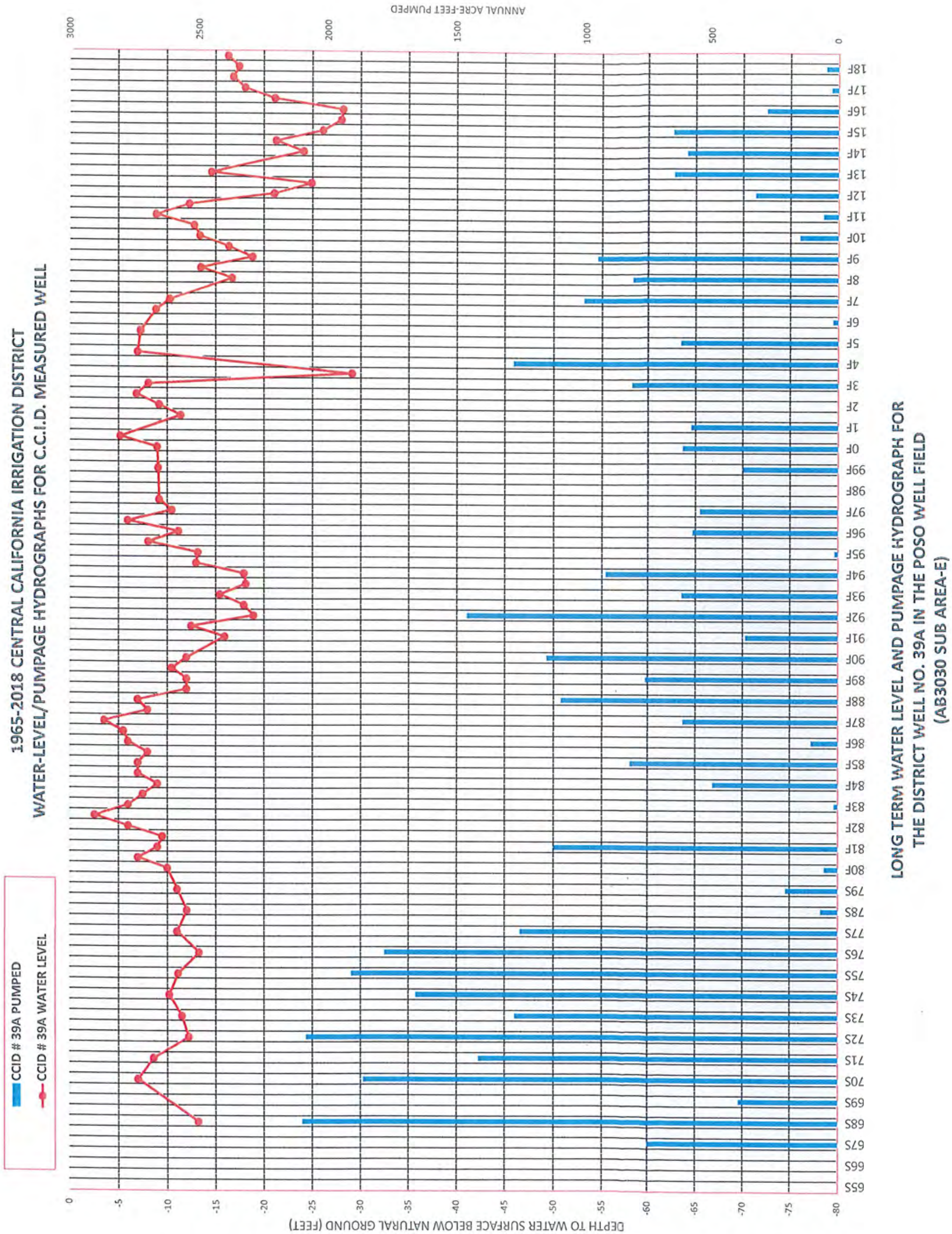
17F
18F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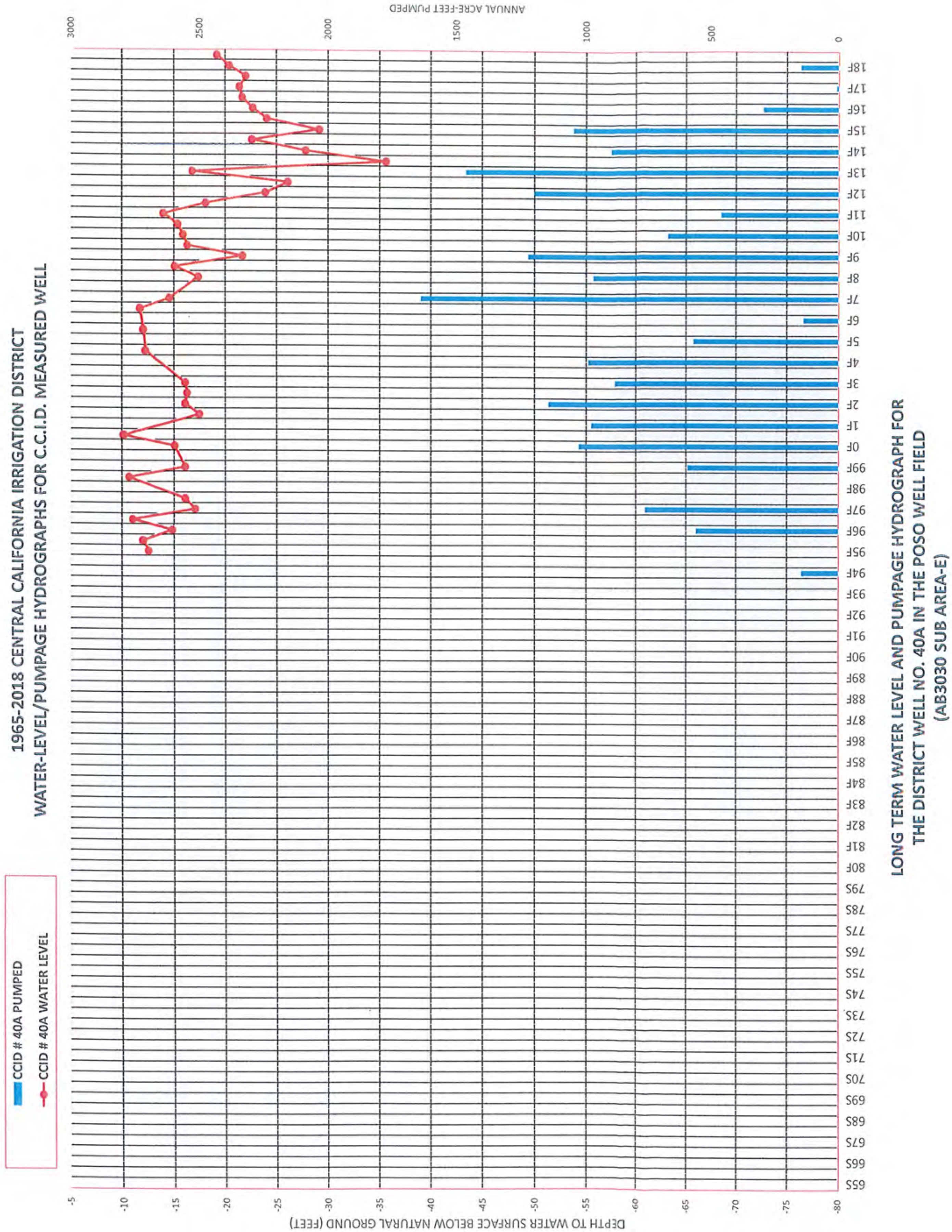
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 39A PUMPED
CCID # 39A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 39A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)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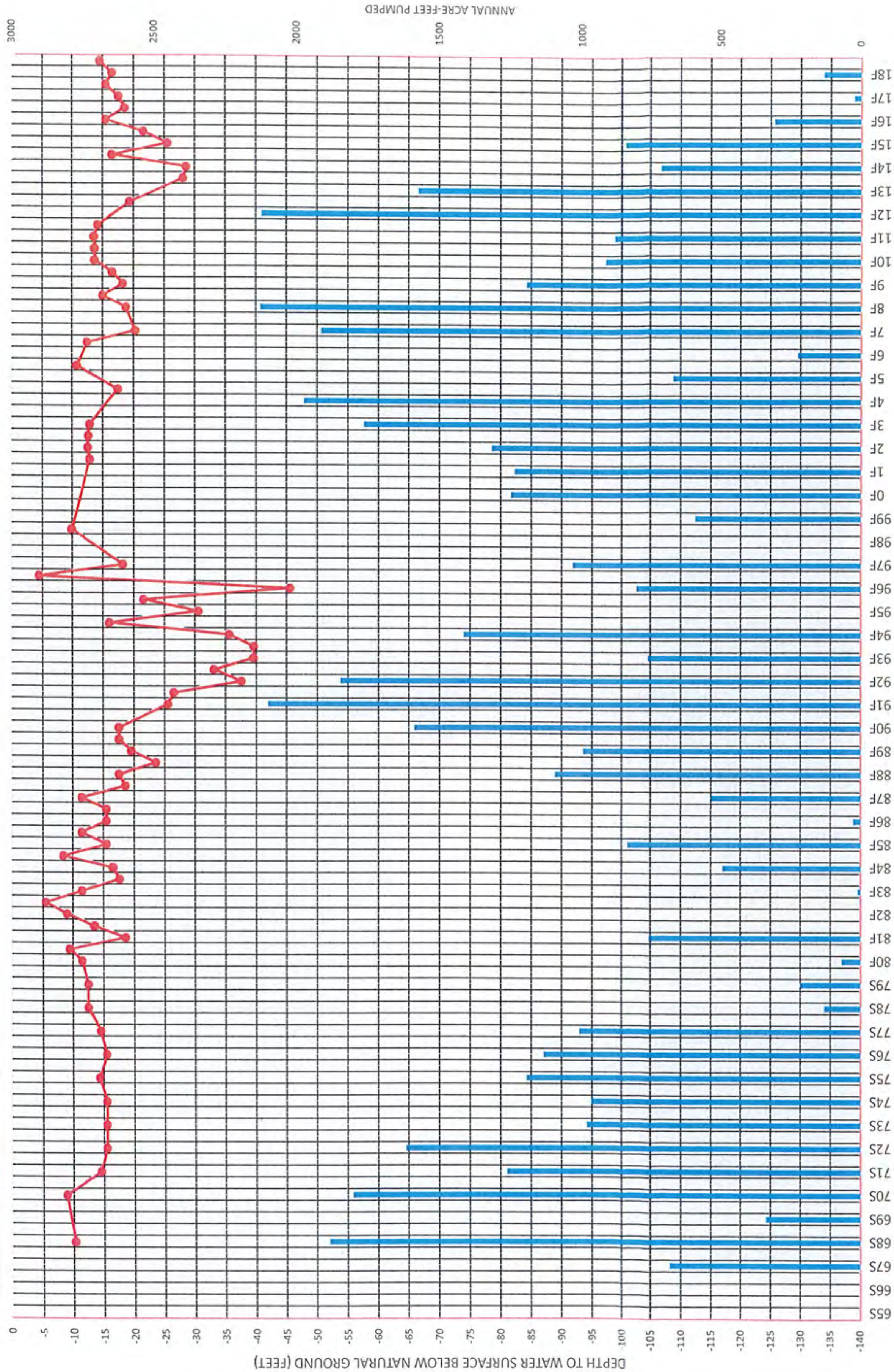
CCID # 40A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 40A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

CCID # 41 PUMPED
CCID # 41 WATER LEVEL



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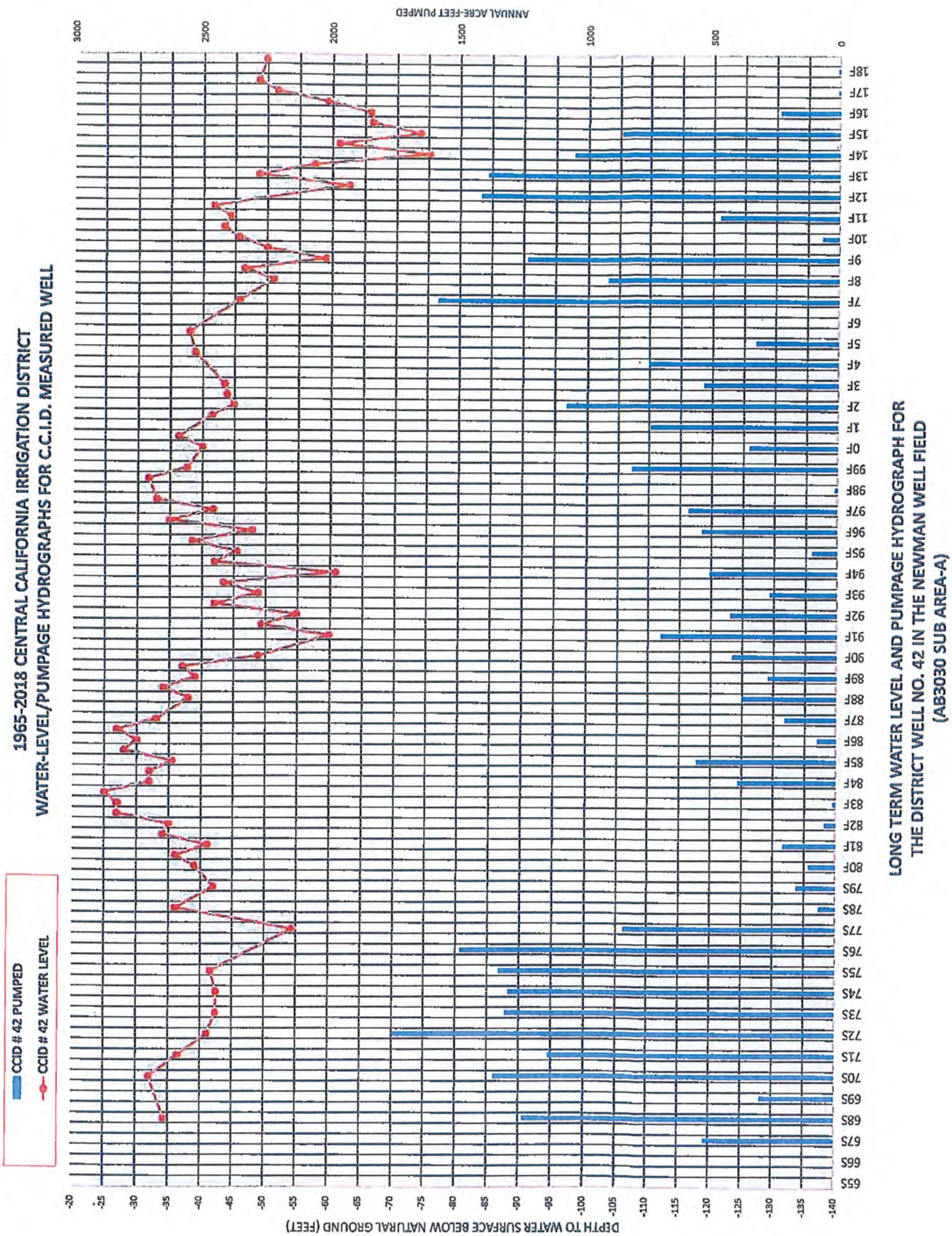
(AB3030 SUB AREA-E)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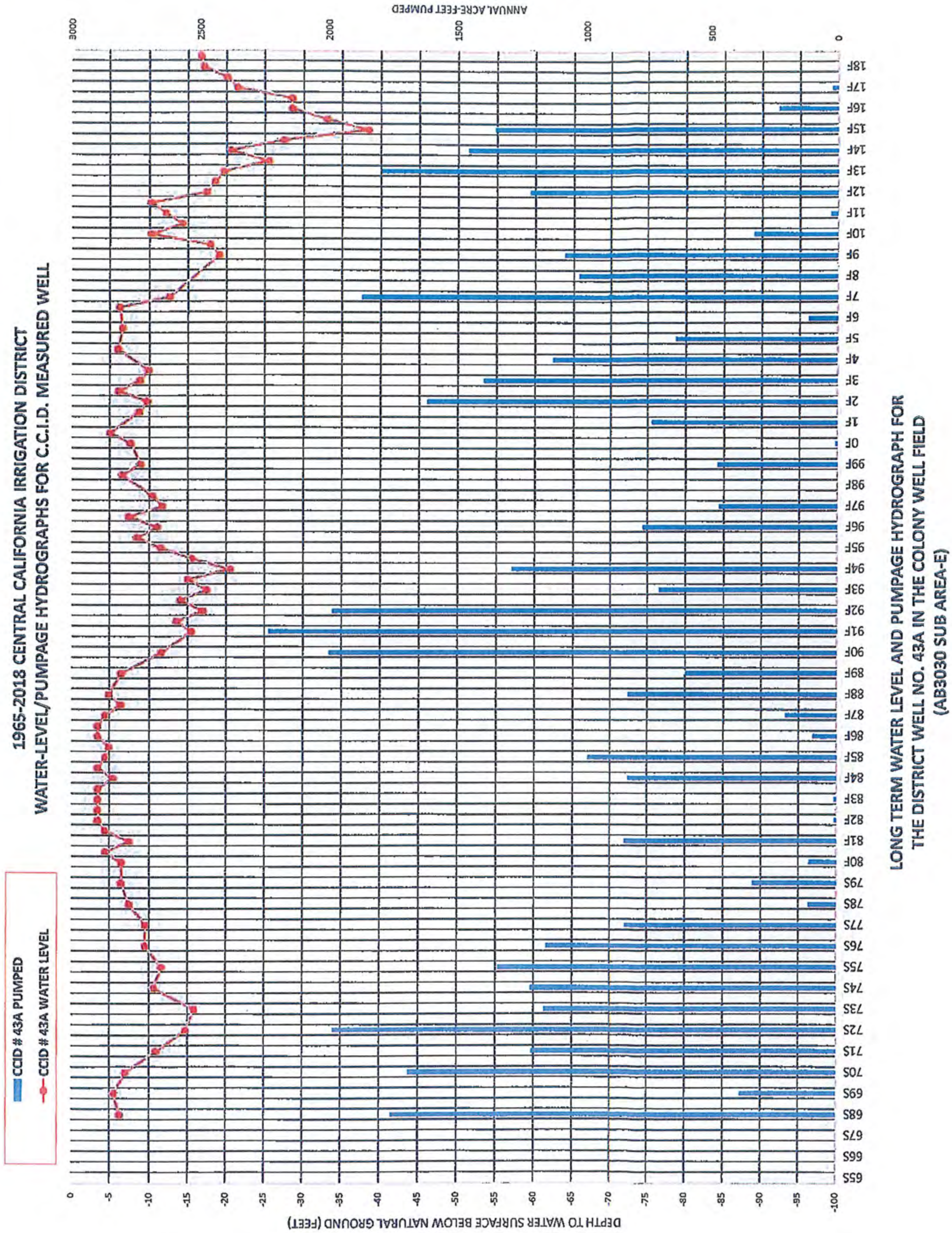
CCID # 42 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 42 IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)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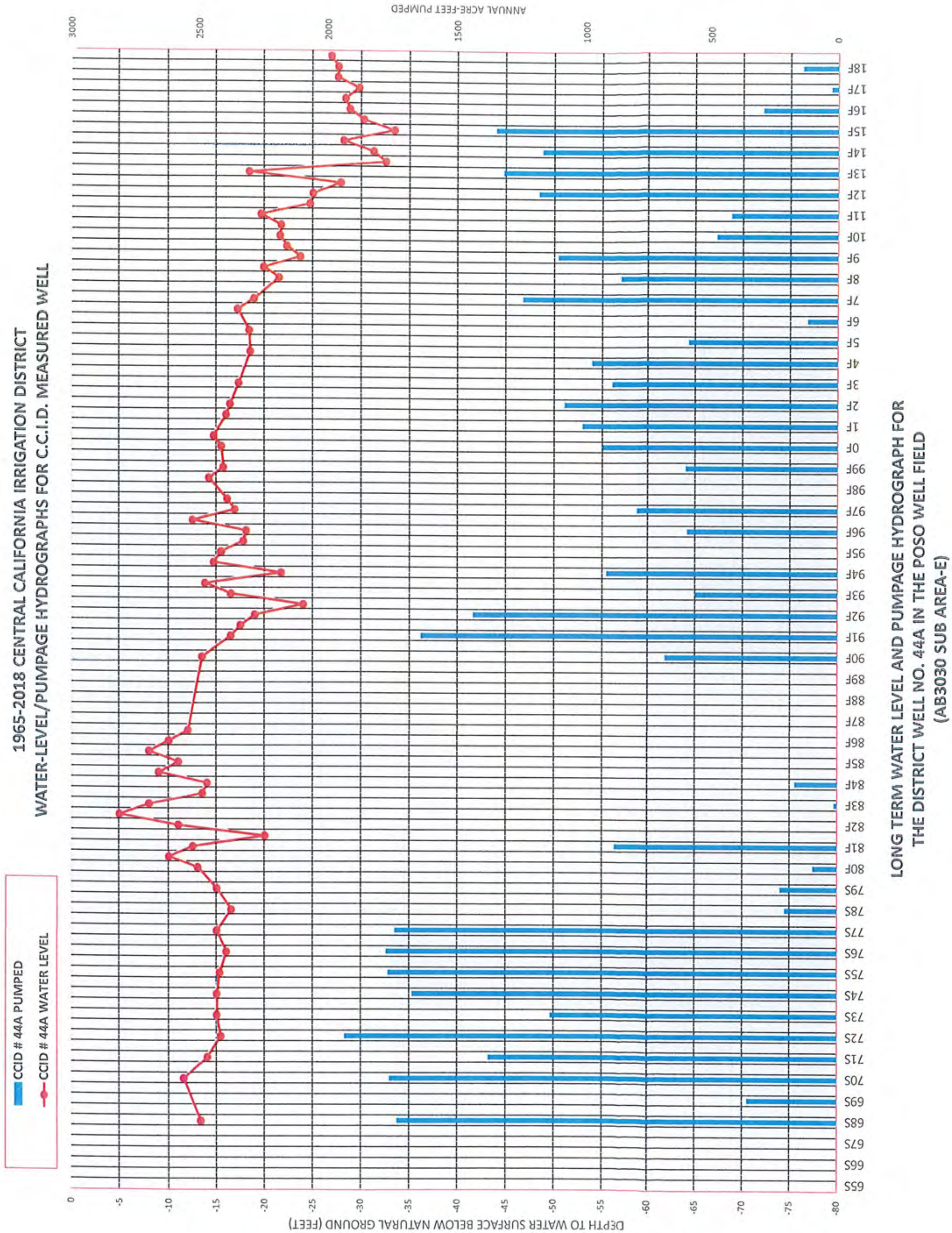
CCID # 43A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 43A IN THE COLONY WELL FIELD
(AB3030 SUB AREA-E)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CCID # 44A PUMPED
CCID # 44A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
0
500
1000
1500
2000
2500
3000
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
65S
66S
67S
68S
69S
70S
71S
72S
73S
74S
75S
76S
77S
78S
79S
80F
81F
82F
83F
84F
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96F
97F
98F
99F
0F
1F
2F
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4F
5F
6F
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11F
12F
13F
14F
15F
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18F
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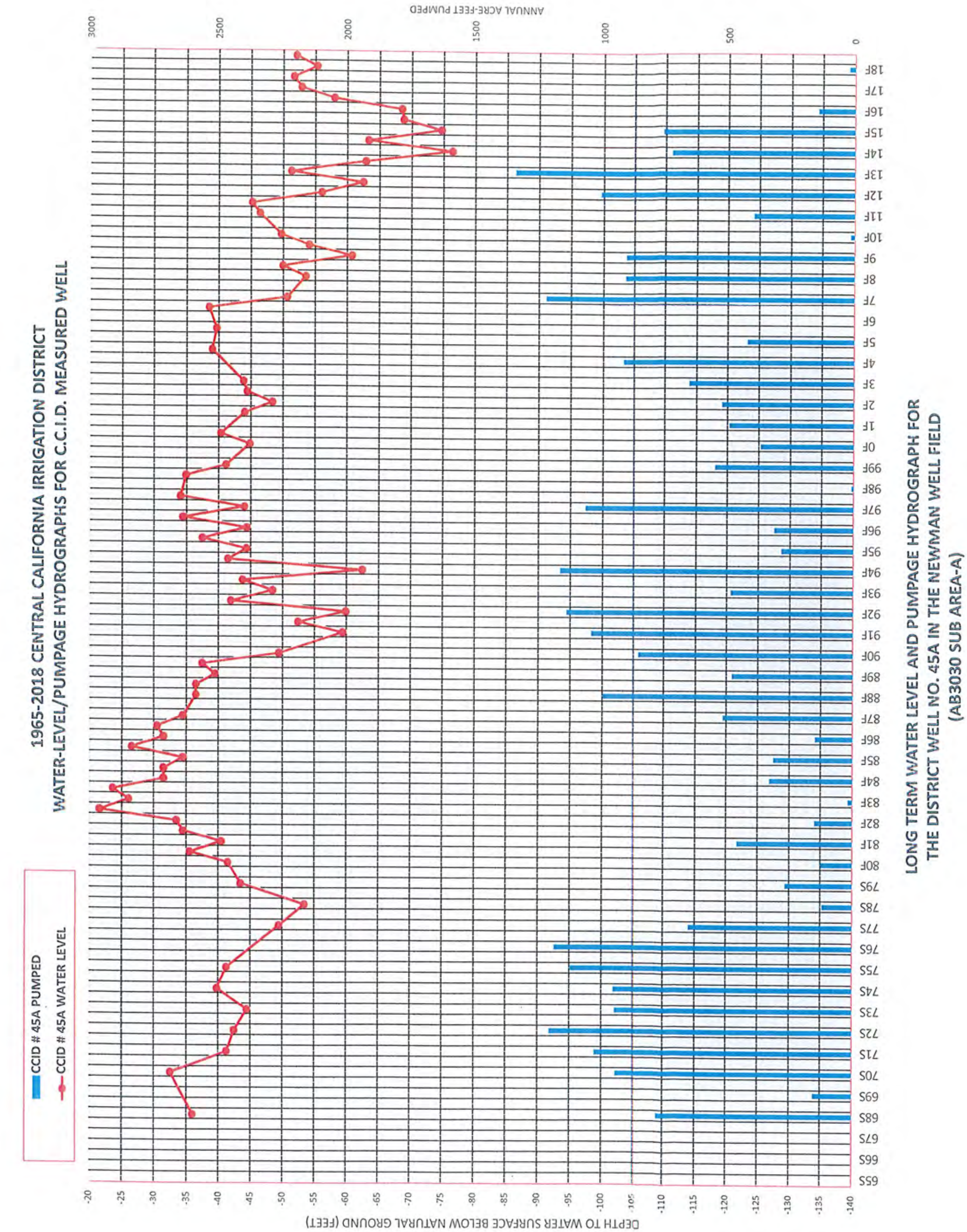
THE DISTRICT WELL NO. 44A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)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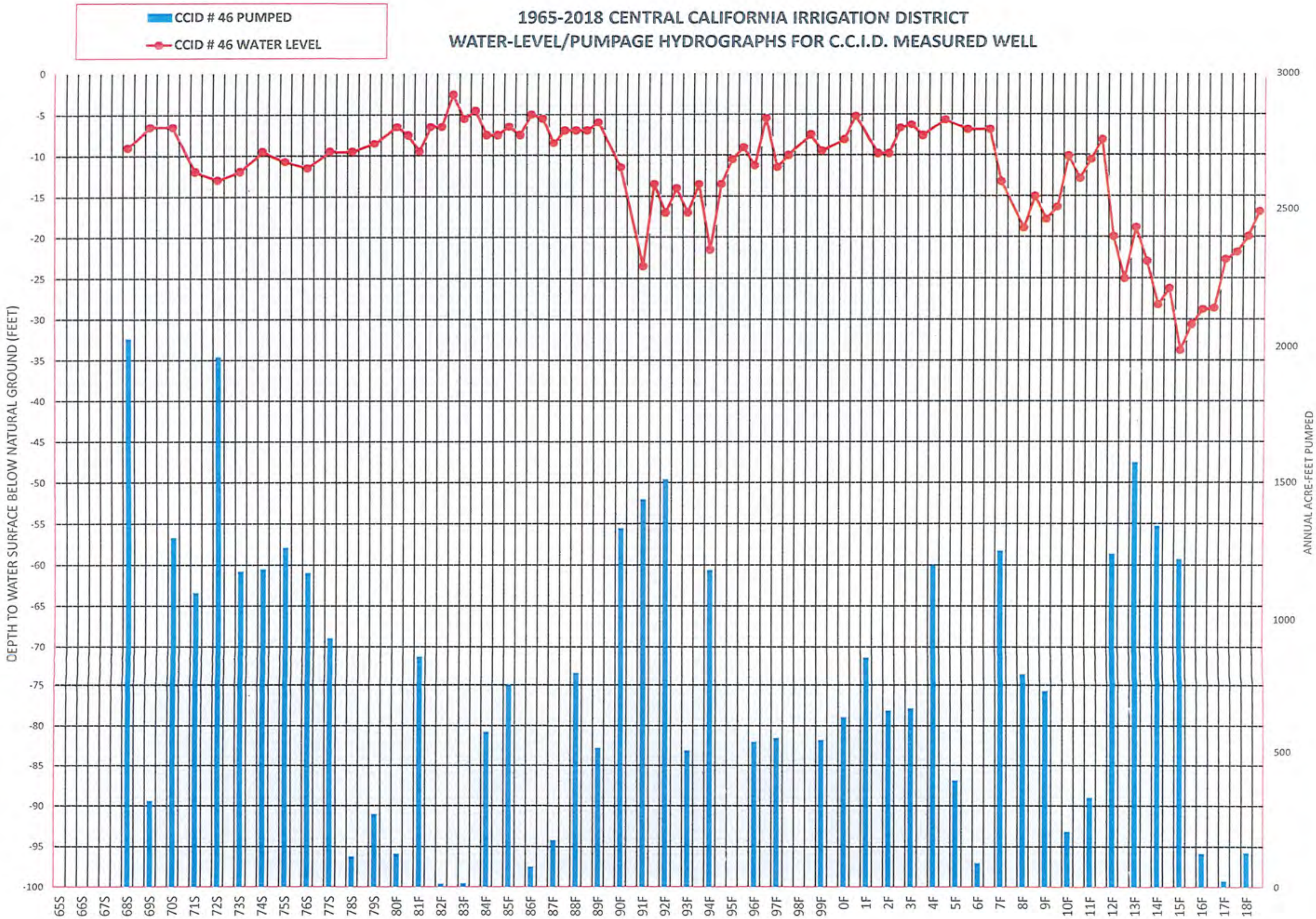
CCID # 45A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 45A IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)



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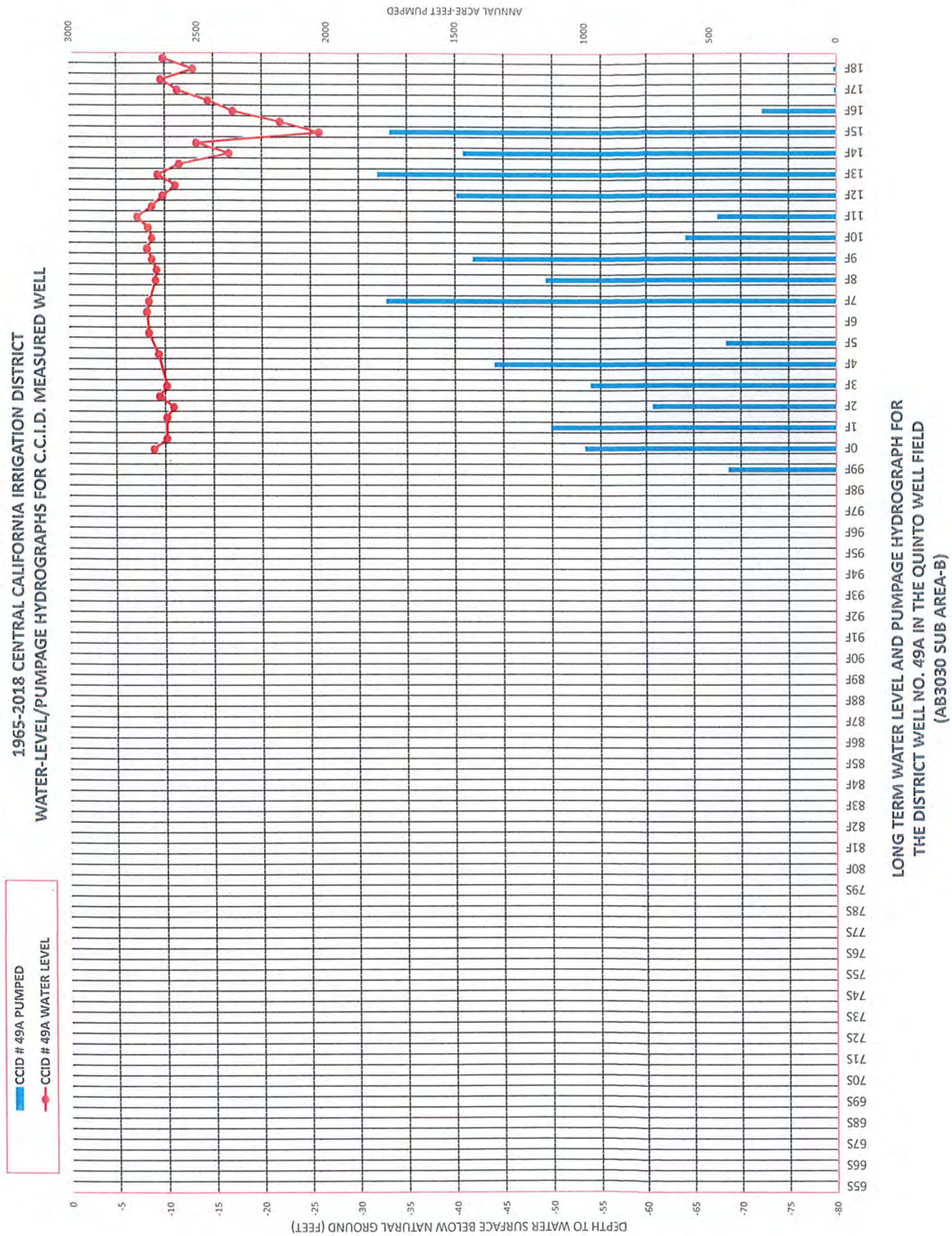
(AB3030 SUB AREA-E)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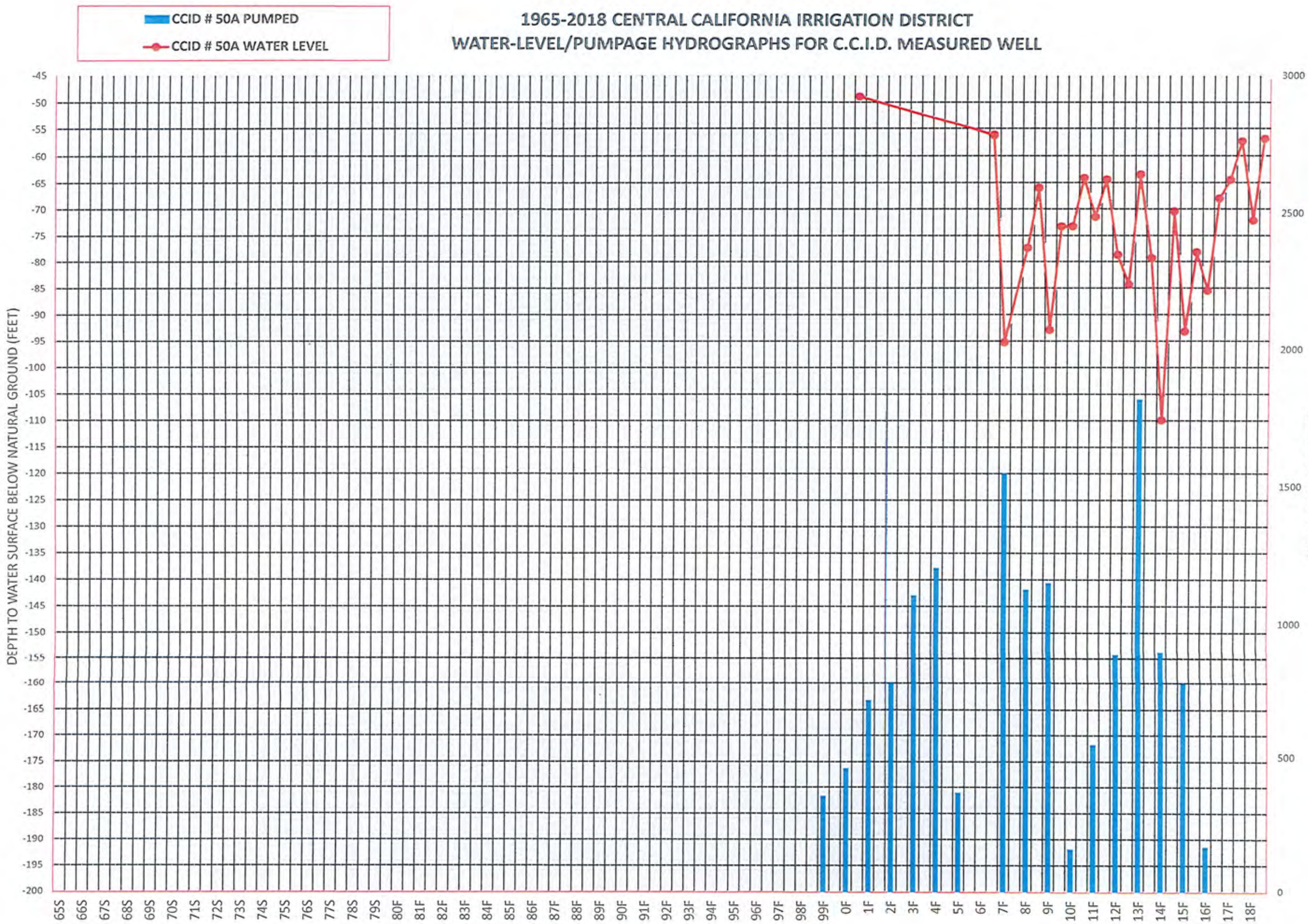
CCID # 49A PUMPED
CCID # 49A WATER LEVEL
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 49A IN THE QUINTO WELL FIELD
(AB3030 SUB AREA-B)
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL



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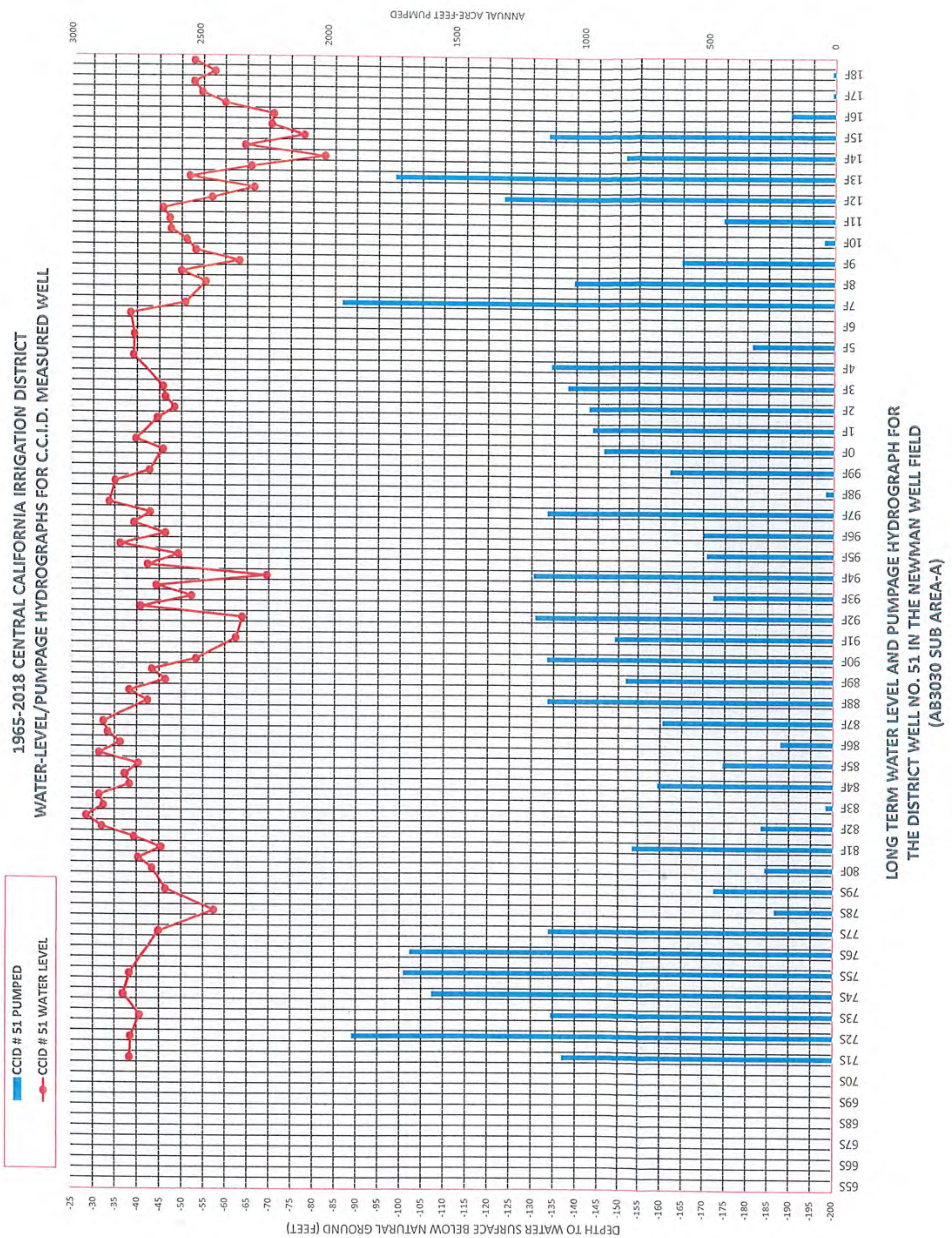
(AB3030 SUB AREA-A)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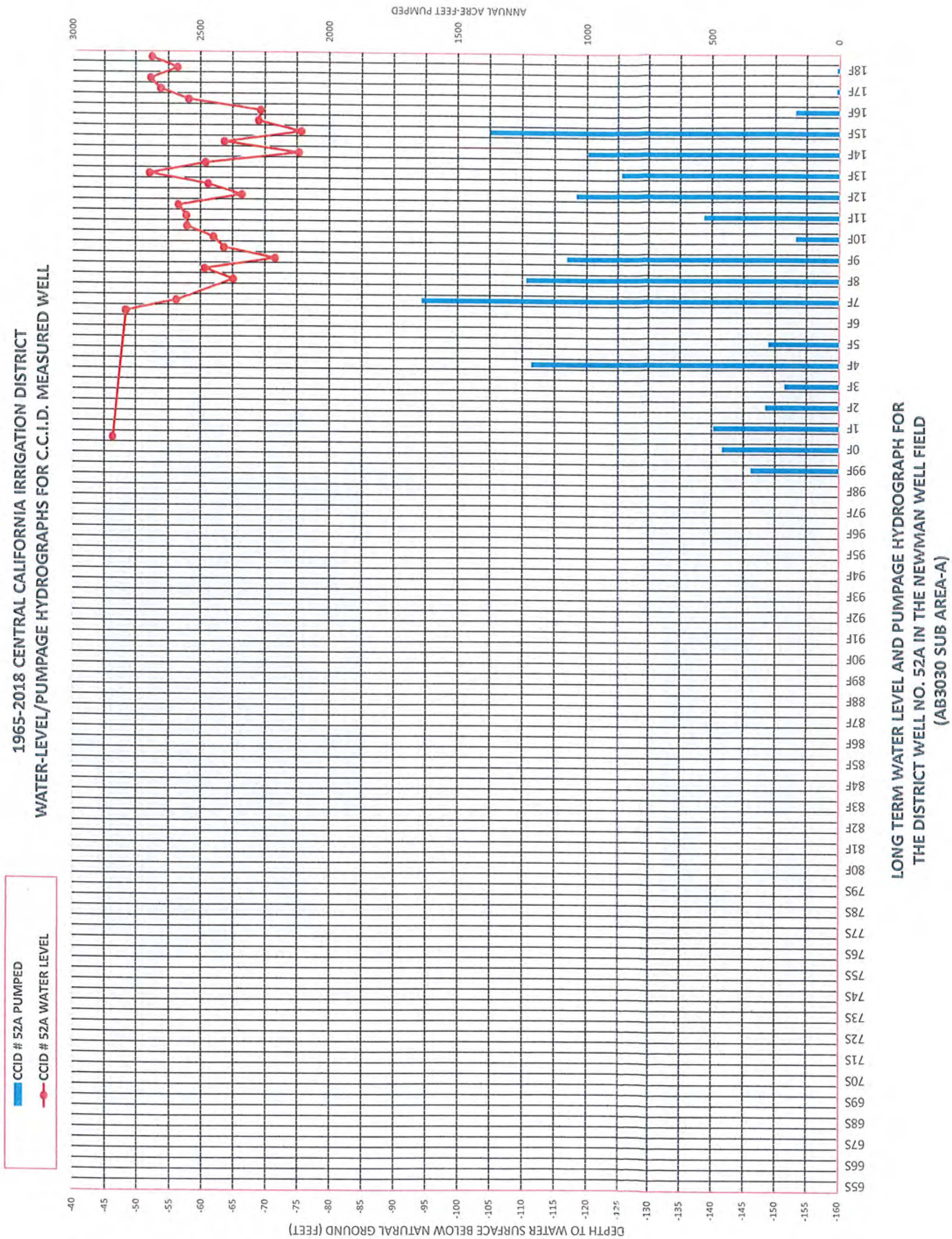
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 51 PUMPED
CCID # 51 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 51 IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)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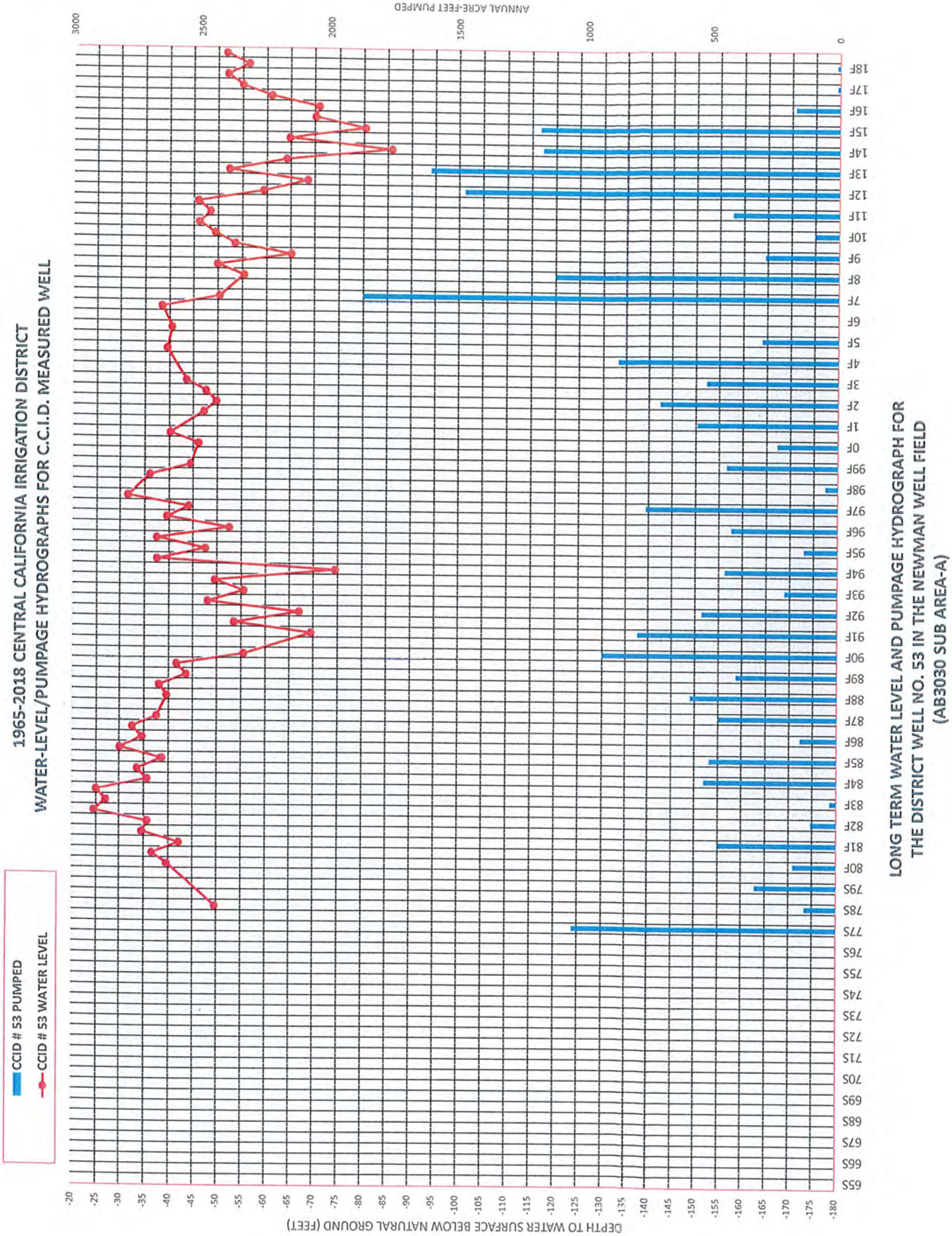
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 52A PUMPED
CCID # 52A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 52A IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)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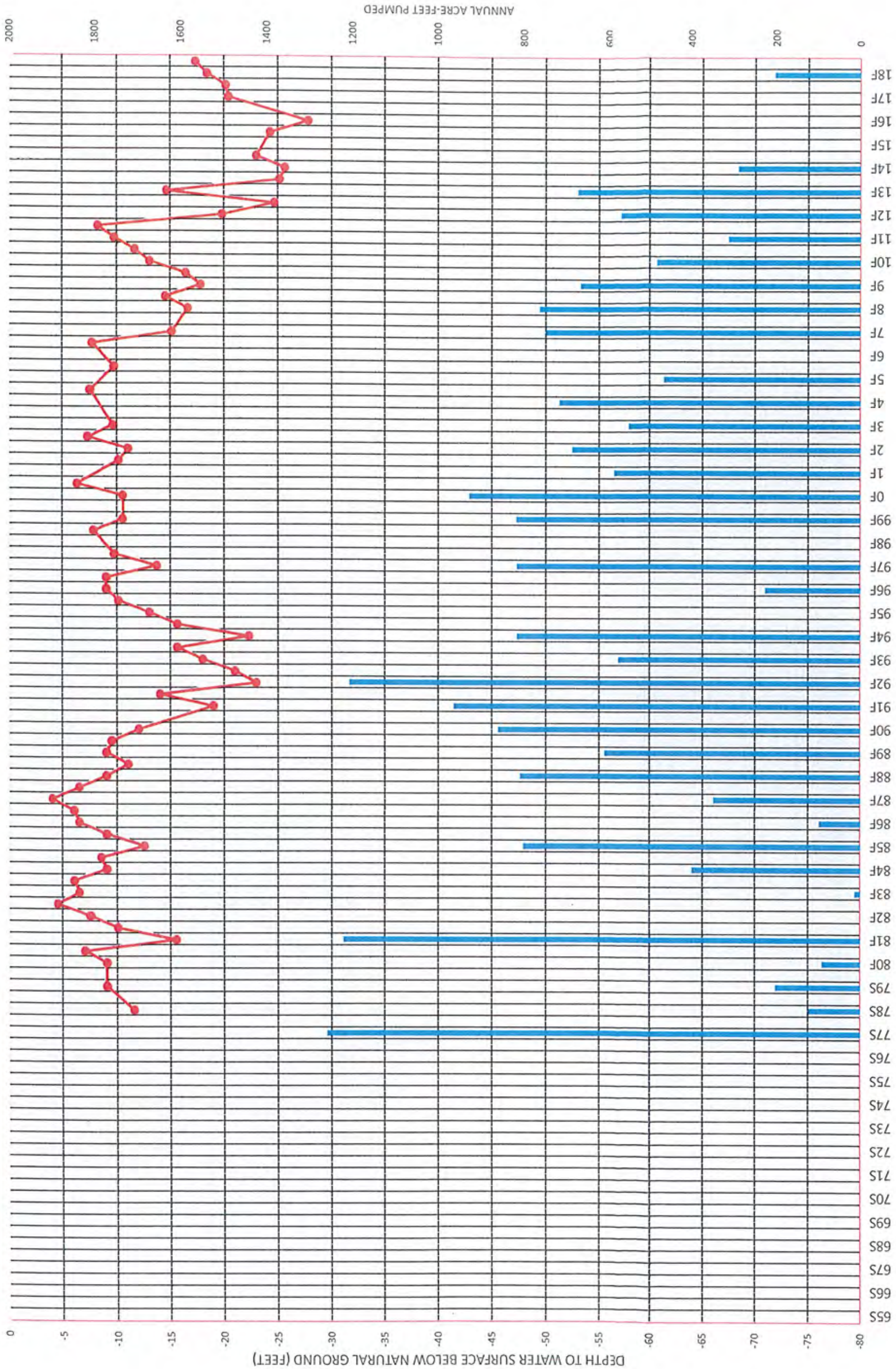
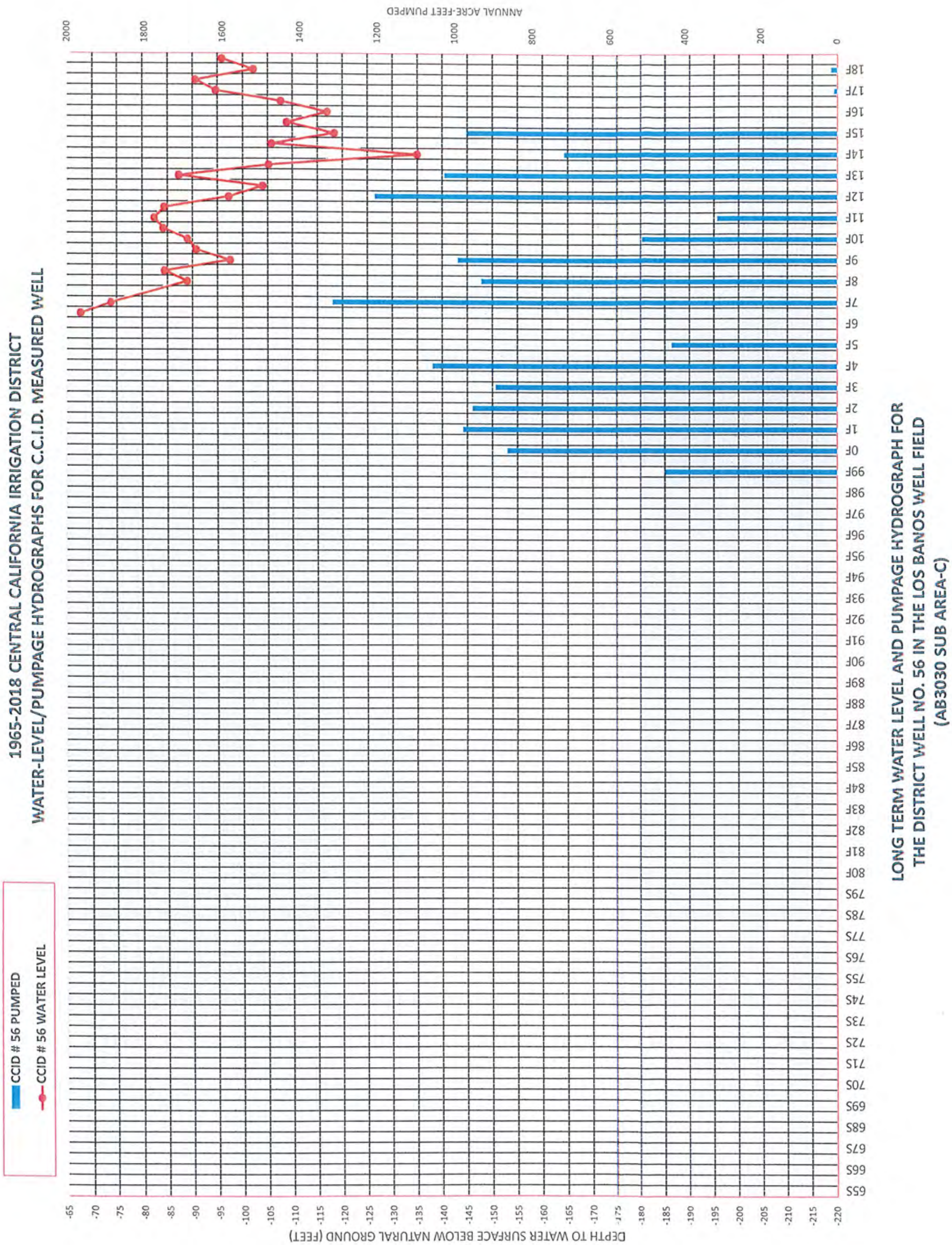
CCID # 53 PUMPED
CCID # 53 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 53 IN THE NEWMAN WELL FIELD
(AB3030 SUB AREA-A)

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL

CCID # 54A PUMPED
CCID # 54A WATER LEVEL



LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 54A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)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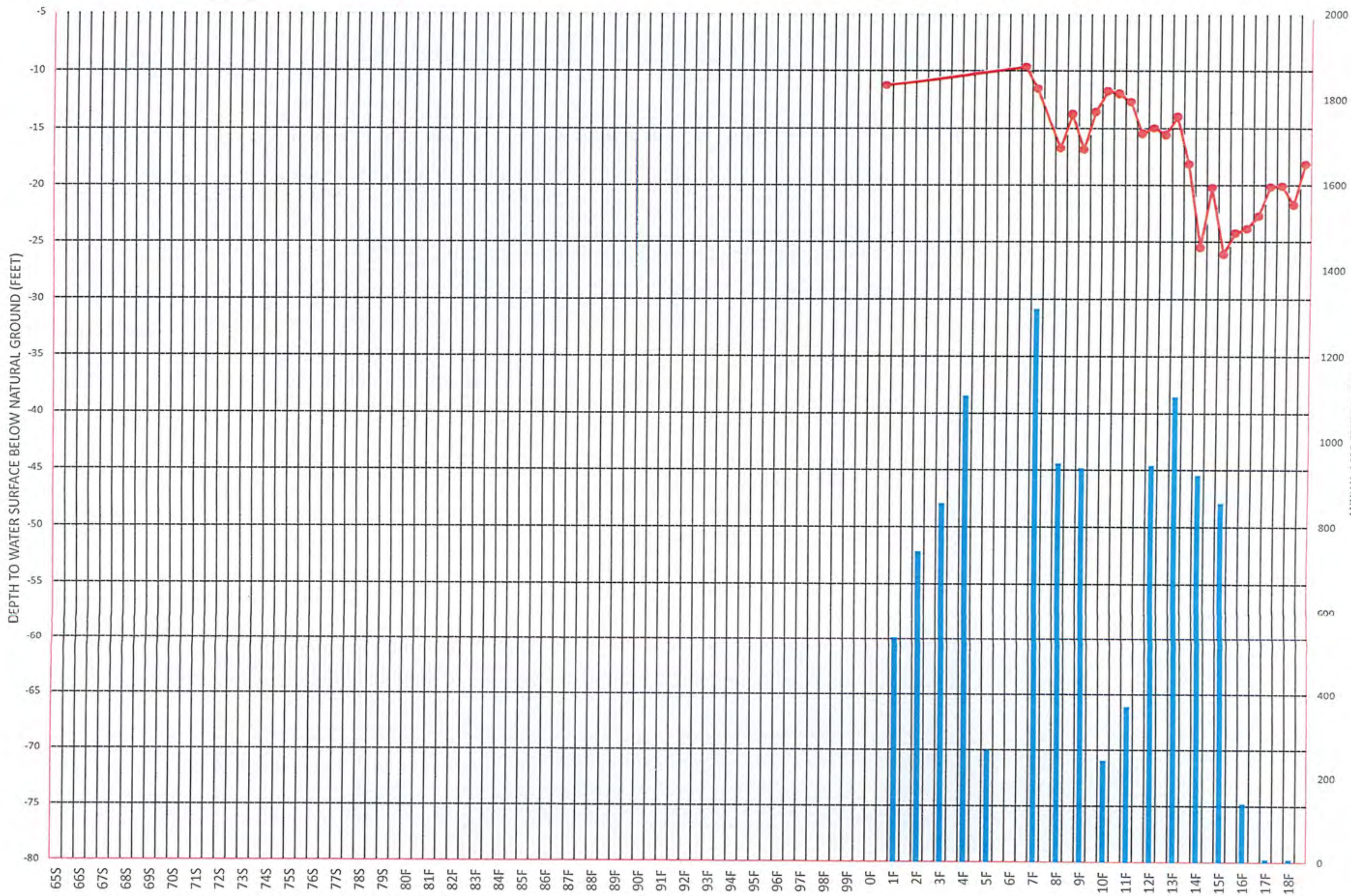
CCID # 56 PUMPED
CCID # 56 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 56 IN THE LOS BANOS WELL FIELD
(AB3030 SUB AREA-C)

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL



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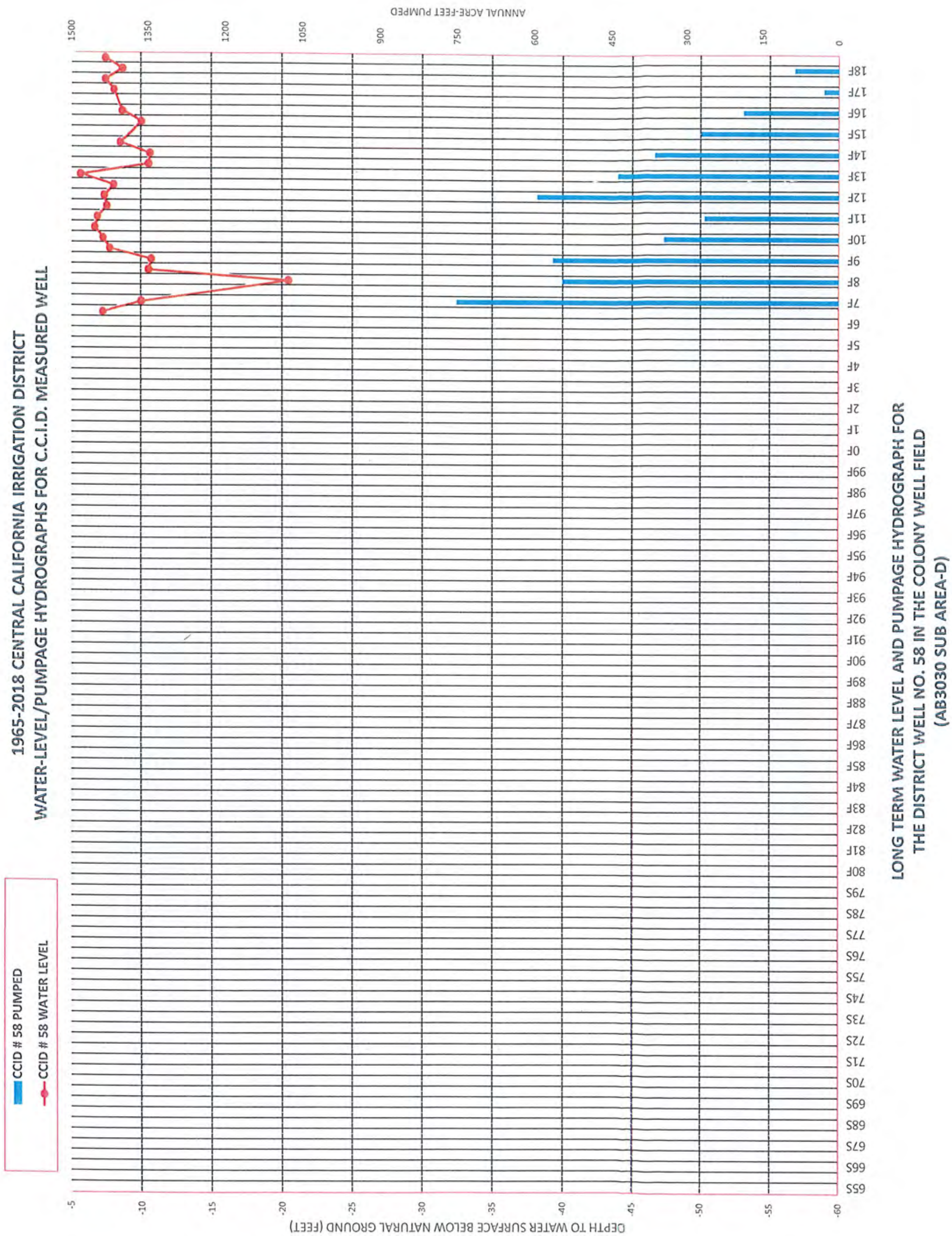
1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 58 PUMPED
CCID # 58 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
1500
1350
1200
1050
900
750
600
450
300
150
0
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
65S
66S
67S
68S
69S
70S
71S
72S
73S
74S
75S
76S
77S
78S
79S
80F
81F
82F
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84F
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91F
92F
93F
94F
95F
96F
97F
98F
99F
0F
1F
2F
3F
4F
5F
6F
7F
8F
9F
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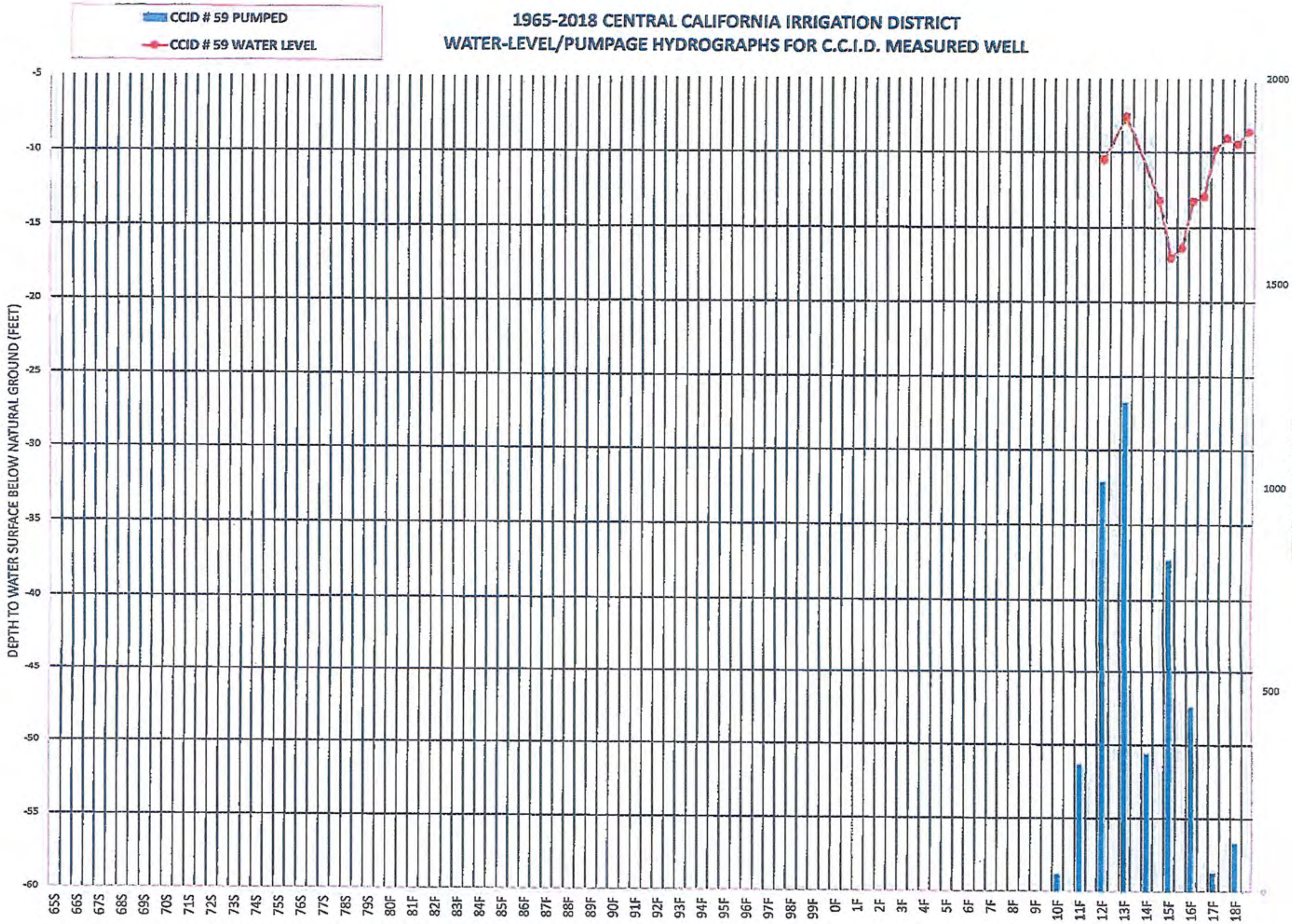
11F
12F
13F
14F
15F
16F
17F
18F
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 58 IN THE COLONY WELL FIELD
(AB3030 SUB AREA-D)

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL



LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
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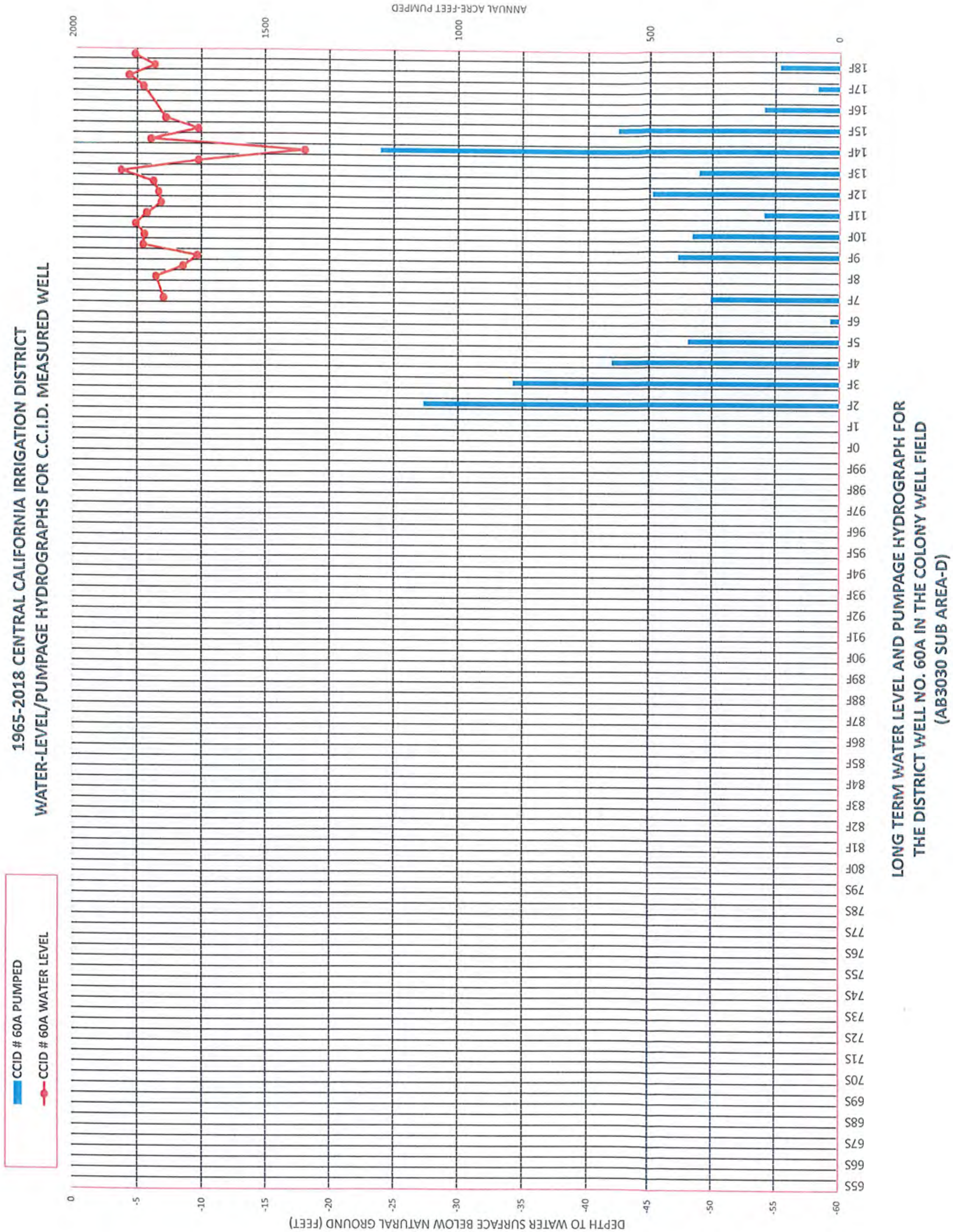
(AB3030 SUB AREA-D)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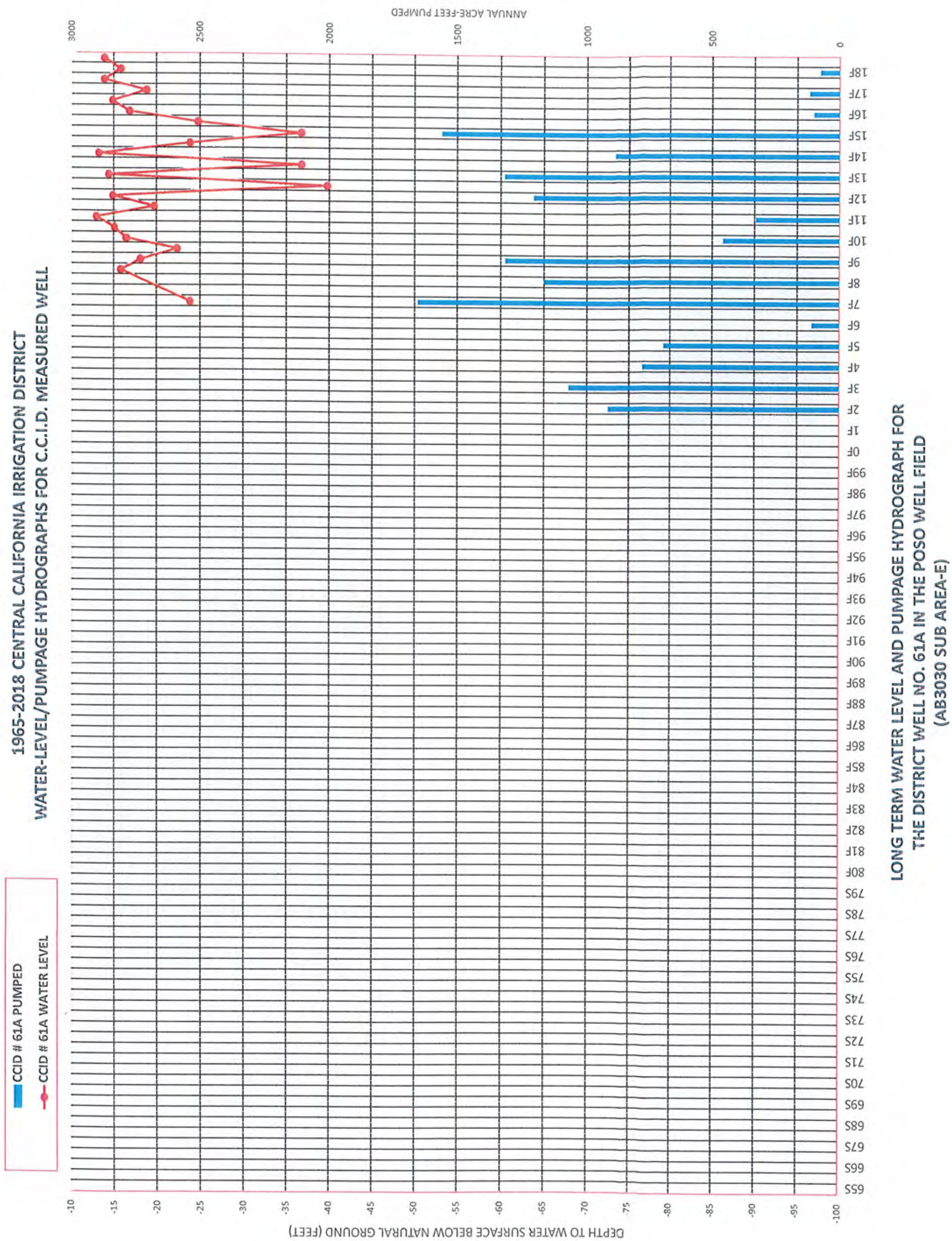
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 60A PUMPED
CCID # 60A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 60A IN THE COLONY WELL FIELD
(AB3030 SUB AREA-D)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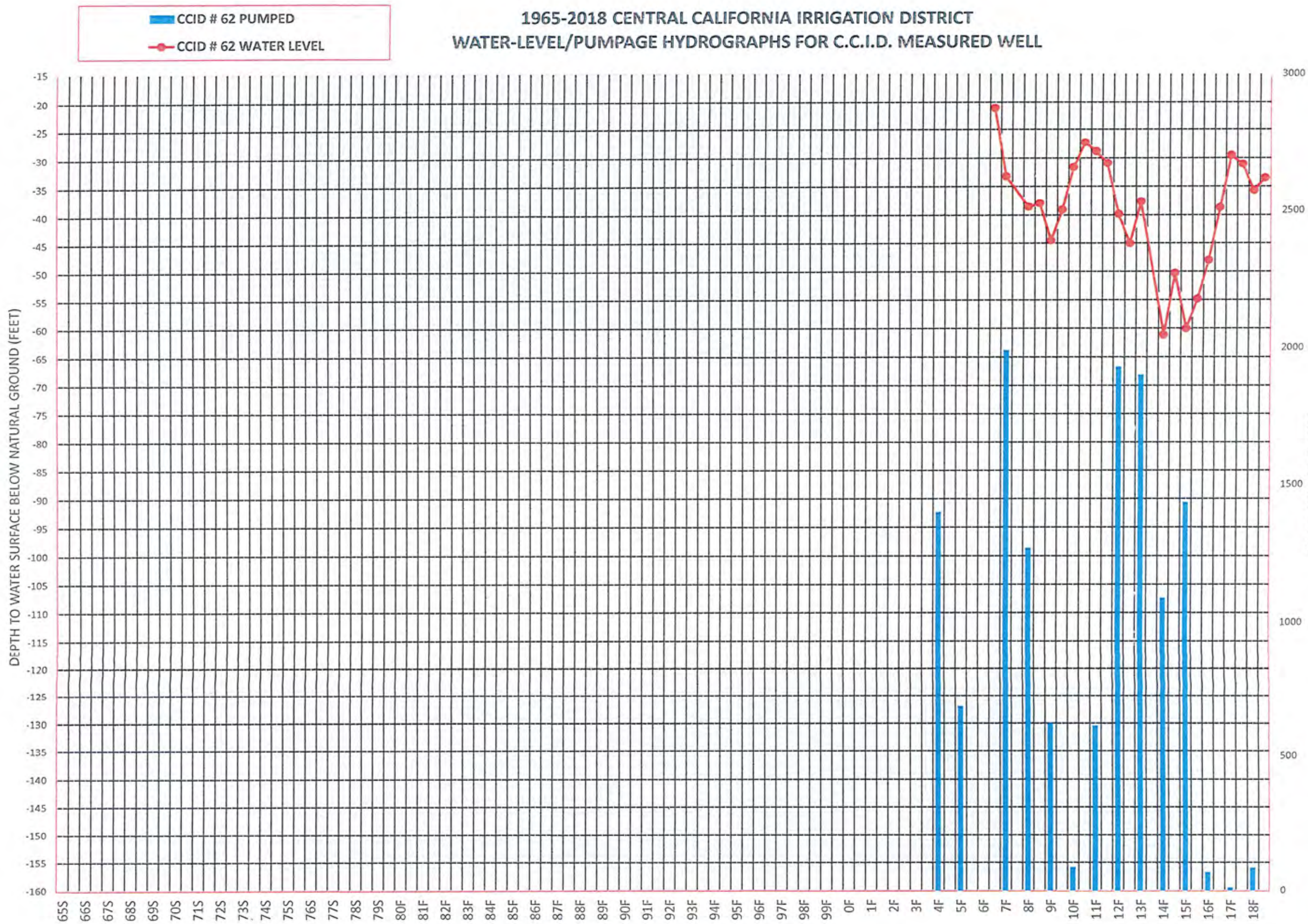
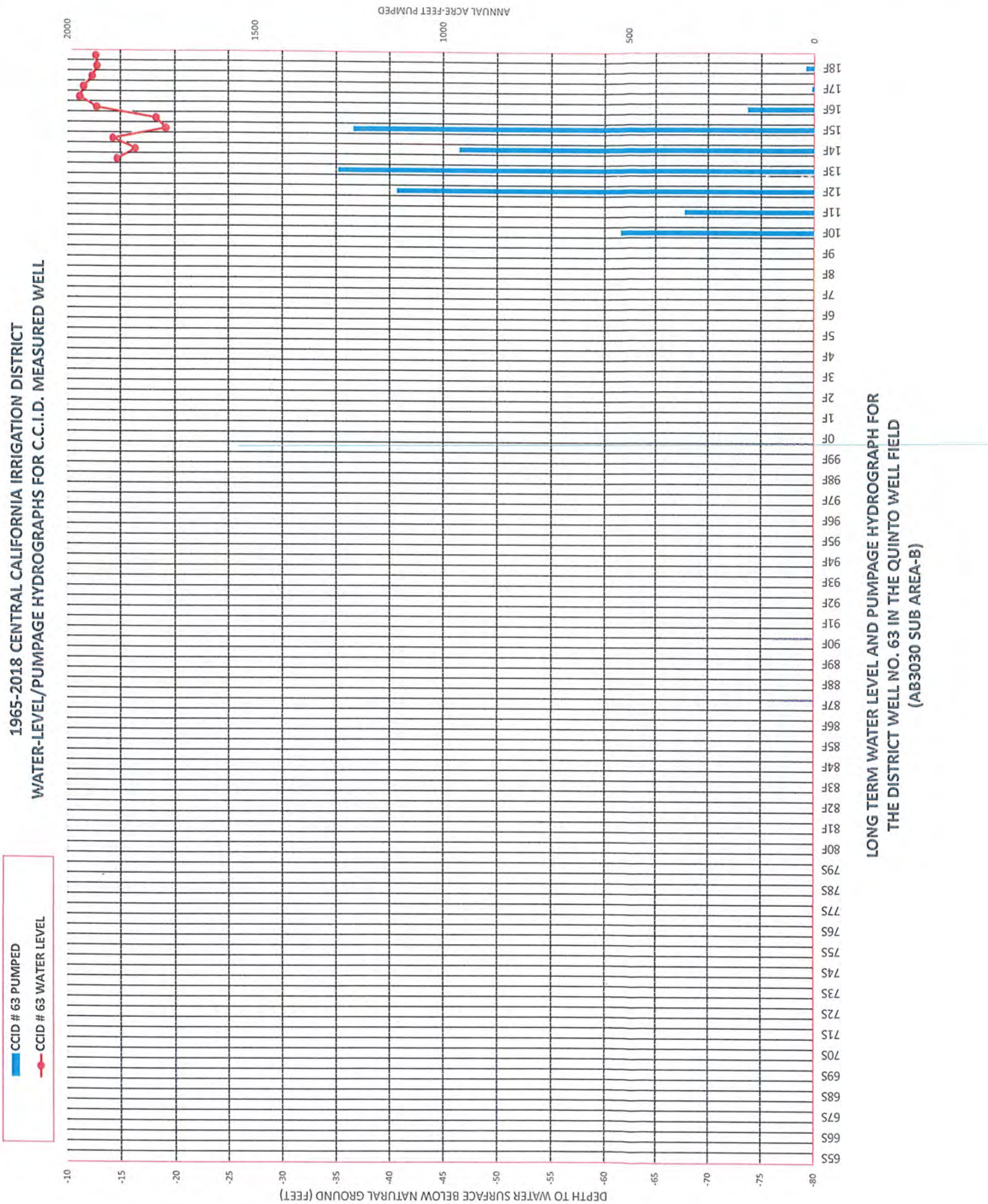
CCID # 61A PUMPED
CCID # 61A WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 61A IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)

1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL



LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 62A IN THE LOS BANOS WELL FIELD
(AB3030 SUB AREA-C)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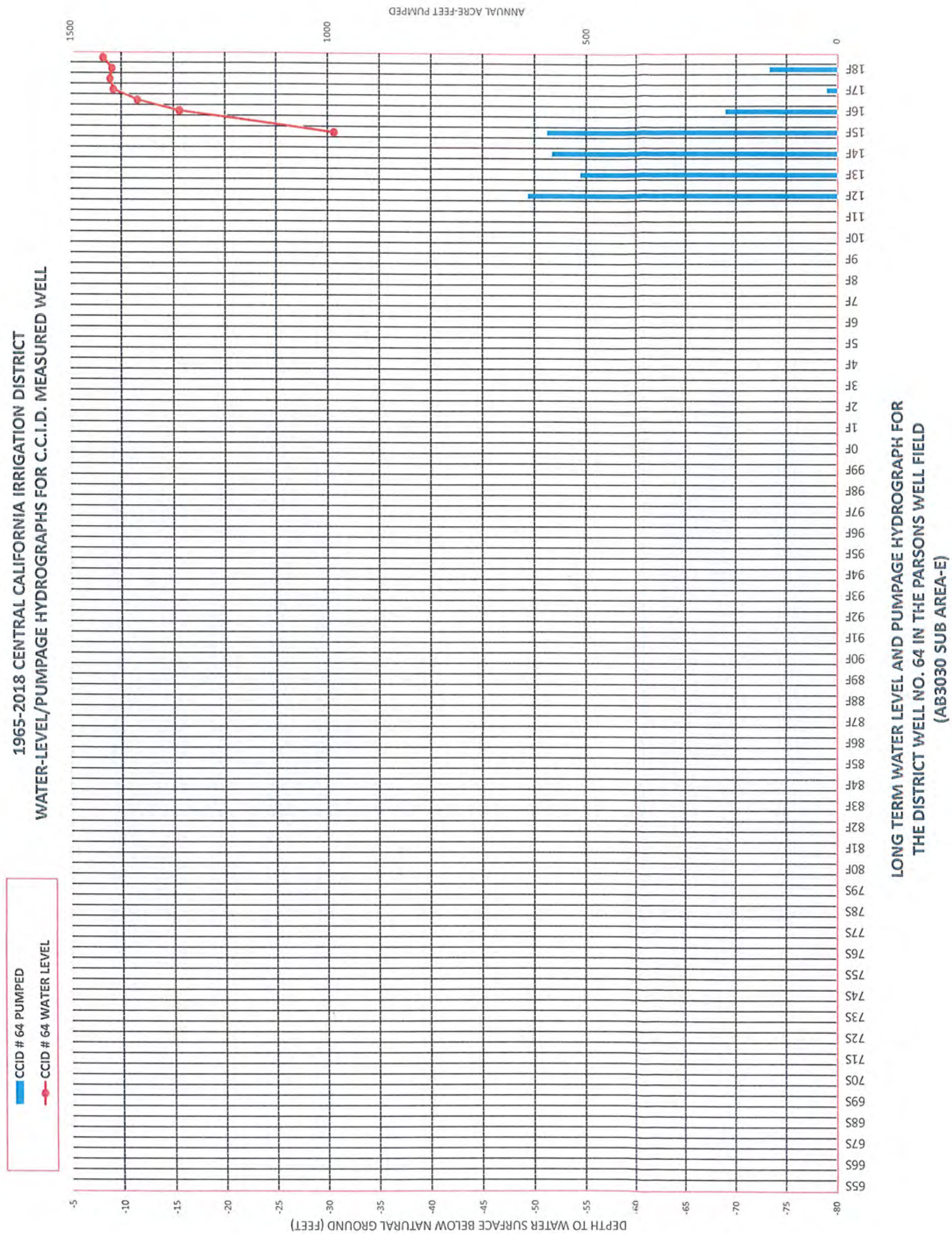
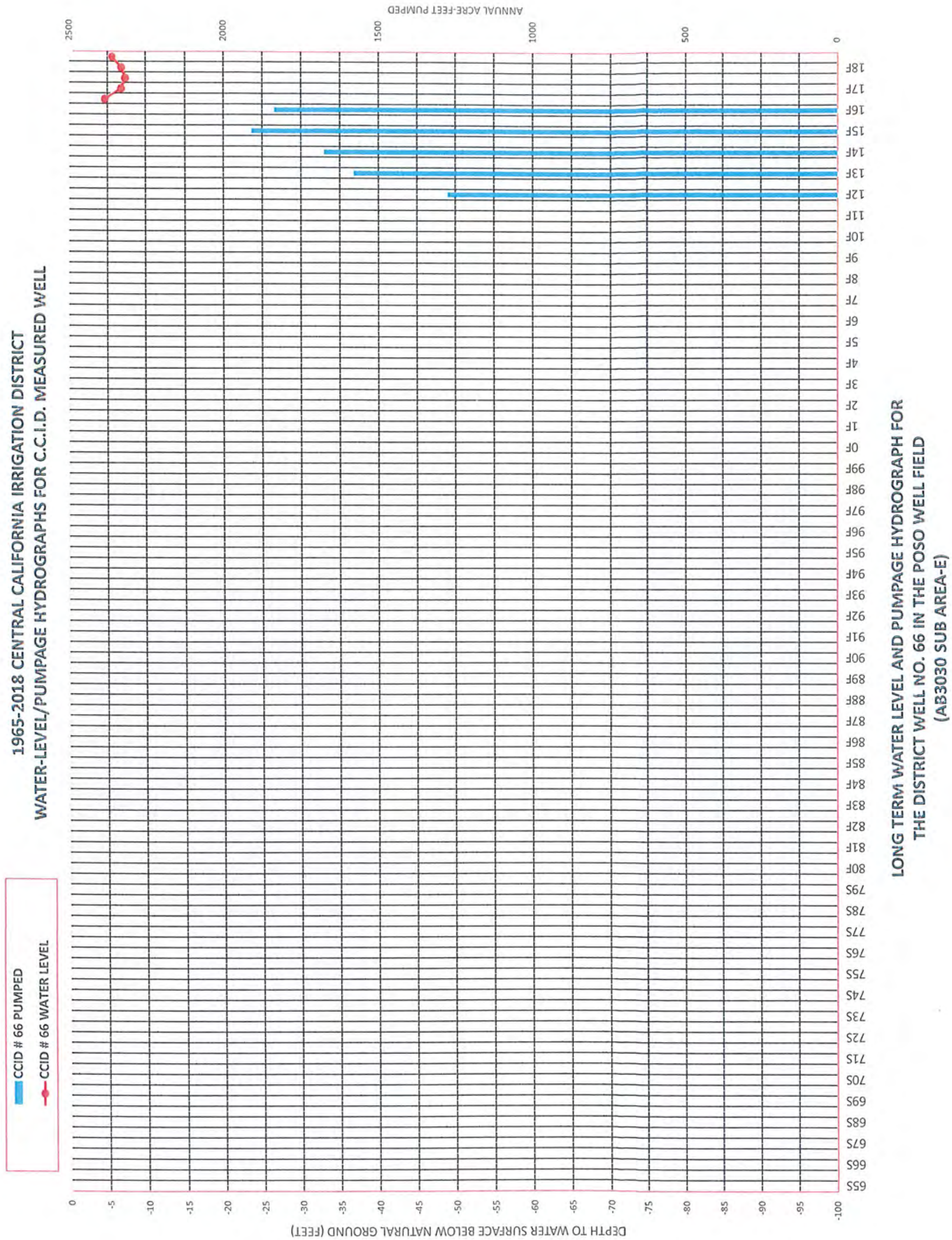
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 63 PUMPED
CCID # 63 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 63 IN THE QUINTO WELL FIELD
(AB3030 SUB AREA-B)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 64 PUMPED
CCID # 64 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 64 IN THE PARSONS WELL FIELD
(AB3030 SUB AREA-E)


1965-2018 CENTRAL CALIFORNIA IRRIGATION DISTRICT
WATER-LEVEL/PUMPAGE HYDROGRAPHS FOR C.C.I.D. MEASURED WELL
CCID # 66 PUMPED
CCID # 66 WATER LEVEL
ANNUAL ACRE-FEET PUMPED
DEPTH TO WATER SURFACE BELOW NATURAL GROUND (FEET)
LONG TERM WATER LEVEL AND PUMPAGE HYDROGRAPH FOR
THE DISTRICT WELL NO. 66 IN THE POSO WELL FIELD
(AB3030 SUB AREA-E)

Appendix J. HCM BMP

Hydrogeologic Conceptual Model Best Management Practice

1. OBJECTIVE

The objective of this Best Management Practice (BMP) is to assist in the use and development of hydrogeologic conceptual models (HCM). The California Department of Water Resources (the Department or DWR) has developed a Best Management Practice for Hydrogeologic Conceptual Model, as part of the obligation in the Technical Assistance Chapter (Chapter 7) of the Sustainable Groundwater Management Act (SGMA) to support the long-term sustainability of California's groundwater basins. The SJREC GSA has reviewed and updated this BMP for inclusion in the GSP. This BMP is meant to provide support to Groundwater Sustainability Agencies (GSAs) when developing a HCM in accordance with the Groundwater Sustainability Plan (GSP) Emergency Regulations (GSP Regulations). This BMP identifies available resources to support development of HCMs.

This BMP includes the following sections:

1. Objective. The objective and brief description of the contents of this BMP.
2. Use and Limitations. A brief description of the use and limitations of this BMP.
3. HCM Fundamentals. A description of HCM fundamental concepts.
4. Relationship of HCM to other BMPs. A description of how the HCM relates to other BMPs and is the basis for development of other GSP requirements.
5. Technical Assistance. A description of technical assistance to support the development of a HCM and potential sources of information and relevant datasets that can be used to further define each component.
6. Key Definitions. Definitions relevant for this BMP as provided in the GSP and Basin Boundary Regulations and in SGMA.
7. Related Materials. References and other materials that provide supporting information related to the development of HCMs.

2. USE AND LIMITATIONS

BMPs developed by the Department and revised by the SJREC GSA, are intended to provide technical guidance to GSAs and other stakeholders. Practices described in these BMPs do not replace or serve as a substitute for the GSP Regulations, nor do they create new requirements or obligations for GSAs or other stakeholders. While the use of BMPs is encouraged, use and/or adoption of BMPs does not equate to an approval determination by the Department. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2. All references to SGMA relate to California Water Code sections in Division 6, Part 2.74.

3. HCM FUNDAMENTALS

A HCM:

1. Provides an understanding of the general physical characteristics related to regional hydrology, land use, geology and geologic structure, water quality, principal aquifers, and principal aquitards of the basin setting;

2. Provides the context to develop water budgets, mathematical (analytical or numerical) models, and monitoring networks; and

3. Provides a tool for stakeholder outreach and communication.

A HCM should be further developed and periodically updated as part of an iterative process as data gaps are addressed and new information becomes available. A HCM also serves as a foundation for understanding potential uncertainties of the physical characteristics of a basin which can be useful for identifying data gaps necessary to further refine the understanding of the hydrogeologic setting. An example of a HCM depicted as a three-dimensional block diagram is shown in **Figure 1**.

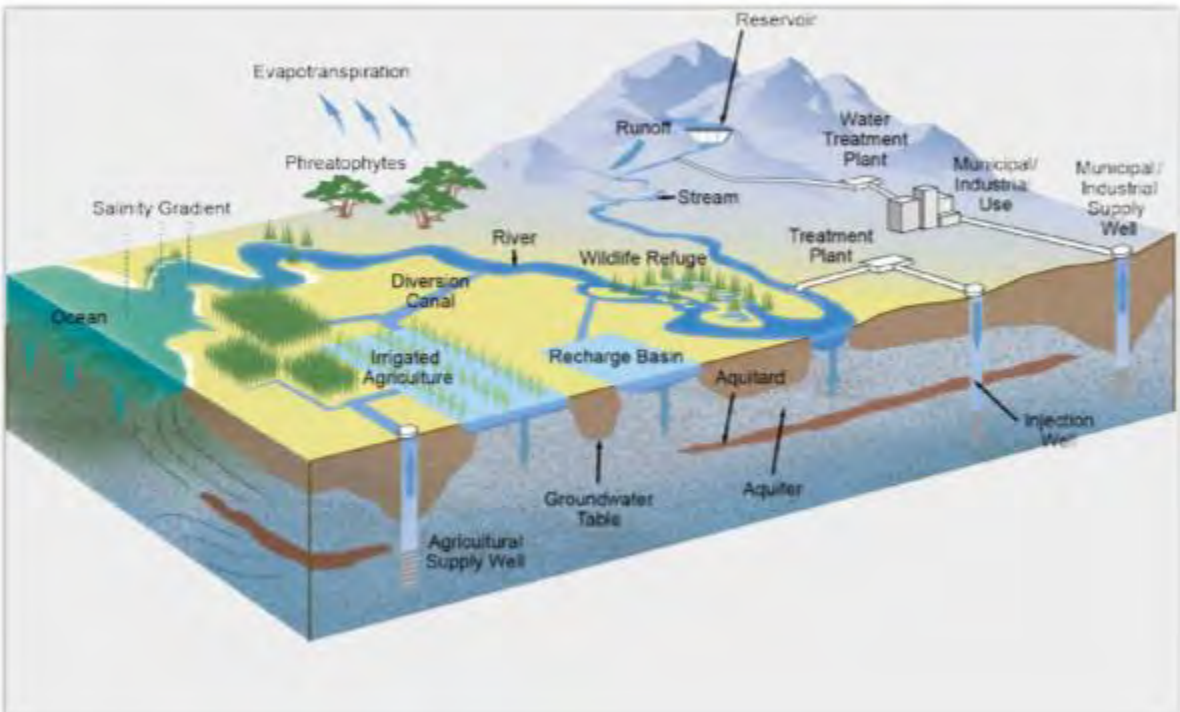


Figure 1 – Example 3-D Graphic Representing a HCM

COMMON HCM USES

The following provides a limited list of common HCM uses:

- Develop an understanding and description of the basin to be managed, specifically the structural and physical characteristics that control the flow, storage, and quality of surface and groundwater
- Identify general water budget components
- Identify areas that are not well understood (data gaps)
- Inform monitoring requirements
- Facilitate or serve as the basis for the development, construction, and application of a mathematical (analytical or numerical) model
- Refine the understanding of basin characteristics over time, as new information is acquired from field investigation activities, monitoring networks, and modeling results
- Provide often highly-technical information in a format more easily understood to aid in stakeholder outreach and communication of the basin characteristics to local water users

- Help identify potential projects and management actions to achieve the sustainability goal within the basin

HCM IN REFERENCE TO THE GSP REGULATIONS

23 CCR §354.14 (a): 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.

GSP Regulations require that each GSP include a HCM for the basin reported in a narrative and graphical form that provides an overview of the physical basin characteristics, uses of groundwater in the basin, and sets the stage for the basin setting (GSP §354.14(a)). The GSP Regulations identify the level of detail to be included for the HCM to aid in describing the basin setting for the GSP development and sustainability analysis.

The HCM requirements outlined pertain to two main types of information:

1. The narrative description is accompanied by a graphical representation of the basin that clearly portrays the geographic setting, regional geology, basin geometry, general water quality, and consumptive water uses in the basin.

2. A series of geographic maps and scaled cross-sections to provide a vertical layering representation and a geographic view of individual datasets including the topography, geology, soils, recharge and discharge areas, source and point of delivery of imported water supplies, and surface water systems that are significant to management of the basin.

A HCM differs from a mathematical (analytical or numerical) model in that it does not compute specific quantities of water flowing through or moving into or out of a basin, but rather provides a general understanding of the physical setting, characteristics, and processes that govern groundwater occurrence within the basin. In that sense, the HCM forms the basis for mathematical (analytical or numerical) model development, and sets the stage for further quantification of the water budget components.

The intent of requiring HCMs in the GSP Regulations is not to provide a direct measure of sustainability, but rather to provide a useful tool for GSAs to develop their GSP and meet other requirements of SGMA.

4. RELATIONSHIP OF HCM TO OTHER BMPS

The purposes of the HCM in the broader context of SGMA implementation include:

- Supporting the evaluation of sustainability indicators, assessing the potential for undesirable results, and development of minimum thresholds;
- Supporting identification and development of potential projects and management actions to address undesirable results that exist or are likely to exist in the future; and
- Supporting the development of monitoring protocols, networks, and strategies to evaluate the sustainability of the basin over time.

The HCM is also linked to other related BMPs as illustrated in **Figure 2**. This figure provides the context of the BMPs as they relate to various steps to sustainability as outlined in the GSP Regulations. The HCM BMP is part of the Basin Setting development step in the GSP Regulations.

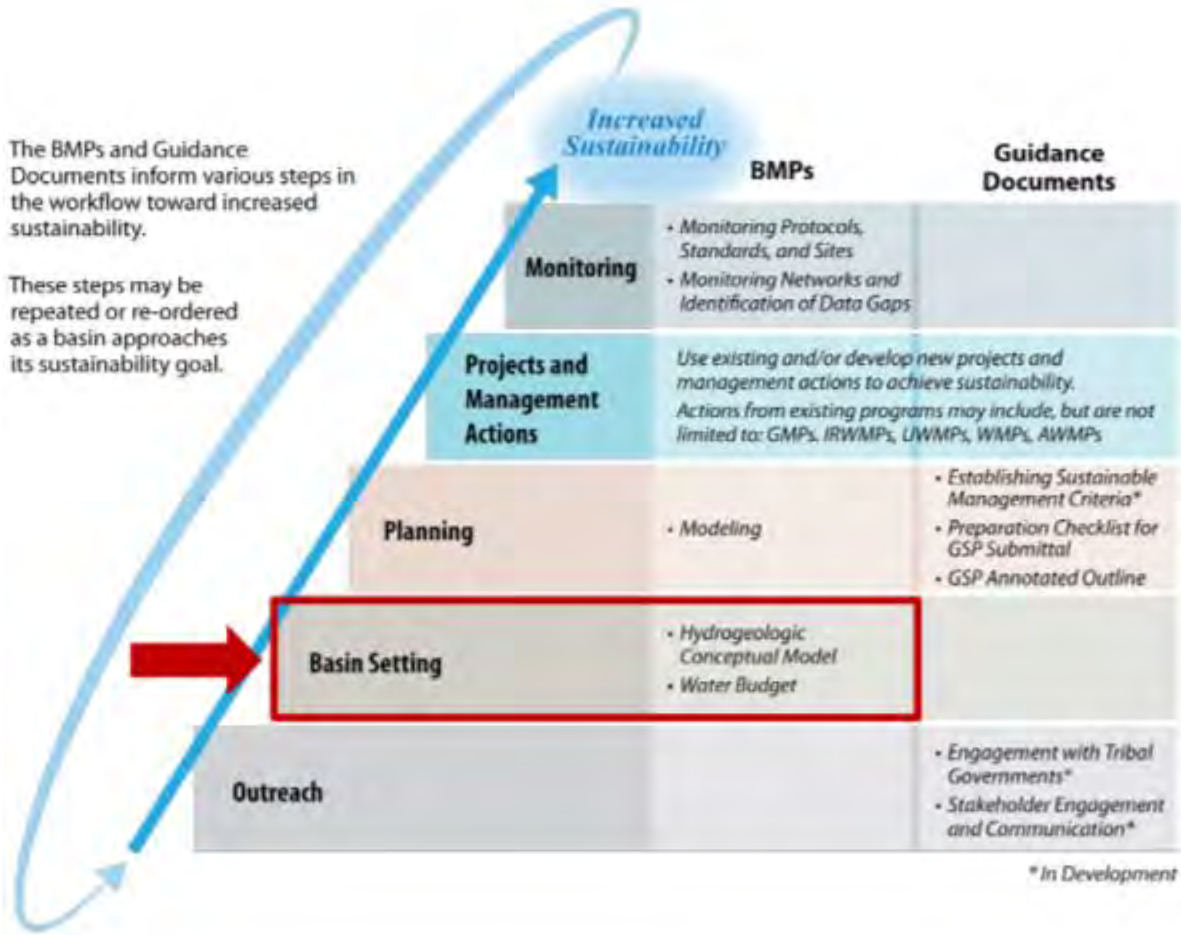


Figure 2 – Logical Progression of Basin Activities Needed to Increase Basin Sustainability

HCM development is the first step to understanding and conveying the GSP basin setting. The HCM is also linked to other GSP components (and applicable related BMPs) as illustrated **Figure 3**. For example, the HCM supports the development of the monitoring networks and activities needed to better understand the distribution and movement of water within a basin, which leads to the initial development and quantification of a water budget. Once the HCM and water budget have been developed, a mathematical (analytical or numerical) model may be built to further evaluate sustainability indicators, assess the probability of future undesirable results, and support basin management decisions as necessary to avoid the occurrence of undesirable results.

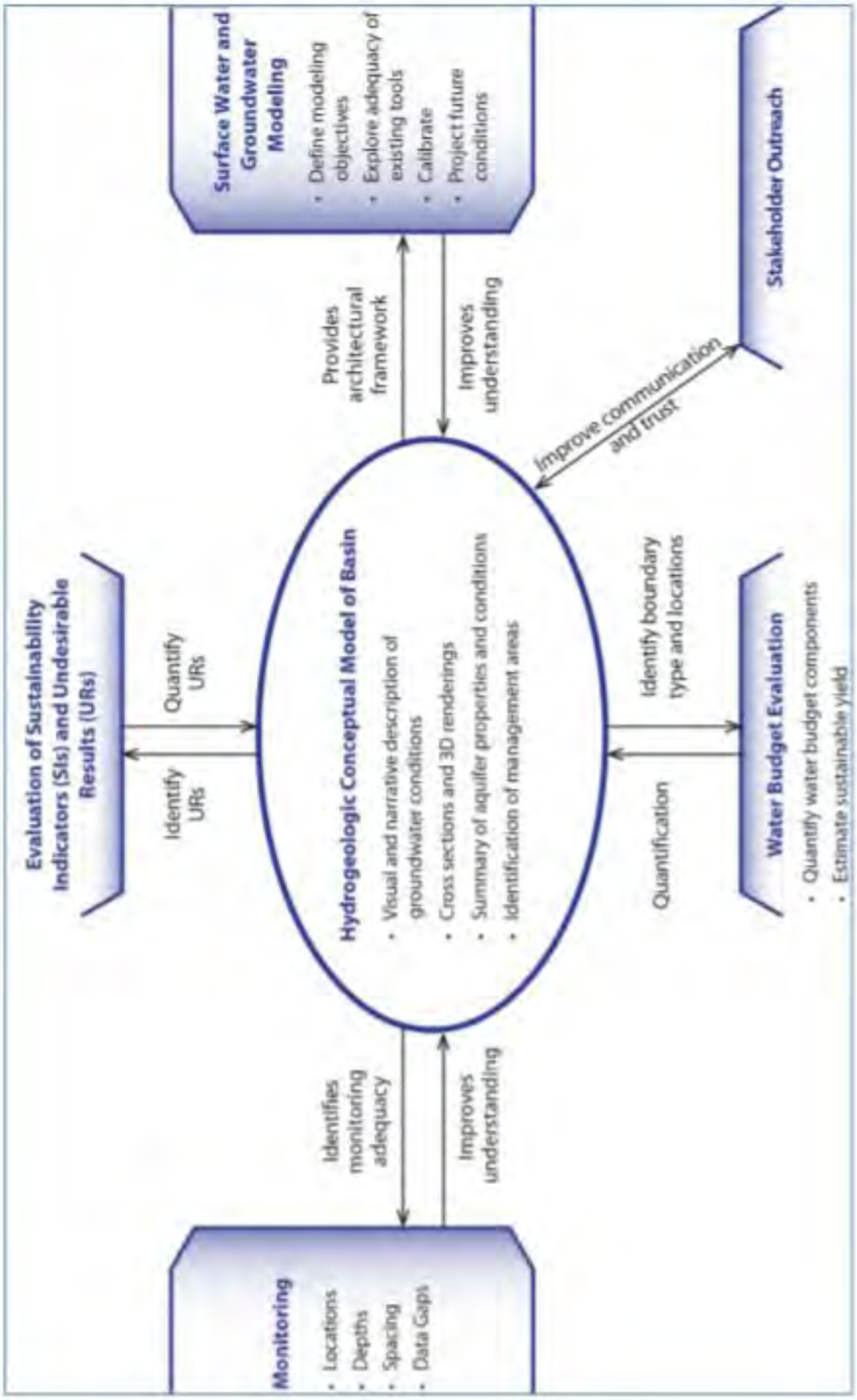


Figure 3 – Interrelationship between HCM and Other BMPs and Guidance Documents

5. TECHNICAL ASSISTANCE

This section provides technical assistance to support the development of a basin HCM including potential sources of information and relevant datasets that can be used to develop each HCM requirement. As described in the GSP Regulations Section 354.12, the Basin Setting shall be prepared by or under the direction of a professional geologist or professional engineer.

CHARACTERIZING THE PHYSICAL COMPONENTS

Each section below is related to the specific GSP Regulation requirements and provides additional technical assistance for the GSA's consideration.

23 CCR §354.14 (b)(1): The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.

The regional geologic and structural setting of a basin describes the distribution, extent, and characteristics of the geologic materials present in the basin along with the location and nature of significant structural features such as faults and bedrock outcrops that can influence groundwater behavior in the basin.

This type of information can often be found in existing geologic maps and documents published by the Department (specifically Bulletin 118 and 160), the United States Geological Survey (USGS), and other local government agencies (references are also provided in Section 7). Groundwater Management Plans and other technical reports prepared for the basin may also include information of this type.

23 CCR §354.14 (b)(2): Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.

Basin boundaries are often geologically controlled and may include bedrock boundaries that define the margins of the alluvial groundwater aquifer system, and therefore represent barriers to groundwater flow. For a map of the Department's Bulletin 118 groundwater basins and subbasins refer to the Department's basin boundary website.

Other basin boundaries may include rivers and streams, or structural features such as faults. Additionally, basins on the coast can be subject to seawater intrusion, which creates another type of boundary to the freshwater basin. Information on these types of boundaries can also be found in reports prepared by State (California Geological Survey) or federal agencies (USGS) or by local agencies or districts. In addition, the presence of seawater along the coastal margin can also reflect the boundary of a coastal basin.

23 CCR §354.14 (b)(3): Definable bottom of the basin.

Several different techniques or types of existing information can be used in the evaluation of the definable bottom of the basin and extent of freshwater.

Defining the Basin Bottom based on Physical Properties

The bottom of the basin may be defined as the depth to bedrock also recognized as the top of bedrock below which no significant groundwater movement occurs. This type of information may be found from reviewing geologic logs from wells drilled for water extraction, as well as from oil and gas exploration wells which tend to be drilled deeper than usable aquifer systems.

Defining the Basin Bottom based on Geochemical Properties

In many basins of the Central Valley, freshwater is underlain by saltier or brackish water that is a remnant of the marine conditions that were present when the Valley was flooded in the geologic past. Several standards exist that can be used to define the base of freshwater and the bottom of the basin in the Central Valley:

- Base of freshwater maps in the Central Valley published by the Department and by USGS
- United States Environmental Protection Agency (US EPA) definition for Underground Source of Drinking Water (USDW)

The Department plans to release a freshwater map for the Central Valley that depicts the useable bottom of the alluvial aquifer. This map assumes that the base of freshwater is defined by the Title 22 State Water Resources Control Board (SWRCB) upper secondary maximum contaminant level recommendation of 1,000 milligrams per liter (mg/L) total dissolved solids (TDS).

The USGS has two base of fresh water maps available in the Central Valley based on 3,000 mg/L TDS.

An alternative threshold available to define the bottom of the groundwater basin is the US EPA USDW standard of less than 10,000 mg/L TDS. In some basins, oil and gas aquifers underlie the potable alluvial aquifer or USDW (defined as less than 10,000 mg/L TDS in Title 40, Section 144.3, of the Code of Federal Regulations). In basins where produced water from underlying oil and gas operations is beneficially used within the basin, or injected into the basin's USDW, the HCM can further characterize the geologic boundaries that separate the USDW from the oil and gas aquifers, and identify the "exempted aquifer" portion of the groundwater basin that has been permitted for underground injection control by the SWRCB Oil and Gas Monitoring Program or the Division of Oil, Gas and Geothermal Resources (DOGGR).

It should be noted that the definable bottom of the basin should be at least as deep as the deepest groundwater extractions; however, this may not be an appropriate method if it conflicts with other local, State, or Federal programs or ordinances. Finally, consideration should be given to how the bottom of the basin is defined in hydraulically-connected adjacent basins, as this could create additional complexity when developing and implementing GSPs.

Defining the Basin Bottom based on Field Techniques

Common field techniques used to define the bottom of alluvial basins can be subdivided into techniques utilizing direct measurements and those utilizing indirect measurements. The most common ones are listed below.

Direct measurement approaches typically involve drilling of multiple wells through the freshwater-bearing alluvial aquifer sediments and into the underlying lithologic units, whether it is bedrock or alluvium, containing groundwater that does not meet the criteria for potable water or an USDW. Once each borehole has been constructed, several different approaches can be taken to estimate the depth to the basin bottom at that location. Compilation of data from multiple wells can then be used to prepare a contour map of the depth to the basin bottom. Typical direct techniques include:

- Installation of multi-port well systems or installation of a nested well array
- Continuous profiling of lithology/groundwater quality using TDS, conductivity, or other downhole geophysical techniques

- Mapping depth to bedrock from borehole

Indirect measurement approaches are typically employed along the ground surface or from helicopters or fixed-wing aircraft. The most common methods used are geophysical techniques or surveys. Typical geophysical techniques that can be used to estimate bedrock depth or groundwater quality profiles include:

- Seismic refraction/reflection surveys
- Gravity surveys
- Magnetic surveys
- Resistivity surveys
- Radar, including ground penetrating radar
- Other Electromagnetic techniques

23 CCR §354.14 (b)(4): Principal aquifers and aquitards, including the following information:
(A) Formation names, if defined.
(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.
(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.
(D) General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.
(E) Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.

Aquifer information is available in geologic reports from the Department and USGS, such as Bulletin 118, and local groundwater management plans and studies. Links to some applicable reports are provided below. The USGS maintains very detailed reports and datasets for groundwater quality throughout the state that can be downloaded from their California Water Science Website (http://ca.water.usgs.gov/). The SWRCB also collects and maintains groundwater quality data, accessible through their GeoTracker GAMA website. (http://www.waterboards.ca.gov/gama/geotracker_gama.shtml)

In addition, the Regional Water Quality Control Boards, with coordination from the SWRCB, manage groundwater quality programs and data related to the Irrigated Lands Regulatory Program (http://www.swrcb.ca.gov/water_issues/programs/agriculture/). These programs are in the early phases of development, and data are being collected by local entities. As groundwater quality data become available through these programs, they may be a good source of information for HCM and GSP development. The Central Valley Regional Water Quality Control Board and SWRCB, in cooperation with stakeholders and the Central Valley Salinity Coalition, collaborate to review and update the basin plans for the Sacramento and San Joaquin river basins, the Tulare Lake Basin, and the Delta Plan for salinity management. As part of this program, technical reports are being developed and groundwater quality data are being collected in the Central Valley aquifer that provide other sources of information for those basins (http://www.cvsalinity.org/).

Uses of groundwater can be found within water quality control plans (known as basin plans), agricultural water management plans (AWMP) and urban water management plans (UWMP), which detail the use of water by agency and by types of beneficial uses. In addition, basin plans describe the water quality objectives and beneficial uses to be protected, with a program of implementation to achieve those objectives.

> *23 CCR §354.14 (b)(5): Identification of data gaps and uncertainty within the hydrogeologic conceptual model.*

An assessment of the uncertainty in the HCM components, along with the identification of data gaps of the physical system and water use practices in the basin, are all necessary elements of the HCM. Typical data gaps and uncertainties related to the HCM include the hydraulic properties of the aquifer and aquitard materials, the depth and thickness of various geologic layers, and adequate geographic distribution of groundwater quality data, among others. It is important to adequately evaluate data gaps and uncertainties within a HCM as these data gaps often drive the types and locations of monitoring that should be conducted to reduce uncertainties in these conceptual model components.

For example, a portion of a groundwater basin may not be well characterized from previous studies and historic monitoring activities; therefore, there is less readilyavailable information to define the HCM in that portion of the basin. Specific data collection activities to address these data gaps could then be considered in the development of the GSP.

GRAPHICAL AND MAPPING REQUIREMENTS

> *23 CCR §354.14 (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.*

In addition to the narrative description of the HCM, another necessary element of a HCM is a graphical representation of the HCM components in the form of at least two geologic cross-sections. A cross-section depicts the vertical layering of the geology and major subsurface structural features in a basin, in addition, but not limited to, other HCM features such as the general location and depth of existing monitoring and production wells and the interaction of streams with the aquifer.

The locations selected for cross-section development in a basin are best informed by the sustainability indicators most critical to that basin, as well as the potential for undesirable results to occur. For example, if subsidence is a known issue in a basin, construction of cross-section(s) may be focused in areas where subsidence has occurred or is at risk of occurring. An example of a scaled cross-section is provided in **Figure 4.**

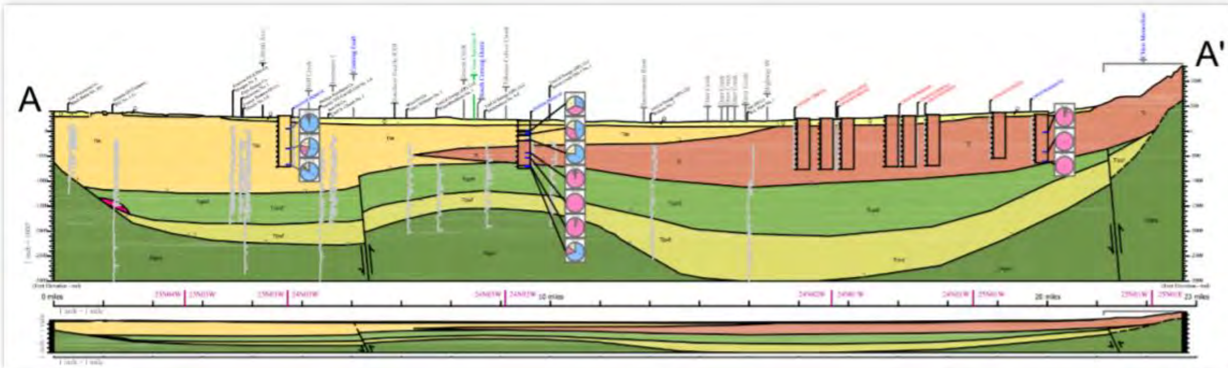


Figure 4 – Example Scaled Cross-Section

Geologic cross-sections should be constructed by a professional geologist, or a person knowledgeable of geologic principles such as the Laws of Superposition, Original Horizontality, cross-cutting relationships, and Walther's Law. The type of cross-section ranges from "conceptual to highly detailed", depending on the intended use. The type of cross-section also depends on the type of subsurface data that is available and the reliability of that data. A full understanding of, and appreciation for, the variety of depositional environments, like sequence stratigraphy, is needed to construct accurate geological cross sections. Cross-section construction considerations include, but are not limited to, the following:

- Geologic cross-sections are often oriented perpendicular to the strike of the regional bedding. If a line of section oblique to the strike of regional bedding is selected, apparent dip of bedding and structural features should be computed and included in the geologic cross-section. It is important to choose a geologically relevant orientation with respect to strike and dip (and to note whether any of the selected orientations depict an apparent dip much different than the true dip).
- The geologic cross-section should not change trend direction, or bend significantly as this can change the relationship of the deposition direction. North and east should be on the right side of the page. If wells logs are projected onto the section the distance they are projected from the section line should be noted.
- The location and orientation of the line of geologic cross-section should be presented in plan view on a geologic map. The horizontal distance between boreholes, geologic contacts, structural features, and surface features is interpreted from the scale of the geologic map. The horizontal scale can be enlarged or reduced, preserving the relative distances, based on cross-section size. The vertical scale of the cross-section can exceed the horizontal scale (vertical exaggeration) in order to more clearly present the subsurface data. However, the scale should be chosen without undue vertical exaggeration.
- Subsurface lithology and structural features should be projected from surface contacts at the dip angle (or apparent dip) reported on the geologic map. Subsurface contacts may be correlated/interpreted between boreholes based on available lithologic logs and professional judgement. The cross-sections should be tied where they cross and to the geologic map at formation contacts.
- Cross-sections should include major aquifer and aquitard units, but it may not be necessary to include all lithologic beds on the cross-section.

- The geologic cross-section should include information provided on lithologic logs for boreholes along the line of section. Information for wells off-set from the line of section can be projected onto the cross-section. The maximum distance for projection of data onto the cross-section will be dependent upon the scale; professional judgement should be used in the selection of the maximum projection distance. The distance for projection of data should be somewhat dependent on the reasonableness one can infer that the units or features continue with some level of certainty. Conversely, if there is uncertainty, dashed lines or question marks are often applied to denote uncertainty.
- The level of detail and quality of available subsurface lithologic logs will vary between boreholes. The quality of individual lithologic logs should be considered when correlating subsurface borehole information.
- Where two cross-section lines intersect, the subsurface interpretations presented on the geologic cross-sections should be consistent at the intersection.
- The data used for horizon boundaries should be shown and posted for reference; and any references used to depict the cross-sections should be cited.

If known, other details should also be included in hydrogeologic cross sections, such as: (1) static water level of each aquifer; (2) screened intervals; (3) total depth of the boring/well; (4) availability of geophysical logs; and (5) type of drilling method. Additional notation on the cross-section may also be helpful for illustration.

23 CCR §354.14 (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.
(2) Surficial geology derived from a qualified map including the locations of cross sections required by this Section.
(3) Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.
(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.
(5) Surface water bodies that are significant to the management of the basin.
(6) The source and point of delivery for imported water supplies.

Geographical representations of the distribution of major data elements in a groundwater basin in map form help illustrate the layout of data and information presented in the HCM. The data for these maps are generally available from various sources such as GIS Shapefiles that can be overlain on a basin-wide base map.

As stated in the GSP Regulations, physical characteristics of the basin need to be displayed on maps. Information is provided on the types of datasets readily available for mapping.

- Topographic information can be found from online USGS topographic maps or more detailed high resolution Digital Elevation Model (DEM) mapping GIS datasets. There are several sources of topographic and DEMs available online, such as the ones provided in Section 7.

- In addition, the ESRI ArcGIS platform also includes DEM data available for use in conjunction with the ESRI GIS software.
- Surficial Geologic information can be downloaded from the California Geological Survey (CGS) and USGS from their interactive mapping tool.
    - CGS - http://maps.conservation.ca.gov/cgs/gmc/
    - USGS - http://ngmdb.usgs.gov/ngmdb/ngmdb_home.html

  The map that is produced to illustrate the surficial geology of the basin should also include the location of the cross-sections.

- The National Resource Conservation Service (NRCS) maintains soil data and Shapefiles nationwide on a county basis available at their website: http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. For additional related soil characteristics in California, see the UC Davis soil interactive maps (http://casoilresource.lawr.ucdavis.edu/).
- Recharge and discharge areas of groundwater are generally not well mapped. This type of information may be available from local and regional groundwater management planning documents, or larger reports form the Department and USGS. Additional recharge maps in California have been developed by the California Soil Resource Lab at UC Davis – The following link is to their Soil Agricultural Groundwater Banking Index (SAGBI): http://casoilresource.lawr.ucdavis.edu/sagbi/
- Surface water mapping data can be downloaded from ESRI base maps within ArcGIS, or downloaded from the National Hydrography Datasets (NHD) datasets: http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd
- Water supplies imported into a basin from state, federal, or local projects need to be mapped for the HCM. This information is generally available from the major suppliers of surface water such as the Department, United States Bureau of Reclamation (USBR), and local water and irrigation districts.

Additional useful information to be mapped may include:

- Groundwater elevation contour maps show the spatial distribution of groundwater elevations and help identify areas of low and high groundwater level areas within a basin. Elevation contour maps can be created from water level data collected from wells that are screened within the same principal aquifers. Information on water level data interpolation to create contour maps can be found in Tonkin et. al (2002).
- Land use maps detail the agricultural and urban land uses, and the distribution of natural vegetation, including potentially groundwater-dependent ecosystems. Land use maps shall use the Department land use classification scheme and maps provided by the Department.

An example of a geologic map is provided in **Figure 5**.

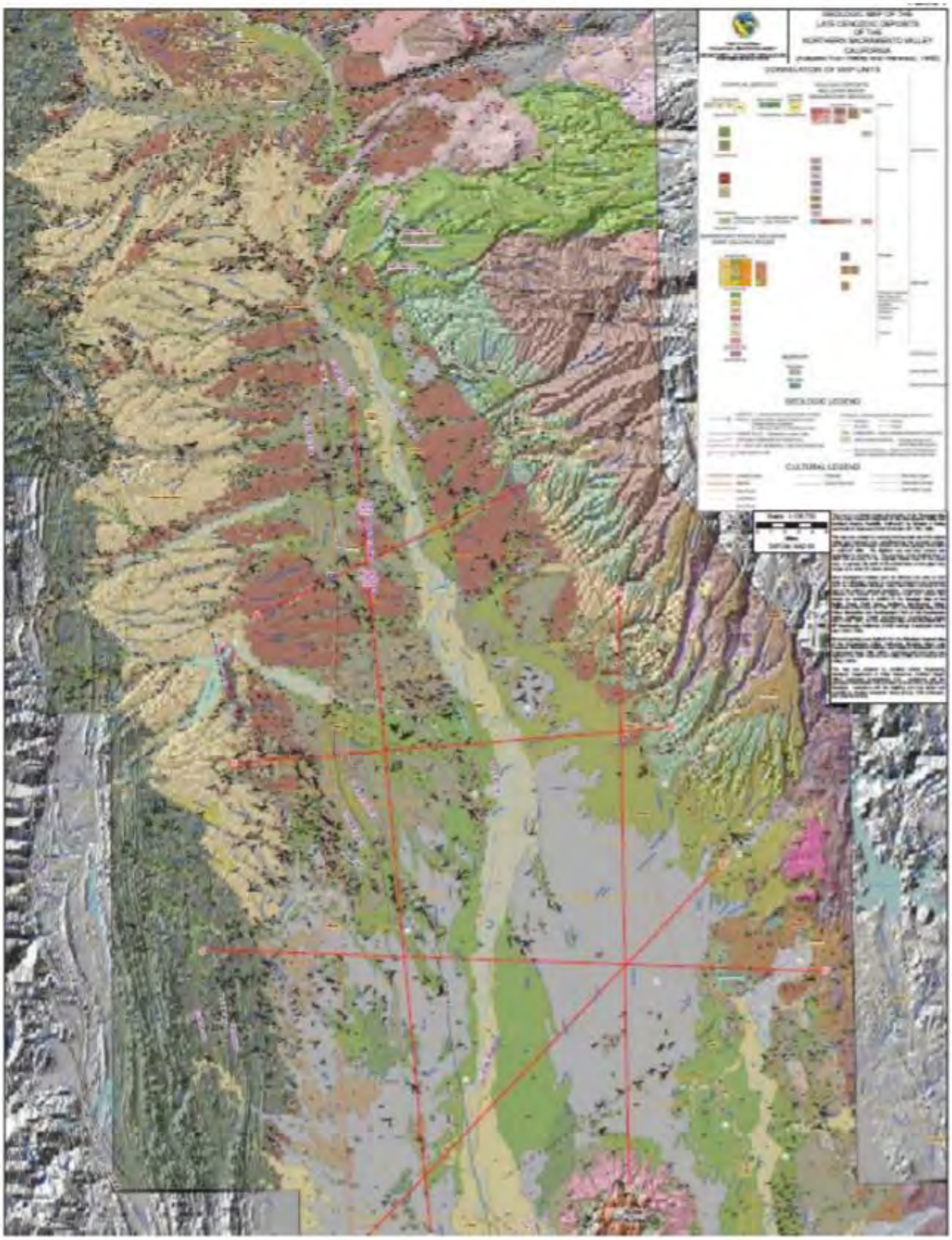


Figure 5 – Example Geologic Map

TYPICAL FLOW OF GRAPHICAL HCM DEVELOPMENT

The HCM requirements outlined in the GSP Regulations pertain to two main types of information:

1. Narrative description of the basin, which can be accompanied by a threedimensional graphic illustration of the HCM to complement the narrative; and

2. At least two scaled cross-sections and geographic maps to provide vertical layering representation and a geographic view of individual datasets, respectively.

The typical flow of graphical HCM development is presented in Figure 6. This figure shows the level of technical representation and detail, from basic cartoon-type representation, to a geographic representation map, to a scaled vertical cross-section that provides more subsurface detail for the HCM.

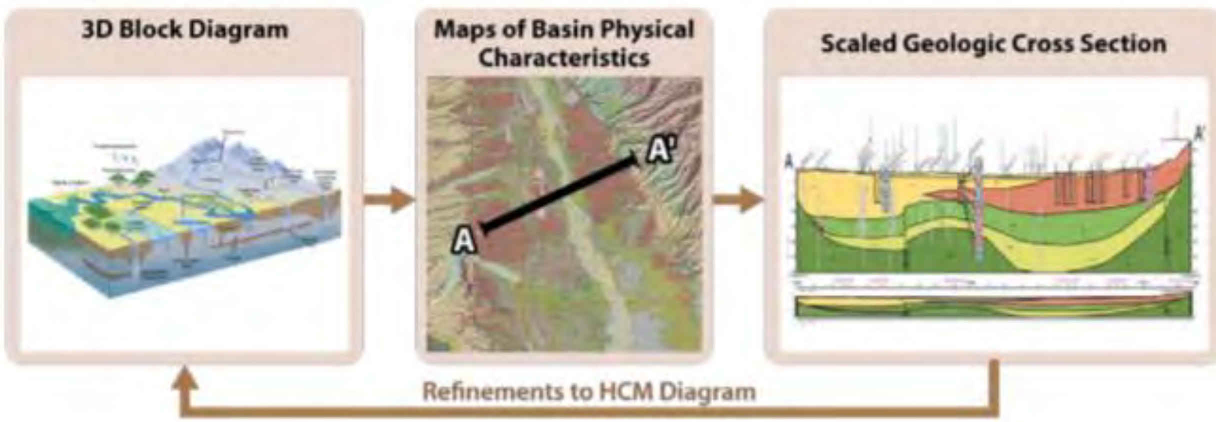


Figure 6 – Steps to Developing Graphic Representations of the HCM

6. KEY DEFINITIONS

The key definitions related to HCM development outlined in applicable SGMA code and regulations are provided below for reference.

SGMA Definitions (California Water Code §10721)

- "Groundwater recharge" or "recharge" means the augmentation of groundwater by natural or artificial means.
- "Recharge area" means the area that supplies water to an aquifer in a groundwater basin.

Groundwater Basin Boundaries Regulations (California Code of Regulations §341)

- "Aquifer" refers to a three-dimensional body of porous and permeable sediment or sedimentary rock that contains sufficient saturated material to yield significant quantities of groundwater to wells and springs, as further defined or characterized in Bulletin 118.
- "Hydrogeologic conceptual model" means a description of the geologic and hydrologic framework governing the occurrence of groundwater and its flow through and across the boundaries of a basin and the general groundwater conditions in a basin or subbasin.

- “Qualified map” means a geologic map of a scale no smaller than 1:250,000 that is published by the U. S. Geological Survey or the California Geological Survey, or is a map published as part of a geologic investigation conducted by a state or federal agency, or is a geologic map prepared and signed by a Professional Geologist that is acceptable to the Department.
- “Technical study” means a geologic or hydrologic report prepared and published by a state or federal agency, or a study published in a peer-reviewed scientific journal, or a report prepared and signed by a Professional Geologist or by a Professional Engineer.

Groundwater Sustainability Plan Regulations (California Code of Regulations §351)

- “Basin setting” refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.
- “Best available science” refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.
- “Data gap” refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed.
- “Principal aquifers” refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.
- “Uncertainty” refers to a lack of understanding of the basin setting that significantly affects an Agency’s ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.
- “Water source type” represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.
- “Water use sector” refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

7. RELATED MATERIALS

This section provides a list of related materials including general references, standards, guidance documents, and selected case studies and examples pertinent to the development of HCMs. For the items identified, available links to access the materials are also provided. In addition, common data sources and links to web-materials are also provided. By providing these links, DWR neither implies approval, nor expressly approves of these documents.

It should also be noted that existing Groundwater Management Plans (GMP), Salt & Nutrient Management Plans (SNMP), Urban Water Management Plans (UWMP), Drinking Water Source Assessment Plans (DWSAP), Agricultural Water Management Plans (AWMP), and Integrated Regional Water Management Plans (IRWMP) may be useful references in the development of HCMs. To the extent practicable, GSAs should utilize and build on available information.

STANDARDS

- ASTM D5979 – 96 (2014) Standard Guide for Conceptualization and Characterization of Groundwater Systems

REFERENCES FOR FURTHER GUIDANCE

Basin Boundary Modifications web page. California Department of Water Resources. http://www.water.ca.gov/groundwater/sgm/basin_boundaries.cfm Accessed December 2016.

California Geological Survey web page. California Department of Conservation. http://www.quake.ca.gov/ Accessed December 2016.

California Soil Resource Lab web page. University of California, Davis. https://casoilresource.lawr.ucdavis.edu/ Accessed December 2016.

California Water Plan (Bulletin 160). California Department of Water Resources. http://www.water.ca.gov/waterplan/cwpu2013/final/index.cfm Accessed December 2016.

California Water Science Center. U.S. Geological Survey. http://ca.water.usgs.gov/ Accessed December 2016.

California's Groundwater, Bulletin 118. California Department of Water Resources. http://water.ca.gov/groundwater/bulletin118.cfm Accessed December 2016.

Central Valley Salinity Alternatives for Long-term Sustainability web page. Central Valley Salinity Coalition. http://www.cvsalinity.org/ Accessed December 2016.

European Commission. 2010. Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 26. Guidance on Risk Assessment and the Use of Conceptual Models for Groundwater. Technical Report – 2010-042.

Fulton, J.W., et. al. 2005. Hydrogeologic Setting and Conceptual Hydrologic Model of the Spring Creek Basin, Centre County, Pennsylvania, June 2005. USGS Scientific Investigation Report 2005-5091. http://pubs.usgs.gov/sir/2005/5091/sir2005-5091.pdf

Geologic Map of California (GMC). California Department of Conservation. http://maps.conservation.ca.gov/cgs/gmc/ Accessed December 2016.

Groundwater Ambient Monitoring and Assessment Program (GAMA) web page. State Water Resources Control Board. http://www.waterboards.ca.gov/gama/geotracker_gama.shtml Accessed December 2016.

Interactive Fault Map. U.S. Geological Survey. http://earthquake.usgs.gov/hazards/qfaults/map/#qfaults Accessed December 2016.

Irrigated Lands Regulatory Program web page. State Water Resources Control Board. http://www.swrcb.ca.gov/water_issues/programs/agriculture/ Accessed December 2016.

National Geologic Map Database. U.S. Geological Survey. https://ngmdb.usgs.gov/ngmdb/ngmdb_home.html Accessed December 2016.

National Map Hydrography. U.S. Geological Survey. https://viewer.nationalmap.gov/viewer/nhd.html?p=nhd Accessed December 2016.

Oil and Gas Monitoring Program web page. State Water Resources Control Board. http://www.waterboards.ca.gov/water_issues/programs/groundwater/sb4/index.shtml Accessed December 2016.

Teresita Betancur V., Carlos Alberto Palacio T. and John Fernando Escobar M. 2012. Conceptual Models in Hydrogeology, Methodology and Results - A Global Perspective, Dr. Gholam A. Kazemi (Ed.), ISBN: 978-953-51-0048-5, InTech, Available from: http://www.intechopen.com/books/hydrogeology-a-globalperspective/conceptualmodels-in-hydrogeology-methodologies-and-results

Tonkin, M. and Larson, S. 2002. Kriging Water Levels with a Regional-Linear and PointLogarithmic Drift, Ground Water, March-April 2002.

Toth, J. 1970. A conceptual model of the groundwater regime and the hydrogeologic environment. Journal Of Hydrology, Volume 10, Issue 1. February. doi:10.1016/0022- 1694(70)90186-1

Web Soil Survey. U.S. Department of Agriculture Natural Resources Conservation Service. http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx Accessed December 2016.

REFERENCES FOR CROSS SECTIONS

Suggestions to Authors of the Reports of the United States Geological Survey, Seventh Edition, 1991. See Section named Cross Sections and Stratigraphic Sections and Preparing Maps and Other Illustrations, with a subsection titled Cross Sections.

Manual of Field Geology, Robert Compton, 1962. Chapter 11, Preparing Geologic Reports, Section 11-10 Detailed Geologic Maps and Cross Sections.

Walker, Roger G. (editor), 1981, Facies Models, Geological Association of Canada Publications, Toronto, Canada, 211 pages.

Reading, H.G. (editor), 1978, Sedimentary Environments and Facies, Elsevier Press New York, 569 pages.

Krumbein, K.C. and L.L. Sloss. 1963, Stratigraphy and Sedimentation, W.H. Freeman and Company, San Francisco, 660 pages.

DATA SOURCES

Geology reports:

Geology of the Northern Sacramento Valley, CA:
http://www.water.ca.gov/pubs/geology/geology_of_the_northern_sacramento_valley__california__june_2014-web/geology_of_the_northern_sacramento_valley__california__june_2014__updated_09_22_2014__website_copy_.pdf

Digital Elevation Models (DEMs):

- http://www.opendem.info/opendem_client.html

- http://viewer.nationalmap.gov/basic/?basemap=b1&category=ned,nedsrc&title=3 DEP%20View
- http://www.brenorbrophy.com/California-DEM.htm

Appendix K. Water Budget BMP

Water Budget Best Management Practice

1. OBJECTIVE

The objective of this Best Management Practice (BMP) is to assist the use and development of water budgets. The Department of Water Resources (the Department or DWR) has developed a Best Management Practice for Water Budget, as part of the obligation in the Technical Assistance Chapter (Chapter 7) of the Sustainable Groundwater Management Act (SGMA) to support the long-term sustainability of California's groundwater basins. The SJREC GSA has reviewed and updated this BMP for inclusion in the GSP. This BMP provides technical assistance to Groundwater Sustainability Agencies (GSAs) and other stakeholders on how to address water budget requirements outlined in the Groundwater Sustainability Plan (GSP) Emergency Regulations (GSP Regulations). This BMP identifies available resources to support development, implementation, and reporting of water budget information.

This BMP includes the following sections:

1. Objective. The objective and brief description of the contents of this BMP.

2. Use and Limitations. A brief description of the use and limitations of this BMP.

3. Water Budget Fundamentals. A description of fundamental water budget concepts.

4. Relationship of Water Budgets to other BMPs. A description of how the water budget BMP relates to other BMPs and how water budget information may be used to support development of other GSP requirements.

5. Technical Assistance. A description of technical assistance to support the development of a water budget, potential sources of information, and relevant datasets that can be used to further define each component.

6. Key Definitions. Definitions relevant for this BMP as provided in the GSP Regulations, Basin Boundary Regulations, SGMA, and DWR Bulletin 118.

7. Related Materials. References and other materials that provide supporting information related to the development of water budget estimates.

2. USE AND LIMITATIONS

This BMP does not create any new requirements or obligations for the GSA or other stakeholders. This BMP is not a substitute for the GSP Regulations and SGMA. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2. All references to SGMA relate to California Water Code sections in Division 6, Part 2.74.

3. WATER BUDGET FUNDAMENTALS

Earth's water is moved, stored, and exchanged between the atmosphere, land surface, and the subsurface according to the hydrologic cycle (**Figure 1**). The hydrologic cycle begins with evaporation from the ocean. As the evaporated water rises, the water vapor cools, condenses, and ultimately returns to the Earth's surface as precipitation (rain or snow). As the precipitation falls on the land surface, some water may infiltrate into the ground to become groundwater, some water may run off and contribute to streamflow, some may evaporate, and some may be used by plants and transpired back into the atmosphere to continue the hydrologic cycle (Healy, R.W. et al., 2007).

A water budget takes into account the storage and movement of water between the four physical systems of the hydrologic cycle, the atmospheric system, the land surface system, the river and stream system, and the groundwater system. A water budget is a foundational tool used to compile water inflows (supplies) and outflows (demands). It is an accounting of the total groundwater and surface water entering and leaving a basin or user-defined area. The difference between inflows and outflows is a change in the amount of water stored.

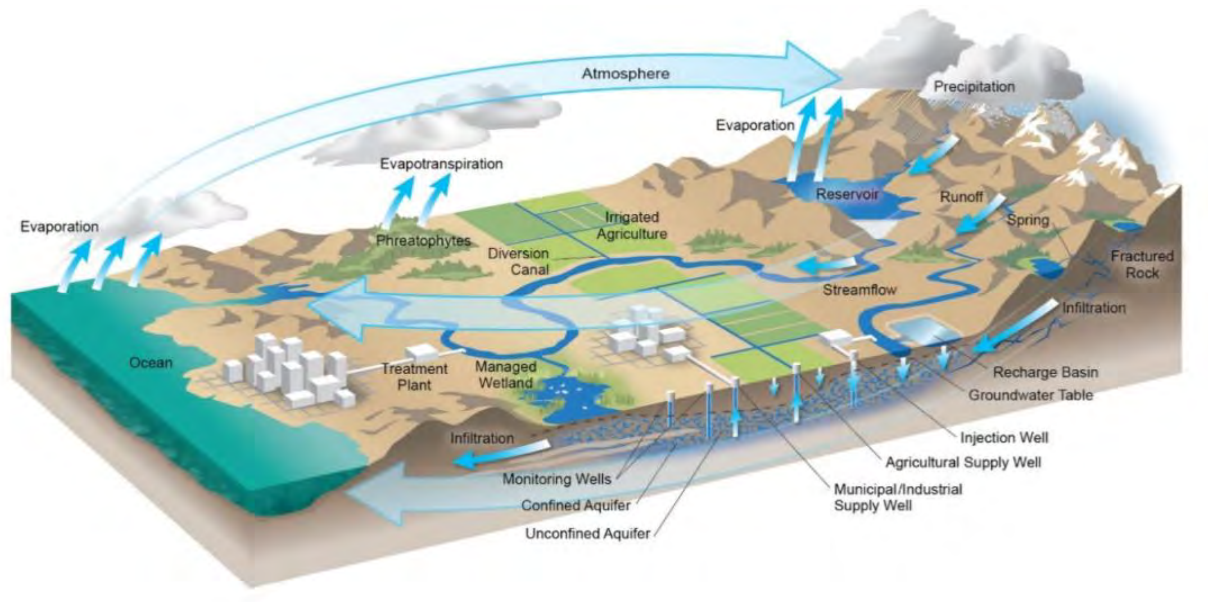


Figure 1 – The Hydrologic Cycle

In resource management it's said, "You can't manage what you don't measure." Similar to a checking account, water budget deposits (inflows) and withdrawals (outflows) are tracked and compared over a given time period to identify if the change in account balance is positive (increase in amount of water stored) or negative (decrease in the amount of water stored). During periods when inflows exceed outflows, the change in volume stored is positive. Conversely, during periods when inflows are less than outflows, the change in storage is negative. Surpluses from previous budget periods can act as a buffer towards isolated annual water budget deficits, but a series of ongoing negative balances can result in long-term conditions of overdraft.

Water budgets can be highly variable between groundwater basins. In some basins, precipitation may be the largest contributor to groundwater recharge. In other basins, leading sources of recharge may stem from infiltration and seepage of irrigation water, conveyance systems, septic systems, and various surface water systems (streams, lakes, reservoirs, etc.). In some areas, high groundwater levels result in seasonal or continuous outflow from the groundwater system to overlying surface water systems. In other basins, lower groundwater levels result in the continuous movement of water from the surface water system to the groundwater system. Assessment and comparison of annual water budget data requires using a consistent, user-defined area and period of evaluation. Under the GSP Regulations, the water budget is developed for the groundwater basin according to the annual water year period (October 1 to September 30).

In principle, a water budget is a simple concept that provides the accounting framework to measure and evaluate all inflows and outflows from all parts of the hydrologic cycle – atmospheric, land surface, surface water, and groundwater systems. In reality, it can be difficult to accurately measure and account for all components of the water budget for a given area. Some water budget components may be estimated independent of the water budget, while others may be calculated based on the fundamental principle that the difference between basin inflows and outflows is balanced by a change in the volume of water in storage. This principle is quantified according to the following water budget equation.

Inflow (a, b, c) - Outflow (a, b, c) = Change in Storage

Equation 1 – Water Budget Equation

Because groundwater basin inflows and outflows are balanced by a change in the amount of water in storage, the above equation may be rearranged to calculate, or “back into”, an unknown component of the water budget equation. For example, if one wishes to determine unknown Outflow component “a”, and all other components of the water budget for the groundwater system have been determined, Outflow “a” can be calculated by rearranging the above water balance equation as follows:

Outflow (a) = Inflow (a, b, c) – Outflow (b, c) – Change in Storage

To illustrate this example, consider a water budget scenario where total inflow from components “a”, “b”, and “c” equals 100 units of water; total outflow from all components other than “a” equals 40 units of water; and the annual change in storage identified through groundwater level measurements is approximately equal to +10 units of water. An estimate of outflow “a” during this period may be calculated from the above water budget equation as shown below. Note that “change in storage” is represented as a positive number to denote an increase in storage and a negative number to denote a decrease in storage.

Outflow (a) = Inflow (a, b, c) – Outflow (b, c) – Change in Storage
50 units = 100 units – 40 units – 10 units

Identifying which water budget components are most appropriate to estimate through balancing of the water budget equation will depend on the local ability to independently measure or estimate the remaining water budget components. It also depends on the relative importance, versus uncertainty, associated with each component in the overall water budget. A higher level of water budget uncertainty often translates to a higher risk that the projects and management actions being evaluated to achieve sustainability, based on future water budget projections, may not achieve the intended outcome within the intended timeframe.

An important consideration when implementing water resource management is the interaction between groundwater and surface water systems. Groundwater flow naturally moves down-gradient, from areas of high groundwater elevation to areas of lower groundwater elevation. In areas where groundwater levels are below the surface water system, the direction of groundwater flow will be from the surface water system to the groundwater system. Streams that receive water from the groundwater system are called “gaining” streams and those that lose water to the groundwater system are called “losing” streams (see **Figure 2**). The gaining or losing character of streamflow may be consistent throughout a stream system or it may be highly variable based on stream reach location and based on seasonal versus annual changes in local climatic conditions and the water inflow (recharge) or outflow (groundwater extraction) for the basin. It is therefore important to clearly identify and characterize stream segments included in the water budget calculation.

Unless additional inflows or supplies are developed, increases in groundwater extraction may eventually result in a hydraulic disconnection between the surface water and groundwater systems in basins where these systems are currently interconnected. Groundwater systems that are disconnected from the surface water system will still receive recharge from the surface water system. However, all further extraction from the groundwater system may be largely balanced through a decline of groundwater in storage and/or a reduction of subsurface outflow from the basin over time.

Another important water budget consideration is stream depletion due to groundwater pumping. In basins with interconnected surface water systems, if inflows (recharge) to the basin remain fixed while the amount of groundwater extraction increases, the increased volume of groundwater extraction, while initially resulting in a decline in the volume of aquifer storage, will eventually be balanced by decreases in the groundwater flow to springs, gaining streams, groundwater-dependent ecosystems or an increase in discharge from losing streams. Shallow production wells in close proximity to surface water systems commonly capture flow directly from the surface water system through induced recharge. Stream depletion associated with pumping wells further removed from surface water systems is more commonly the result of the indirect capture of groundwater flow that would otherwise have discharged to the surface water system sometime in the future. In both situations, streamflow depletion will continue until a new equilibrium between the outflow associated with groundwater extraction and the inflow from surface water depletion is established.

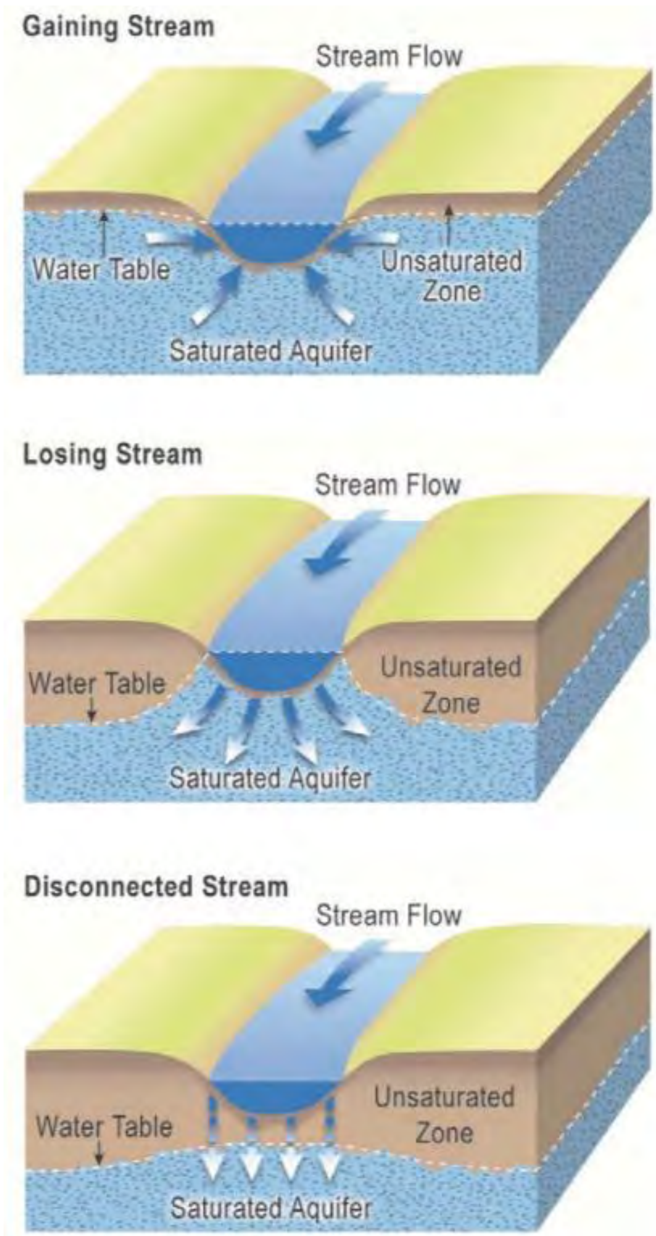


Figure 2 – Gaining, Losing, and Disconnected Streams

The transition from storage depletion to stream depletion will affect water budget accounting over time. The time lag to reach this new equilibrium is directly related to the location and construction of production wells, the thickness and hydrologic conductivity of the aquifer system, and the capacity and timing of the groundwater extraction. In many basins, stream depletion due to groundwater extraction will continue for decades prior to reaching a new equilibrium (Barlow, P.M. and Leake, S.A., 2012). Because of this transitional process, a water budget based on "average conditions" may not reflect this change. It's also important to recognize that water budget accounting during early stages of groundwater basin development may have different storage and basin outflow values than water budget accounting for a later time period, when the basin is approaching equilibrium.

To accurately identify and evaluate the various inflow and outflow components of the water budget, it is important to adequately characterize the interaction between surface water and groundwater systems through sufficient monitoring of groundwater levels and streamflow conditions. The Monitoring Networks and Identification of Data Gaps and Monitoring Protocol, Standards, and Sites BMPs have additional information regarding GSP monitoring requirements.

Characterization of stream depletion due to groundwater extraction requires adequate data and analysis. In the absence of adequate data, integrated groundwater-surface water models are often used to assist with water budget accounting and forecasting. Additional information regarding consideration of models under the GSP Regulations is provided in the Modeling BMP and in Section 5 of this BMP.

Water Budget Uses

Water budget accounting may be very general or very detailed, depending on the hydrologic complexities of the basin, the scale and intent of water budget accounting, and the importance of understanding the individual water budget components necessary to support water resource decision making. Some of the general and GSP Regulation-specific water budget uses and applications are provided below.

General Water Budget Uses

- Develop an accounting and characterize spatial and temporal distribution of inflows and outflows to a watershed, groundwater basin, or management area.
- Identify the primary beneficial uses and users of water and determine which water budget components are most critical to the area.
- Improve communication between the local land use planners and water resource managers.
- Estimate water budget components that are not easily measured or well understood.
- Evaluate how the surface and groundwater systems respond to the seasonal and long-term changes to supplies, demands, and climatic conditions.
- Identify the timing and volume of inflows and outflows that will result in a balanced water budget condition for a management area.
- Develop a water supply assessment of future conditions to better understand the effects of proposed land and water use changes, climate change, and other factors to the local and regional water budget.
- Inform additional monitoring needs.
- Identify the interaction between surface water and groundwater systems, including changes over time.

GSP-Related Water Budget Uses

SGMA requires local agencies to develop and implement GSPs that achieve sustainable groundwater management by implementing projects and management actions intended to ensure that the basin is operated within its sustainable yield by avoiding undesirable results. A key component in support of this effort is an accounting and assessment of the current, historical, and projected water budgets for the basin. The following provides a partial list of potential GSP-related water budget applications and uses:

- Develop an accounting and characterize spatial and temporal distribution of inflows and outflows to the basin by water source type and water use sector, to identify the main beneficial uses and users, and determine which water budget components are most critical to achieving sustainable groundwater management (§354.18(b)).
- Assess how annual changes in historical inflows, outflows, and change in basin storage vary by water year type (hydrology) and water supply reliability (§354.18(c)(2)).
- Develop an understanding of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability to operate the basin within the sustainable yield (§10733.6(b)(3)).
- Improve coordination and communication between the GSA and water supply or management agencies, local land use approval agencies, and interested parties who may be subject to sustainable groundwater management fees (§355.4(b)(4)).
- Facilitate coordination of water budget data and methodologies between agencies preparing a GSP within the basin (§357.4) or between basins (§357.2).
- Identify data gaps and uncertainty associated with key water budget components and develop an understanding of how these gaps and uncertainty may affect implementation of proposed projects and water management actions.
- Evaluate how the surface and groundwater systems have responded to the annual historical changes in the water budget inflows and outflows (§354.18(c)(2)).
- Determine the rate and volume of surface water depletion caused by groundwater use that has adverse impacts on the beneficial uses of the surface water and may lead to undesirable results (§354.16(f) and 354.28(c)(1)).
- Identify which water budget conditions commonly result in overdraft conditions (354.18(b)(5).
- Estimate the sustainable yield for the basin (§354.18 and 10727.6(g)).
- Forecast projected inflows and outflows to the basin over the planning and implementation horizon (§354.18(c)(3)).
- Evaluate the effect of proposed projects and management actions on future water budget projections (§354.44(b)).
- Evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate (§65362.5(a)).
- Inform monitoring requirements (§354.34(b)(4)).
- Inform development and quantification of sustainable management criteria, such as the sustainability goal, undesirable results, minimum thresholds, and measureable objectives (§354.22).
- Help identify potential projects and management actions to achieve the sustainability goal for the basin within 20 years of GSP implementation (§354.44).

Water Budgets in Reference to the GSP Regulations

With respect to the GSP Regulations, developing a water budget that accurately identifies and tracks changing inflows and outflows to a basin will be a critically important tool to support decision making.

Complexity of water budgets will vary by groundwater basin according to the local complexities of the basin hydrology, physical setting, spatial and temporal distribution of supplies and demands, historical water management practices and the presence or absence of undesirable results. Ongoing parallel efforts to monitor and verify water budget components will help improve accuracy; however, some level of uncertainty is inherent in each water budget. An important objective of water budget accounting under the GSP Regulations is to develop an understanding of what level of water budget certainty and detail is sufficient for making effective basin management decisions.

The GSP water budget requirements are not intended to be a direct measure of groundwater basin sustainability; rather, the intent is to quantify the water budget in sufficient detail so as to build local understanding of how historical changes to supply, demand, hydrology, population, land use, and climatic conditions have affected the six sustainability indicators in the basin, and ultimately use this information to predict how these same variables may affect or guide future management actions. Building a coordinated understanding of the interrelationship between changing water budget components and aquifer response will allow local water resource managers to effectively identify future management actions and projects most likely to achieve and maintain the sustainability goal for the basin.

Another important aspect of documenting water budget information in the GSP is to ensure the Department is provided with sufficient information to demonstrate that the GSP conforms to all SGMA and GSP Regulation requirements, and, when implemented, is likely to achieve the sustainability goal within 20 years and maintain sustainability over the 50 year planning and implementation horizon.

4. RELATIONSHIP OF THE WATER BUDGET TO OTHER BMPS

Quantifying the current, historical, and projected water budget for the basin is just one of several interrelated GSP elements the GSAs will use to help understand the basin setting, evaluate groundwater conditions, determine undesirable results, develop sustainability criteria, establish appropriate monitoring networks, and ultimately identify future projects and management actions that are likely to achieve and maintain the sustainability goal for the basin. **Figure 3** illustrates the relationship of the water budget BMP to the other BMPs, and to the overall steps towards achieving sustainability under SGMA and the GSP Regulations.

Figure 3 identifies the water budget BMP as part of the Basin Setting portion of the GSP Regulations (§354.12). However, the water budget BMP also directly supports, or is supported by, several other BMPs and Guidance Documents such as stakeholder outreach, development of the Hydrogeologic Conceptual Model (HCM), modeling, monitoring networks, monitoring protocols, and establishing sustainable management criteria. Basin monitoring feeds into the understanding of the HCM and groundwater conditions, which then supports the understanding and quantification of the water budget and model development. It ultimately supports evaluation of sustainability indicators, undesirable results, and basin management decisions to achieve the sustainability goal for the basin.

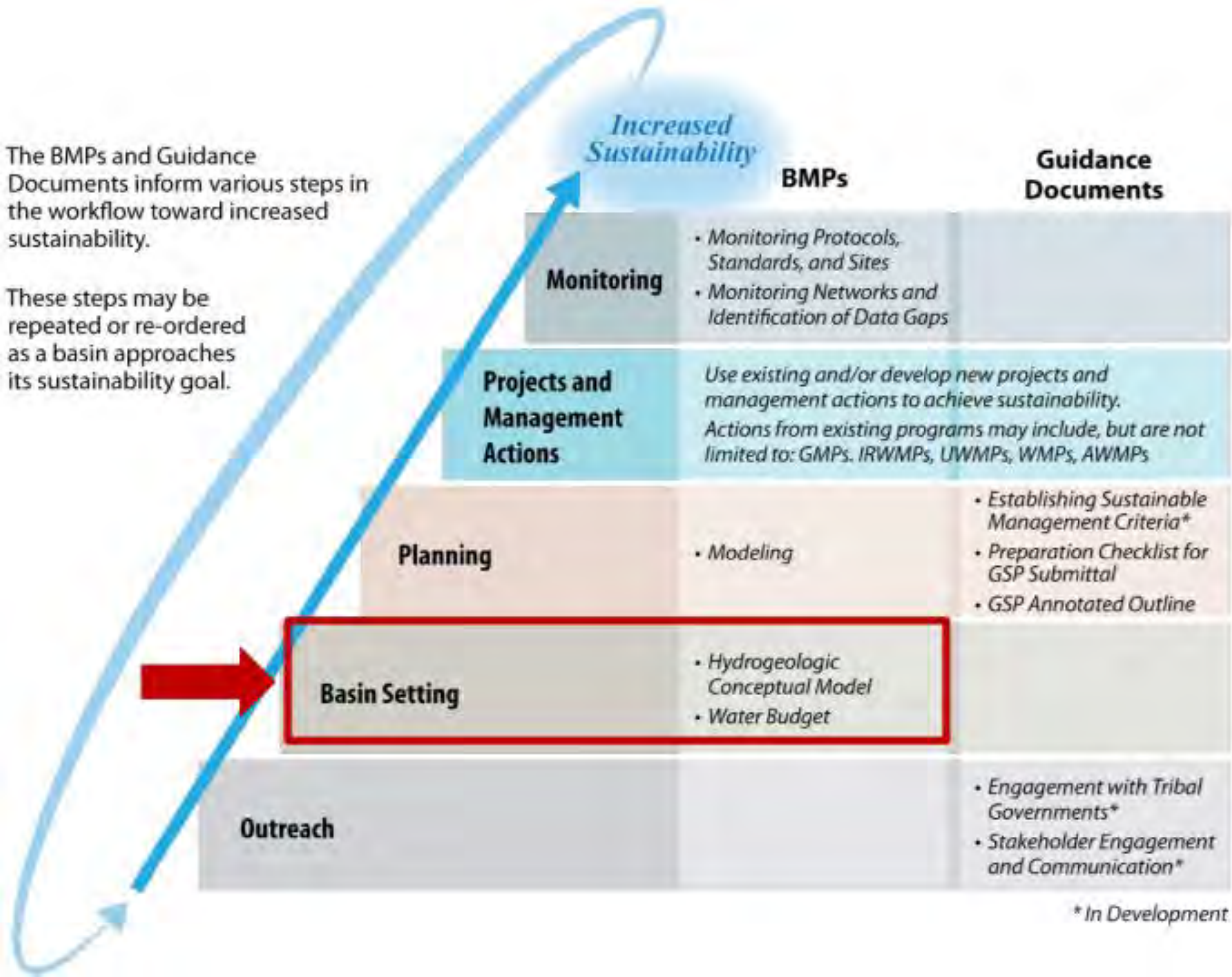


Figure 3 – Logical Progression of Basin Activities Needed to Increase Basin Sustainability

5. TECHNICAL ASSISTANCE

Implementing sustainable groundwater management under SGMA and the GSP Regulations requires development of a water budget. It should identify and account for basin inflows, outflows, and change in storage over changing temporal and spatial conditions of supply, demand, and climate with sufficient accuracy. This section provides guidance for the development of a water budget, including potential sources of information, reporting formats, and relevant datasets that can be used to further quantify and estimate the various water budget components.

GENERAL WATER BUDGET REQUIREMENTS

The following section highlights and provides guidance and technical assistance on the general requirements for all GSP-developed water budgets.

> ***Subarticle 2. Basin Setting***
> ***23 CCR §354.12: Introduction to Basin Setting***
> *Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.*

Professional Certification

Water budget requirements are provided in Subarticle 2, under the Basin Setting portion of the GSP Regulations. Introduction to the basin setting stipulates that GSP water budget information, and all information provided under Subarticle 2 of the GSP Regulations, is to be prepared by or under the direction of a professional geologist or professional engineer. The qualifications and requirements for professional engineers and geologists are governed by the Professional Engineers Act (Business and Professions Code §6700) and the Geologist and Geophysicist Act (Business and Professions Code §8700). Information regarding the professional codes and licensing lookup are provided below.

- Professional Engineers Act: http://www.bpelsg.ca.gov/laws/pe_act.pdf
- Professional Geologist and Geophysicist Act: http://www.bpelsg.ca.gov/laws/gg_act.pdf
- Professional License Lookup: http://www.bpelsg.ca.gov/consumers/lic_lookup.shtml

Water Budget Data, Information, and Modeling Requirements

23 CCR §354.18(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.*

Water Budget Data Requirements: GSP Regulations stipulate the need to use the best available information and the best available science to quantify the water budget for the basin. Best available information is common terminology that is not defined under SGMA or the GSP Regulations. Best available science, as defined in the GSP Regulations, refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, which is consistent with scientific and engineering professional standards of practice.

It is understood that initial steps to compile and quantify water budget components may be constrained by GSP timelines and limited funding, and may consequently need to rely on the best available information that is obtainable at the time the GSP is developed. Information describing potential sources of data to support the quantification of water budget components is provided later in this BMP under Water Budget Data Resources. This section also includes a listing of data to be provided by the Department as part of the Department's technical assistance.

As GSAs compile and assess the various water budget components for the basin, each GSA will work to identify, prioritize, and fill data gaps as an ongoing effort to further refine water budget data and information based on the best available science.

Sustainability will ultimately depend on the GSA's ability to manage the basin within the identified uncertainty of water budget information to meet the locally defined objectives and thresholds of the outcome-based sustainable management criteria identified in §354.22. However, the initial approval of the GSP by the Department requires GSAs to gather and present a level and quality of water budget information that will demonstrate the GSP will likely achieve the sustainability goal for the basin under the substantial compliance requirements in §355.2 of the GSP Regulations.

Use of Models to Determine Water Budgets: GSP Regulations do not require the use of a model to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater. However, if a model is not used, the GSA is required to describe in the GSP an equally effective method, tool, or analytical model to evaluate projected water budget conditions.

Groundwater basins with acceptable water budget conditions, minimal undesirable results, and limited proposed changes to future groundwater demands may be able to identify and describe equally effective methods or tools to quantify and forecast future water budget conditions in sufficient detail.

In basins with interconnected surface water systems or complex spatial and temporal variations in water budget components, quantifying and forecasting streamflow depletion and other water budget components is best determined from an experienced local professional and/or the use of a numerical groundwater and surface water model. Modeling results may also be an effective tool for outreach and communication, and can prove useful in analyzing and quantifying some of the more difficult-to-measure water budget components.

Additional information regarding the requirements, application, and availability of models and modeling data is provided in the Modeling BMP.

Defining Basin Area and Water Budget Systems

23 CCR §354.18(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.*

Three-Dimensional Basin Area: Prior to developing a water budget for the basin, GSAs must first identify the vertical and lateral extent of the basin as described under the HCM (§354.14) portion of the GSP Regulations. The HCM is based on technical studies and qualified maps that characterize the physical basin area and the interaction of surface water and groundwater systems in the basin. It requires evaluation of the physical systems related to regional hydrology, land use, geology and geologic structure, water quality, principal aquifers, and principal aquitards in the basin. Additional information regarding development of the HCM may be found in the HCM BMP.

The lateral boundaries of the basin are determined by the Department and conform to those boundaries provided in Bulletin 118. The vertical basin boundary, or definable bottom of the basin, is determined by the GSA and may be delineated by either, 1) a structural barrier to groundwater flow as determined by local geology, or 2) the base of fresh water as determined by groundwater quality information. In general, deep portions of the basin not part of the groundwater flow path can be excluded from analysis; conversely, if the those portions of the basin are part of the flow path or are being managed, they should be included in the analysis. Basin boundaries may be periodically modified through SGMA under §10722.

In addition to the lateral and vertical basin boundaries, the water budget accounting takes into consideration the exchange of water between subsystems within the hydrologic cycle. **Figure 4** is a generalized schematic illustrating the potential interaction between water budget components and the surface water system and groundwater system for a groundwater basin or management area.

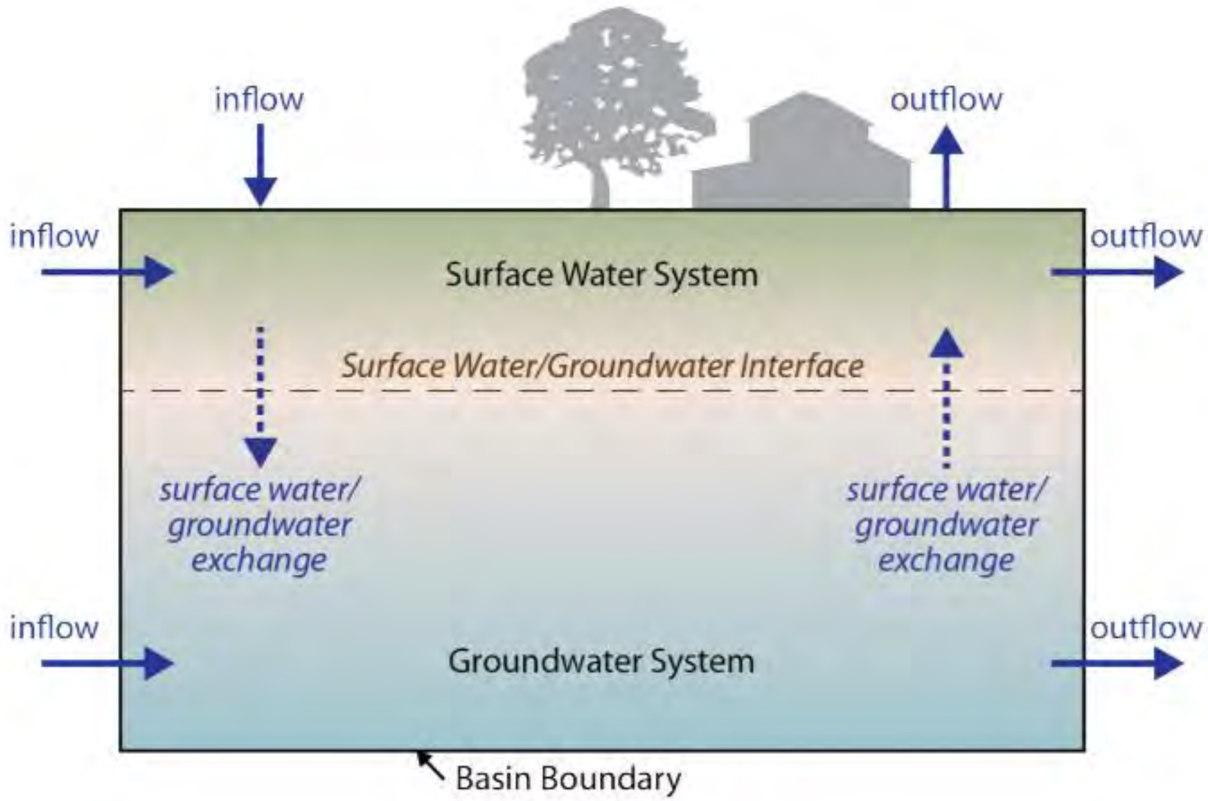


Figure 4 – Conceptual Basin Boundary, Surface Water and Groundwater Systems, and Inflows and Outflows

The surface water system is represented by water at the land surface within the lateral boundaries of the basin. Surface water systems include lakes, streams, springs, and man-made conveyance systems (including canals, drains, and pipelines). Near-surface processes such as stream underflow, infiltration from surface water systems or outflow due to evapotranspiration from the root zone are often included for convenience as part of the surface water accounting. Root zone processes may also be accounted for explicitly by defining a separate land surface system and quantifying exchanges with the surface water system and groundwater system, as well as exchanges with the atmosphere. An example of explicit accounting for the land surface system is provided later in this document based on water budgets prepared as part of the California Water Plan (DWR Bulletin 160).

The groundwater system is represented by that portion of the basin from the ground surface to the definable bottom of the basin, extending to the lateral boundary of the basin. The groundwater system will be characterized by one or more principal aquifers and represents the physical basin area used to quantify the annual change in volume of groundwater stored, as required in the water budget. The same three-dimensional basin area should also be used for GSAs to optionally identify the volume of groundwater in storage or the groundwater storage capacity, as necessary, to assist in the determination of sustainable yield.

> ***23 CCR §354.20(a). Management Areas:*** *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.*

Management Areas: Although the GSP Regulations only require quantification of water budget components for the basin, each GSA may choose to further subdivide and report the water budget by one or more management areas to help facilitate GSP implementation, and to help demonstrate GSP substantial compliance to the Department under §355.2 of the GSP Regulations (Department Review of Adopted Plan). If management areas are developed, additional information and graphics will be needed to define the names, locations, and distribution of management areas within the basin. Graphical representations of the physical setting and characteristics of the basin will be largely provided under HCM requirements in §354.14 of the GSP Regulations.

> ***23 CCR §357.4(a). Coordination Agreements:*** *Agencies intending to develop and implement multiple Plans pursuant to Water Code Section 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies, and that elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting.*

Coordination of Water Budget Data: When one or more GSPs are being developed by one or more GSAs for the same basin, §10727(b)(3) of SGMA and §357.4 of the GSP Regulations require a coordination agreement between all GSAs developing a GSP within the basin. As stated in the GSP Regulations citation above, the coordination agreement is to ensure that GSPs are developed and implemented using the same data and methodologies. Specifically, the coordination agreements need to describe how the Agencies utilize the same data and methodologies for the following water budget related components:

- Surface water supply
- Total water use
- Change in groundwater storage
- Water budget
- Sustainable yield

Thus, when presenting water budget information for basins with one or more GSPs, all GSPs for the basin need to identify and describe the existing coordination agreements for the basin, the point of contact of each agreement, how the individual coordinating agencies have taken steps to ensure that each GSP for the basin is utilizing the same data and methodologies for the above water budget components, and how the GSP is fulfilling the coordination requirements identified under §357.4 of the GSP Regulations.

For many basins within the Central Valley, Salinas Valley and elsewhere, not all lateral boundaries for contiguous basins serve as a barrier to groundwater or surface water flow. In situations where a basin is adjacent or contiguous to one or more additional basins, or when a stream or river serves as the lateral boundary between two basins, it is necessary to coordinate and share water budget data and assumptions. This is to ensure compatible sustainability goals and accounting of groundwater flows across basins, as described in §357.2 (Interbasin Agreements) of the GSP Regulations.

As described in SGMA, the Department shall evaluate whether a GSP adversely affects the ability of an adjacent basin to implement its GSP or impedes the ability to achieve its sustainability goal. In order to adequately evaluate this condition, in many cases this will necessitate GSA coordination and sharing of water budget data, methodologies, and assumptions between contiguous basins including:

- Accurate accounting and forecasting of surface water and groundwater flows across the basin boundaries
- Application of best available data and the best available science

In these interbasin situations, it is highly recommended that water budget accounting describe how individual agencies took steps to ensure that each GSP for the basin is utilizing compatible data and methodologies for the water budget components identified under interbasin coordination in §357.4 of the GSP Regulations.

Accounting and Quantification of Water Budget Components

23 CCR §354.18(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. (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. (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow. (4) The change in the annual volume of groundwater in storage between seasonal high conditions. (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. (6) The water year type associated with the annual supply, demand, and change in groundwaterstored. (7) An estimate of sustainable yield for the basin.

Accounting of the water budget components includes: 1) an annual quantification of inflows and outflows across the basin boundaries, 2) the exchange of water between the surface water system and groundwater system, and 3) the change in volume of groundwater in storage. Surface water entering and leaving the basin and inflow to the groundwater system must be accounted for by water source type. Outflows from the groundwater system must be accounted for by water use sector. The annual accounting of surface water entering and leaving the basin should also include the annual change in surface water storage within lakes and reservoirs that contribute significant water supplies to the basin.

The GSP water budget components are conceptually illustrated in the water budget schematic shown previously in **Figure 4**. **Figure 5** expands upon **Figure 4** by depicting the individual water budget components identified by the GSP Regulations.

Quantification of the annual water budget inflows, outflows, and change in storage for the basin is to be generated by water year through direct measurements or estimates based on data. As previously discussed, the water budget must also be based on best available information and science. Methods to quantify water budget components may vary depending on basin-specific conditions, best available information, and the consideration of uncertainties associated with each method. Methods may change over time as monitoring networks are improved and data gaps are filled.

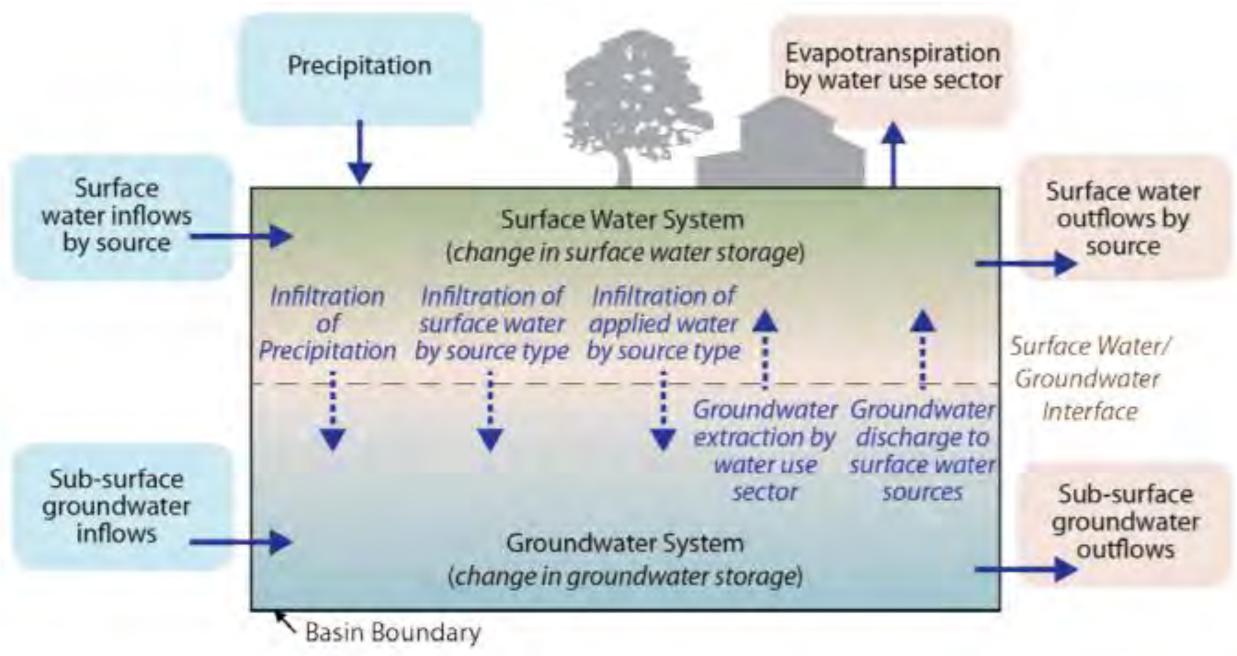


Figure 5 – Required Water Budget Components

Additional discussion regarding consideration of direct and indirect approaches to quantify water budget components is provided under Identifying and Selecting Methodologies to Estimate Water Budget Components. Information describing potential data sources to support quantification of change in storage is provided later in this section under Water Budget Data Resources, including data to be provided by the Department specifically for the purpose of supporting GSP water budget development.

The following information provides a breakdown of the seven overarching water budget component requirements listed above and included in §354.18(b) of the GSP Regulations.

(1) Total surface water entering and leaving the basin by water source type.
Water budget components associated with the river and stream system include the surface water entering (inflow) and leaving the basin (outflow). The inflow and outflow of surface water to the basin is required to be annually quantified as a total annual volume in acre-feet per year (af/yr) according to the surface water body (name) and the water sources type. Water source type represents the source from

which water is derived to meet the applied beneficial uses. Surface water sources should be identified as one of the following:

- Central Valley Project
- State Water Project
- Colorado River Project
- Local supplies
- Local imported supplies

Much of the surface water flowing into the basin is diverted and applied to meet the beneficial uses within the basin. It is recommended that total annual volume of applied surface water (af/yr) also be quantified according to the appropriate water use sector and the total applied water area (acres). For urban water suppliers, the diverted and applied surface water use should include the total annual volume of use for all urban areas within the basin and the average daily gallons of per capita use (gpcd) for the basin. A breakdown of the applied surface water accounting by basin and by water use sector is provided as follows:

- Urban: total annual volume (af/yr)
- Industrial: total annual volume (af/yr) and total applied water area (acres)
- Agricultural: total annual volume (af/yr) and applied water area (acres)
- Managed Wetlands: total annual volume (af/yr) and applied water area (acres)
- Managed Recharge: total annual volume (af/yr) and applied water area (acres)
- Native Vegetation: total annual volume (af/yr) and applied water area (acres)
- Other (as needed): total annual volume (af/yr) and applied water area (acres)

Applied surface water supply may be further subdivided by management area as needed to facilitate water budget accounting and to help demonstrate GSP substantial compliance under §355.2 of the GSP Regulations.

Surface Water Available for Groundwater Recharge or In-Lieu Use: In addition to the above GSP Regulation requirement to include an accounting of the total surface

Oil & Gas Field-Produced Water
Significant quantities of water are produced as a by-product of oil and gas extraction in some basins. Where applicable, it is important to characterize this water in terms of aquifer depletion, beneficial use, quality, and reliability.

• Aquifer Depletion. Oil and gas-bearing formations are often at a depth below the groundwater flow system. Is the quantity of produced water accounted for in the hydrogeologic conceptual model? Will depletion of this water cause Undesirable Results such as subsidence?

• Beneficial Use. Describe the uses for the produced water. Is the produced water being supplied as a beneficial use such as irrigation or recharge, or is it being evaporated? If so, it should be included as a water supply type in the water budget accounting.

• Quality. Describe the quality of the produced water, existing use permits, and any treatment processes employed. Describe the use or discharge relative to RWQCB Basin Plan Objectives.

• Reliability. Availability of produced water will fluctuate with oil and gas production. Oil fields have limited production durations that may be incompatible with long-term groundwater sustainability. Oil field-produced water will generally not be an acceptable supply for establishing sustainability, but may be a component of an initial basin recovery effort. The reliability of produced water should be characterized in the GSP if it is being use as a source of supply.

water entering and leaving the basin, §10727.2(d)(5) of SGMA requires the GSP include a description of the surface water supply used, or available for use, for groundwater recharge or in-lieu use.

The Department currently estimates the volume of water available for replenishment of the groundwater in the State. The statewide water available for replenishment is being estimated on a regional basis. This regional estimate will not fulfill the SGMA requirement to identify the surface water supply used, or available for use, for groundwater recharge or in-lieu use at the basin level. However, the Department's process, methods, and sources of data for surface water supply availability should provide valuable assistance to GSAs.

(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.

Inflows to the groundwater system are to be annually quantified by water year type for the basin as the total annual volume (af/yr) according to the water source type and water use sector.

An accounting of inflows to the groundwater systems should include, but may not be limited to, the following:

- Subsurface groundwater inflow (af/yr)
- Infiltration of precipitation (af/yr)
- Infiltration of applied water (af/yr)
- Infiltration from surface water systems (af/yr)
- Infiltration or injection from managed recharge projects (af/yr)

It is also important to identify and account for inflows or outflows to the groundwater system that may originate from outside the identified basin area. For example, application and infiltration of oil field-produced water should be identified as a separate source of imported water, while the injection of water beneath the definable bottom of the basin should be identified as an outflow from the basin when applicable (see text box discussion of oil field-produced water considerations). In addition, depending on the definable bottom of the basin, groundwater being injected to maintain a seawater intrusion barrier may need to be recognized as an outflow from the groundwater basin. Subsurface outflow needed to prevent seawater intrusion should be quantified.

For areas having Urban Water Management Plans (UWMP) or Agricultural Water Management Plans (AWMP), the GSP water budget assessment of urban and agricultural areas should be consistent with the water budget reporting in the most recent UWMPs and AWMPs, unless more recent information is available.

(3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.

An annual accounting of groundwater outflow from the basin should be total volume (ac-ft) by water source type and water use sector. Sources of groundwater outflow should include, but not be limited to, the following:

- Evapotranspiration: (af/yr)
- Groundwater discharge to surface water sources (af/yr)
- Subsurface groundwater outflow (af/yr)
- Groundwater extraction by water use sector:
    - Urban (af/yr) and (gpcd)
    - Industrial (af/yr)
    - Agricultural (af/yr)
- Managed Wetlands (af/yr)
- Managed Recharge (af/yr)
- Infiltration from the following: (af/yr)
    - Other (as needed)

  Note: if oil and gas production wells are producing or applying water within the basin, as defined in the HCM, an accounting of the produced water is to be included as a source of applied water.

Outflows from the groundwater system may be further subdivided by management area as needed to facilitate water budget accounting and to help demonstrate GSP substantial compliance under §355.2 of the GSP Regulations.

(4) The change in the annual volume of groundwater in storage between seasonal high conditions.

In addition to the inflow and outflow components of the water budget, the annual change in the volume of groundwater in storage (af/yr) is required to be provided in tabular and graphical form according to water year type and the associated total annual volume of groundwater extraction for the basin. In addition, the GSP should provide some level of discussion regarding the variation between annual change of groundwater in storage versus annual changes in surface water supply, water year type, water use sector, sustainable yield and overdraft conditions (if present or potentially present).

The change in groundwater in storage is the total change in storage between seasonal high conditions, which typically occurs in the spring. It is recommended that the change in storage estimates be based on observed changes in groundwater levels within the basin. However, change in groundwater storage may also be calculated as the difference between annual inflows and outflows according to the water budget equation in Section 3, where all inflows and outflows can be reliably measured or estimated.

Similar to other water budget components, the method to quantify change in storage will likely vary depending on basin-specific conditions and available information, and include consideration of uncertainties associated with each method.

Assessment of change in storage under future water budget projections may require the use and application of a groundwater flow model. If a model is used to estimate future changes in groundwater storage, the Modeling BMP should be followed.

Changes in surface water storage (reservoirs, lakes, and ponds) will also be an important water budget component in some basins. For these basins, change in storage should be identified as change in groundwater storage and surface water storage.

The annual change in groundwater storage may also be further subdivided according to management areas, as needed, to help facilitate water budget accounting and to help demonstrate GSP substantial compliance under §355.2 of the GSP Regulations.

(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.

The GSP water budget must include an assessment of groundwater overdraft conditions. Determination of overdraft conditions requires the evaluation of current and historical water budget conditions. As described in DWR Bulletin 118, overdraft occurs when groundwater extraction exceeds groundwater recharge over a period of years, resulting in a decrease in groundwater storage.

Overdraft conditions should be assessed by calculating change in groundwater storage over a period of years during which water year and water supply conditions approximate average conditions. Overdraft conditions should be evaluated as changes in groundwater storage by water year type. For basins without an existing water year index, water year types will be developed, classified, and provided by the Department based on annual precipitation as a percentage of the previous 30-year average precipitation for the basin. Water year classifications will be divided into five categories ranging from wet, above normal, below normal, dry, to critically dry conditions.

Single-year reduction in groundwater storage during critical, dry or below normal water years may not represent overdraft conditions. Reductions in groundwater storage in above normal or wet years or over a period of average water year conditions may indicate overdraft conditions. All annual change in groundwater storage estimates from water budget accounting should be included and discussed in the GSP.

If overdraft conditions are identified, the GSP shall describe projects or management actions, including a quantification of demand reduction, increased supply or other methods, for the mitigation of overdraft, as required under §354.44(b)(2) of the GSP Regulations.

When evaluating if the GSP is likely to achieve the sustainability goal for the basin, the Department will consider whether the GSP includes a reasonable assessment of overdraft conditions and a reasonable means to mitigate overdraft as required under §354.4(b)(6) of the GSP Regulations.

(6) The water year type associated with the annual supply, demand, and change in groundwater stored.

In order for local resource managers to develop an understanding of the relationship between changing hydrologic conditions and the associated aquifer response to changing water supply, demand, and storage, the GSP water budget accounting must be reported according to water year type. Even though the GSP Regulations only require annual water budget accounting and reporting, in order for local water resource managers to adequately understand the timing and distribution of water supply and demand and to implement effective water management actions, local water budget accounting may need to be conducted on a monthly or more frequent basis. As mentioned previously in the overdraft discussion, water year types will be developed, classified, and provided by the Department for those basins not having an existing water year index. GSP water budgets detailing supply, demand, and change in groundwater stored according to water year type will help facilitate assessment of overdraft conditions and estimates of sustainable yield for the basin.

(7) An estimate of sustainable yield for the basin

Estimating sustainable yield includes evaluating current, historical, and projected water budget conditions. Sustainable yield is defined in SGMA legislation and refers to 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. 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).

TABULAR AND GRAPHICAL REPRESENTATION OF THE WATER BUDGET COMPONENTS

The water budget information is to be in tabular and graphical form. This presentation of the data may take many forms depending on the sources of water inflow and outflow to the basin and the water use sectors within the basin.

A sample water budget tabulation is illustrated in **Table 1**. **Table 1** includes a listing of required water budget components to support a complete accounting of groundwater basin inflows and outflows. Additional water budget components not explicitly listed in the Regulations may be necessary for some basins in order to adequately evaluate sustainability and to identify and evaluate projects and management actions to address undesirable results. For example, in basins where treated produced water generated from oil and gas operations is used as a source of supply, the annual volume of the produced water being applied for beneficial use should be quantified and described according to water supply type and water use sector.

Additional tables depicting a breakdown of water budget accounting by water use sector and water source type may be needed to better understand the individual supplies and demands for some basins, and the percent of total supply that is met by each water source type.

Multiple graphical depictions of the various water budget components will likely be needed to fully illustrate the water budget accounting in many basins. The graphics should include charts and maps to show the trends and spatial distribution of the various water budget components. A general graphic summarizing the inflows, outflows and change in storage by water year type will be needed to provide an understanding of the overall water balance for the basin by water year type. Graphics and tables should depict complete and separate water budgets for the basin as a whole, the surface water system, and the groundwater system by basin or management area and by water year type. In addition, more detailed maps and figures that separately depict basin inflows and outflows by water source type, water use sector, and water year will likely be needed to better understand the relationship and overall importance of the various water sources and water use sectors.

Water Year:
Water Year Type:

INFLOWS		OUTFLOWS	
Inflow Source	Volume (af/yr)	Outflow Sink	Volume (af/yr)
Surface Water Inflow\1		Surface Water Outflow\1	
Precipitation		Evapotranspiration\4	
Subsurface Groundwater Inflow	______	Subsurface Groundwater Outflow	______
Total Basin Inflow		Total Basin Outflow	
Subsurface Groundwater Inflow		Subsurface Groundwater Outflow	
Infiltration of Precipitation		Groundwater Extraction\1	
Infiltration from Surface Water Systems\2		Discharge to surface water systems\2	
Infiltration of Applied Water\3	______		______
Total Groundwater Inflow		Total Groundwater Outflow	

Change in Surface Storage Volume	
Change in Groundwater Volume	

\1 by water source type

\2 lakes, streams, canals, springs, conveyance systems

\3 includes applied surface water, groundwater, recycled water, and reused water

\4 by water use sector

Table 1 – Simple Water Budget Tabulation Example

A sample paired bar graphic illustrating balanced water budgets for both the basin and the groundwater system including the required water budget components is presented as Figure 6. Each pair of bars shows inflows on the left and outflows on the right. In this illustration, more water flows out of the basin than flows in during the water year, resulting in an annual reduction in groundwater storage.

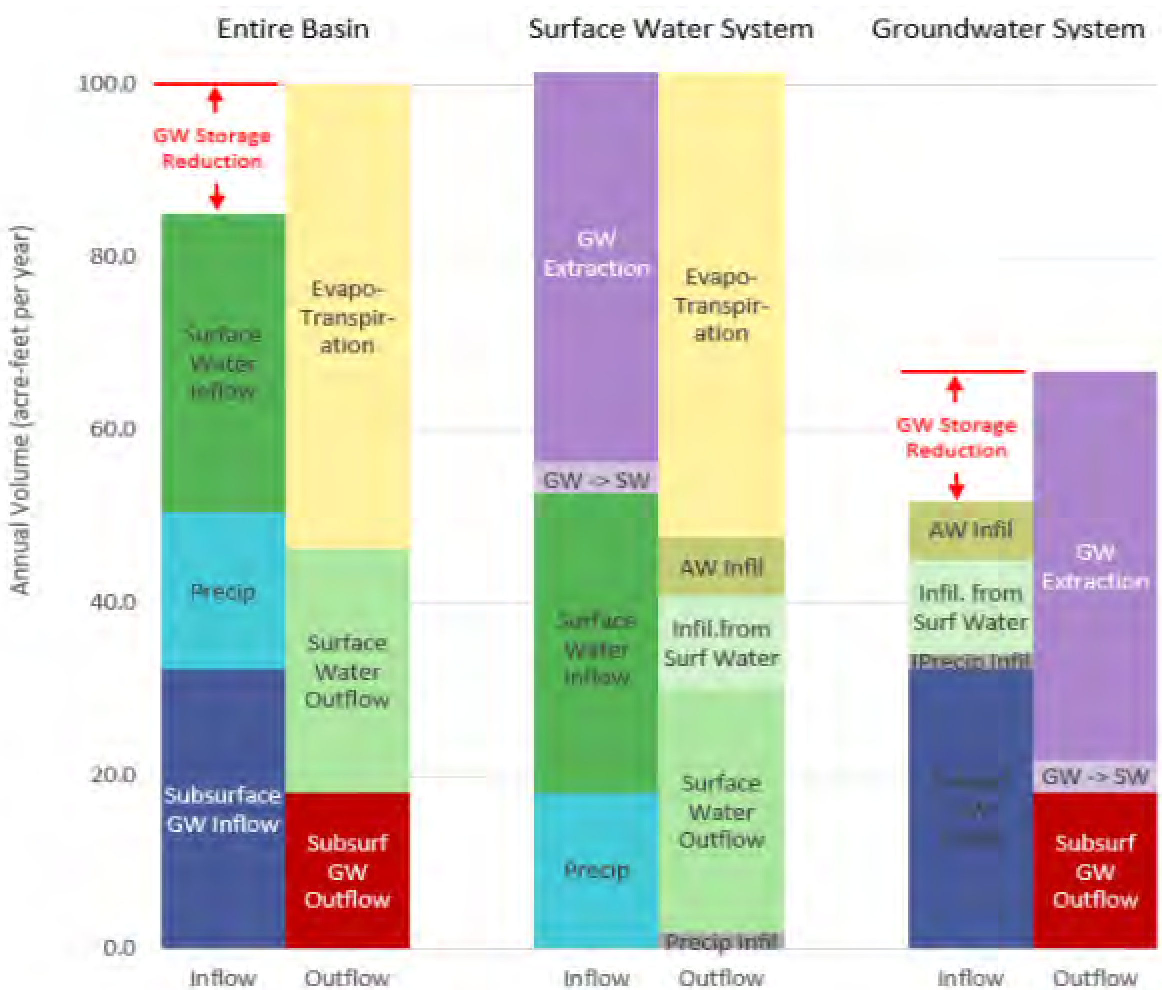


Figure 6 – Paired Bar Water Budgets

Additional graphical examples depicting water supplies and water use by water year type are provided in the Department's California Water Plan Update 2013 (Volume 1, Chapter 3, pages 3-33 - 3-40), and the California Groundwater Update 2013 (Chapter 2, pages 17-22). Online links to these reports are provided in Section 7, under Guidance and General References. Supplementary example graphics are being developed and will be provided as part of the Department's technical assistance.

An example of a detailed water budget developed by the Department as part of a pilot project to develop water budgets for future California Water Plan updates is provided in the text boxes on the following pages. The example includes hydrologic systems (e.g., the atmospheric system and land surface system) and other water budget components not explicitly required by the GSP Regulations. Conversely, the example does not explicitly include all of the water budget components required by the GSP Regulations. For example, deep percolation from the land surface to the groundwater system is included in the example, as compared to infiltration of precipitation and infiltration of applied water as required by the GSP Regulations. As discussed previously, more detailed accounting than required by the GSP Regulations, including additional components included in the example, may be necessary in some basins to adequately evaluate sustainability, and to identify and evaluate projects and management actions to address undesirable results.

Example of a Detailed Water Budget Including Additional Components Not Identified in the GSP Regulations

It may be useful in some basins to develop water budgets with additional detail not explicitly identified in the GSP Regulations. The following example, based on water budgets being developed as part of future updates of the California Water Plan, illustrates additional water budget components that may be included. **Figure 6** depicts the water budget as a combination of four hydrologic systems, including the atmospheric system, the land surface system, the river and stream system (also including conveyances and lakes and reservoirs), and the groundwater system. In contrast to the GSP Regulations, wherein the land surface system and river and stream system are, in essence, combined to form the surface water system, these systems are broken out explicitly.

Inflows and outflows to and from the user-defined area are illustrated in **Figure 7** as blue and orange arrows, while the flow of water within the user-defined area is shown as a series of purple arrows. Although not specifically depicted in **Figure 7**, the exchange of water in the root zone is included within the lower portion of the land surface system. The unsaturated zone in **Figure 7** is the portion of the subsurface that lies between the land surface system and the groundwater table, which defines the upper portion of the groundwater system. In reality, the thickness and distribution of the unsaturated zone may vary significantly according to the historical groundwater demand and water management practices in the basin. In areas with shallow groundwater conditions, the groundwater system may connect directly to the land surface system, eliminating the unsaturated zone and causing groundwater to discharge directly to the land surface through seeps, wetlands, or springs.

Short descriptions of the various water budget components within the user-defined area for the example are provided below.

River and Stream System: The river and stream system includes an accounting of water budget components for rivers and streams, lakes and reservoirs, and conveyance systems. Water budget components for the river and stream system include surface water entering and leaving the basin or user-defined area (includes imported or exported surface water), as well as the interaction of surface water with the atmospheric, land surface, and groundwater systems within the basin. **Figure 7** shows that inflows to the river and stream system may include stream flows entering into the basin, inflow from rainfall-runoff and agricultural and urban return flow contributions from the land surface system, inflow from the groundwater system, and direct precipitation to the surface water body. Outflows from the river and stream system primarily include diversions, conveyance seepage, streamflow losses to the groundwater, evaporation to the atmospheric system, and stream flows leaving the user-defined area.

Land Surface System: The land surface system includes an accounting of inflows and outflows associated with the various native and managed land use activities. It includes the exchange of water over the land surface, including the root zone, and the exchange of water with the other hydrologic systems within the user-defined area. The root zone occupies the upper portion the land surface where plants extract moisture to meet their water needs. The unsaturated zone is below the land surface system and represents the portion of the basin that receives percolated water from the root zone and either transmits it as deep percolation to the groundwater system or to reuse within the land surface system, or both. Subsurface soil and geologic conditions will help inform estimates of reuse and deep percolation.

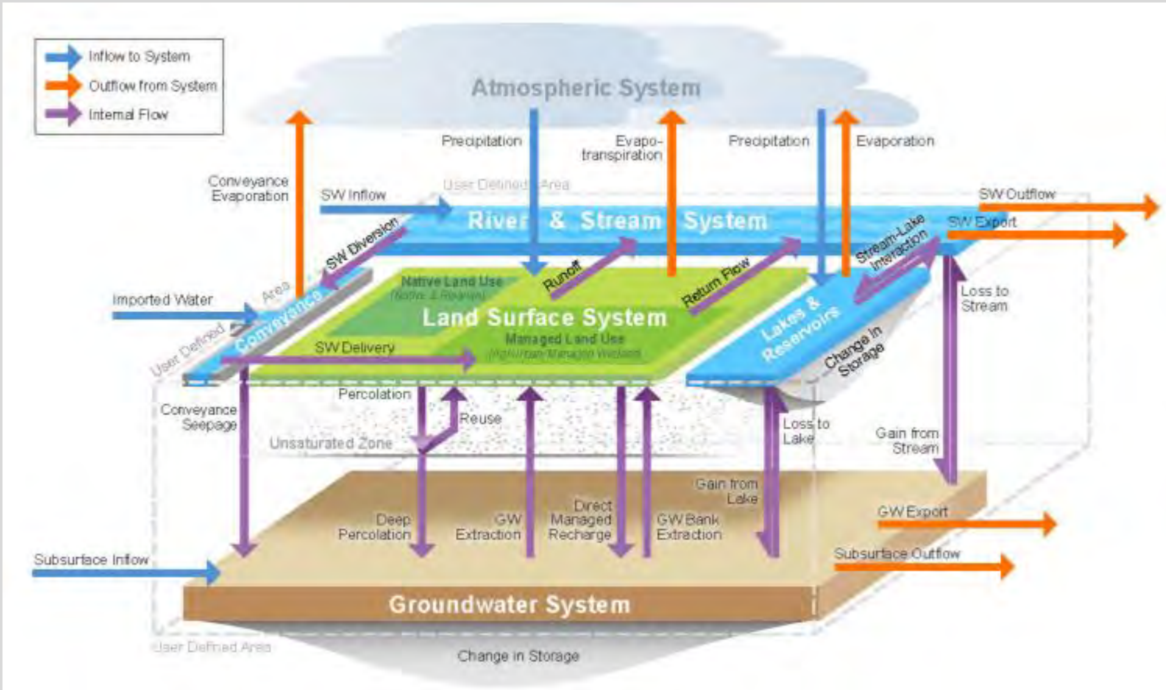


Figure 7 – Water Budget Schematic Showing the Interrelationships among Potential Water Budget Components and the Water Systems that Comprise the Hydrologic Cycle

Inflows to the land surface system may include the inflow of water from diversions from the river and stream system, groundwater extraction, direct precipitation to the land surface, and reuse of percolated water from the unsaturated zone. In areas having a high groundwater table or in locations where the subsurface geology causes outflow from the groundwater system to the land surface, inflows to the land surface system may also come from the capillary movement or direct outflow of groundwater into the land surface system through seeps, wetlands, or springs. Outflows from the land surface system include rainfall-runoff, agricultural and urban return flows to the river and stream system, percolation of precipitation of applied water and direct managed recharge to the groundwater system, and evapotranspiration to the atmospheric system.

Groundwater System: The groundwater system is represented by that portion of the user-defined area extending vertically from the base of the unsaturated zone to the definable bottom of the basin and laterally to the DWR Bulletin 118 basin boundary. In the GSP, the groundwater system will also be characterized by one or more principal aquifers and represent the physical extent of the basin that is used to quantify the annual change in volume of groundwater stored. The same three-dimensional basin should also be used for GSAs to optionally identify the volume of groundwater in storage or the groundwater storage capacity, as necessary, to assist in the determination of sustainable yield.

Inflows to the groundwater system include subsurface groundwater flow entering the user-defined area, deep percolation generated by precipitation and irrigation water infiltrating downward through the root and unsaturated zones, seepage into the aquifer from the river and stream system, and managed recharge through spreading basins or aquifer injection wells. Outflows from the groundwater system primarily include subsurface groundwater outflow leaving user-defined area, groundwater extraction from wells, and discharge to the river and stream system. Additional outflows from the groundwater system may also occur due to shallow groundwater discharge from seeps, wetlands, and springs.

In situations where groundwater rises within the root zone of the land surface system, outflows due to evapotranspiration are typically attributed to the groundwater system.

Based on the detailed water budget example, graphics and tables can be developed to depict complete and separate water budgets for the land surface system, the groundwater system, the river and stream system, and a combination of these systems. These graphics and tables can be developed by water year type for the basin as a whole, by management area, or for other user-defined areas of interest. Examples of graphics depicting water budgets over time for the basin as a whole and for the groundwater system are provided in Figure 8. In this figure, the outflows are shown to the left, and the inflows are shown on the right. Annual change in storage may be represented as an inflow or an outflow depending on whether the amount of water in storage increases or decreases during a given time period of interest. An increase in storage is represented as an outflow, while a decrease in storage is represented as an inflow.

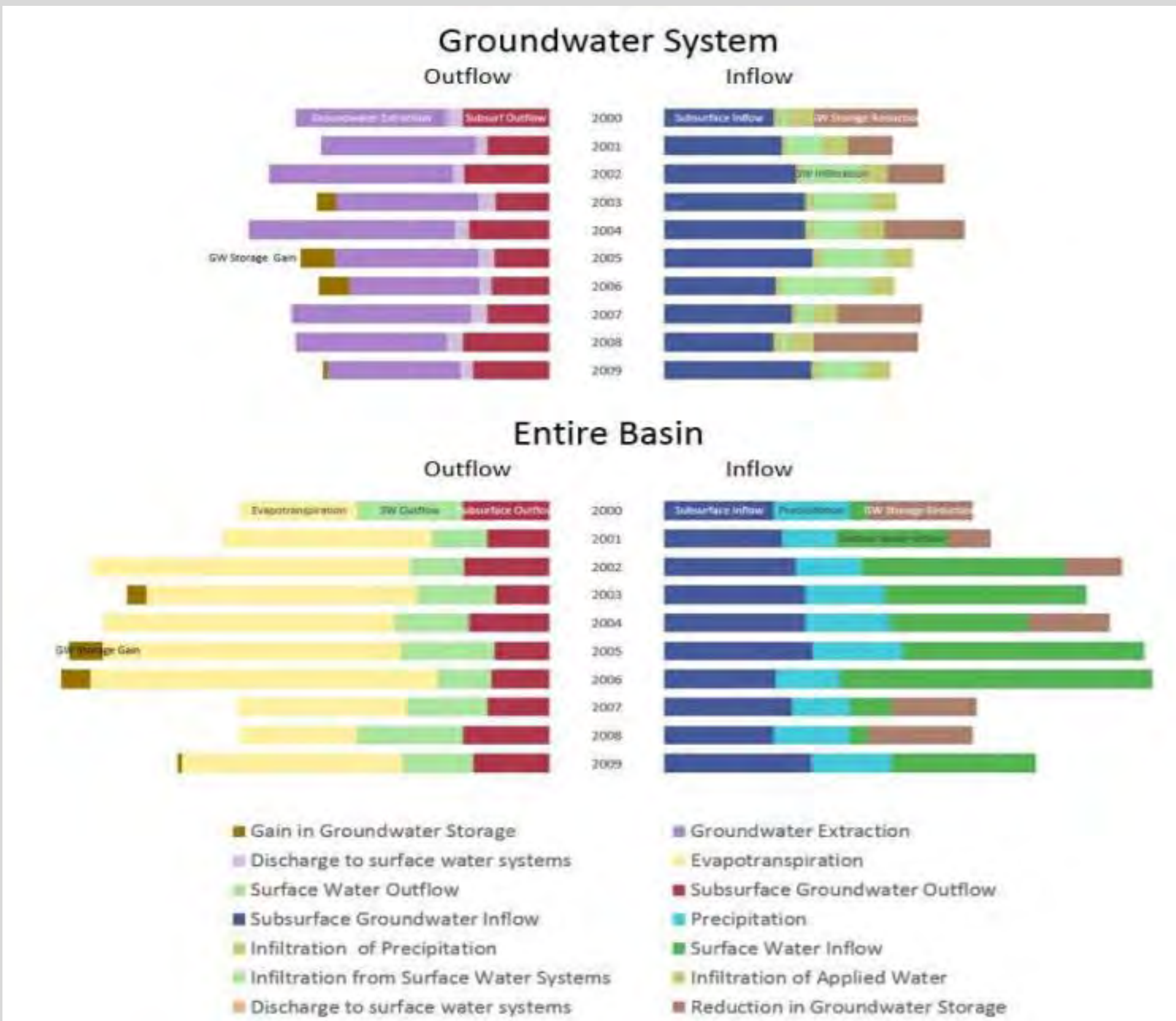


Figure 8 – Water Budget Inflows, Outflows, and Change in Storage by Water Year for Groundwater System and Entire Basin

DEFINING WATER BUDGET TIME FRAMES

23 CCR §354.18(c): Each Plan shall quantify the current, historical, and projected water budget for the basin

The GSP Regulations require a water budget for current, historical, and projected basin conditions. Descriptions of the water budget requirements are provided below.

Current Water Budget Assessment §354.18(c)(1)

The GSP is required to provide an accounting of current water budget conditions to inform local resource managers and help the Department understand the existing supply, demand and change in storage under the most recent population, land use, and hydrologic conditions. The current water budget is required to quantify all seven of the general water budget requirements listed in §354.18(b).

Historical Water Budget Assessment §354.18(c)(2)

The historical water budget accounting is required to evaluate how past water supply availability or reliability has previously affected aquifer conditions and the ability of the local resource managers to operate the basin within sustainable yield. The historical assessment is specifically required to include the following:

- Use at least the most recent ten years of surface water supply information to quantify the availability of historical surface water supply deliveries. The reliability of historical surface water deliveries is to be calculated based on the planned versus actual annual surface water deliveries, by surface water source, and water year type.
- Quantify and assess at least the most recent ten years of historical water budget information by water year type. The ten years of historical water budget information is to be used to help estimate the projected future water budgets and future aquifer response to the sustainable groundwater management projects and actions being proposed over the GSP planning and implementation horizon. The intent of the historical water budget evaluation is also to provide the necessary data and information to calibrate the tools or methods used to project future water budget conditions. Depending on the historical variability of supplies, demands, and land use; the level of historical groundwater monitoring in the basin; and the type of tool being used to estimate future projects and associated aquifer response; additional historical water budget information may be needed for adequate calibration.
- Use at least the most recent ten years of water supply reliability and water budget information to describe how the historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the local agency to operate the basin within sustainable yield. To assist in the evaluation, sustainable yield should be evaluated by water year type, as previously described in (7) An estimate of sustainable yield for the basin.

Projected Water Budget Assessment §354.18(c)(3)

The projected water budget accounting is used to quantify the estimated future baseline conditions of supply, demand, and aquifer response to GSP implementation. It is also required to evaluate and identify the level of uncertainty in the estimate, and to include historical water budget information to estimate future baseline conditions concerning hydrology, water demand and surface water supply reliability over the 50-year planning and implementation horizon. Methods used to estimate the projected water budget include the following three requirements:

- Use 50 years of historical (where available) precipitation, evapotranspiration, and stream flow information as the future baseline hydrology conditions, while taking into consideration uncertainties associated with the estimated climate change and sea level rise projections.
- Use the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demands, while taking into account future water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.
- Use the most recent water supply information as the baseline condition for estimating future surface water supply, while applying the historical surface water supply reliability identified in §354.18(c)(2) and taking into consideration the projected changes in local land use planning, population growth, and climate.

Time frames required for the evaluation of current, historical, and projected water budget conditions are illustrated graphically in Figure 9. The illustration also includes a description of data to be supplied by the Department. Additional discussion of data and data sources is provided in greater detail in subsequent sections of this BMP (Water Budget Data Resources).

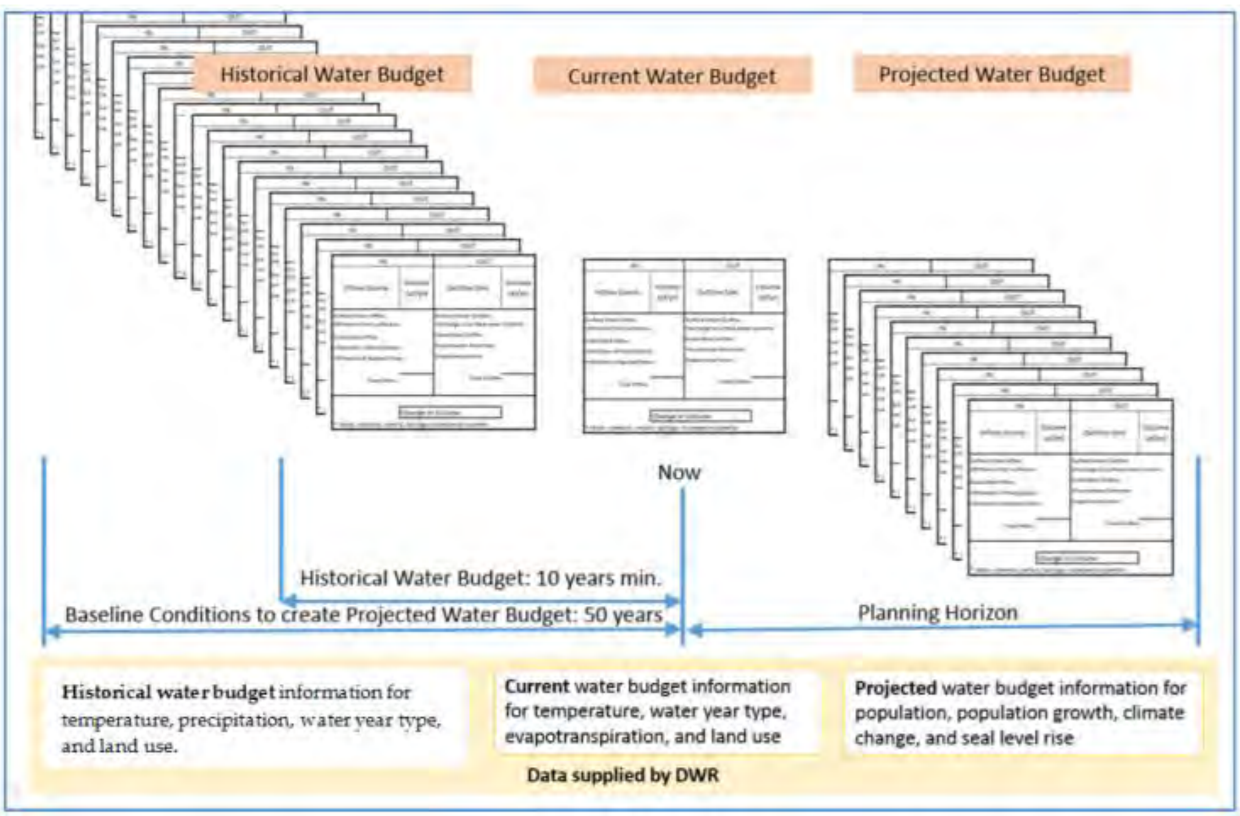


Figure 9 – GSP Water Budget Time Frames

Although the GSP Regulations only require annual quantification of the current, historical, and projected water budget information, in order to adequately assess projected water budget scenarios, GSAs may want to perform water budget accounting on a monthly or even a daily basis, especially if a groundwater model is used to compile and assess future water budget and aquifer conditions. In these situations, model results can be aggregated to annual values to support the GSP and subsequent annual reporting. Water budget accounting for shorter than annual time periods provides information necessary to support sustainable management of the basin through more timely evaluation of the water supply and demands by water use sector, of the potential undesirable results, and of the associated need for potential projects and management actions.

IDENTIFYING AND SELECTING METHODOLOGIES TO ESTIMATE WATER BUDGET COMPONENTS

As discussed above, individual components of the water budget may be estimated independently or based on estimates of other water budget components using the water budget equation. A comprehensive review of methodologies for each water budget component is beyond the scope of this BMP; however, the reader is encouraged to review water budget data resources described under Water Budget Data Resources and related materials referenced in Section 7. Selection of a methodology for a particular water budget component should consider the following:

- Whether the basin includes multiple GSAs intending to implement multiple GSPs (requires coordination agreement and description of how the same data and methodology are being used).
- How historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability to operate the basin within sustainable yield.
- Past and current approaches to quantifying water budget components in the basin.
- Alternative approaches representing the best available information and the best available science.
- Data available to support application of the methodology.
- The methods being used for GSP development in adjacent basins.
- The magnitude of the water budget component relative to other components in the basin.
- Accuracy and uncertainty associated with the methodology and supporting data

Some water budget components lend themselves to direct monitoring and measurement more than others. For example, physical processes at the ground surface, such as surface water diversion, groundwater extraction, and precipitation can be directly measured with a high degree of accuracy, certainty, and reliability using various meters, data loggers, and other readily available monitoring devices. These approaches to monitoring support utilization of the best available science, reflect industry standards, and result in defensible data that meets the uncodified finding of SGMA to collect data necessary to resolve disputes regarding sustainable yield, beneficial uses, and water rights (SGMA Uncodified Findings (b)(3)).

In contrast, other water budget components such as infiltration from surface water systems, subsurface groundwater flows across basin boundaries, and seawater intrusion into the basin cannot be measured directly and must be estimated using other approaches.

The methodologies, assumptions, and data sources used to quantify water budget components are to be documented in the GSP. Much of the information needed to quantify a component of the water budget may be available in existing planning documents and on-line data sources (see Water Budget Data Resources below).

As described in the Coordination of Water Budget Data section in this BMP, for situations where basin boundaries are adjacent or contiguous to one or more additional basins, or when a stream or river serve as the lateral boundary between two basins, it is recommended that water budget accounting in adjacent basins develop “interbasin” agreements to facilitate exchange of water budget information, as described in §357.2 of the GSP Regulations.

EVALUATING ACCURACY AND UNCERTAINTY OF WATER BUDGET COMPONENTS

Careful consideration should be given to documenting the accuracy and uncertainty of the data being used and in selecting which components are estimated independently versus estimated based on the principle of mass balance, as described above. In all cases, any components estimated based on the water budget equation (Equation 1) should be examined closely for reasonableness. For example, if past experience suggests that a typical value for infiltration of precipitation is around 5 to 10 percent of the total inflow for a given basin, but solution of the water budget equation for infiltration of precipitation results in an estimate of 50 percent of total inflow from infiltration of precipitation, additional examination of the other water budget components is warranted.

Evaluation of accuracy and uncertainty associated with individual water budget components is important because it improves understanding of the sensitivity and range of uncertainty of the various water budget components, which subsequently supports and informs development of GSP sustainable management criteria (§354.22) and projects and management actions (§354.44) that are being implemented and proposed to achieve sustainability.

WATER BUDGET DATA RESOURCES

Data resources to assist in development of a water budget will vary according to past water management studies and water resource investigations conducted in the region. However, several sources of potentially useful information were identified and are described below. These sources include data to be provided by the Department as part of technical assistance to support GSP development and sustainable water management, as well as other available sources of information.

Data Provided by the Department (§354.18(d) and (f))

Data from the Department, as available, to develop the water budget identified in the Regulations includes the following (§354.18(d) and (f)):

- **Historical Information:** Monthly minimum, maximum, and mean temperature and precipitation; water year type for areas outside the Central Valley; and Central Valley land use information.
- **Current Information:** Monthly minimum, maximum, and mean temperature; water year type; evapotranspiration, and statewide land use information.
- **Projected Information:** Population, population growth, climate change, and sea level rise.
- **Modeling Support:** The California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and Integrated Water Flow Model (IWFM).

Agencies developing a water budget may choose to use other data of comparable quality, as allowed by GSP Regulation §354.18(d). As mentioned previously, if a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions, an equally effective method, tool, or analytical model must be identified and described in the plan (§354.18(e)). A water budget completed outside of a model may be useful as part of model calibration to confirm the reasonableness of water budget produced by the model.

Climate Change and Sea Level Rise. GSP Regulations require future water budget estimates to take into consideration changing climate and sea level rise when evaluating water supply, demand, and reliability for the basin over the planning and implementation horizon. Due to the spatial and temporal complexities associated with evaluating the basin response to changing climate, land use, and proposed projects, it is anticipated that most GSAs will utilize a hydrologic model to evaluate the various potential future basin conditions. In an effort to support consistent GSP analysis of future sustainability conditions, the Department will provide GSAs with a climate change guidance document to qualify data sources and identify acceptable methods for analyzing future climate change conditions for GSP development. These datasets will be publically posted and include future condition estimates of temperature, precipitation, runoff, sea level, and projected SWP and CVP deliveries. The data will not assume implementation of the California WaterFix Program.

Additional Data and Resources

Several other data sources exist in addition to those data specifically identified in the GSP Regulations to be provided by the Department. Some of these include data available from the Department not specifically listed in the GSP Regulations. A summary of data available to support water budget development is provided in **Table 2**. The table is not intended to provide an exhaustive list of data and sources to support water budget development, but rather to provide a reference to data that may be helpful. Specific data selected to support water budget development will depend on methodologies selected to estimate water budget components.

Table 2 – Potential Data Sources to Support Water Budget Development

Data Type	Date Sources	Notes
Air Temperature	DWR, PRISM, CIMIS, NOAA, USBR	Historical and current conditions available from DWR, PRISM, CIMIS, and NOAA. Projected future conditions available from DWR and USBR.
Precipitation	DWR, PRISM, CIMIS, NOAA, NASA, USBR	Historical and current conditions available from DWR, PRISM, CIMIS, NOAA, and NASA. Projected future conditions available from DWR and USBR.
Water Year Type	DWR	
Land Use	DWR, USDA, City, County General Plans, Local Agencies	Historical and current conditions available from DWR, USDA CDL, city & county general plans, and local agencies (including county agricultural commissioners).
Evapotranspiration	DWR, CIMIS, CalSIMETAW, UCCE, ITRC-METRIC	Historical and current conditions include reference evapotranspiration, total evapotranspiration, and amount of evapotranspiration derived from applied irrigation water. Could include traditional approaches and/or satellite remote sensing approaches.
Population	DWR, State Dept. of Finance, U.S. Census Bureau, UWMPs	Historical and current conditions from Dept. of Finance, U.S. Census, and UWMPs. Projected future conditions from DWR and UWMPs.
Climate Change	DWR, USBR	May include projected temperature, precipitation, evapotranspiration, streamflows, projected project supplies, etc.
Sea Level Rise	DWR	
Applied Water	AWMPs, UWMPs, UCCE, DWR, Local Agencies	Historical and current applied irrigation water demands reported in AWMPs, UCCE publications, and DWR reports. Historical, current, and projected urban demands described in UWMPs.
Groundwater Level	DWR, USGS, Local Agencies	DWR sources include GIC and WDL.
Aquifer Thickness and Layering	DWR, USGS, Local/Regional Studies	DWR and USGS sources include C2VSIM and CVHM models and other studies. Local and regional studies and models may also be available.
Aquifer Hydraulic Conductivity	DWR, USGS, Local/Regional Studies	DWR and USGS sources include C2VSIM and CVHM models and other studies. Local and regional studies and models may also be available.
Digital Elevation Model	USGS	Utilized to estimate surface water runoff from precipitation.
Streamflow	DWR, USGS, Local Agencies	DWR sources include CDEC and WDL.

Data Type	Date Sources	Notes
Surface Water Diversions	Local Agencies, SWRCB, eWRIMS, DWR, USBR	
Municipal/Industrial Groundwater Pumping	UWMPs, Local Agencies	
Agricultural Groundwater Pumping	AWMPs, DWR, USGS, Local Agencies	
Specific Yield	DWR, USGS, Local/Regional Studies	DWR and USGS sources include C2VSIM and CVHM models and other studies. Local and regional studies and models may also be available.
Surface Soil Properties	NRCS	
Per-Capita Water Use	UWMPs, DWR, USGS, Local Agencies	
Tabled Acronyms:	AWMP – Agricultural Water Management Plan C2VSIM – California Central Valley Groundwater-Surface Water Simulation Model CalSIMETAW – California Simulation of Evapotranspiration of Applied Water Model CDEC – California Data Exchange Center CIMIS – California Irrigation Management Information System CVHM – Central Valley Hydrologic Model DWR – Department of Water Resources eWRIMS – Electronic Water Rights Information Management System GIC – Groundwater Information Center NASA – National Aeronautics and Space Administration NOAA – National Oceanic and Atmospheric Administration NRCS – Natural Resources Conservation Service PRISM –Parameter-elevation Relationships on Independent Slopes Model SWRCB – State Water Resources Control Board UCCE – University of California Cooperative Extension USBR – United States Bureau of Reclamation USDA – United States Department of Agriculture USGS – United States Geological Survey UWMP – Urban Water Management Plan WDL – Water Data Library	

Additional Data Sources

Additional sources of available information include data from State and federal agencies, research institutions, local water resource management entities, and other local data collection and sharing activities. A partial list of data sources associated with existing water resource management programs are provided below:

- Urban Water Management Plans (UWMPs) http://www.water.ca.gov/urbanwatermanagement/
- Agricultural Water Management Plans (AWMPs), http://www.water.ca.gov/wateruseefficiency/agricultural/agmgmt.cfm
- Groundwater Management Plans (GWMPs), http://water.ca.gov/groundwater/groundwater_management/GWM_Plans_inCA. cfm
- Integrated Regional Water Management Plans (IRWMPs), http://water.ca.gov/irwm/stratplan/
- Groundwater Ambient Monitoring and Assessment Program (GAMA), http://www.swrcb.ca.gov/gama/
- Irrigated Lands Regulatory Program (ILRP) http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/

A comprehensive list of all available sources of water budget data from state and federal agencies, research institutions, and local water management entities is beyond the scope of this BMP. Some additional sources of water budget-related information from select State and federal agencies are provided below.

Department of Water Resources

- Groundwater Information Center (GIC) http://water.ca.gov/groundwater/gwinfo/index.cfm
- California Statewide Groundwater Elevation Monitoring Program (CASGEM) http://water.ca.gov/groundwater/casgem/
- Water Data Library (WDL) http://www.water.ca.gov/waterdatalibrary/
- California Data Exchange Center (CDEC) http://cdec.water.ca.gov/
- California Irrigation Management Information System (CIMIS) http://wwwcimis.water.ca.gov/cimis/welcome.jsp
- Land Use Surveys: http://www.water.ca.gov/landwateruse/lusrvymain.cfm
- Groundwater –Surface Water Simulation Model: The following the Department Bay-Delta site list information for the C2VSim Central Valley GroundwaterSurface water simulation model. This same website contains additional links to the Department water budget tools such as:
    - California Central Valley Groundwater-Surface Water Simulation Model
    - http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/index_C2VSIM.cfm
    - Integrated Water Flow Model (IWFM) http://baydeltaoffice.water.ca.gov/modeling/hydrology/IWFM/index.cfm
    - Irrigation Demand Calculator (IDC) http://baydeltaoffice.water.ca.gov/modeling/hydrology/IDC/index_IDC.cfm
    - CalLite: Central Valley Water Management Screening Model http://baydeltaoffice.water.ca.gov/modeling/hydrology/CalLite/index.cfm
    - Water Resource Intergraded Modeling System (WRIMS) model engine (formally named CALSIM) http://baydeltaoffice.water.ca.gov/modeling/hydrology/CalSim/index.cfm
    - Delta Simulation Model II (DSM2) http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dsm2/dsm2.cfm

- Bulletin 118 http://water.ca.gov/groundwater/bulletin118/index.cfm
- California Groundwater Update 2013 http://www.water.ca.gov/waterplan/topics/groundwater/index.cfm
- Bulletin 160: California Water Plan Update 2013 http://www.water.ca.gov/waterplan/cwpu2013/final/index.cfm
- Bulletin 230-81: Index to Sources of Hydrologic Data http://www.water.ca.gov/waterdatalibrary/docs/historic/Bulletins/Bulletin_230/Bulletin_230__1981.pdf
- Additional DWR Data Topics http://water.ca.gov/nav/index.cfm?id=106
- Additional DWR Bulletin and Reports http://water.ca.gov/waterdatalibrary/docs/historic/bulletins.cfm

State Water Resources Control Board

- Electronic Water Rights Information Management System (eWRIMS) http://www.swrcb.ca.gov/waterrights/water_issues/programs/ewrims/
- GeoTracker https://geotracker.waterboards.ca.gov/

United States Geological Survey:

- Central Valley Hydrologic Model (CVHM) http://ca.water.usgs.gov/projects/central-valley/central-valley-hydrologicmodel.html
- Water Data Discovery: http://water.usgs.gov/data/
- Surface Water Information: http://water.usgs.gov/osw/
- Groundwater Information Pages: http://water.usgs.gov/ogw/

Additional USGS Water Budget Related Materials by Topic

Developing a Water Budget

This USGS Circular is a general reference for developing a water budget; it includes the key components of the water budget, exchanges of water between these components, and case studies of water-budget development and the use of water budgets in managing hydrologic systems. http://pubs.usgs.gov/circ/2007/1308/

Recharge Estimation

Modeling, field-based, and other methods have been used to estimate recharge. Those included here are examples of methods potentially applicable to relatively large areas. A comprehensive overview of recharge estimation methods is available in this book: https://pubs.er.usgs.gov/publication/70156906.

This USGS report is a compilation of methods and case studies for recharge estimation in the arid and semiarid southwestern U.S., including eastern and southeastern California: http://pubs.usgs.gov/pp/pp1703/index.html

Modeling of Recharge

Basin Characterization Model (BCM): developed by USGS for use in estimating natural recharge, and has been applied to all of California and other regions in the western US and internationally. This

regional water-balance model differs from rainfallrunoff models because it incorporates estimates of shallow bedrock permeability to spatially distribute in-place natural recharge across the landscape. Content on the website below describes the model and associated methods, and provides links to output datasets available for historical and future projections of climate, and to associated publications of applications. The BCM is currently undergoing revisions to further improve the accuracy of recharge estimates for California; these revisions will be completed in mid-2017.
http://ca.water.usgs.gov/projects/reg_hydro/projects/dataset.html

The Farm Process: a tool developed by the USGS to improve the estimation of recharge (and pumping) associated with irrigated agriculture. It is available in various versions of MODFLOW; the most recent version is in MODFLOW-OWHM.

- Primary documentation, Version 1: http://pubs.usgs.gov/tm/2006/tm6A17/
- Documentation of Version 2: http://pubs.usgs.gov/tm/tm6a32/
- Version 3 is in MODFLOW-OWHM: http://water.usgs.gov/ogw/modflow-owhm/

GSFLOW: a coupled ground-water and surface-water flow model developed by the USGS and based on the integration of the Precipitation-Runoff Modeling System (PRMS) and the Modular Ground-Water Flow Model (MODFLOW-2005). Features of both PRMS and MODFLOW aid in recharge estimation.
http://pubs.usgs.gov/tm/tm6d1/

SWB: a modified Thornthwaite-Mather soil-water-balance code developed by the USGS for estimating groundwater recharge. http://pubs.usgs.gov/tm/tm6-a31/

INFIL: a grid-based, distributed-parameter watershed model developed by the USGS, for estimating net infiltration below the root zone. The link below provides documentation of the model, the associated software, and examples of applications. http://water.usgs.gov/nrp/gwsoftware/Infil/Infil.html

Case Studies for Recharge Estimation using Modeling

MODFLOW: Natural recharge estimates, and uncertainty analysis of recharge estimates, using a regional-scale model of groundwater flow and land subsidence, Antelope Valley, California.
https://pubs.er.usgs.gov/publication/70155814

INFIL: Estimating spatially and temporally varying recharge and runoff from precipitation and urban irrigation in the Los Angeles Basin, California. http://dx.doi.org/10.3133/sir20165068

Geophysical Methods for Estimating Recharge

This USGS report describes many geophysical methods for investigating groundwater recharge; it includes case studies and a list of references for further information.
http://pubs.usgs.gov/pp/pp1703/app2/pp1703_appendix2.pdf

Surface-Water/Groundwater Interactions

- This USGS Circular is a general reference for groundwater and surface water, and their interdependence: http://pubs.usgs.gov/circ/circ1139/

- This USGS Circular describes the process of streamflow depletion by wells, and ways of understanding and managing the effects of groundwater pumping on streamflow: http://pubs.usgs.gov/circ/1376/
- This USGS document outlines Field Techniques for Estimating Water Fluxes Between Surface Water and Ground Water: http://pubs.usgs.gov/tm/04d02/
- This USGS document identifies methodologies for Using Diurnal Temperature Signals to Infer Vertical Groundwater-Surface Water Exchange: http://onlinelibrary.wiley.com/doi/10.1111/gwat.12459/abstract

Baseflow Analysis

- General link to USGS software associated with baseflow analysis http://water.usgs.gov/software/lists/groundwater#flow-based
- U.S. Geological Survey Groundwater Toolbox, A Graphical and Mapping Interface for Analysis of Hydrologic Data (Version 1.0)—User Guide for Estimation of Base Flow, Runoff, and Groundwater Recharge From Streamflow Data: http://pubs.usgs.gov/tm/03/b10/ and http://water.usgs.gov/ogw/gwtoolbox/

Streamflow Trend Evaluation

User Guide to Exploration and Graphics for RivEr Trends (EGRET) and dataRetrieval: R Packages for Hydrologic Data: http://pubs.usgs.gov/tm/04/a10/

Water Use

Guidelines for preparation of State water-use estimates for 2005: http://pubs.usgs.gov/tm/2007/tm4e1/

Climate-Related Analysis

HydroClimATe: Hydrologic and Climatic Analysis Toolkit: http://pubs.usgs.gov/tm/tm4a9/

BCM Time Series Graph Tool: Enabling analyses of climate and hydrology variables, including recharge and runoff, for all HUC-8 watersheds in California for historical and future climates: http://climate.calcommons.org/article/about-bcm-time-series-graph-tool

Climate Smart Watershed Analyst: Enabling analyses of climate and hydrology variables, for time series and seasonality for planning watersheds in the San Francisco Bay Area for historical and future climates: http://geo.pointblue.org/watershed-analyst/

6. KEY DEFINITIONS

The key definitions related to Water Budget development outlined in applicable SGMA code and regulations are provided below for reference.

SGMA Definitions (California Water Code §10721)

(b) "Basin" means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Water Code § 10722.

(c) “Bulletin 118” means the department’s report entitled “California’s Groundwater: Bulletin 118” updated in 2003, as it may be subsequently updated or revised in accordance with § 12924.

(r) “Planning and implementation horizon” means a 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.

(t) “Recharge area” means the area that supplies water to an aquifer in a groundwater basin.

(v) “Sustainable groundwater management” means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) “Sustainable yield” means 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.

(x) “Undesirable result” means one or more of the following effects caused by groundwater conditions occurring throughout the basin:

> (1) Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
>
> (2) Significant and unreasonable reduction of groundwater storage.
>
> (3) Significant and unreasonable seawater intrusion.
>
> (4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
>
> (5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.
>
> (6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

(y) “Water budget” means an accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

(aa) “Water year” means the period from October 1 through the following September 30, inclusive

Groundwater Basin Boundaries Regulations (California Code of Regulations §341)

(f) “Aquifer” refers to a three-dimensional body of porous and permeable sediment or sedimentary rock that contains sufficient saturated material to yield significant quantities of groundwater to wells and springs, as further defined or characterized in Bulletin 118.

(q) “Hydrogeologic conceptual model” means a description of the geologic and hydrologic framework governing the occurrence of groundwater and its flow through and across the boundaries of a basin and the general groundwater conditions in a basin or subbasin.

Groundwater Sustainability Plan Regulations (California Code of Regulations §351)

(b) “Agricultural water management plan” refers to a plan adopted pursuant to the Agricultural Water Management Planning Act as described in Part 2.8 of Division 6 of the Water Code, commencing with Section 10800 et seq.

(d) “Annual report” refers to the report required by Water Code §10728.

(e) “Baseline” or “baseline conditions” refer to historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin.

(g) “Basin setting” refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.

(h) “Best available science” refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.

(l) “Data gap” refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed.

(n) “Groundwater flow” refers to the volume and direction of groundwater movement into, out of, or throughout a basin.

(o) “Interconnected surface water” refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

(q) “Interim milestone” refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

(r) “Management area” refers to an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.

(s) “Measurable objectives” refer to 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.

(t) “Minimum threshold” refers to a numeric value for each sustainability indicator used to define undesirable results.

(aa) “Principal aquifers” refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

(ad) “Seasonal high” refers to the highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.

(ae) “Seasonal low” refers to the lowest annual static groundwater elevation that is typically measured in the Summer or Fall, and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

(af) “Seawater intrusion” refers to the advancement of seawater into a groundwater supply that results in degradation of water quality in the basin, and includes seawater from any source.

(ah) “Sustainability indicator” refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code §10721(x).

(ai) “Uncertainty” refers to a lack of understanding of the basin setting that significantly affects an Agency’s ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

(aj) “Urban water management plan” refers to a plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 et seq.

(ak) “Water source type” represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.

(al) “Water use sector” refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

(am) “Water year” refers to the period from October 1 through the following September 30, inclusive, as defined in the Act.

(an) “Water year type” refers to the classification provided by the Department to assess the amount of annual precipitation in a basin.

Bulletin 118 Definitions

“Beneficial use” of water in Bulletin 118 references 23 categories of water uses identified by the State Water Resource Control Board and are listed and briefly described in Appendix E.

"Groundwater overdraft" refers to the condition of a groundwater basin 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 water supply conditions approximate average conditions.

"Groundwater in storage" refers to the quantity of water in the zone of saturation.

"Groundwater Storage Capacity" refers to the volume of void space that can be occupied by water in a given volume of a formation, aquifer, or groundwater basin.

"Safe yield" refers to the maximum quantity of water that can be continuously withdrawn from a groundwater basin without adverse effect

"Saturated zone" refers to the zone in which all interconnected openings are filled with water, usually underlying the unsaturated zone.

7. RELATED MATERIALS

This section provides a list of related materials including associated SGMA BMPs, general references, and selected case studies and examples pertinent to the development of water budgets. For the items identified, available links to access the materials are also provided. By providing these links, DWR neither implies approval, nor expressly approves of these documents.

REFERENCES FOR FURTHER GUIDANCE

- Barlow, P.M., and Leake, S.A., 2012, Streamflow depletion by wells— Understanding and managing the effects of groundwater pumping on streamflow: U.S. Geological Survey, Circular 1376. http://pubs.usgs.gov/circ/1376/
- Chang, S.W., T.P. Clement, M.J. Simpson, and K.K. Lee. 2011. Does Sea-level Rise Have an Impact on Saltwater Intrusion, Advances in Water Resources 34:1283- 1291. http://www.mj-simpson.com/pdf/ADWR_2011.pdf
- Healy, R.W., Winter, T.C., LaBough, J.W., and Franke, L.O., 2007, Water Budgets: Foundations for Effective Water-Resources and Environmental Management. U.S. Geological Survey, Circular 1308. http://pubs.usgs.gov/circ/2007/1308/
- Loaiciga, H.A., T.J. Pingel, and E.S. Garcia. 2012. Sea Water Intrusion by Sea-level Rise: Scenarios for the 21st Century, Ground Water, 50L37-47 http://onlinelibrary.wiley.com/doi/10.1111/j.1745-6584.2011.00800.x/abstract
- Winter, T.C., Harvey, J.W., Franke, O.L., and Alley, W.M., 1998, Ground Water and Surface Water, A Single Resource. U.S. Geological Survey, Circular 1139. http://pubs.usgs.gov/circ/circ1139/#pdf
- California Water Plan Update 2013. Department of Water Resources, 2013. Volume 3. Resource Management Strategies. http://www.water.ca.gov/waterplan/cwpu2013/final/index.cfm
- California's Groundwater Update 2013, Department of Water Resources, 2013. http://www.water.ca.gov/waterplan/topics/groundwater/index.cfm

SELECTED CASE STUDIES AND EXAMPLES

- Development and Calibration of the California Central Valley GroundwaterSurface Water Simulation Model (C2VSim), Version 3.02-CG. DWR Technical Memorandum. California

Department of Water Resources (DWR) Bay-Delta Office. 2013. http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/download/C2VSim_Model_Report_Final.pdf

- Groundwater Availability of the Central Valley, California. Professional Paper 1766. USGS. 2009. http://pubs.usgs.gov/pp/1766/PP_1766.pdf
- Scott Valley Integrated Hydrologic Model: Data Collection, Analysis, and Water Budget. Final Report. University of California – Davis, Department of Land, Air, and Water Resources. 2013. http://groundwater.ucdavis.edu/files/165395.pdf
- Selected Approaches to Estimate Water-Budget Components of the High Plains, 1940 through 1949 and 2000 through 2009. Scientific Investigations Report 2011– 5183. USGS. 2011. http://pubs.usgs.gov/sir/2011/5183/pdf/sir2011-5183.pdf
- Simulated Effects of Ground-Water Withdrawals and Artificial Recharge on Discharge to Streams, Springs, and Riparian Vegetation in the Sierra Vista Subwatershed of the Upper San Pedro Basin, Southeastern Arizona. Scientific Investigations Report 2009-5207. USGS. April, 2014. http://pubs.usgs.gov/sir/2008/5207/sir2008-5207.pdf
- Evaluation of Simulations to Understand Effects of Groundwater Development and Artificial Recharge on Surface Water and Riparian Vegetation, Sierra Vista Subwatershed, Upper San Pedro Basin Arizona. Open-File Report 2012-1206. USGS. 2012. https://pubs.usgs.gov/of/2012/1206/of2012-1206.pdf\

PROFESSIONAL CERTIFICATION RESOURCES

- Professional Engineers Act: http://www.bpelsg.ca.gov/laws/pe_act.pdf
- Professional Geologist and Geophysicist Act: http://www.bpelsg.ca.gov/laws/gg_act.pdf
- Professional License Lookup: http://www.bpelsg.ca.gov/consumers/lic_lookup.shtml

Appendix L. Modeling BMP

Modeling Best Management Practice

1. OBJECTIVE

The objective of this Best Management Practice (BMP) is to assist with the use and development of groundwater and surface water models. The California Department of Water Resources (the Department or DWR) has developed a Best Management Practice for Modeling, as part of the obligation in the Technical Assistance chapter (Chapter 7) of the Sustainable Groundwater Management Act (SGMA) to support the long-term sustainability of California's groundwater basins. The SJREC GSA has reviewed and updated this BMP for inclusion in the GSP. This BMP provides technical assistance to Groundwater Sustainability Agencies (GSAs) and other stakeholders on how to address modeling requirements outlined in the Groundwater Sustainability Plan (GSP) Emergency Regulations (GSP Regulations). This BMP identifies available resources to support the development of groundwater and surface water models.

This BMP includes the following sections:

1. Objective. The objective and outline of the contents of this BMP.
2. Use and Limitations. A description of the use and limitation of this BMP.
3. Modeling Fundamentals. A description of fundamental modeling concepts.
4. Relationship of modeling to other BMPs. A description of how modeling relates to other BMPs and is a tool used to develop other GSP requirements.
5. Technical Assistance. A description of technical assistance for the development of a model, potential sources of information, and relevant datasets that can be used to further define model components.
6. Key Definitions. Definitions relevant for this BMP as provided in the GSP Regulations, Basin Boundary Regulations, and SGMA.
7. Related Materials. References and other materials related to the development of models.

2. USE AND LIMITATIONS

This BMP was developed by the Department and updated by the SJREC GSA, to provide technical guidance to GSAs and other stakeholders. Practices described in this BMP does not replace the GSP Regulations, nor does it create new requirements or obligations for GSAs or other stakeholders. In addition, using this BMP to develop a GSP does not equate to an approval determination by the Department. The SJREC GSA will use measured data and an analytical model to the greatest extent feasible. This BMP will elaborate on the use of numerical models in such instance that the SJREC GSA relies on a numerical model result as part of the GSP analysis. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2. All references to SGMA relate to California Water Code sections in Division 6, Part 2.74.

3. MODELING FUNDAMENTALS

As modified from Barnett and others (2012), a model is any computational method that represents an approximation of the hydrologic system. While models are, by definition, a simplification of a more complex reality, they have proven to be useful tools over several decades for addressing a range of groundwater problems and supporting the decision-making process. Models can be useful tools for estimating the potential hydrologic effects of proposed water management activities.

Surface water and groundwater systems are affected by natural processes and human activity. They require targeted and ongoing management to maintain surface water and groundwater resources within acceptable limits, while providing desired economic and social benefits. Sustainable groundwater management and policy decisions must be based on knowledge of the past and present behavior of the surface and groundwater system, the likely response to future changes and management actions, and the understanding of the uncertainty in those responses.

The location, timing, and magnitude of hydrologic responses to natural or human induced events depend on a wide range of factors. Such factors include the nature and duration of the event that is impacting groundwater, the subsurface properties, and the connection with surface water features such as rivers and oceans. Through observation of these characteristics, a conceptual understanding of the system can be developed.

Models provide insight into the complex system behavior and (when appropriately designed) can assist in developing conceptual understanding. Models provide an important framework that brings together conceptual understanding, data, and science in a hydrologically and geologically consistent manner. In addition, models can estimate and reasonably bound future groundwater conditions, support decisionmaking about monitoring networks and management actions, and allow the exploration of alternative management approaches. However, there should be no expectation that a single ‘true’ model exists. All models and model results will have some level of uncertainty. Models can provide decision makers an estimate of the predictive uncertainty that exists in model forecasts. By gaining a sense of the magnitude of the uncertainty in model predictions, decision makers can better accommodate the reality that all model results are imperfect forecasts and actual basin responses to management actions will vary from those predicted by modeling.

GENERAL TYPES OF MODELS AND MODELING SOFTWARE

There are various modeling approaches, methods, and software that can be used for GSP development and implementation. This section provides a general description of a few widely used types of models and the variety of software typically used for modeling. These model types are not mutually exclusive. For example, an integrated groundwater and surface water model can also be described as a numerical model.

Each GSA is responsible for determining the appropriate modeling method, software, and the level of detail needed to demonstrate that undesirable results can be avoided and the sustainability goal in each basin is likely to be achieved within 20 years of GSP implementation. A table of select, currently available, modeling codes (the model computation engine) and applications (the constructed model including inputs) is provided in Appendix A.

TYPES OF MODELS

Conceptual Models

A conceptual model is often considered the first step in understanding the groundwater flow system and developing a mathematical model. A conceptual model includes a narrative interpretation and graphical representation of a basin based on known characteristics and current management actions. Conceptual models do not necessarily include quantitative values. For more details on developing a conceptual model, please refer to the Hydrogeologic Conceptual Model (HCM) BMP.

Mathematical Models

A model that simulates groundwater flow or solute transport by solving an equation, or series of equations, that reasonably represents the physical flow and transport processes is referred to as a mathematical model. Mathematical models differ from conceptual models in that they are capable of providing quantitative estimates of the water budget components. Mathematical models are often divided into two categories: analytical and numerical models or tools.

Analytical Models and Tools

Analytical models generally require assumptions that significantly simplify the physical system being evaluated. For example, topographic boundary conditions are generally limited to simple geometric shapes in these solutions, and aquifer properties are often required to be homogeneous and isotropic. The physical configuration of the management action is also typically idealized for the purposes of analysis and, therefore, influences related to project geometry are ignored. Often only one component (a measured or simulated value or relationship) of the groundwater system is evaluated at a time, and this approach omits the evaluation of potential interactions with other components. For example, a spreadsheet could use a simple equation to estimate the aquifer drawdown in one location based on pumping at another location, without considering the potential influence on nearby streams.

However, analytical models and tools can successfully and inexpensively be employed to gain strong conceptual and general quantitative understanding of groundwater basin dynamics, which includes interactions with pumping, groundwater storage, groundwater quality, seawater intrusion, land subsidence, and interaction with surface water. The applicability of this approach is well suited to initial scoping studies, basins with simple hydrologic conditions or areas operating sustainably. This analysis may be limited when used as the only modeling tool.

Numerical Models and Tools

Numerical modeling tools are widely used in groundwater flow and transport analysis to evaluate the change to the groundwater system caused by changes in conditions due to management actions, changes in population and land use, climate change, or other factors. These numerical models allow for a more realistic representation of the physical system, including geologic layering, complex boundary conditions, and stresses due to pumping, recharge and land use demands. GSPs developed for complex basins with significant groundwater withdrawals and/or surface water - groundwater interaction may use a numerical groundwater - surface water model to demonstrate that the GSP will avoid undesirable results and achieve the sustainability goal within the basin. Several of the available modeling codes and associated applications are discussed in more detail in Appendix A.

Integrated Hydrologic Water Models

A fully integrated surface water and groundwater model refers to a suite of codes that jointly solve the numerical solutions for surface processes (such as irrigation deliveries and stream diversions), surface flows and groundwater heads together. Many models include the ability to simultaneously simulate streamflow and its interconnection with the aquifer system.

Coupled Groundwater and Surface Water Models

A coupled groundwater and surface water model uses separate models for surface water and the groundwater systems. Coupled models are set up such that the solution from one model (i.e., surface water modeling output) can be used as input into the second model (i.e., groundwater model) to solve the groundwater flow equations and to consider the stresses (boundary conditions) imposed by the surface water information.

Transport Models

Transport model codes add a layer of complexity beyond what is provided by groundwater-flow models. These models allow for the assessment of a variety of problems, including the potential migration of existing contaminant plumes due to management actions, or the changes in groundwater quality over time after a remediation project is implemented. These types of models are not as widely used for water resources planning, but need to be considered for basins in which existing contamination impairs the use of groundwater as the source of supply and/or affect other areas of the basin now or as a potential result of future management actions.

TYPES OF MODELING SOFTWARE

Groundwater modeling typically requires the use of a number of software types, including the following (modified from Barnett and others, 2012):

- The model code that solves the equations for groundwater flow and/or solute transport, sometimes called simulation software or the computational engine
- A graphical user interface (GUI) that facilitates preparation of data files for the model code, runs the model code and allows visualization and analysis of results
- Software for processing spatial data, such as a geographic information system (GIS), and software for representing hydrogeological conceptual models
- Software that supports model calibration, sensitivity analysis and uncertainty analysis
- Programming and scripting software that allows additional calculations to be performed outside of or in parallel with any of the above types of software
- A wide range of model codes to solve problems related to groundwater flow and/or transport, such as model codes that simulate farm water management, plant-water interactions, unsaturated zone flow and transport processes, stream flow processes, surface water - groundwater interactions, land subsidence, watershed processes, climate, geochemical reactions, economic water management optimization, or parameter calibration
- Software to process spreadsheets used in an analytical model.

Some software is public domain and open-source (freely available and able to be modified by the user) and some is commercial and closed (proprietary design that is only available in an executable form that cannot be modified by the user).

Some software fits several of the above categories; for example, a model code may be supplied with its own GUI or a GIS may be supplied with a scripting language. Some GUIs support one model code while others support many. Most model codes that solve the groundwater flow and/or transport equation have an integrated capability to also simulate some or many of the related processes listed above, such as surface water - groundwater interaction.

COMMON MODEL USES

The following provides a partial list of general and SGMA-related uses for models

General Uses (modified from Barnett and others, 2012)

- Improving hydrogeological understanding (synthesis of data).
- Aquifer simulation (evaluation of aquifer behavior).
- Calculating and verifying water budget components, such as recharge, discharge, change in storage and the interaction between surface water and groundwater systems (water resources assessment).
- Predicting impacts of alternative hydrological or development scenarios (to assist decision-making).
- Managing resources (assessment of alternative policies).
- Sensitivity and uncertainty analysis (to guide data collection and risk-based decision-making).
- Visualization (to communicate aquifer behavior).
- Providing a repository for information and data that influence groundwater conditions.

GSP-Related Uses

- Developing an understanding and assessment of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability to operate the basin within sustainable yield.
- Assessing how annual changes in historical inflows, outflows, and changes in basin storage vary by water year type (hydrology) and water supply reliability.
- Evaluating how the surface and groundwater systems respond to the annual changes in the water budget inflows and outflows.
- Identifying which management actions and water budget situations may result in overdraft conditions or undesirable results.
- Facilitating the estimate of sustainable yield for the basin.
- Optimizing proposed projects and management actions and evaluating the potential effects those activities have on achieving the sustainability goal for the basin.
- Evaluating future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.
- Informing monitoring requirements.
- Informing development and quantification of sustainable management criteria, such as the sustainability goal, undesirable results, minimum thresholds, and measureable objectives.
- Helping identify potential projects and management actions and optimizing their design to achieve the sustainability goal for the basin within 20 years of GSP implementation.
- Identifying data gaps and uncertainty associated with key water budget components and model forecasts, and developing an understanding of how these gaps and uncertainty may affect implementation of proposed projects and water management actions.

MODELS IN REFERENCE TO THE GSP REGULATIONS

Developing and applying models to aid in determining sustainable groundwater management results in multiple benefits to GSAs and stakeholders. Constructing and calibrating the model improves understanding of the critical processes that influence sustainability indicators within the basin. The application of the model to forecast the influence of projects and management actions on basin conditions provides a framework within which a GSA can screen and select appropriate projects and management actions that lead to the achievement of the sustainability goal for the basin. Additionally, models can play a critical role in simulating the changing climate conditions that may occur during the 50-year planning and implementation horizon required under SGMA. It should be noted that in general, groundwater and surface water models are more effective at comparing the benefits and impacts of various management strategies with respect to one another rather than predicting exact management outcomes. So while a model can assist in selecting the best alternative from a variety of options, uncertainty will still remain in the forecasted outcome of a particular alternative. Adaptive management will always be a necessary component of program implementation.

A significant consideration that must be addressed by all GSAs is whether modeling is necessary or required for developing and implementing its GSP. In most basins, the spatial and temporal complexity of the data will require some application of modeling to accurately assess the individual and cumulative effects of proposed projects and management actions on avoiding or eliminating undesirable results and achieving the basin's sustainability goal. It is each GSA's role to carefully consider if changing basin conditions and proposed projects and management actions have the potential to trigger undesirable results within the basin or in adjacent basins, and whether a model is necessary to demonstrate that the proposed projects and management actions will achieve the sustainability goal. Therefore, the use of models for developing a GSP is highly recommended, but not required. The use of a model will ultimately depend on the individual characteristics and complexity of the basin setting, the presence or absence of undesirable results, and the presence or absence of interconnected surface water systems. As stated in GSP Regulation sections §354.18 (f) and §354.28(c)(6), "if a numerical groundwater and surface water model is not used to quantify the water budget and depletions of interconnected surface water, the GSP shall identify and describe an equally effective method, tool, or analytical model to accomplish these requirements".

Similar to the question of whether models should be used during GSP development is the question of the appropriate level of model complexity. Simple models require fewer data, less complex software, and are, therefore, often less expensive, and have much shorter run times. These characteristics are advantageous when focusing on a single undesirable result. However, simple models may overlook important system components and the interconnectedness of undesirable results, and may be difficult to calibrate to historical data. Complex models can incorporate more data and professional judgment. Therefore, they often result in a more accurate representation of the groundwater system. However, complex models are more expensive and difficult to build, require more data and more technical expertise, and the complexity can lead to a false impression of accuracy; a complex model may in fact be less accurate.

Fundamentally, a good model strategy is to follow the principle of parsimony: to build the simplest model that honors all relevant available data and knowledge, while providing a reasonable modeling tool to achieve the desired decision support at a desirable level of certainty. It may be necessary to use complex models to assess certain undesirable results, and it may be possible to use simple models to assess other undesirable results.

Some guidance on what might influence model complexity is provided in the modeling considerations section of this BMP. Since significant professional judgment goes into the development of a model, two models of the same basin – even if they are built with the same model code - are likely to differ in their design and their outcome. Where multiple models exist, differences between model outcomes, after a careful assessment of the differences in model design and assumptions, may provide an important opportunity to further assess uncertainty in predicted outcomes and to further direct future data collection programs. Importantly, multiple models with differing outcomes should not be interpreted a priori as one model being (more) right and others being (more) wrong.

While models are useful and often invaluable tools for understanding a basin and predicting future basin conditions, in most cases, they are not the only available means for demonstrating that a basin has met its sustainability goal. Satisfactorily demonstrating that all undesirable results have been avoided and the sustainability goal has been met will be a function of the data collected and reported during GSP implementation.

4. RELATIONSHIP OF MODELING TO OTHER BMPS

The purposes of modeling in the broader context of SGMA implementation include:

1. Supporting the development of the water budget
2. Establishing the Sustainable Management Criteria (sustainability goal, undesirable results, minimum thresholds, and measurable objectives)
3. Supporting identification and development of potential projects and management actions to address undesirable results that exist or are likely to exist in the future
4. Supporting the refinement of the monitoring network in the basin over time

Modeling is also linked to other related BMPs as illustrated in **Figure 1**. This figure provides the context of the BMPs as they relate to logical progression to sustainability as outlined in the GSP Regulations. The modeling BMP is part of the planning step in the GSP Regulations.

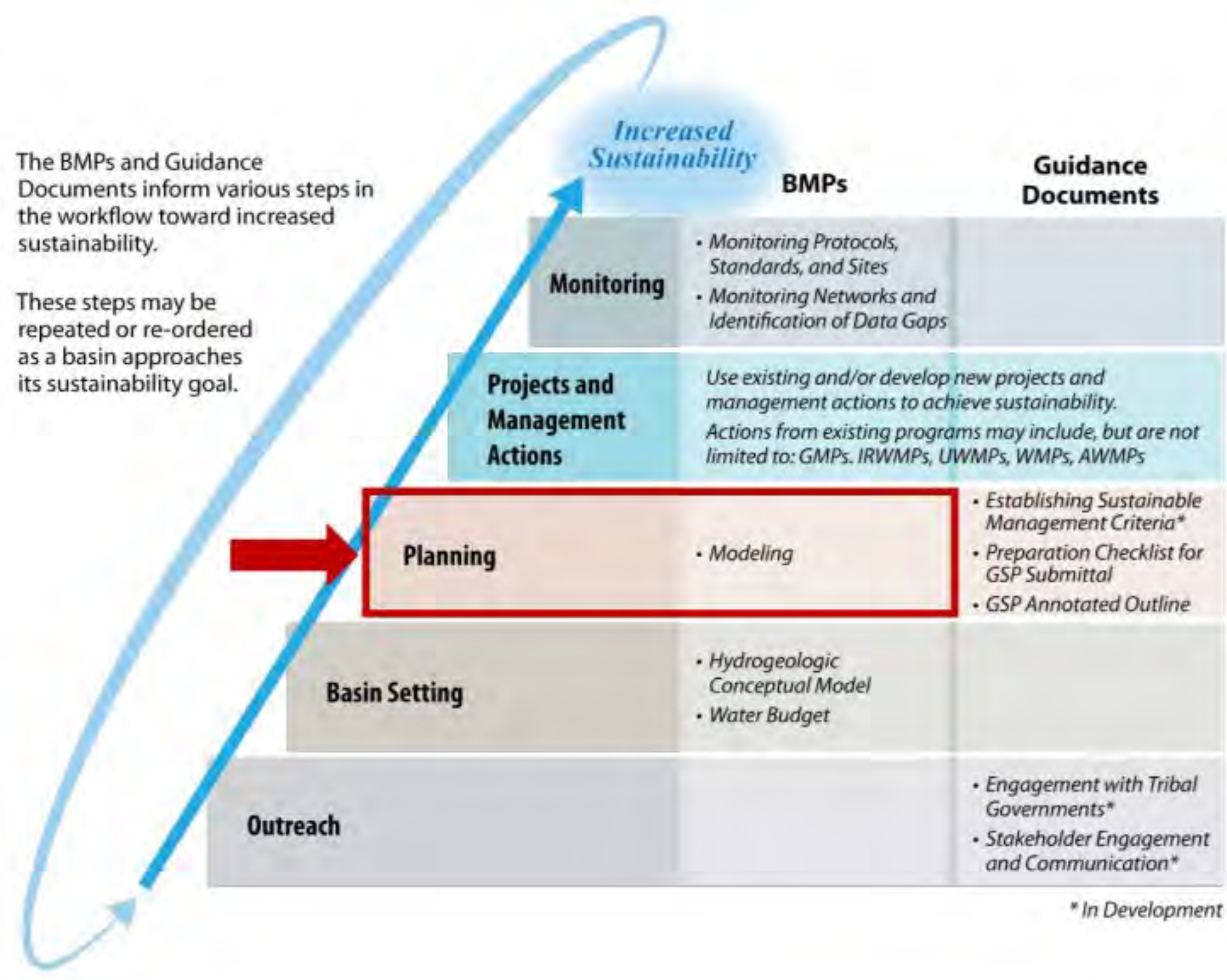


Figure 1 – Logical Progression of Basin Activities Needed to Increase Basin Sustainability

5. TECHNICAL ASSISTANCE

This section provides technical assistance and guidance to support the development of models under SGMA and the GSP Regulations, including potential sources of information and relevant datasets that can be used to develop and implement the various modeling components.

GUIDING PRINCIPLES FOR MODELS USED IN SUPPORT OF GSPS

The Department is providing the following four modeling principles to help foster SGMA's intent to promote transparency, coordination, and data sharing. They help guide GSAs in their selection and use of models for sustainable groundwater management, and expedite Department review of GSP-related modeling analysis and findings.

1. Model documentation (documentation of model codes, algorithms, input parameters, calibration, output results, and user instructions) is publicly available at no cost. In particular, the model documentation should explain (or refer to available literature that explains) how the mathematical equations for the various model code components were derived from physical principles and solved, and guidance on limitations of the model code.

2. The mathematical foundation and model code have been peer reviewed for the intended use. Peer review is not intended to be a “stamp-of-approval” or disapproval of the model code. Instead, the goal of peer review is to inform stakeholders and decision-makers as to whether a given model code is a suitable tool for the selected application, and whether there are limits on the temporal or spatial uses of the model code, or other analytic limits.

3. The GSP descriptions of the conceptual model, the site-specific model assumptions, input parameters, calibration, application scenarios, and analytical results demonstrate that the quantification of the forecasted water budget, sustainable management criteria (sustainability goal, undesirable results, minimum thresholds, and measurable objectives), proposed projects and management actions are reasonable and within the range of identified uncertainties, to evaluate the GSP-identified outcomes of sustainability for the basin.

4. If requested, provide the Department with a free working copy of the complete modeling platform (for example native MODFLOW and IWFM input files, output files, and executables) that allows the Department to run the model, create and verify results, view input and output files, or perform any other evaluation and verification.

GENERAL MODELING REQUIREMENTS

23 CCR §352.4(f) Groundwater and surface water models used for a Plan shall meet the following standards:

(1) The model shall include publicly available supporting documentation.

(2) The model shall be based on field or laboratory measurements, or equivalent methods that justify the selected values, and calibrated against site-specific field data.

(3) Groundwater and surface water models developed in support of a Plan after the effective date of these regulations shall consist of public domain open-source software.

The intent of requiring standards for models in the GSP Regulations is to promote a consistent approach to the development and coordination of models in California. This will allow the Department to evaluate these models and related GSPs within basins and between basins across the state. A description of the specific modeling standards listed in §352.4(f) is provided below.

(1) The model shall include publicly available supporting documentation.

Models used for a GSP are required to provide publicly available supporting documentation in the form of:

1. An explanation of the modeling code, the physical processes simulated by the code, associated mathematical equations, and assumptions, which are typically found in publicly available theoretical documentation, user instructions or manuals. This information should be referenced by the model developer in their documentation of the model application.

2. A description of the model application, including the construction of the model by the GSA that describes the conceptual model, simulation model development, assumptions, data inputs, boundary conditions, calibration, uncertainty analysis, and other applicable model application elements. This documentation should be a component of a GSP, and included as an appendix to characterize the technical work that went into developing and applying the model for GSP

development and implementation. The California Water and Environmental Modeling Forum (CWEMF) has developed a framework for documenting and archiving a groundwater flow model application that can be tailored for GSA use (CWEMF, 2000).

(2) The model shall be based on field or laboratory measurements, or equivalent methods that justify the selected values, and calibrated against site-specific field data.

The development of a mathematical model starts with assembling applicable information relevant to the basin or site-specific characteristics. A detailed HCM forms the basis of the model by providing relevant physical information of the aquifer and surface systems, as well as applicable boundary conditions of the basin and stressors (such as pumping and recharge). Previous field evaluations, studies and literature may provide additional data for the model development. For more sitespecific information, field testing can be performed, e.g., targeted aquifer tests to determine parameters such as hydraulic conductivity, transmissivity, and storage coefficients. In addition, field tests allow for the calibration of the model to field data. Calibration of the model should be performed by comparing simulated values to observed field data such as groundwater levels, groundwater flow directions, groundwater discharge rates, water quality concentrations, land subsidence observations, measurements of surface water and groundwater exchange, or chloride concentrations as an indicator for seawater intrusion. Additional information on these topics is provided in the modeling considerations and modeling process sections.

(3) Groundwater and surface water models developed in support of a Plan after the effective date of these regulations shall consist of public domain open-source software.

Public domain codes published through government agencies like the Department, the U.S. Army Corps of Engineers Hydrologic Engineering Center, and United States Geological Survey (USGS), are often widely distributed, relatively inexpensive, and generally accepted model codes with features that can be and have been used to simulate a wide range of hydrogeological conditions. Public domain codes, including many listed in Appendix A, have received extensive peer review, case studies document their general applicability, and their limitations have been published in the scientific literature. Many were originally developed, and are continually being refined, by government agencies such as the Department and USGS. Proprietary codes may share many attributes with public domain codes; however, the source code is not generally available for review, they require the purchase of a license to use the software, and the peer review may be limited.

The GSP Regulations require that all new models developed in support of a GSP after the effective date of the GSP Regulations (August 15, 2016) use public domain open- source software to promote transparency and expedite review of models by the Department. The requirement to use public domain open-source software allows for different agencies, stakeholders, and the Department to view input and output data, and run the model, without using a proprietary code; this requirement may help encourage collaborative actions and data sharing that could lead to increased coordination within and between basins. Models developed and actively used in groundwater basins prior to the GSP Regulations effective date can be used for GSP development and implementation, even if they do not use public domain and opensource software as shown in **Figure 2**.

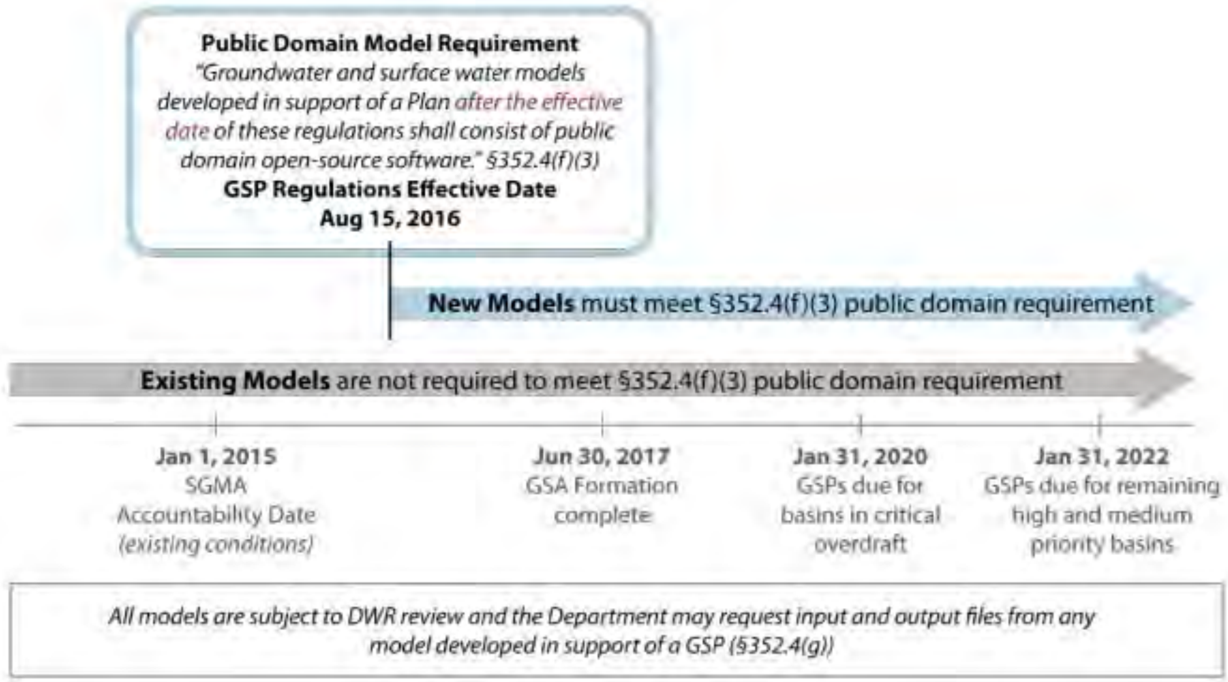


Figure 2 - GSP Regulations Effective Date and Model Development Timeline

The public domain and open-source software requirement only applies to model codes that solve the equations for groundwater flow and transport, and does not apply to other supporting software used to generate model input files or process model output data (such as Microsoft Excel, various GUIs, or GIS mapping software). In addition, the public domain and open-source software requirement does not apply to other boundary evaluation models or tools that provide input to the model or GSP, including watershed evaluation models, estimates of runoff, irrigation demand (if calculated outside the groundwater model), municipal demand (if calculated outside the groundwater model), or other related models.

23 CCR §352.4(g) The Department may request data input and output files used by the Agency, as necessary. The Department may independently evaluate the appropriateness of model results relied upon by the Agency, and use that evaluation in the Department's assessment of the Plan.

All models are subject to Department review and the Department may request input and output files from any model developed in support of a GSP, including any software-specific files.

MODELING CONSIDERATIONS

A model should be selected and developed with clearly defined objectives to provide specific information in support of developing a GSP. Examples of the GSP needs and modeling objectives that should be considered when selecting and developing a model include the following.

Addressing Sustainability Indicators

The management of each sustainability indicator poses unique technical challenges. Each GSA will need to characterize the current and projected status of each sustainability indicator in the basin, and identify the point at which conditions in the basin cause undesirable results. Models must be selected and developed that provide GSAs ample information about the future condition of each sustainability indicator relevant to the basin, and improve the GSA's ability to avoid undesirable results and achieve the Sustainability Goal in the basin.

The need to model each sustainability indicator will be specifically related to the current and potential presence and magnitude of undesirable results in the basin. As the magnitude and distribution of undesirable results increase, the complexity associated with adequately identifying appropriate projects and management actions to achieve sustainability may surpass the ability of simple analytical tools and lead towards the need to apply more complex numerical modeling techniques. Models are also tools that can help establish the Sustainable Management Criteria. Specific modeling considerations for each of the sustainability indicators are described below.

Lowering of Groundwater Levels

One of the most common effects of unsustainable groundwater management is the chronic lowering of groundwater levels. While an assessment of current and/or historical groundwater pumping on groundwater levels can be performed based on groundwater level measurements, forecasting future conditions that may differ from historical conditions will likely require the development of a model, unless the management area can show operating sustainably. All models are capable of simulating the effects of groundwater pumping on groundwater levels and, therefore, forecasts of groundwater level impacts due to basin management actions are readily available from any model of adequate detail and complexity. However in basins where surface water - groundwater interaction plays a significant role in the basin water budget, the groundwater flow model selected to forecast basin conditions resulting from management actions should be capable of accounting for the effects of pumping on streamflow. Addressing this sustainability indicator does not promote or exclude any particular models. Instead, the GSA should assess which modeling tool will provide estimates of groundwater levels at the appropriate spatial distribution to support GSP development and implementation.

Reduction of Groundwater Storage

Estimates of changes in groundwater storage volume can be computed based on observed groundwater level changes, along with knowledge of the geometry and hydraulic and hydrogeologic properties of the aquifer system. Therefore, historical changes in groundwater storage can be estimated from aquifer and groundwater monitoring data. However, forecasting future storage changes due to projects and management actions will likely require a modeling tool of some type. In addition, models are capable of providing the geographic distribution of changes in storage at specific locations. All transient groundwater and surface water models are capable of computing changes in groundwater storage within a basin due to particular management actions and, therefore, estimation of change in groundwater storage is readily available from any transient model of adequate detail and complexity. Addressing this sustainability indicator does not promote or exclude any particular model. Instead, the GSA should assess which modeling tool will provide estimates of groundwater storage changes at the appropriate spatial distribution and accuracy to support GSP development and implementation, particularly based on the types of management actions considered in the basin.

Seawater Intrusion

The Delta-Mendota Subbasin is highly unlikely to have any impacts to Seawater Intrusion. Therefore, modeling of Seawater Intrusion is not required.

Degraded Water Quality

In basins with impaired water quality, the GSP's projects and management actions could cause impaired groundwater to flow towards municipal or other water supply wells. In these basins, the model code or codes (see Appendix A) should be capable of simulating the extent and flow direction of the impaired groundwater. This could require a model with particle tracking capabilities or a model with chemical transport capabilities. To satisfy the requirement that an open-source public domain flow model code be used for all new models under SGMA, groundwater quality will likely be simulated with open source particle tracking or transport codes that can be coupled to the flow model, such as PATH3D or MT3D.

Known contaminants shall be monitored and managed to restrict the migration of contamination plumes in areas where the GSA has control over the migration.

Land Subsidence

Groundwater basins may be subject to subsidence from groundwater pumping. In these basins, the GSA should implement a model code or codes (see Appendix A) capable of accurately simulating significant groundwater level changes over time, the resulting potential for drawdown-induced subsidence, and the loss of inelastic groundwater storage due to sediment compaction. If the historical subsidence has been significant, the GSA may want to select a model code that incorporates land subsidence directly into the groundwater flow process. If the amount of historical subsidence is not significant, controlling and abating subsidence could be estimated with simpler, one-dimensional calculations that are external to the groundwater flow model.

Local expertise shall be used to determine the potential causes and possible mitigation efforts to mitigate land subsidence.

Depletion of Interconnected Surface Water

> 23 CCR §354.28 (b) The description of minimum thresholds shall include the following:
>
> (1) 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.
>
> (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 minimum threshold established for depletions of interconnected surface water shall be supported by the following:
>
> > (A) The location, quantity, and timing of depletions of interconnected surface water.
> >
> > (B) 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.

Depletion of interconnected surface water occurs when groundwater levels decline beneath a surface water system that is hydraulically connected at any point by a continuous saturated zone between the underlying aquifer and the overlying surface water system. It should be noted that there is a difference between natural occurring depletion of interconnected surface water and the depletion of interconnected surface water due to local groundwater extractions. While the GSA has no direct control over naturally occurring depletion of interconnected surface water, the GSA will monitor and manage depletion of interconnected surface water due to local groundwater extractions. The pattern of surface water depletion can be complex, both spatially and temporally, depending on the characteristics of the streambed sediments and the distribution of drawdown in the underlying aquifer system. If groundwater in a basin is in hydraulic connection with the surface water system, the selected model code or codes (see Appendix A) used to evaluate basin sustainability must be capable of accurately depicting the effects of changing groundwater levels and stream stages on the resulting depletion of interconnected surface water.

If a numerical groundwater and surface water model is not used to quantify surface water depletions, an equally effective method, tool, or analytical model must be identified and described in the GSP (§354.28(b)(6)(B)).

Developing Water Budgets

> 23 CCR §354.18 (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.
>
> (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.

Models are useful tools to develop water budgets as they have the ability to account for all inflows and outflows to the basin and estimate changes in storage over time. Specifically, a model can be used to predict water budgets at varying scales under future conditions and climate change, as well as with the inclusion of management scenarios. The Water Budget BMP includes more details on the development of surface water and groundwater budget and the associated required components.

If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions, an equally effective method, tool, or analytical model must be identified and described in the GSP (§354.18(e)).

Forecasting Future Conditions

One significant and important benefit of using a model is the computational ability to forecast and evaluate multiple basin conditions over time. Any modeling approach should be capable of readily simulating reductions in available surface water supplies, changes in land use and associated water demands, and the effects of climate change influencing meteorological conditions across the basin, and quantifying the uncertainty in these predictions.

Assessing Impacts of Potential GSP Projects and Management Actions

Each GSP must demonstrate how the selected projects and management actions will achieve the sustainability goal for the basin within 20 years of GSP implementation. Impacts on sustainability indicators from the various projects and management actions in a GSP can be best estimated by an appropriately developed and calibrated model. Model simulations can include a variety of potential projects and management actions, and identify those that appear to be successful at achieving the sustainability goal for the basin. Furthermore, the model simulations can demonstrate sustainability over the range of climatic patterns that may occur in the future. Simulations of future conditions, with or without projects, must include an assessment of prediction uncertainty about these simulated outcomes based on appropriate statistical analysis of parameter/boundary condition uncertainty during the sensitivity analysis and calibration process.

GSAs may additionally want to weigh a number of alternative strategies that can all achieve sustainability and identify those that can be implemented at the lowest cost. The selected model should be accurate and detailed enough to demonstrate the different impacts on various parties from proposed projects and management actions, and allow GSAs to choose among various alternative strategies. Formal groundwater management optimization routines are one type of tool that may be used, in conjunction with groundwater (or integrated hydrologic) models, to achieve this goal.

Identifying Data Gaps and Monitoring Needs

Models can help GSAs identify additional data that could reduce uncertainty in the GSP development and implementation. Models can perform a large number of simulations, each with a different set of hydrogeologic parameters, to assess: 1) which parameters have the greatest sensitivity on model estimates of key sustainability indicators, and 2) the magnitude of variability imparted in model forecasts of sustainability due to the level of uncertainty in the value of key model parameters. Results from a model's uncertainty analysis can be used to prioritize data collection activities according to which parameters are most influential on various sustainability indicators. For example, if modeling results indicate that achieving sustainability is heavily dependent on infiltration of surface water, it will be important to focus characterization activities on better understanding the rate and variability of surface water infiltration, and what actions influence these processes. In addition, focused field studies to estimate the physical values of associated model parameters, such as the streambed hydraulic conductivity for groundwater and surface water exchange, are valuable.

Uncertainty analysis can provide useful input in the following areas:

- Prioritization of data collection efforts to target key basin characteristics driving the potential for undesirable results with the goal of reducing the level of remaining uncertainty.
- The selection of a reasonable margin of operational flexibility in specifying measurable objectives, minimum thresholds, and proposed projects and management actions (allowable surface water diversions, pumping quantities, etc.).
- A platform for integrating the uncertainty of the effects of climate change and sea-level rise on sustainable basin operations.

Assessing Impacts on Adjacent Basins

Coordination of modeling efforts between adjacent basins is critical in assessing the current understanding of the basin inflows and outflows, and evaluating the potential effects from projects and management actions in one basin on adjacent basins. For example, boundary heads and flows computed by different models or methods needs to be checked for consistency. Boundary conditions and general parameter values for adjacent models are expected to be consistent. Interagency coordination agreements, as required under the GSP Regulations (§357.4), stress the importance of basin-wide planning and modeling. Interbasin agreements are optional, but are recommended in the GSP Regulations (§357.2) to help with establishing a consistent understanding of basin conditions across adjacent basins, and to aid in development of models with consistent assumed properties and boundary conditions. Items that may be affected and need to be coordinated among adjacent basins relate to existing undesirable results, basin sustainability goals, water budgets, minimum thresholds and measurable objectives, and general land use plans.

Model Adaptability

Modeling to support sustainable groundwater management is an ongoing effort. The initial model developed to support a sustainability assessment must be based on the best available information, the level of expert knowledge about the basin, and the best available science at the time of model development. As new data are collected and an improved understanding of the basin is developed over time, through either additional characterization, monitoring efforts, or both, the predictive accuracy of the model (or models) should be improved through a refinement of the underlying model assumptions (aquifer properties, stratigraphy, boundary conditions, etc.), as well as more robust calibration due to a larger database of calibration targets (groundwater levels, surface water flows, a more robust climatic dataset, etc.). The model selected to provide long-term support of a groundwater basin should be able to adapt to refined hydrogeologic interpretations and incorporate additional data.

Incorporating model adaptability allows a GSP to start with relatively simple models, and add complexity over time. It may be beneficial to initially defer to simple yet adaptable models. As the amount of information and expert knowledge about a basin increases, complexity can be added to these simple models to reduce the amount of predictive uncertainty.

Spatial Extent of the Model and Model Boundaries

A single GSP or multiple GSPs with a coordination agreement must be developed for an entire basin. Therefore, to predict whether undesirable results currently exist or may occur in the future, the model should at a minimum cover the entire basin. For some sustainability indicators, such as changing groundwater levels causing depletions of interconnected surface water, the model boundaries may need to extend beyond the basin boundary to accurately simulate the effects of pumping. Additionally, the model must be capable of evaluating whether the basin's projects and management actions adversely affect the ability of adjacent basins to implement their Plan or achieve and maintain their sustainability goals over the planning and implementation horizon. Important areas of consideration that may call for an expanded model domain are: 1) the ability to simulate the magnitude and variability in the exchange of groundwater and surface water systems between a basin of interest and adjacent groundwater basins; and 2) the ability to simulate boundary conditions that may lie outside of the basin of interest, but still have an influence on the water budget of the basin under consideration. In many cases, the model needs to be large enough to encompass the entire area affected by the GSA's groundwater activities such as pumping and recharge projects that the model is intended to assess.

Regional scale models may not always be appropriate for basin management because the model grid might be too coarse to accurately assess local sustainability indicators. However, in these cases regional scale models can be used as a basis for basin-wide models. Regional models can provide boundary conditions that can be implemented into basin-wide models. Alternatively, fine grid models can be nested into regional models. This can be done by either locally refining the mesh structure of a regional model, or using tools such as the Telescopic Mesh Refinement (TMR) or Local Grid Refinement (LGR) packages.

Data Availability

The availability of basin-specific information may influence model selection and construction. Basins with a large amount of data may support a more complex modeling platform than a basin with a paucity of available data. However, the complexity of the model should be based on the surface water and groundwater use and potential issues in the basin. Hydrologic processes that may affect SGMA undesirable results also need to be considered for model development.

Importance of Land Use Practices in Agricultural Basins

It is important that models developed for basins with significant agricultural water use be responsive to changes in agricultural practices. These changes may entail changes in crop types, irrigation practices, irrigation water source, or other changes related to land use practices. Some model codes, such as the Department Integrated Water Flow Model (IWFM) and the USGS' One Water Hydrologic Model (OWHM) explicitly simulate the effects of changing agricultural practices and surface water uses. Agricultural practices may also be addressed in model pre-processors such as GIS tools or spreadsheets for other model codes.

Model Results Presentation

Models are important tools that can aid with stakeholder engagement and common understanding of the basin, as well as the establishment of sustainable management criteria, and projects and management actions, through the presentation of outputs in graphical and mapping formats. Using model results in coordination with HCM graphical representations provides a means of communication with interested parties in the basin by providing detailed basin information. Where multiple models exist, an informed comparison to results from other models may be useful to confirm results or identify potential additional uncertainties.

Models developed for management support should provide clear information to decision makers, and must be capable of efficiently and effectively conveying simulation output in a format that is understandable by a wide variety of stakeholders with varying levels of technical expertise.

GUIs are commercially available for different types of model codes. These GUIs, in addition to other commonly used software, such as Microsoft Excel and ESRIs software, are powerful tools to help with processing data into model input formats, more efficiently run models, and provide a platform to visualize model outputs and create figures for stakeholder communication and reporting needs. These GUIs are not part of the model code itself, but are an external software that can be used to make the modeling process more streamlined. Therefore, GUIs do not fall under the “public domain and open source” definition that the model codes need to adhere to per the GSP Regulations.

THE GROUNDWATER MODELING PROCESS

Modeling depends on and reflects the judgement and experience of the groundwater modeler(s). There is no formula or discrete set of steps that will ensure that a model is accurate or reliable. However, there are recommended steps and protocols that groundwater modelers should follow. The general steps are shown graphically in **Figure 3**, and discussed below.

1**. Establish the model's purpose and objectives.** Models generally cannot reliably answer all questions about groundwater behavior. For the purposes of SGMA, the GSA should assess which sustainability indicators need to be simulated by the model (or models), and develop the model purpose to address these. GSAs should also establish protocols at this stage for where the model will be housed, how the model will be updated, and the terms of model use by various GSA members. Stakeholder input is an important component of model development; specifically, during the early planning phase of model development when the purpose and objectives of the model are being considered and near the end of the modeling process when various modeling scenarios are being considered.

2. **Collect and organize hydrogeologic data.** The amount of available data and accuracy of available data will drive the complexity and detail included in both the conceptual model and mathematical model. All GSA members should, to the degree possible, provide data of similar accuracy and completeness to ensure that the entire model reflects a similar level of data density and integrity. Raw data collected as part of the basin setting and HCM development should be organized at this stage. Once these data are organized into a database, they are processed into input files for modeling, with specific file formats as required by the chosen code. As an example, the Central Valley Hydrologic Model (CVHM) website has a framework for the organization of the raw data with links to the data sources, as well as related GIS shapefiles and CVHM input files of the processed data (http://ca.water.usgs.gov/projects/central-valley/central-valleyspatial-database.html).

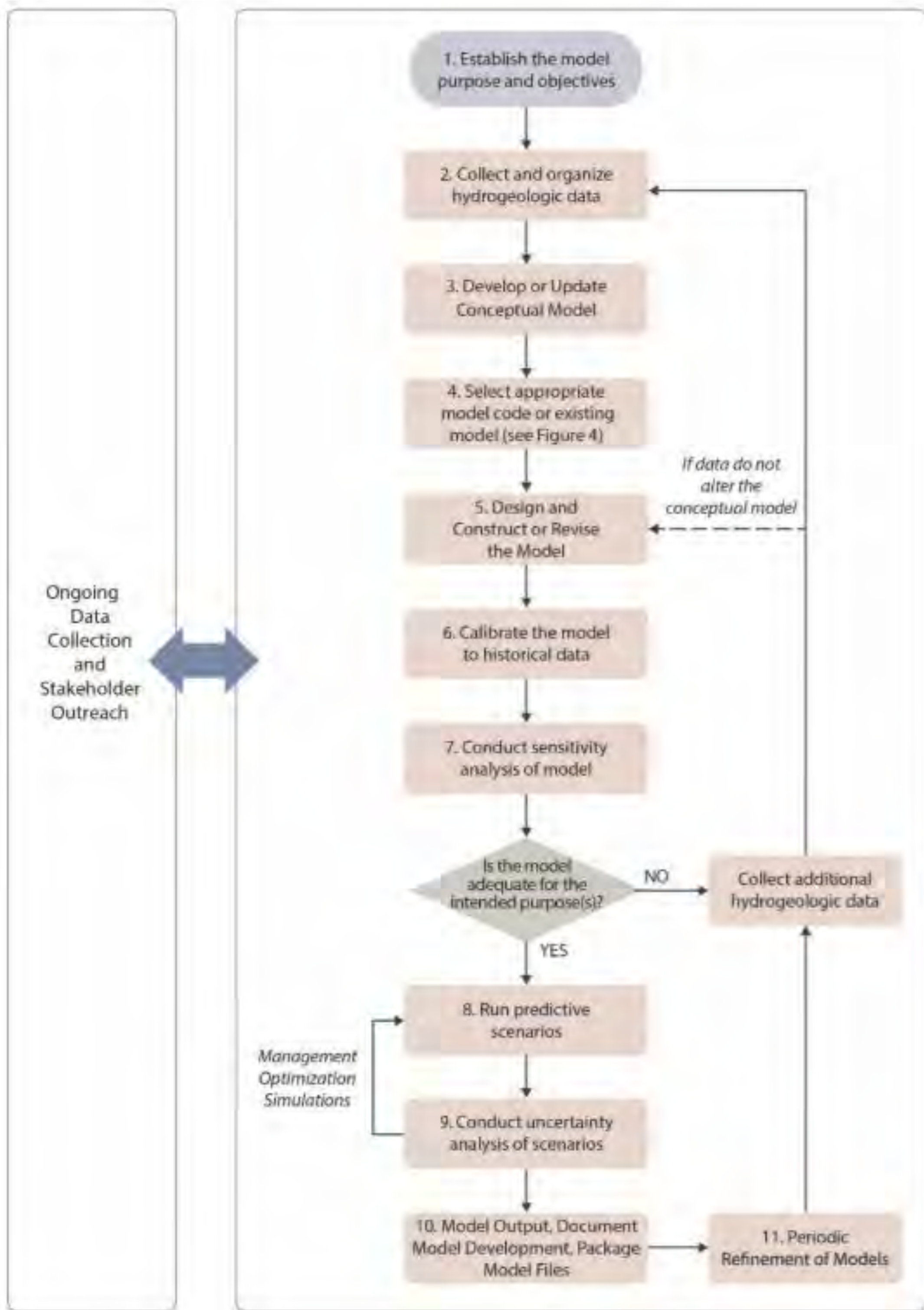
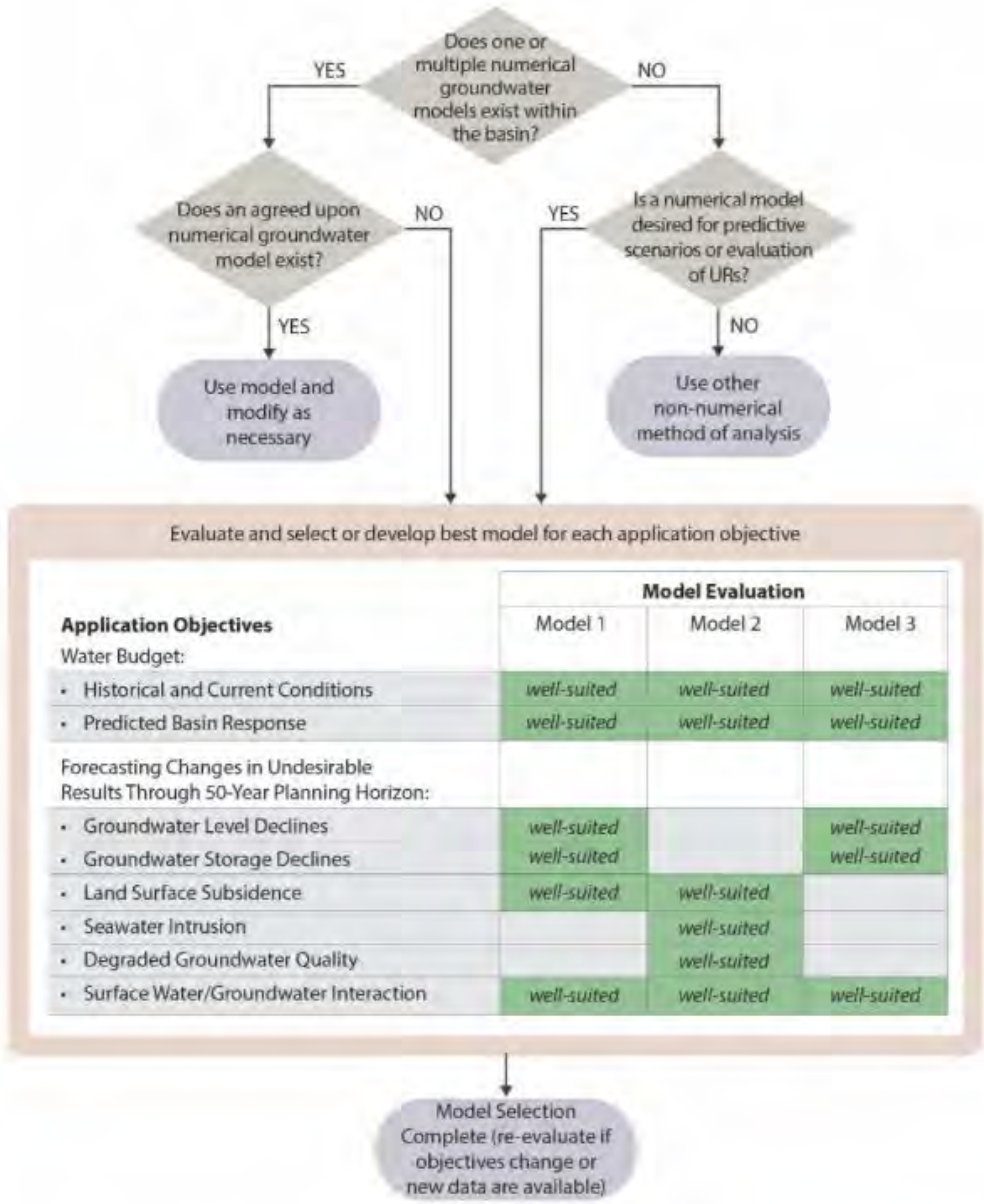


Figure 3: General Modeling Process

3. **Develop a conceptual model of the basin.** The conceptual model forms the structural, hydrogeologic, and hydrologic basis of the mathematical (analytical or numerical) model. The conceptual model identifies the key parameters of physical setting, aquifer structure and range of aquifer parameters, hydrologic processes, and boundary conditions that govern groundwater and surface water occurrence within the basin. The conceptual model provides the technical foundation of the model and an initial interpretation of a basin based on known characteristics and current management actions. In addition to aquifer characteristics and groundwater management activities, the conceptual model includes a conceptual understanding of the surface features, water uses, land uses, water management activities, and any other processes in the basin that affect surface and groundwater uses. Although a conceptual model does not necessarily include quantitative values, it should identify the range of reasonable parameter values for the aquifer materials that occur in the basin and that reflect the scale of the model. A sound and well-developed conceptual model is essential to the development of a reliable mathematical model. For more details on developing a hydrogeologic conceptual model, please refer to the HCM BMP.

4. **Select the appropriate model code or existing model.** The selected model code or existing model must be able to simulate all the processes that might significantly influence the various sustainability indicators. However, modelers should practice pragmatism and avoid unnecessary model complexity. In many basins, there may be one or multiple existing models already in use. It is preferable to avoid competing models that perform similar functions in a single basin. The GSA should compare existing models and decide if one of these models is better suited for GSP development and implementation. If multiple models are used in a basin, GSAs should consider the potential overlap and differences between the models, and how the different model results could inform management uncertainty.

Figure 4 provides a flowchart that may aid in the comparison and selection of an appropriate model if multiple models exist in a basin and GSAs opt to use a single model. In addition, two interactive maps of a select number of existing, available, model applications in California are available at the following links (DWR – http://www.water.ca.gov/groundwater/MAP_APP/index.cfm ; USGS – http://ca.water.usgs.gov/sustainable-groundwater-management/californiagroundwater-modeling.html).



Application Objectives	Model Evaluation: Model 1	Model 2	Model 3
Water Budget:			
• Historical and Current Conditions	well-suited	well-suited	well-suited
• Predicted Basin Response	well-suited	well-suited	well-suited
Forecasting Changes in Undesirable Results Through 50-Year Planning Horizon:			
• Groundwater Level Declines	well-suited		well-suited
• Groundwater Storage Declines	well-suited		well-suited
• Land Surface Subsidence	well-suited	well-suited	
• Seawater Intrusion		well-suited	
• Degraded Groundwater Quality		well-suited	
• Surface Water/Groundwater Interaction	well-suited	well-suited	well-suited

Figure 4: Generalized Model Selection Process
Note: Selected model needs to adhere to the public domain open source requirements.

5. Design and construct (or revise) the model. In this step, the conceptual model developed in step three is implemented in the selected model code. This step includes constructing the model grid, populating the model with hydrogeologic parameters, assigning boundary conditions, and adding water budget components to the model. Models should maintain simplicity and parsimony of hydrogeologic parameters, while simultaneously simulating the important hydrogeologic details that will drive basin sustainability.

6. Calibrate the numerical model to historical data. Model calibration is required by the GSP Regulations (§352.4(f)(2)). Calibration is performed to demonstrate that the model reasonably simulates known, historical conditions. Calibration generally involves iterative adjustments of various model aspects until the model results match historical observations within an agreed-to tolerance. Hydrogeologic parameters such as hydraulic conductivity, specific yield and leakance coefficients are often modified during model calibration. However, adjustment of parameter values must be constrained within the range of reasonable values for the aquifer materials identified in the conceptual model. Aspects of the water budget, such as recharge rate or private pumping rate, may also be modified during calibration.

One of the primary values of model calibration is to identify problems in the hydrogeologic conceptual model. If a model fails to reproduce observed data, then the representation of the conceptual model in the numerical model contains inaccuracies. While the ability to achieve an acceptable calibration does not necessarily prove that a model is a good representation of the physical system, difficulties encountered during calibration can help identify areas where the conceptualization of the physical system is lacking and more data may be needed to improve the model conceptualization.

No model is perfectly calibrated, and establishing desired calibration accuracy a priori is difficult. One criteria that could be considered is whether additional calibration would change a GSA's approach to achieving sustainability. If a more accurate model does not change the decision a GSA would make, then additional calibration is not necessary. The USGS has published calibration guidelines (Reilly and Harbaugh, 2004), and other modeling guidelines exist to help estimate calibration adequacy. For example, the correlation coefficient between the simulated and observed groundwater elevations, for instance, can be used as a statistic to determine how well a model is calibrated. "Generally, a value of R that is greater than 0.90 indicates that the trends in the weighted simulated values closely match those of the weighted observations" (Hill and Tiedeman, 2007).

7. Conduct sensitivity analysis of the model. The model calibration process typically includes or is followed by a sensitivity analysis to identify parameters or boundary conditions to which model forecasts are particularly sensitive. Parameters that are both highly sensitive and poorly constrained may be good candidates for future data collection. Sensitivity analysis provides a measure of the influence of parameter uncertainty on model predictions. By systematically varying parameter values within reasonable ranges, GSAs can assess how sensitive the calibrated model is to uncertainty in these parameters, and where future data collection efforts could be focused. This step of the modeling process can also help to determine whether the calibrated model can conduct required simulations with the desired level of accuracy.

8. Develop and run predictive scenarios that establish expected future conditions under varying climatic conditions, and implementing various projects and management actions. Predictive scenarios should be designed to assess whether the GSP's projects and management actions will achieve the sustainability goal, and the anticipated conditions at five-year interim milestones. Predictive scenarios for the GSP should demonstrate that the sustainability goal will be maintained over the 50-year planning and implementation horizon.

9. Conduct an uncertainty analysis of the scenarios. This is to identify the impact of parameter uncertainty on the use of the model's ability to effectively support management decisions and use the results of these analyses to identify high priority locations for expansion of monitoring networks. Predictive uncertainty analysis provides a measure of the likelihood that a reasonably constructed and calibrated model can still yield uncertain results that drive critical decisions. It is important that decision makers understand the implications of these uncertainties when developing long-term basin management strategies. As discussed in other sections of this BMP, this type of analysis can also identify high-value data gaps that should be prioritized to improve confidence in model outputs, and yield a tool that has an increased probability of providing useful information to support effective basin management decisions. A formal optimization simulation of management options may be employed, taking advantage of the predictive uncertainty analysis to minimize economic costs of future actions, while meeting regulatory requirements at an acceptable risk level.

10. Model output, document model code and model application development, and package model files. Model data outputs are used for GSP development and analysis of sustainability indicators and inform proposed management actions. The GSP needs to include documentation on the modeling tools used for GSP development. This documentation can be provided in the form of a technical appendix to the GSP and should include both information on the model code (i.e., referenced from user manuals) and detailed descriptions of the model application development. Model code information should include an explanation of the model code, associated mathematical equations, and assumptions, which are typically found in publicly available theoretical documentation, user instructions or manuals. This information should be referenced by the model user in their documentation of the model application. The description of the model application should include detailed information on the model conceptualization, assumptions, data inputs, boundary conditions, calibration, sensitivity and uncertainty analysis, and other applicable modeling elements such as model limitations. In addition, final model files used for decision making in the GSP should be packaged for release to the Department.

11. Revise and refine model regularly during implementation. After GSP development and during the implementation of the GSP, new data will be available through monitoring and collection from local agencies. As new data are made available through annual updates and the 5-year review process, models can be updated and refined. These new data will be useful for regular model updates and recalibration to reduce model uncertainties and better assess the future effects of management actions on the basin's sustainability indicators.

6. KEY DEFINITIONS

The key definitions related to surface water and groundwater modeling outlined in this BMP are provided below for reference.

SGMA Definitions (California Water Code §10721)

- "Basin" refers to a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Chapter 3 (commencing with Section 10722).

- “Coordination agreement” means a legal agreement adopted between two or more groundwater sustainability agencies that provides the basis for coordinating multiple agencies or groundwater sustainability plans within a basin pursuant to this part.
- “Condition of long-term overdraft”: The condition of a groundwater basin where the average annual amount of water extracted for a long-term period, generally 10 years or more, exceeds the long-term average annual supply of water to the basin, plus any temporary surplus. Overdraft during a period of drought is not sufficient to establish a condition of long-term overdraft if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
- “Groundwater” refers to water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.
- “Groundwater recharge” refers to the augmentation of groundwater, by natural or artificial means.
- “Planning and implementation horizon” means a 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.
- “Sustainability goal” means 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.
- “Sustainable groundwater management” means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.
- “Sustainable yield” means 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.
- “Undesirable result” refers to: One or more of the following effects caused by groundwater conditions occurring throughout the basin:
    - 1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
    - 2. Significant and unreasonable reduction of groundwater storage.
    - 3. Significant and unreasonable seawater intrusion.
    - 4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
    - 5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
    - 6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

- "Water budget" is an accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.
- "Water year" refers to the period from October 1 through the following September 30, inclusive

Groundwater Basin Boundaries Regulations (California Code of Regulations §341)

- "Hydrogeologic conceptual model" is a description of the geologic and hydrologic framework governing groundwater flow through and across the boundaries of a basin and the general groundwater conditions in a basin.

Groundwater Sustainability Plan Regulations (California Code of Regulations §351)

- "Basin setting" refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.
- "Best available science" means the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision that is consistent with scientific and engineering professional standards of practice.
- "Best management practice" refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.
- "Data gap" refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed.
- "Groundwater flow" refers to the volume and direction of groundwater movement into, out of, or throughout a basin.
- "Interconnected surface water" refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.
- "Interim milestone" refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.
- "Measurable objectives" refer to 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.
- "Minimum threshold" refers to a numeric value for each sustainability indicator used to define undesirable results.
- "Plan implementation" refers to an 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.
- "Sustainability indicator" refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).
- "Uncertainty" refers to a lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and

management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

7. RELATED MATERIALS

The following links provide examples, standards, and guidance related to modeling. By providing these links, the Department neither implies approval, nor expressly approves of these documents.

STANDARDS

- ASTM D5718-95: Standard Guide for Documenting a Groundwater Flow Model Application.
- ASTM D5880-95: Standard Guide for Subsurface Flow and Transport Modelling.
- ASTM D5981-96: Standard Guide for Calibrating a Groundwater Flow Model Application.

REFERENCES FOR FURTHER GUIDANCE

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Barnett B., L.R. Townley, V. Post, R.E. Evans, R.J. Hunt, L. Peeters, S. Richardson, A.D. Werner, A. Knapton, and A. Boronkay, 2012. Australian groundwater modelling guidelines, National Water Commission, Canberra, June, 191 p. http://archive.nwc.gov.au/library/waterlines/82

Brush, C.F., and Dogrul, E.C. June 2013. User Manual for the California Central Valley Groundwater-Surface Water Simulation Model (C2VSim), Version 3.02-CG.

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Harter T. and H. Morel-Seytoux, 2013. Peer Review of the IWFM, MODFLOW and HGS Model Codes: Potential for Water Management Applications in California's Central Valley and Other Irrigated Groundwater Basins. Final Report, California Water and Environmental Modeling Forum, August 2013, Sacramento. http://www.cwemf.org

Hill M.C. and C.R. Tiedeman. 2007. Effective Groundwater Model Calibration: With Analysis of Data, Sensitivities, Predictions, and Uncertainty. Wiley. 480 pages. January.

Merz, S.K. 2013. Australian groundwater modelling guidelines: companion to the guidelines, National Water Commission, Canberra, July, 31 p. http://archive.nwc.gov.au/library/waterlines/82

Moran, T., 2016. Projecting Forward, A framework for Groundwater Model Development Under the Sustainable Groundwater Management Act. Final Report, Stanford, Water in the West, November 2016. http://waterinthewest.stanford.edu/publications/groundwater-model-report

Murray–Darling Basin Commission (MDBC) 2001, Groundwater flow modelling guideline, report prepared by Aquaterra, January 2001.

Peralta, R., 2012. Groundwater Optimization Handbook: Flow, Contaminant Transport, and Conjunctive Management 1st edition. Boca Raton, Florida, 474 p.

Reilly, T.E., 2001. System and boundary conceptualization in groundwater flow simulation: Techniques of water resource investigations of the United States geological survey, book 3, applications of hydraulics, Chapter B8, Reston, VA, 38 p. http://pubs.usgs.gov/twri/twri-3_B8/

Reilly, T.E., and A.W. Harbaugh, 2004. Guidelines for evaluating ground-water flow models: USGS scientific investigations report 2004-5038, Reston, VA, 30 p. http://pubs.usgs.gov/sir/2004/5038/PDF.htm

United States Geological Survey (USGS). 2009. Groundwater Availability of the Central Valley Aquifer, California. U.S. Geological Survey Professional Paper 1766. Groundwater Resources Program. Reston, VA.

APPENDIX A - EXISTING MODEL CODES AND MODEL APPLICATIONS

There are many existing model codes and model applications being used in basins throughout the state. The Department and USGS have coordinated and compiled a table of available model codes (see Appendix A) and interactive maps displaying a select number of existing model applications in California.

- DWR: http://www.water.ca.gov/groundwater/MAP_APP/index.cfm
- USGS: http://ca.water.usgs.gov/sustainable-groundwatermanagement/california-groundwater-modeling.html

Currently, there are two existing, calibrated, and actively updated and maintained model applications that cover the Central Valley aquifer system. These models can be a great source of data and provide a good starting point for basins within the Central Valley that currently do not have a model. A brief description of these models is provided below. Other regional applications of these models have also been developed for specific purposes.

California Central Valley Groundwater-Surface Water Simulation Model (C2VSim)

The Department developed, maintains, and regularly updates C2VSim. It has been used for several large-scale Central Valley studies. C2VSim is an integrated numerical model based on the finite element grid IWFM that simulates the movement of water through a linked land surface, groundwater, and surface water flow systems. The C2VSim model includes monthly historical stream inflows, surface water diversions, precipitation, land use, and crop acreage data from October 1921 through September 2009. The model simulates the historical response of the Central Valley's groundwater and surface water flow system to historical stresses, and can also be used to simulate response to projected future stresses (DWR, 2016). http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/index_C2VSIM.cfm

Central Valley Hydrologic Model (CVHM)

CVHM is a three-dimensional numerical groundwater flow model developed by USGS and documented in Groundwater Availability of the Central Valley Aquifer, California (USGS, 2009). CVHM simulates groundwater and surface water flow, irrigated agriculture, and other key hydrologic processes over the Central Valley at a uniform grid-cell spacing of 1 mile on a monthly basis using data from April 1961 to September 2003. CVHM simulates surface water flows, groundwater flows, and land subsidence in response to stresses from water use and climate variability throughout the Central Valley. It uses the MODFLOW-2000 (USGS, 2000) finite-difference groundwater flow model code combined with a module called the farm process (FMP) (USGS, 2006) to simulate irrigated agriculture. It can be used in a similar

manner to C2VSim to simulate response to projected future stresses.
http://ca.water.usgs.gov/projects/central-valley/central-valley-hydrologic-model.html

Summary of Commonly Used Groundwater Model Codes in California.					
Model Code	**Description**	**Download**	**Documentation**	**Maintained by**	**Applicability to SGMA Sustainability Indicator**
IWFM	Finite-element code for integrated water resources modeling	http://baydeltaoffice.water.ca.gov/modeling/hydrology/I WFM/	DWR, 2016. Integrated Water Flow Model: IWFM -2015, Theoretical Documentation, Central Valley Modeling Unit Support Branch Bay-Delta Office	DWR	Groundwater levels Storage Interconnected SW/GW Subsidence
IDC	Stand-alone executable version of IWFM root zone compotent (iwfm Demand Calculator).	http://baydeltaoffice.water.ca.gov/modeling/hydrology/IDC/index_IDC.cfm	DWR, 2016. IWFM Demand Calculator: IDC-2015, Theoretical Documentation and User's Manual, Central Valley Modeling Unit Support Branch Bay-Delta Office	DWR	Land use water budget
MODFLOW	Finite-difference groundwater flow code; several versions available with related modules.	http://water.usgs.gov/ogw/modfl ow/	Current core version is MODFLOW -2005: USGS. 2005. MODFLOW-2005, The U.S. Geological Survey Modular Ground-Water Model— the Ground-Water Flow Process. USGS Techniques and Methods 6–A16	USGS	Groundwater levels Storage Interconnected SW/GW Subsidence Seawater intrusion
MODFLOW-OWHM	MODFLOW based integrated hydrologic flow model (One Water Hydrologic Flow Model).	integrated hydrologic flow model (One Water Hydrologic Flow Model). http://water.usgs.gov/ogw/modfl ow-owhm/	USGS. 2014, One-Water Hydrologic Flow Model (MODFLOW-OWHM). U.S. Geological Survey Techniques and Methods 6-A51.	USGS	Groundwater levels Storage Interconnected SW/GW Subsidence Seawater Intrusion

Summary of Commonly Used Groundwater Model Codes in California.					
Model Code	**Description**	**Download**	**Documentation**	**Maintained by**	**Applicability to SGMA Sustainability Indicator**
MODFLOW-USG	MODFLOW-USG: An Unstructured Grid Version of MODFLOW for Simulating Groundwater Flow and Tightly Coupled Processes Using a Control Volume FiniteDifference Formulation	http://water.usgs.gov/ogw/mfusg /	Panday, Sorab, Langevin, C.D., Niswonger, R.G., Ibaraki, Motomu, and Hughes, J.D., 2015, MODFLOW-USG version 1.3.00: An unstructured grid version of MODFLOW for simulating groundwater flow and tightly coupled processes using a control volume finite-difference formulation: U.S. Geological Survey Software Release, 01 December 2015, http://dx.doi.org/10.5066/F7R20ZFJ	USGS	Groundwater levels Storage Interconnected SW/GW Subsidence
GSFLOW	GSFLOW: coupled groundwater and surface-water flow mode	http://water.usgs.gov/ogw/gsflo w/	Regan, R.S., Niswonger, R.G., Markstrom, S.L., Maples, S.R., and Barlow, P.M., 2016, GSFLOW version 1.2.1: Coupled Groundwater and Surface-water FLOW model: U.S. Geological Survey Software Release, 01 October 2016, http://dx.doi.org/10.5066/F7WW7FS0	USGS	Groundwater levels Storage Interconnected SW/GW
MT3D[1]	Modular 3-D MultiSpecies Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Groundwater Systems. Postprocessing code to MODFLOW for transport modeling	http://hydro.geo.ua.edu/mt3d/	Zheng, Chunmiao, 2010, MT3DMS v5.3 Supplemental User's Guide, Technical Report to the U.S. Army Engineer Research and Development Center, Department of Geological Sciences, University of Alabama, 51 p	University of Alabama	Water quality/contaminant plumes

Summary of Commonly Used Groundwater Model Codes in California.

Model Code	Description	Download	Documentation	Maintained by	Applicability to SGMA Sustainability Indicator
RT3D	Modular Code for Simulating Reactive Multi-species Transport in 3-Dimensional Groundwater Systems. Postprocessing code to MODFLOW for transport modeling.	http://bioprocess.pnnl.gov/rt3d.downloads.htm#doc	Clement, P. T, 1997, A Modular Computer Code for Simulating Reactive Multi-species Transport in 3-Dimensional Groundwater Systems, Pacific Northwest National Laboratory	Pacific Northwest National Laboratory	Water quality/contami nant plumes
Path3D	A particle-tracking program for MODFLOW that can simulate advective transport	http://www.sspa.com/software/path3d	Zheng, C., 1992, Path3D, a groundwater pass and travel time simulator, S.S. Papadopulos & Associates, Inc..	S.S. Papadopulos & Associates	Water quality/contami nant plumes
MOD-PATH3DU	Groundwater path and travel time simulator for unstructured model grids	http://www.sspa.com/software/modpath3du	Muffles, C, M. Tonkin, M. Ramadhan, X. Wang, C. Neville, and J.R. Craig, 2016, Users guide for mod-PATH3DU; a groundwater pass and travel time simulator, S.S. Papadopulos & Assoc. Inc, and the University of Waterloo.	S.S. Papadopulos & Associates	Water quality/contami nant plumes
SEAWAT	MODFLOW MT3D based model designed to simulate three-dimensional variable-density groundwater flow.	http://water.usgs.gov/ogw/seawat/	Langevin, C.D., SEAWAT: a computer program for simulation of variable-density groundwater flow and multi-species solute and heat transport: U.S. Geological Survey Fact Sheet FS 2009-3047, 2 p	USGS	Seawater intrusion
MODPATH	Particle-Tracking post-processing tool for MODFLOW.	http://water.usgs.gov/ogw/modpath/	USGS. 2012, User guide for MODPATH version 6—A particle-tracking model for MODFLOW: U.S. Geological Survey Techniques and Methods, book 6, chap. A41	USGS	Groundwater flow path tracking for groundwater quality, Seawater intrusion, and other flowrelated processes

Summary of Commonly Used Groundwater Model Codes in California.					
Model Code	**Description**	**Download**	**Documentation**	**Maintained by**	**Applicability to SGMA Sustainability Indicator**
INFIL 3.0	Watershed model to estimate net infiltration below the root zone.	http://water.usgs.gov/nrp/gwsoftware/Infil/I nfil.html	U.S. Geological Survey, 2008, Documentation of computer program INFIL3.0-A distributed-parameter watershed model to estimate net infiltration below the root zone: U.S. Geological Survey Scientific Investigations Report 2008-5006.	USGS	

Notes:

- Additional DWR modeling tools and resources are available at: http://www.water.ca.gov/groundwater/sgm/index.cfm and http://baydeltaoffice.water.ca.gov/modeling/
- Additional USGS modeling tools and resources are available at: http://water.usgs.gov/software/lists/groundwater
- This list does not contain all available models in California and there are model codes in use in California that are currently proprietary (such as MicroFem, MODFLOW-Surfact, MODHMS) but may be allowed if the model applications were developed and used prior to the effective date of the GSP Regulations.

Appendix M. SMC BMP

Sustainable Management Criteria Best Management Practice

1. OBJECTIVE

The Department of Water Resources (the Department) developed this Best Management Practice (BMP) document to describe activities, practices, and procedures for defining the sustainable management criteria required by the Groundwater Sustainability Plan Regulations (GSP Regulations).[1] This BMP characterizes the relationship between the different sustainable management criteria – the *sustainability goal*, *undesirable results*, *minimum thresholds*, and *measurable objectives* – and describes best management practices for developing these criteria as part of a Groundwater Sustainability Plan (GSP). The SJREC GSA has reviewed and updated this BMP for inclusion in its' GSP.

The Sustainable Groundwater Management Act (SGMA)[2] and GSP Regulations specify the requirements of a GSP. This BMP does not impose new requirements, but describes best management practices for satisfying the requirements of SGMA and the GSP Regulations. This BMP is reasonable and supported by the best available information and best available science.[3]

Examples provided in this BMP are intentionally simplified and are intended only to illustrate concepts. The level of detail in any of these simplified examples (e.g., the number of minimum thresholds defined in a hypothetical basin, the number of minimum thresholds that constitute an undesirable result, etc.) may not represent the actual level of detail required to achieve sustainability.

2. INTRODUCTION

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.[4] The avoidance of undesirable results is thus critical to the success of a GSP.

GSP Regulations collect together several requirements of a GSP under the heading of "Sustainable Management Criteria" in Subarticle 3 of Article 5.[5] Sustainable management criteria include:

- **Sustainability Goal**

- **Undesirable Results**
- **Minimum Thresholds**
- **Measurable Objectives**

The development of these criteria relies upon information about the basin developed in the *hydrogeologic conceptual model*, the description of current and historical groundwater conditions, and the *water budget*.

Key terms are *italicized* the first time they are presented, indicating that a definition for the term is provided in the Key Definitions section located at the end of this document.

SGMA REQUIREMENT TO QUANTIFY SUSTAINABILITY

The enactment of SGMA in 2014 was a landmark effort to manage California's groundwater in a sustainable manner. The SGMA legislation established definitions of undesirable results, introduced the statutory framework and timelines for achieving sustainability, and identified requirements that local agencies (i.e. GSAs) must follow to engage the beneficial uses and users of groundwater within a basin, among many other important topics. The GSP Regulations developed by the Department specify the documentation and evaluation of groundwater conditions within a basin and the requirements for the development and implementation of plans to achieve or maintain sustainability required by SGMA.

As described in SGMA, sustainable conditions within a basin are achieved when GSAs meet their sustainability goal and demonstrate the basin is being operated within its *sustainable yield*. Sustainable yield can only be reached if the basin is not experiencing undesirable results. The GSP Regulations focus the development of GSPs on locally-defined, quantitative criteria, including undesirable results, minimum thresholds, and measurable objectives. Undesirable results must be eliminated through the implementation of projects and management actions, and progress toward their elimination will be demonstrated with empirical data (e.g., measurements of groundwater levels or subsidence). Quantitative sustainable management criteria allow GSAs to clearly demonstrate sustainability and allow the public and the Department to readily assess progress.

Properly documenting the requirements identified in Subarticle 3, Introduction to Sustainable Management Criteria, in Article 5 of the GSP Regulations, is imperative to maintaining an outcome-based approach to SGMA implementation and must be completed for the Department to consider the approval of a GSP.

3. PRELIMINARY ACTIVITIES

A GSA will need to understand the basin's physical condition, the overlying management and legal structures, and the basin's water supplies and demands prior to developing sustainable management criteria. As a result, before a GSA begins the process of developing sustainable management criteria, the following activities should be completed:

Understand the Basin Setting

A thorough understanding of the historical and current state of the basin is necessary before sustainable management criteria can be set. Much of this understanding is gained from historic hydrogeologic reports and in the development of a hydrogeologic conceptual model, water budget, and description of groundwater conditions. For more information, see the Hydrogeologic Conceptual Model BMP, Water Budget BMP, and Modeling BMP.

Inventory Existing Monitoring Programs

Minimum thresholds and measurable objectives are set at individual representative monitoring sites. GSAs should compile information from existing monitoring programs (e.g., number of wells and their construction details, which aquifers they monitor). As sustainable management criteria are set, monitoring networks may need to be expanded and updated beyond those used for existing, pre-SGMA monitoring programs. Additional information on monitoring networks is included in the Monitoring Networks and Identification of Data Gaps BMP.

Engage Interested Parties within the Basin

When setting sustainable management criteria, GSAs must consider the beneficial uses and users of groundwater in their basin. Consideration of the potential effects on beneficial uses and users underpin the minimum thresholds. GSAs must explain their decision-making processes and how public input was used in the development of their GSPs. There are specific SGMA requirements for GSAs to engage with interested parties within a basin. For more information about requirements of engagement, refer to the Stakeholder Communication and Engagement Guidance Document.

4. SETTING SUSTAINABLE MANAGEMENT CRITERIA

This section describes the development of sustainable management criteria. The section is organized as follows:

- Assessment of *sustainability indicators*, significant and unreasonable conditions, *management areas*, and representative monitoring sites
- Minimum thresholds
- Undesirable results
- Measurable objectives
- Sustainability goal

This organization follows a chronological ordering that GSAs can use as they plan for sustainable management criteria development, although they do not have to proceed in that order. Furthermore, setting sustainable management criteria will likely be an iterative process. Initial criteria may need to be adjusted to address potential effects on the beneficial uses and users of groundwater, land uses, and property interests. The GSA should evaluate whether the sustainable management criteria, as a whole, adequately characterize how and when significant and unreasonable conditions occur, and define a path toward sustainable groundwater management in the basin.

ASSESSMENT OF SUSTAINABILITY INDICATORS, SIGNIFICANT AND UNREASONABLE CONDITIONS, MANAGEMENT AREAS, AND REPRESENTATIVE MONITORING SITES

Sustainability Indicators

Sustainability indicators are the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, become undesirable results.[6] Undesirable results are one or more of the following effects:

Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods

Significant and unreasonable reduction of groundwater storage

Significant and unreasonable seawater intrusion

Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies

- Significant and unreasonable land subsidence that substantially interferes with surface land uses
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

The significant and unreasonable occurrence of any of the six sustainability indicators constitutes an undesirable result.

The default position for GSAs should be that all six sustainability indicators apply to their basin. If a GSA believes a sustainability indicator is not applicable for their basin, they must provide evidence that the indicator does not exist and could not occur. For example, GSAs in basins not adjacent to the Pacific Ocean, bays, deltas, or inlets may determine that seawater intrusion is not an applicable sustainability indicator, because seawater intrusion does not exist and could not occur. In contrast, simply demonstrating that groundwater levels have been stable in recent years is not sufficient to determine that land subsidence is not an applicable sustainability indicator. As part of the GSP evaluation process, the Department will evaluate the GSA’s determination that a sustainability indicator does not apply for reasonableness. The Delta-Mendota Subbasin is unlikely to experience significant and unreasonable seawater intrusion and references included in this BMP are for illustrative purposes only.

Sustainability Indicators in the Context of SGMA versus the California Water Plan

The term “sustainability indicator” is used in GSP regulations to refer to “any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).” It is important to note that the term ‘sustainability indicator’ is not unique to SGMA. The California Water Plan Update 2013 includes a California Water Sustainability Indicators Framework that uses the term ‘sustainability indicator’ in a way that differs from SGMA. Sustainability indicators in the context of the California Water Plan inform users about the relationship of water system conditions to ecosystems, social systems, and economic systems.

Water managers and users should not confuse sustainability indicators in the context of SGMA with sustainability indicators associated with the California Water Plan or with any other water management programs.

Significant and Unreasonable Conditions

GSAs must consider and document the conditions at which each of the six sustainability indicators become significant and unreasonable in their basin, including the reasons for justifying each particular threshold selected. A GSA may decide, for example, that localized inelastic land subsidence near critical infrastructure (e.g., a canal) and basinwide loss of domestic well pumping capacity due to lowering of groundwater levels are both significant and unreasonable conditions. These general descriptions of significant and unreasonable conditions are later translated into quantitative undesirable results, as described in this document. The evaluation of significant and unreasonable conditions should identify the geographic area over which the conditions need to be evaluated so the GSA can choose appropriate representative monitoring sites.

Use of Management Areas

A GSA may wish to define *management areas* for portions of its basin to facilitate groundwater management and monitoring. Management areas may be defined by natural or jurisdictional boundaries, and may be based on differences in water use sector, water source type, geology, or aquifer characteristics. Management areas may have different minimum thresholds and measurable objectives than the basin at large and may be monitored to a different level. However, GSAs in the basin must provide descriptions of why those differences are appropriate for the management area, relative to the rest of the basin.

Using the land subsidence example from the preceding subsection, GSAs in the hypothetical basin may decide that a management area in the vicinity of the canal is appropriate because the level of monitoring must be higher in that area, relative to the rest of the basin. GSAs may also desire to set more restrictive minimum thresholds in that area relative to the rest of the basin.

While management areas can be used to define different minimum thresholds and measurable objectives, other portions of the GSP (e.g., hydrogeologic conceptual model, water budget, notice and communication) must be consistent for the entire GSP area.

Representative Monitoring Sites

Representative monitoring sites are a subset of a basin's complete monitoring network, where minimum thresholds, measurable objectives, and *interim milestones* are set, when applicable. Representative monitoring sites can be used for one sustainability indicator or multiple sustainability indicators. **Figure 1** shows how different combinations of representative monitoring sites can be used to assess seawater intrusion and lowering of groundwater levels in a hypothetical groundwater basin.

GSAs can only select representative monitoring sites after determining what constitutes significant and unreasonable conditions in a basin. Using the example discussed in the preceding subsections, the GSA would use a different combination of representative monitoring sites for localized inelastic land subsidence than it would for basinwide groundwater level decline. The GSA must explain how the combination of representative monitoring sites selected for each sustainability indicator can assess the significant and unreasonable groundwater condition.

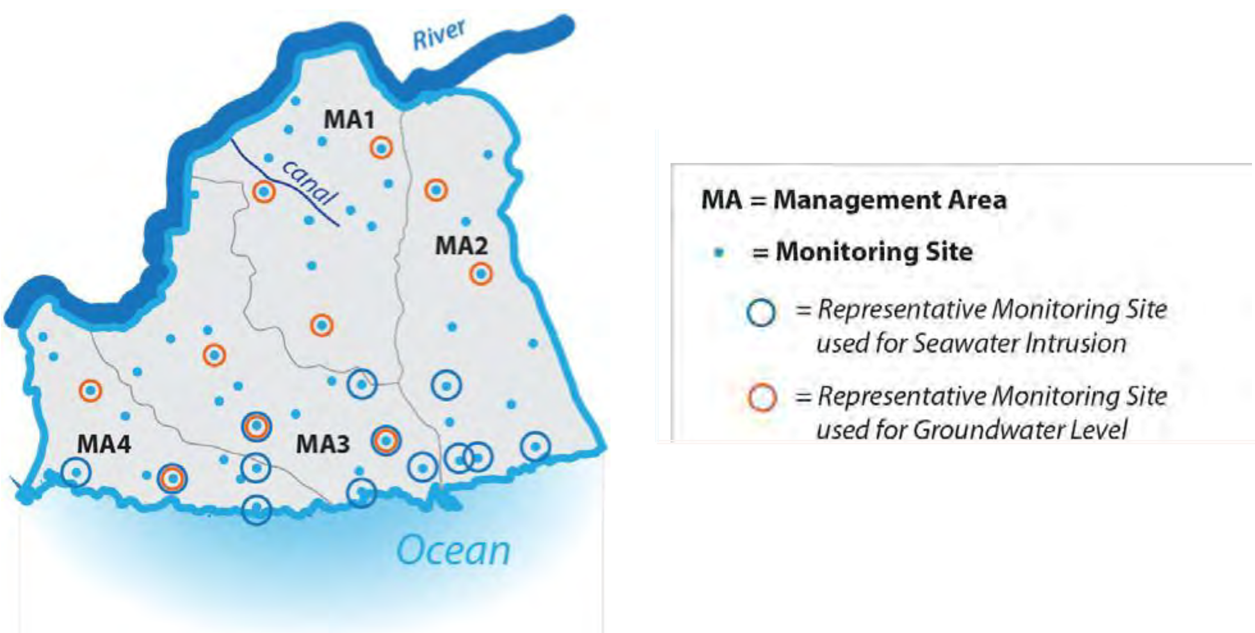


Figure 1. Example Monitoring Network and Representative Monitoring Sites

MINIMUM THRESHOLDS

A minimum threshold is the quantitative value that represents the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the basin. GSAs will need to set minimum thresholds at representative monitoring sites for each applicable sustainability indicator after considering the interests of beneficial uses and users of groundwater, land uses, and property interests in the basin. Minimum thresholds should be set at levels that do not impede adjacent basins from meeting their minimum thresholds or sustainability goals.

Required Components for all Minimum Thresholds

GSP Regulations require six components of information to be documented for each minimum threshold.[7] The six components (in italicized text) and considerations for how they should be addressed are as follows:

1. *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.*

   The GSP must include an analysis and written interpretation of the information, data, and rationale used to set the minimum threshold. For instance, if a groundwater level minimum threshold is set to protect shallow domestic supply wells, the GSA should investigate information such as the depth ranges of domestic wells near the representative monitoring site, aquifer dimensions, groundwater conditions, and any other pertinent information.

2. *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.*

   The GSP must describe the relationship between each sustainability indicator’s minimum threshold (e.g., describe why or how a water level minimum threshold set at a particular representative monitoring site is similar to or different to water level thresholds in nearby representative monitoring sites). The GSP also must describe the relationship between the selected minimum threshold and minimum thresholds for other sustainability indicators (e.g., describe how a water level minimum threshold would not trigger an undesirable result for land subsidence).

3. *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.*

   The GSP must describe how the minimum threshold has been set to avoid impacts to adjacent basins. This can be supported by information such as an independent plans' ability to show historic and projected sustainable groundwater management, an interbasin agreement, documentation of coordination with GSAs in adjacent basins, and general descriptions of how the minimum threshold is consistent with sustainable management criteria in adjacent basins. Information provided for this component will likely be enhanced beyond the initial GSP in future annual reports and five-year updates. It may be important to inform GSAs in adjacent basins where minimum thresholds are planned and their quantitative values.

4. *How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.*

   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 and identification of the beneficial uses of groundwater, 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. *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.*

   The GSP must discuss relevant standards that pertain to the sustainability indicator and justify any differences between the selected minimum threshold and those standards. For instance, the GSP will need to justify why a different level was used if a water quality minimum threshold is set at a different level than a state or federal maximum contaminant level (MCL).

6. *How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.*

   Subarticle 4 of the GSP Regulations addresses monitoring networks. The GSP must document the metrics that will be monitored (e.g., groundwater level, groundwater quality) as well as the frequency and timing of measurement (e.g., twice per year in the spring and fall).

Descriptions for these six components are required for all minimum thresholds. However, descriptions for individual components can be shared for multiple minimum thresholds, where appropriate (e.g., in some instances a single description could be provided to describe how a group of minimum thresholds were selected to avoid causing undesirable results in an adjacent basin).

Required Minimum Threshold Metrics for Each Sustainability Indicator

In addition to the six components described above that apply to all minimum thresholds, the GSP Regulations contain specific requirements and metrics for each sustainability indicator.[8] The purpose of the specific requirements is to ensure consistency within groundwater basins and between adjacent groundwater basins. In some instances a minimum threshold may be described as a management strategy to mitigate impacts from an adjacent GSP/Subbasin.

Specific requirements for the metrics used to quantify each sustainability indicator are listed below and shown in **Figure 2**:

- The minimum threshold metric for the **chronic lowering of groundwater levels** sustainability indicator shall be a groundwater elevation measured at the representative monitoring site.
- The minimum threshold for **reduction of groundwater storage** is a volume of groundwater that can be withdrawn from a basin or management area, based on measurements from multiple representative monitoring sites, without leading to undesirable results. Contrary to the general rule for setting minimum thresholds, the reduction of groundwater storage minimum threshold is not set at individual monitoring sites. Rather, the minimum threshold is set for a basin or management area.
- The minimum threshold metric for **seawater intrusion** shall be the location of a chloride isocontour. Contrary to the general rule for setting minimum thresholds, the seawater intrusion minimum threshold is not set at individual monitoring sites. Rather, the minimum threshold is set along an isocontour line in a basin or management area.
- The minimum threshold metric for **degraded water quality** shall be water quality measurements that indicate degradation at the monitoring site. This can be based on migration of contaminant plumes, number of supply wells, volume of groundwater, or the location of a water quality isocontour within the basin. Depending on how the GSA defines the degraded water quality minimum threshold, it can be defined at a site, along the isocontour line, or as a calculated volume.
- The minimum threshold metric for **land subsidence** shall be a rate and the extent of land subsidence.
- The minimum threshold metric for **depletion of interconnected surface waters** shall be a rate or volume of surface water depletion.

Sustainability Indicators	Lowering GW Levels	Reduction of Storage	Seawater Intrusion	Degraded Quality	Land Subsidence	Surface Water Depletion
Metric(s) Defined in GSP Regulations	• Groundwater Elevation	• Total Volume	• Chloride concentration isocontour	• Migration of Plumes • Number of supply wells • Volume • Location of isocontour	• Rate and Extent of Land Subsidence	• Volume or rate of surface water depletion

Figure 2. Minimum Threshold Metrics

Examples and Considerations for Minimum Thresholds

The following provides graphical examples and considerations for use by GSAs when setting minimum thresholds. The following subsections are organized by sustainability indicator and are illustrative examples only, as GSAs may have other considerations when setting minimum thresholds.

Chronic Lowering of Groundwater Levels Minimum Threshold

Figure 3 illustrates a hypothetical groundwater level hydrograph and associated minimum threshold at a representative monitoring site. In this hypothetical example, the GSA set the minimum threshold at some level below conditions at the time of GSP submission. Note that this and many subsequent examples in this document use 2020 as the hypothetical GSP submission date. The actual GSP submission date required by SGMA varies. GSPs must be submitted by January 31, 2020 for high- and medium-priority basins determined by the Department to be critically overdrafted. All other high- and medium-priority basins must submit GSPs by January 31, 2022.

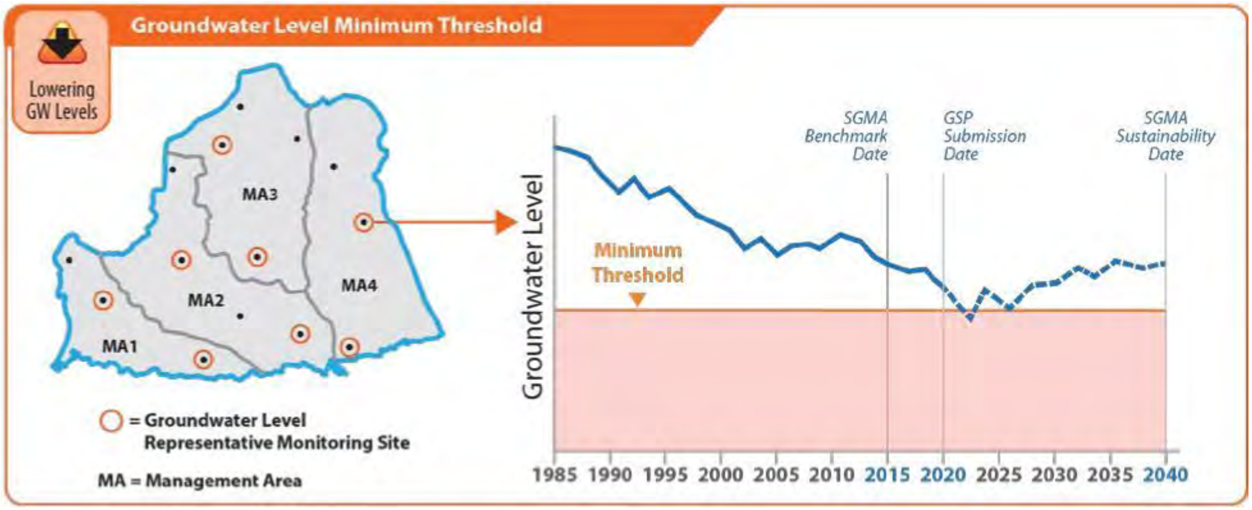


Figure 3. Example Groundwater Level Minimum Threshold Established at a Representative Monitoring Site

Considerations when establishing minimum thresholds for groundwater levels at a given representative monitoring site may include, but are not limited to:

- What are the historical groundwater conditions in the basin?
- What are the average, minimum, and maximum depths of municipal, agricultural, and domestic wells?
- What are the screen intervals of the wells?
- What impacts do water levels have on pumping costs (e.g., energy cost to lift water)?
- What are the adjacent basin's minimum thresholds for groundwater elevations?
- What are the potential impacts of changing groundwater levels on groundwater dependent ecosystems?
- Which principal aquifer, or aquifers, is the representative monitoring site evaluating?

Reduction in Groundwater Storage Minimum Threshold

Figure 4 illustrates a hypothetical graph depicting the volume of groundwater available in storage through time, and the associated minimum threshold for the basin.

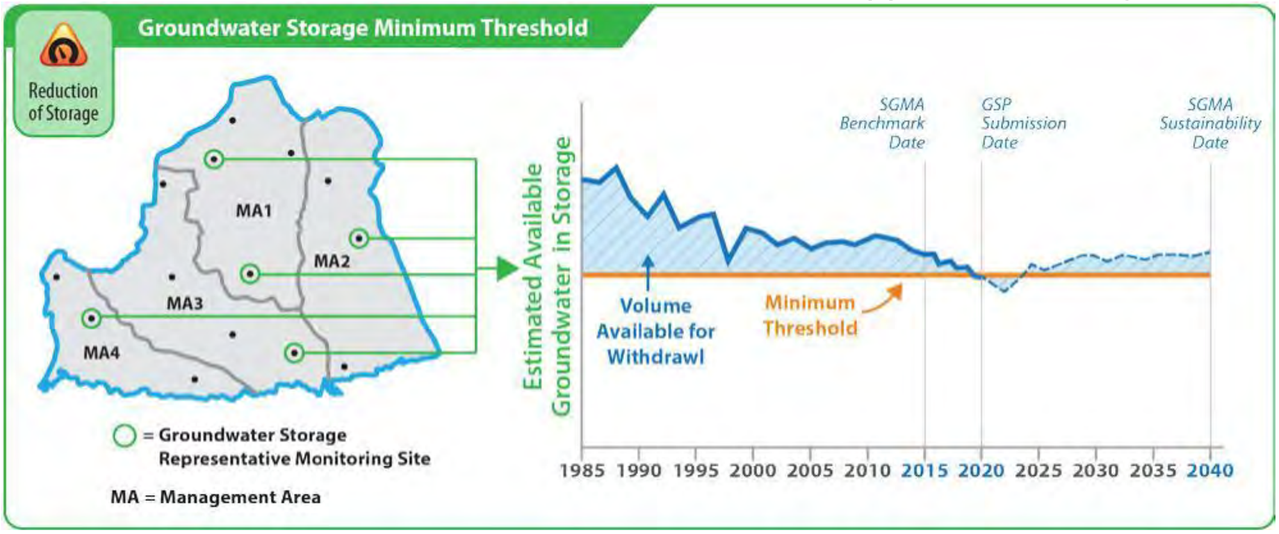


Figure 4. Example Groundwater Storage Minimum Threshold Established at the Basin Scale

Considerations when establishing the minimum threshold for groundwater storage may include, but are not limited to:

- What are the historical trends, water year types, and projected water use in the basin?
- What groundwater reserves are needed to withstand future droughts?
- Have production wells ever gone dry?
- What is the effective storage of the basin? This may include understanding of the:
  - Average, minimum, and maximum depth of municipal, agricultural, and domestic wells.
  - Impacts on pumping costs (i.e., energy cost to lift water).
- What are the adjacent basin's minimum thresholds?

Seawater Intrusion Minimum Threshold

Figure 5 illustrates hypothetical chloride isoconcentration contours for two aquifers in a coastal basin. The isoconcentration contours are used as minimum thresholds for seawater intrusion.

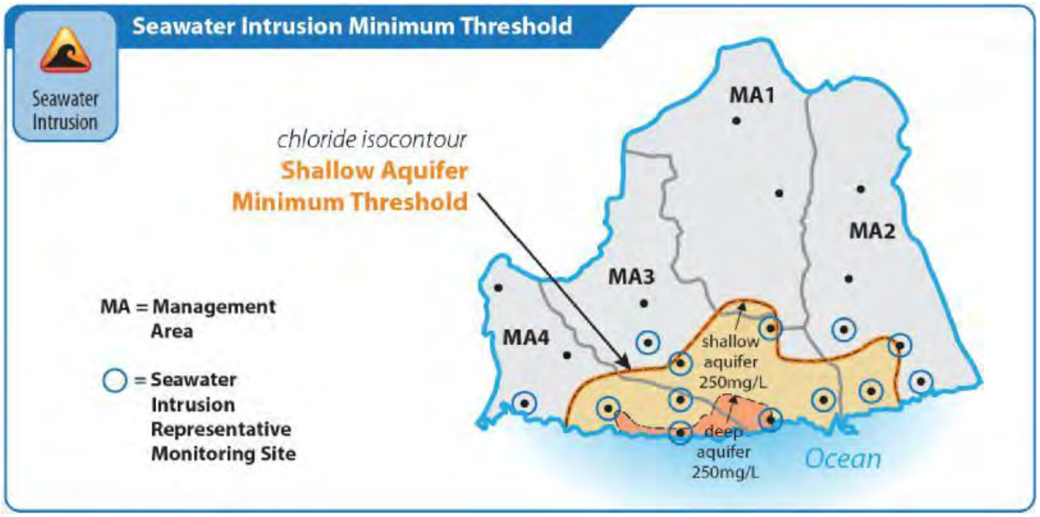


Figure 5. Example Seawater Intrusion Minimum Threshold Established at the Chloride Isocontour

Considerations when establishing minimum thresholds for seawater intrusion at a given isocontour location may include, but are not limited to:

- What is the historical rate and extent of seawater intrusion in affected principal aquifers?
- How are land uses in the basin sensitive to seawater intrusion?
- What are the financial impacts of seawater intrusion on agricultural, municipal, and domestic wells?
- What are the Regional Water Quality Control Board Basin Plan objectives?
- What are the adjacent basin's minimum thresholds?

Degraded Groundwater Quality Minimum Threshold

Figure 6 illustrates two hypothetical minimum thresholds for groundwater quality in a basin. The minimum threshold depicted on the top graph is associated with point source contamination (e.g., PCE released from a dry cleaner) and the minimum threshold depicted on the lower graph is associated with nonpoint source contamination (e.g., nitrate in groundwater from regional land use practices).

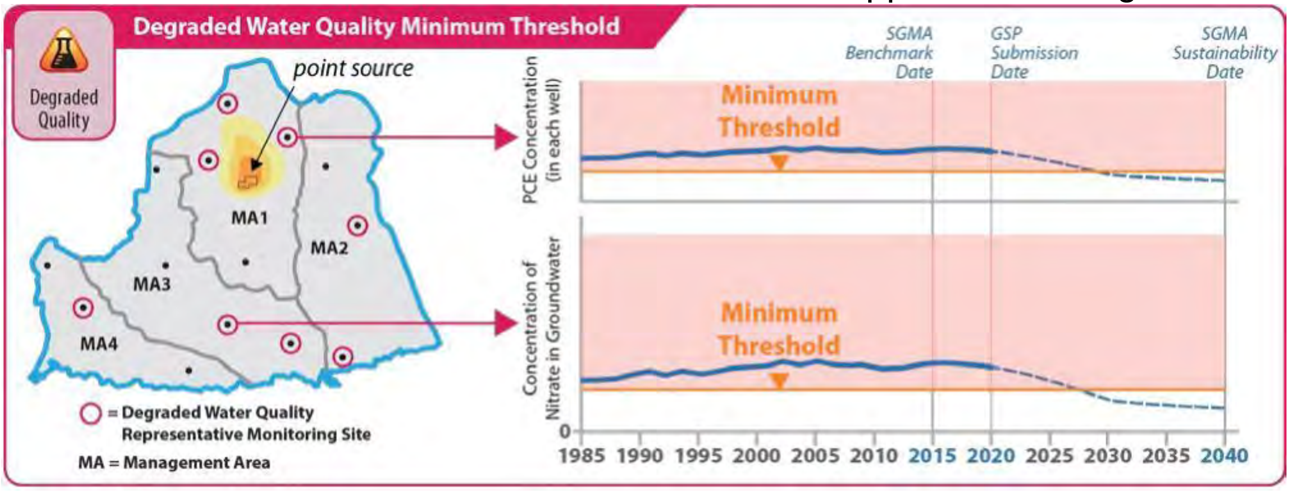


Figure 6. Example Degraded Water Quality Minimum Threshold Established for Point and Nonpoint Source Pollutants

Considerations when establishing minimum thresholds for water quality may include, but are not limited to:

- What are the historical and spatial water quality trends in the basin?
- What is the number of impacted supply wells?
- What aquifers are primarily used for providing water supply?
- What is the estimated volume of contaminated water in the basin?
- What are the spatial and vertical extents of major contaminant plumes in the basin, and how could plume migration be affected by regional pumping patterns?
- What are the applicable local, State, and federal water quality standards?
- What are the major sources of point and nonpoint source pollution in the basin, and what are their chemical constituents?
- What regulatory projects and actions are currently established to address water quality degradation in the basin (e.g., an existing groundwater pump and treat system), and how could they be impacted by future groundwater management actions?
- What are the adjacent basin's minimum thresholds?

Land Subsidence Minimum Threshold

Figure 7 illustrates a hypothetical minimum threshold for land subsidence in a basin. The minimum threshold depicts a cumulative amount of subsidence at a given point.

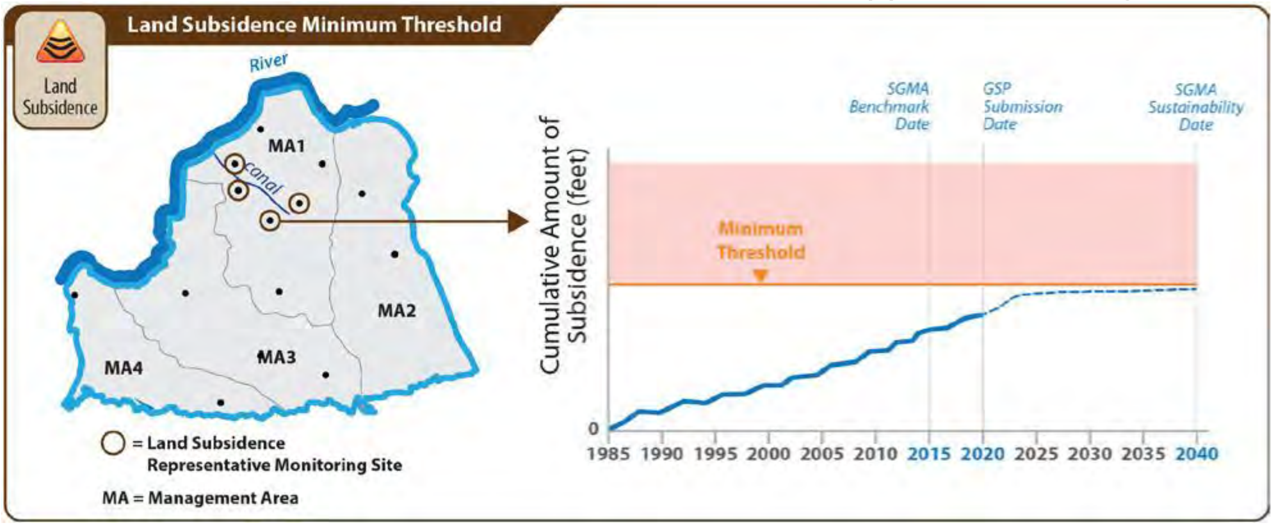


Figure 7. Example Land Subsidence Minimum Threshold

Considerations when establishing minimum thresholds for land subsidence at a given representative monitoring site may include, but are not limited to:

- Do principle aquifers in the basin contain aquifer material susceptible to subsidence?
- What are the historical, current, and projected groundwater levels, particularly the historical lows?
- What is the historical rate and extent of subsidence?
- What are the land uses and property interests in areas susceptible to subsidence?
- What is the location of infrastructure and facilities susceptible to subsidence (e.g., canals, levees, pipelines, major transportation corridors)?
- What are the adjacent basin's minimum thresholds?

Depletion of Interconnected Surface Water Minimum Threshold

Figure 8 shows a hypothetical minimum threshold for depletion of interconnected surface waters. This example presents the potential stream depletion rate (or volume) due to groundwater pumping simulated by the basin's integrated hydrologic model. Other approaches for demonstrating stream depletion, instead of the use of a numerical model, may be valid.

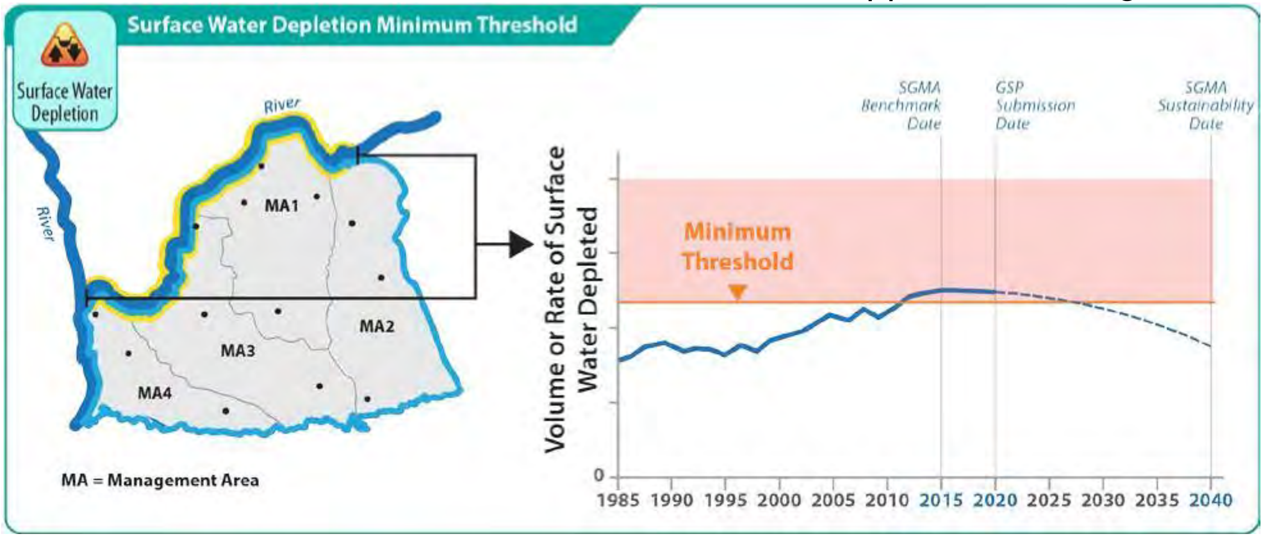


Figure 8. Example of Depletion of Interconnected Surface Water Minimum Threshold

Considerations when establishing minimum thresholds for depletions of interconnected surface water may include, but are not limited to:

- What are the historical rates of stream depletion for different water year types?
- What is the uncertainty in streamflow depletion estimates from analytical and numerical tools?
- What is the proximity of pumping to streams?
- Where are groundwater dependent ecosystems in the basin?
- What are the agricultural and municipal surface water needs in the basin?
- What are the applicable State or federally mandated flow requirements?

Using Groundwater Elevations as a Proxy

GSP Regulations allow GSAs to use groundwater elevation as a proxy metric for any (or potentially all) of the sustainability indicators when setting minimum thresholds[9] and measurable objectives[10], provided the GSP demonstrates that there is a significant correlation between groundwater levels and the other metrics.[11]

Two possible approaches for using groundwater elevation as a proxy metric for the definition of sustainable management criteria are:

(1) Demonstrate that the minimum thresholds and measurable objectives for chronic declines of groundwater levels are sufficiently protective to ensure significant and unreasonable occurrences of other sustainability indicators will be prevented. In other words, demonstrate that setting a groundwater level minimum threshold satisfies the minimum threshold requirements for not only

chronic lowering of groundwater levels but other sustainability indicators at a given site.

(2) Identify representative groundwater elevation monitoring sites where minimum thresholds and measurable objectives based on groundwater levels are developed for a specific sustainability indicator. In other words, the use of a groundwater level minimum threshold is not intended to satisfy the minimum threshold requirements for chronic lowering of groundwater but is intended solely for establishing a threshold for another sustainability indicator.

Subsidence as an Example

As described below, either approach could be applied to subsidence.

- **Approach 1** – Groundwater level minimum thresholds are above historical low groundwater levels. The GSA determines and documents that avoidance of the minimum thresholds for groundwater levels will also ensure that subsidence will be avoided. In this approach, the GSA would be applying the same numeric definition to two undesirable results – chronic lowering of groundwater and subsidence (**Figure 9**).
- **Approach 2** – The GSA has determined that specific areas are prone to subsidence, knows what the historical low groundwater levels are for those areas, and has demonstrated that no additional inelastic land subsidence will occur as long as groundwater levels remain above a certain threshold. The GSA develops minimum thresholds for land subsidence based on groundwater levels for the areas prone to subsidence (**Figure 9**). These land subsidence representative monitoring sites are not necessarily included as representative monitoring sites for groundwater level decline.

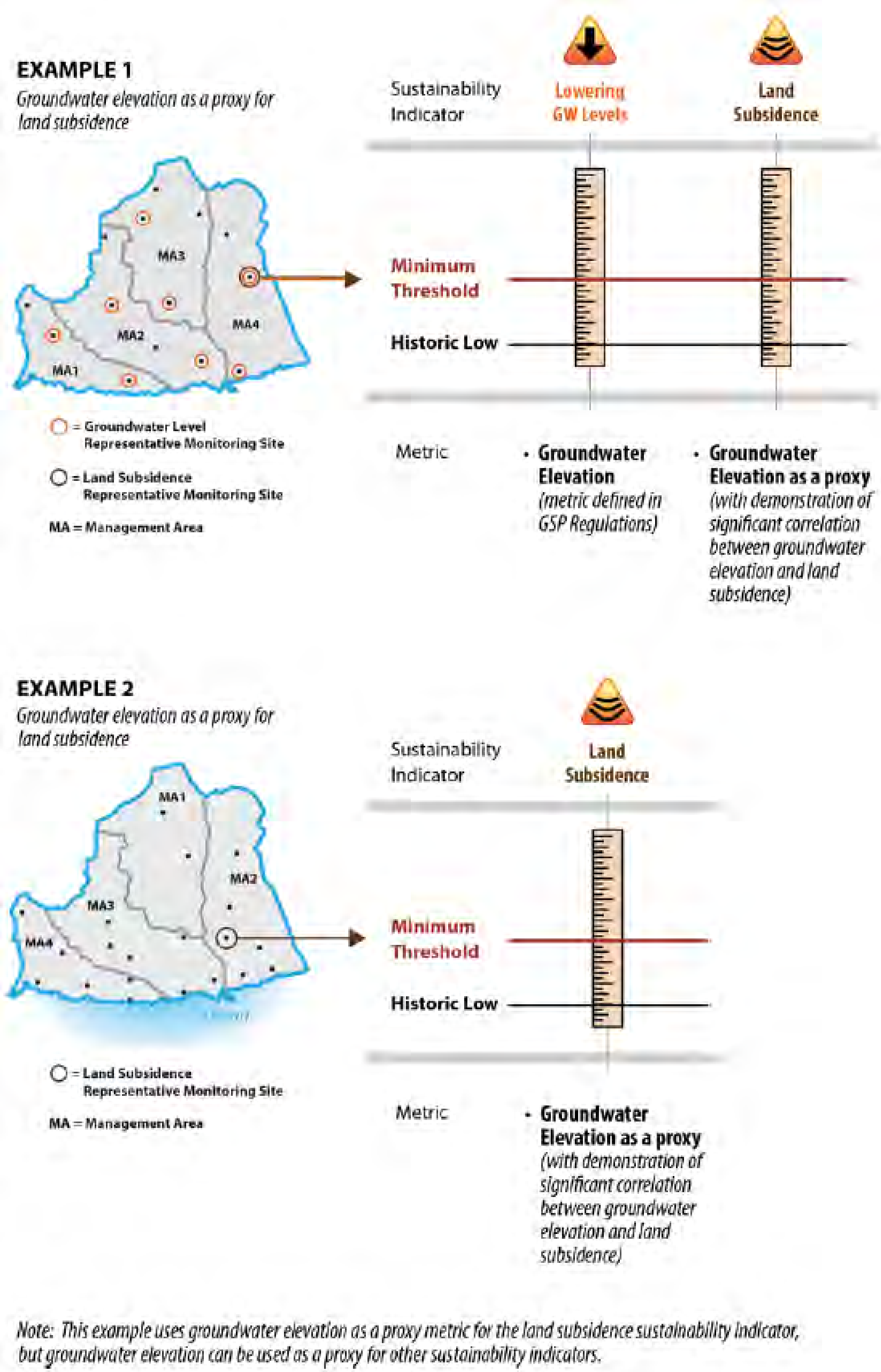


Figure 9. Example of Using Groundwater Elevation as a Proxy for Subsidence Monitoring

UNDESIRABLE RESULTS

Undesirable results occur when conditions related to any of the six sustainability indicators become significant and unreasonable. Undesirable results will be used by the Department to determine whether the sustainability goal has been achieved within the basin.

All undesirable results will be based on minimum thresholds exceedances. Undesirable results will be defined by minimum threshold exceedances at a single monitoring site, multiple monitoring sites, a portion of a basin, a management area, or an entire basin. Exceeding a minimum threshold at a single monitoring site is not necessarily an undesirable result, but it could signal the need for modifying one or more management actions, or implementing a project to benefit an area before the issue becomes more widespread throughout the basin. However, the GSP must define when an undesirable result is triggered.

The GSP must include a description for each undesirable result. Undesirable results must be agreed upon by all GSAs within a basin. If there is more than one GSP in the basin, a single undesirable result definition must be agreed upon and documented in the coordination agreement.

GSP Regulations require three components for each undesirable result.[12] The three components (in italicized text) and considerations for how they should be addressed are as follows:

1. *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.*[13]
   The GSP documents the factors that may lead to, or have led to, undesirable results. These factors may be localized or basinwide. An example of a localized cause for undesirable results is a group of active wells that are inducing significant and unreasonable land subsidence in a nearby canal. An example of a basinwide cause is general overpumping of groundwater that leads to a significant and unreasonable reduction of groundwater storage. There will often be multiple causes for groundwater conditions becoming significant and unreasonable, and GSAs must investigate each. Even if a basin does not currently have undesirable results, the GSP Regulations require GSAs to consider the causes that would lead to undesirable results and define undesirable results using minimum thresholds.
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.[14]

The GSP Regulations require undesirable results to be quantified by minimum threshold exceedances. GSAs have significant flexibility in defining the combinations of minimum threshold exceedances that constitute an undesirable result GSAs should evaluate multiple spatial scales when setting the criteria for undesirable results. Consider an example of two basins. In the first basin, 50 percent of wells have water levels below their assigned minimum threshold. In the second basin, all wells have water levels above their minimum thresholds except for one well where water levels are 800 feet below the minimum threshold. Both basins likely have an undesirable result. GSAs should define their undesirable results to be protective of both scenarios.

3. *The potential effects of the undesirable result on beneficial uses and users of groundwater, land uses, and property interests.*[15]

The GSA, having acquired information regarding beneficial uses and users of groundwater in the basin, land uses, and property interests tied to groundwater, should describe the effects of each of the potential undesirable results for the basin. The description should make clear how potential effects on beneficial uses and users were considered in the establishment of the undesirable results.

Experiencing Undesirable Results

Avoidance of the defined undesirable results must be achieved within 20 years of GSP implementation (20-year period). Some basins may experience undesirable results within the 20-year period, particularly if the basin has existing undesirable results as of January 1, 2015. The occurrence of one or more undesirable results within the initial 20-year period does not, by itself, necessarily indicate that a basin is not being managed sustainably, or that it will not achieve sustainability within the 20-year period. However, GSPs must clearly define a planned pathway to reach sustainability in the form of interim milestones, and show actual progress in annual reporting.

Failing to eliminate undesirable results within 20 years, or failing to implement a GSP to achieve the sustainability goal established for a basin, will result in the Department deeming the GSP inadequate and could result in State Water Resources Control Board intervention. Failing to meet interim milestones could indicate that the GSA is unlikely to achieve the sustainability goal in the basin.

Example of Undesirable Results

This section provides a simplified example to illustrate the relationship between certain sustainable management criteria. The example is for one sustainability indicator (lowering groundwater levels, using the metric of groundwater elevation. The concepts in the example could be extended to other sustainability indicators using other metrics.

In the example, a hypothetical basin has set minimum thresholds, interim milestones, and measurable objectives for groundwater levels (**Figure 10**) at a network of eight representative monitoring points; to simplify this example, the criteria are assumed to be the same at each well. After considering the conditions at which lowering of groundwater levels would become significant and unreasonable, the GSA has determined that minimum threshold exceedances (i.e., groundwater levels dropping below the minimum threshold) at three or more representative monitoring sites would constitute an undesirable result.

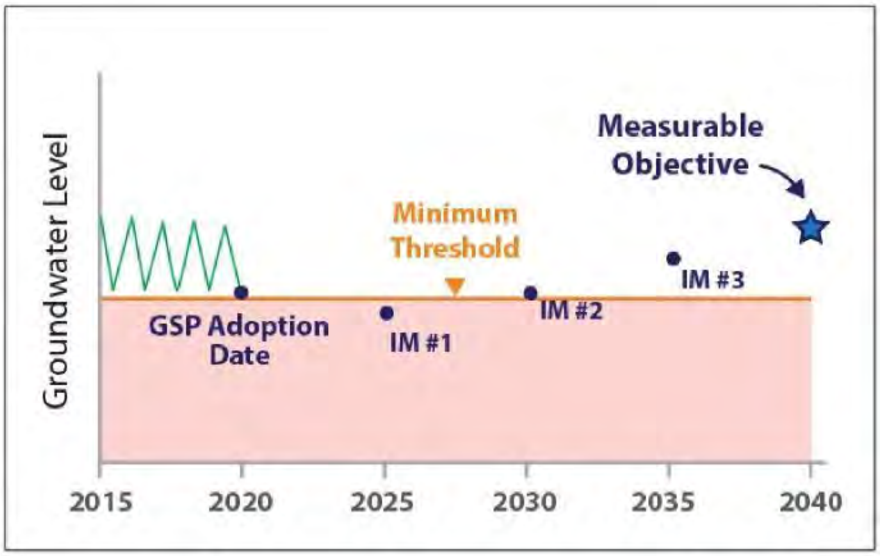


Figure 10. Example Minimum Threshold, Interim Milestones (IM), and Measurable Objective

In each of the following scenarios, the GSA monitors groundwater levels at the representative monitoring sites for the 20-year period following GSP submission.

Scenario 1 – Minimum Threshold Exceedances without an Undesirable Result

In this scenario (**Figure 11**), one of the eight representative monitoring wells has periodic minimum threshold exceedances over a several-year period after submission of the GSP. After this period, groundwater levels at the representative monitoring site increase and remain above the minimum threshold. Groundwater levels at all other representative monitoring sites remain above the minimum threshold for the entire 20-year period following GSP submission. Groundwater levels at all sites are at or above the measurable objective at the end of the 20-year period. Despite periodic minimum threshold exceedances at one representative monitoring well, the basin never experienced an undesirable result for this sustainability indicator. The original GSP submission foresaw potential minimum threshold exceedances as shown by the first five-year interim milestone set below the minimum threshold.

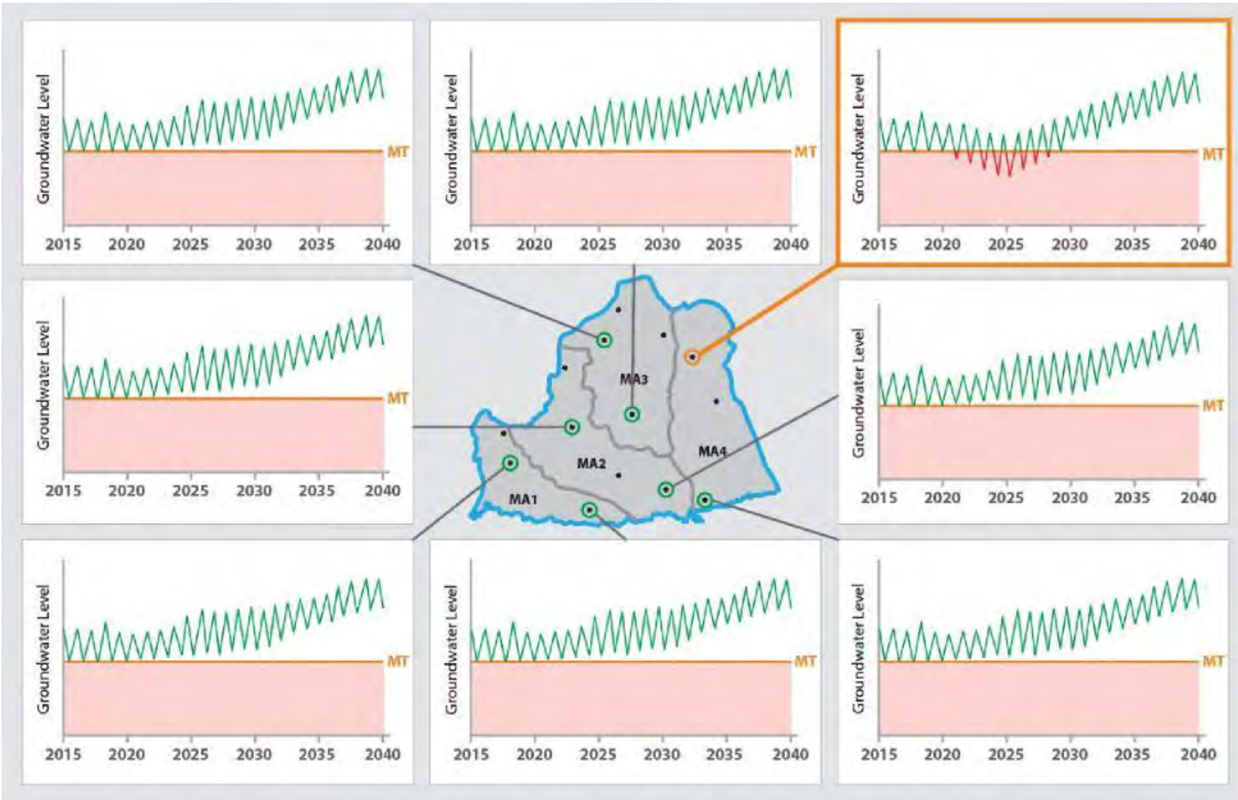


Figure 11. Example Groundwater Level Representative Monitoring Sites – Scenario 1

Scenario 2 – Minimum Threshold Exceedances with Undesirable Results Eliminated Within 20 Years

In this scenario (**Figure 12**), three of the eight representative monitoring wells have periodic minimum threshold exceedances over a several-year period after submission of the GSP. After this period, groundwater levels at the three representative monitoring sites increase and remain above their respective minimum thresholds. Groundwater levels at all other representative monitoring sites remain above the minimum threshold for the entire 20-year period following GSP submission. Groundwater levels at all sites are at or above the measurable objective at the end of the 20-year period.

As opposed to Scenario 1, this basin did experience an undesirable result during the period of minimum threshold exceedance at the three representative monitoring wells. However, the basin was sustainably managed because the GSA planned for a period of minimum threshold exceedances via their interim milestones, and because the GSA implemented necessary projects and management actions to eliminate the undesirable result and achieve the measurable objective.

Note that if the GSAs in this hypothetical basin had not planned for continued groundwater level decline via appropriate interim milestones, or had not implemented the necessary projects and management actions to eliminate the undesirable result, the Department could have determined that the GSA was not likely to achieve the sustainability goal for the basin within the 20-year period.

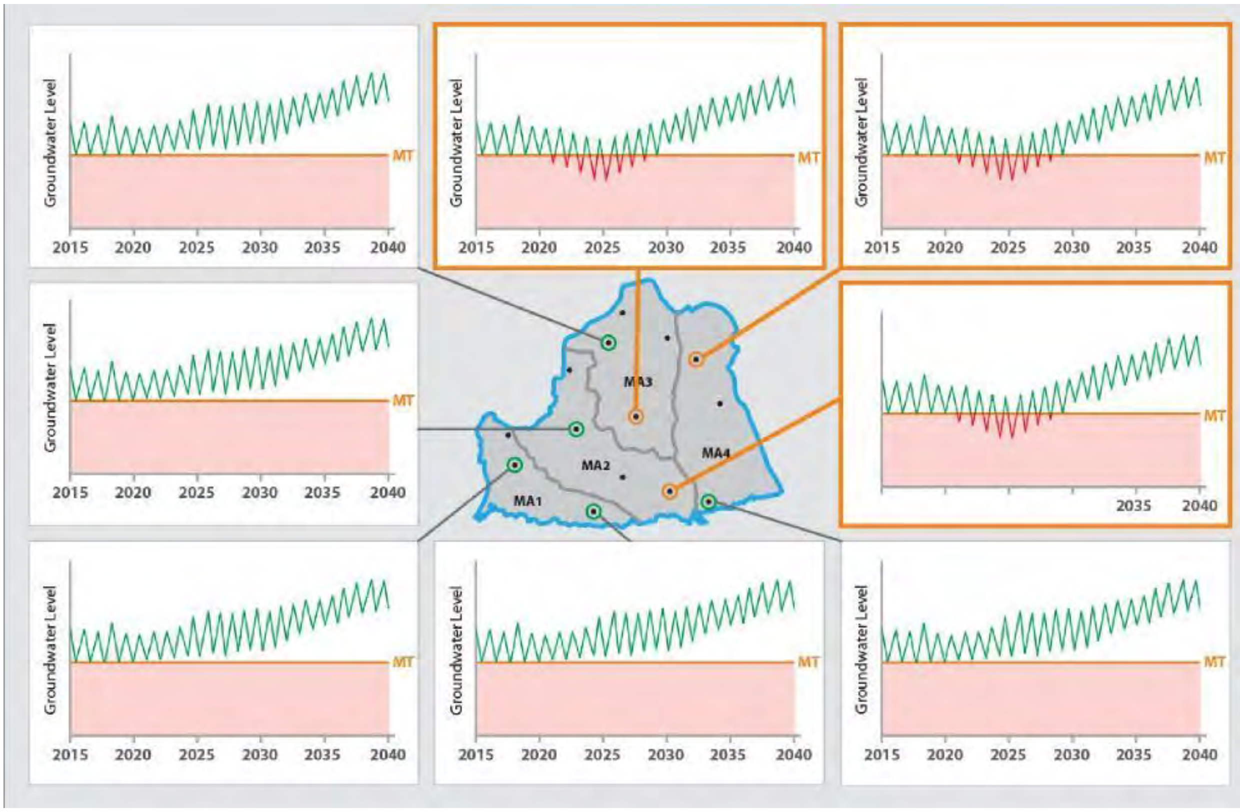


Figure 12. Example Groundwater Level Representative Monitoring Sites – Scenario 2

Scenario 3 – Minimum Threshold Exceedances with Undesirable Results Not Eliminated Within 20 Years

In this scenario (**Figure 13**), three of the eight representative monitoring wells have minimum threshold exceedances beginning approximately five years after submission of the GSP. Unlike Scenario 2, groundwater levels continue to decline at the three representative monitoring sites throughout the 20-year period following GSP submission, and are well below both their minimum thresholds and interim milestones. The basin experiences an undesirable result when the three wells begin exceeding their minimum thresholds, and the undesirable result persists throughout the 20-year period. Sustainable groundwater management was not achieved in the basin for this scenario.

Although this example shows undesirable results persisting for the 20-year period, in a real situation the Department would likely determine that the GSA was unlikely to achieve the sustainability goal at one of the interim milestones, thereby triggering State intervention much earlier in the 20-year period. It is beyond the scope of this example or this document to discuss details of State intervention, but it is important to note that State intervention can occur within the 20-year period following GSP submittal.

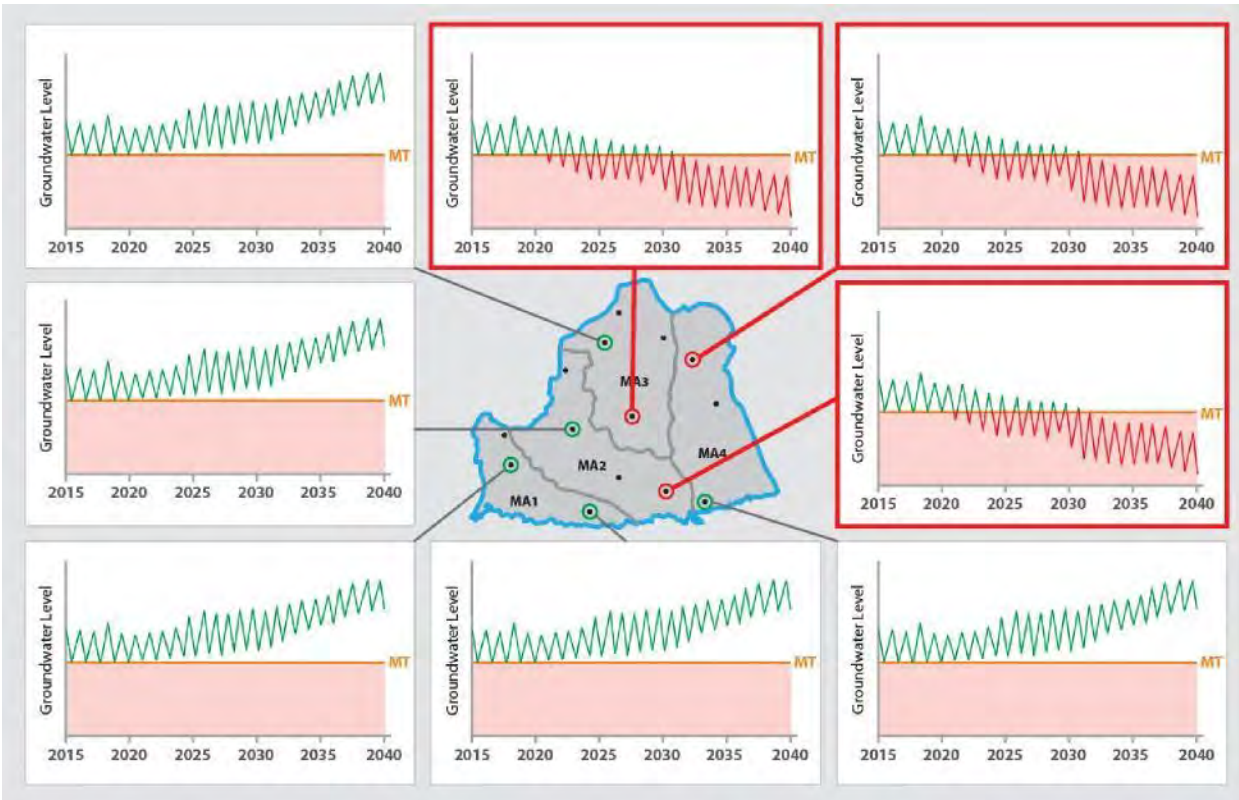


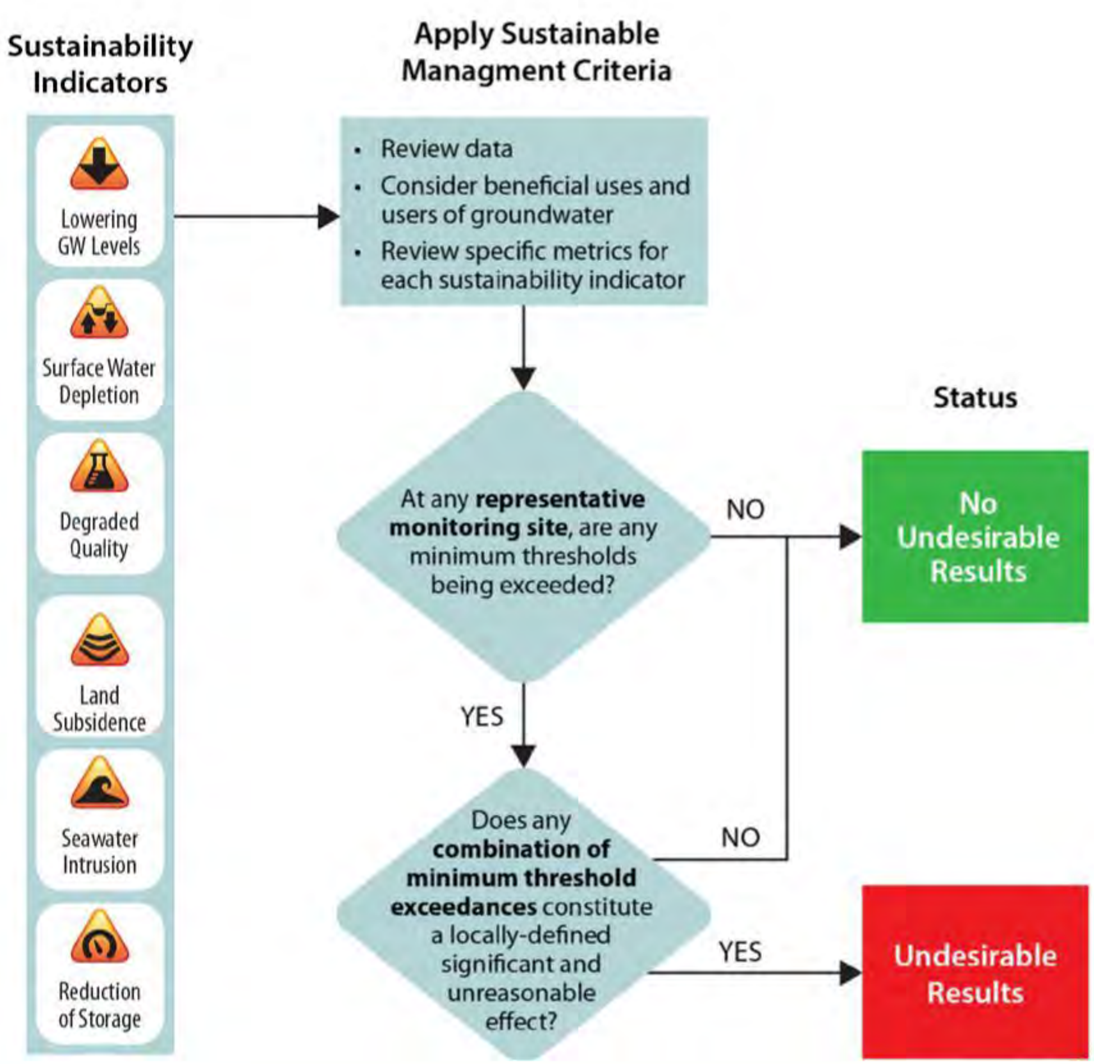
Figure 13. Example Groundwater Level Representative Monitoring Sites – Scenario 3

Relationship between Sustainability Indicators, Minimum Thresholds, and Undesirable Results

Sustainability indicators are the six effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, are undesirable results. For example, surface water depletion due to groundwater pumping is a sustainability indicator because it is an effect that must be monitored to determine whether it has become significant and unreasonable.

Sustainability indicators become undesirable results when a GSA-defined combination of minimum thresholds is exceeded. Those combinations of minimum threshold exceedances define when a basin condition becomes significant and unreasonable.

The relationship between sustainability indicators, minimum thresholds, and undesirable results is shown in the illustration below.



MEASURABLE OBJECTIVES

Measurable objectives are quantitative goals that reflect the basin's desired groundwater conditions and allow the GSA to achieve the sustainability goal within 20 years. Measurable objectives are set for each sustainability indicator at the same representative monitoring sites and using the same metrics as minimum thresholds. Measurable objectives should be set such that there is a reasonable margin of operational flexibility (**Figure 14**) between the minimum threshold and measurable objective that will accommodate droughts, climate change, conjunctive use operations, or other groundwater management activities. There are exceptions to this general rule. For example, if the minimum threshold for land subsidence is zero, the measurable objective may also be zero. Projects and management actions included in GSPs should be designed to meet the measurable objectives, with specific descriptions of how those projects and management actions will achieve their desired goals.

In addition to the measurable objective, interim milestones must be defined in five-year increments[16] at each representative monitoring site using the same metrics as the measurable objective, as illustrated in **Figure 14**. These interim milestones are used by GSAs and the Department to track progress toward meeting the basin's sustainability goal. Interim milestones must be coordinated with projects and management actions proposed by the GSA to achieve the sustainability goal. The schedule for implementing projects and management actions will influence how rapidly the interim milestones approach the measurable objectives (i.e., the path to sustainable groundwater management).

The Department will periodically (at least every five years) review GSPs to determine, among other items, whether failure to meet interim milestones is likely to affect the ability of the GSA(s) in a basin to achieve the sustainability goal.[17]

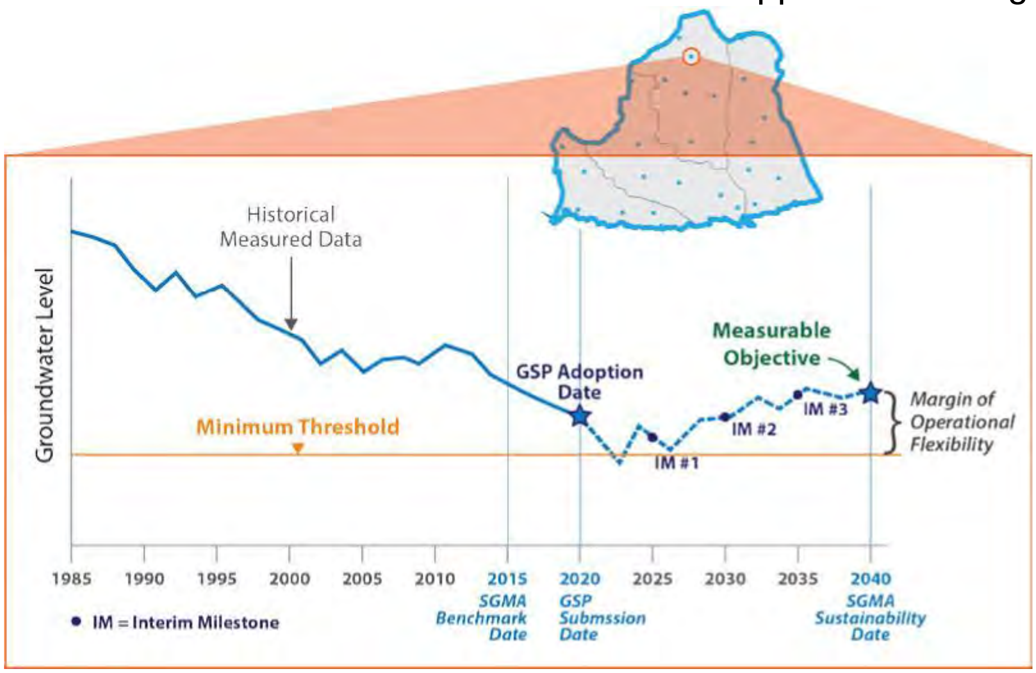


Figure 14. Relationship between Minimum Thresholds, Measurable Objectives, Interim Milestones (IM), and Margin of Operational Flexibility for a Representative Monitoring Site

The Path to Sustainable Groundwater Management

There will be many paths to sustainable groundwater management based on groundwater conditions and locally-defined values. **Figure 14** shows the relationship between minimum thresholds, measurable objectives, interim milestones, and margin of operational flexibility for a hypothetical basin. In the example used for **Figure 14**, groundwater levels are predicted to initially decline for the first five years after GSP adoption, and then rise over the subsequent 15 years to meet the measurable objective. At five-year increments, there are interim milestones to check the basin's progress towards the measurable objective. In **Figure 14**, the measured data never drops below the minimum threshold. This is just one example of a path towards reaching sustainability. The Department recognizes that there are different sustainability paths based on basin conditions, future supply and demand forecasts, and implementation of groundwater improvement projects. Three additional potential paths to sustainability are illustrated in **Figure 15**.

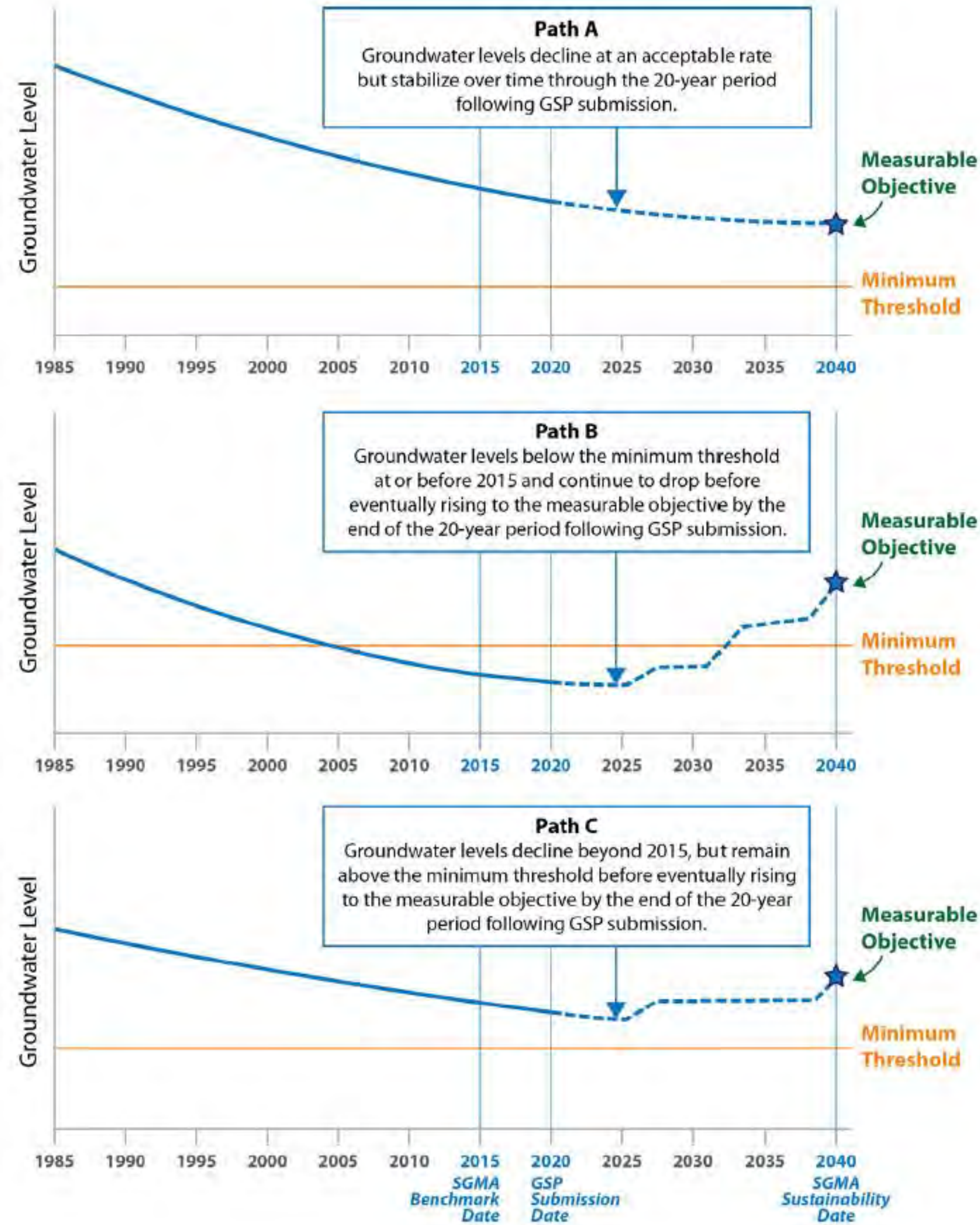


Figure 15. Potential Paths to Sustainability

Measurable Objectives when an Undesirable Result Occurred before January 1, 2015

SGMA states that a GSP "may, but is not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015." Once minimum thresholds have been developed and an undesirable result numerically defined, the GSA may evaluate whether that undesirable result was present prior to January 1, 2015. This evaluation is not possible until the GSA has defined what constitutes a significant and unreasonable condition (an undesirable result).

SUSTAINABILITY GOAL

GSAs must develop a sustainability goal that is applicable to the entire basin.

The sustainability goal should succinctly state the GSA's objectives and desired conditions of the groundwater basin, how the basin will get to that desired condition, and why the measures planned will lead to success.

Unlike the other sustainable management criteria, the sustainability goal is not quantitative. Rather, it is supported by the locally-defined minimum thresholds and undesirable results. Demonstration of the absence of undesirable results supports a determination that basin is operating within its sustainable yield and, thus, that the sustainability goal has been achieved.

GSA's should consider the following when developing their sustainability goal:

- **Goal description**. The goal description should qualitatively state the GSA's objective or mission statement for the basin. The goal description should summarize the overall purpose for sustainably managing groundwater resources and reflect local economic, social, and environmental values within the basin.
- **Discussion of measures**. The sustainability goal should succinctly summarize the measures that will be implemented. This description of measures should be consistent with, but may be less detailed than, the description of projects and management actions proposed in the GSP. Examples of measures a GSA could implement include demand reduction and development of groundwater recharge projects. The goal should affirm that these measures will lead to operation of the basin within its sustainable yield.
- **Explanation of how the goal will be achieved in 20 years**. The sustainability goal should describe how implementation of the measures will result in sustainability. For example, if the measures include demand reduction and implementation of groundwater recharge projects, then the goal would explain how those measures will lead to sustainability (e.g., they will raise groundwater levels above some threshold values and eliminate or reduce future land subsidence).

Note that most of the sustainability goal can only be finalized after minimum thresholds and undesirable results have been defined, projects and management actions have been identified, and the projected impact of those projects and management actions on groundwater conditions have been evaluated. Therefore, completion of the sustainability goal will likely be one of the final components of GSP development.

Role of Sustainable Yield Estimates in SGMA

In general, the sustainable yield of a basin is the amount of groundwater that can be withdrawn annually without causing undesirable results. Sustainable yield is referenced in SGMA as part of the estimated basinwide water budget and as the outcome of avoiding undesirable results.

Sustainable yield estimates are part of SGMA's required basinwide water budget. Section 354.18(b)(7) of the GSP Regulations requires that an estimate of the basin's sustainable yield be provided in the GSP (or in the coordination agreement for basins with multiple GSPs). A single value of sustainable yield must be calculated basinwide. This sustainable yield estimate can be helpful for estimating the projects and programs needed to achieve sustainability.

SGMA does not incorporate sustainable yield estimates directly into sustainable management criteria. Basinwide pumping within the sustainable yield estimate is neither a measure of, nor proof of, sustainability. Sustainability under SGMA is only demonstrated by avoiding undesirable results for the six sustainability indicators.

CONCLUSIONS

The key to demonstrating a basin is meeting its sustainability goal is by avoiding undesirable results. Sustainable management criteria are critical elements of the GSP that define sustainability in the basin.

Before setting sustainable management criteria, the GSA should understand the basin setting by establishing a hydrogeological conceptual model, engage stakeholders, and define management areas as applicable. This document addresses best management practices for developing sustainable management criteria, including minimum thresholds, undesirable results, measurable objectives, and the sustainability goal.

Setting sustainable management criteria can be a complex, time consuming, and iterative process depending on the complexity of the basin and its stakeholders. GSAs should allow sufficient time for criteria development during the GSP development process. The public should be engaged early in the process so their perspectives can be considered during sustainable management criteria development. To ensure timely stakeholder participation, it may be useful for GSAs to set a timeline for development of the sustainable management criteria.

5. KEY DEFINITIONS

The key definitions related to sustainable management criteria development outlined in applicable SGMA code and regulations are provided below for reference.

SGMA Definitions (California Water Code 10721)

(d) "Coordination agreement" means a legal agreement adopted between two or more groundwater sustainability agencies that provides the basis for coordinating multiple agencies or groundwater sustainability plans within a basin pursuant to this part.

(r) "Planning and implementation horizon" means a 50-year period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.

(u) "Sustainability goal" means 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.

(v) "Sustainable groundwater management" means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) "Sustainable yield" means 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.

(x) "Undesirable result" means one or more of the following effects caused by groundwater conditions occurring throughout the basin:

(1) Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

(2) Significant and unreasonable reduction of groundwater storage.

(3) Significant and unreasonable seawater intrusion.

(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.

(6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Groundwater Sustainability Plan Regulations (California Code of Regulations 351)

(g) "Basin setting" refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.

(h) "Sustainability indicator" refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

(q) "Interim milestone" refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

(r) "Management area" refers to an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.

(s) "Measurable objectives" refer to 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.

(t) "Minimum threshold" refers to a numeric value for each sustainability indicator used to define undesirable results.

(x) "Plan" refers to a groundwater sustainability plan as defined in the Act.

(y) "Plan implementation" refers to an 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.

(ag) "Statutory deadline" refers to the date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.

NOTES

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[1] See 23 CCR § 350 *et seq*.

[2] See Water Code § 10720 *et seq*.

[3] See 23 CCR § 355.4(b)(1)

[4] See Water Code § 10721(v)

[5] See 23 CCR § 354.22 *et seq.*

[6] See 23 CCR § 351(ah); *see also* Water Code § 10721(x).

[7] See 23 CCR § 354.28(b)

[8] See 23 CCR § 354.28(c)

[9] See 23 CCR § 354.28(d)

[10] See 23 CCR § 354.30(d)

[11] See 23 CCR § 354.36(b)

[12] See 23 CCR § 354.26(b)

[13] See 23 CCR 354.26(b)(1)

[14] See 23 CCR 354.26(b)(2)

[15] See 23 CCR 354.26(b)(3)

[16] See 23 CCR § 354.30(e)

[17] See 23 CCR § 355.6(c)(1)

Appendix N. Monitoring Protocols BMP

Groundwater Monitoring Protocols, Standards, and Sites Best Management Practice

1. OBJECTIVE

The objective of this Best Management Practice (BMP) is to assist in the development of Monitoring Protocols. The California Department of Water Resources (the Department or DWR) has developed a Best Management Practice for Groundwater Monitoring Protocols, Standards and Sites, as part of the obligation in the Technical Assistance chapter (Chapter 7) of the Sustainable Groundwater Management Act (SGMA) to support the long-term sustainability of California's groundwater basins. The SJREC GSA has reviewed and updated this BMP for inclusion in the GSP. This BMP provides technical assistance to Groundwater Sustainability Agencies (GSAs) and other stakeholders to aid in the establishment of consistent data collection processes and procedures. Finally, this BMP identifies available resources to support the development of monitoring protocols.

This BMP includes the following sections:

1. Objective. A brief description of how and where monitoring protocols are required under SGMA and the overall objective of this BMP.
2. Use and Limitations. A brief description of the use and limitations of this BMP.
3. Monitoring Protocol Fundamentals. A description of the general approach and background of groundwater monitoring protocols.
4. Relationship of Monitoring Protocols to other BMPs. A description of how this BMP is connected with other BMPS.
5. Technical Assistance. Technical content providing guidance for regulatory sections.
6. Key Definitions. Descriptions of definitions identified in the GSP Regulations or SGMA.
7. Related Materials. References and other materials that provide supporting information related to the development of Groundwater Monitoring Protocols.

2. USE AND LIMITATIONS

BMPs developed by the Department, and updated by the SJREC GSA, provides technical guidance to GSAs and other stakeholders. Practices described in these BMPs do not replace the GSP Regulations, nor do they create new requirements or obligations for GSAs or other stakeholders. In addition, using this BMP to develop a GSP does not equate to an approval determination by the Department. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2. All references to SGMA relate to California Water Code sections in Division 6, Part 2.74.

3. MONITORING PROTOCOL FUNDAMENTALS

Establishing data collection protocols that are based on best available scientific methods is essential. Protocols that can be applied consistently across all basins will likely yield comparable data. Consistency of data collection methods reduces uncertainty in the comparison of data and facilitates more accurate communication within basins as well as between basins.

Basic minimum technical standards of accuracy lead to quality data that will better support implementation of GSPs.

4. RELATIONSHIP OF MONITORING PROTOCOL TO OTHER BMPS

Groundwater monitoring is a fundamental component of SGMA, as each GSP must include a sufficient network of data that demonstrates measured progress toward the achievement of the sustainability goal for each basin. Where applicable and within reason, a standard set of protocols needs to be developed and utilized.

It is important that data is developed in a manner consistent with the basin setting, planning, and projects/management actions steps identified on **Figure 1** and the GSP Regulations. The inclusion of monitoring protocols in the GSP Regulations also emphasizes the importance of quality empirical data to support GSPs and provide comparable information from basin to basin.

Figure 1 provides a logical progression for the development of a GSP and illustrates how monitoring protocols are linked to other related BMPs. This figure also shows the context of the BMPs as they relate to various steps to sustainability as outlined in the GSP Regulations. The monitoring protocol BMP is part of the Monitoring step identified in **Figure 1**.

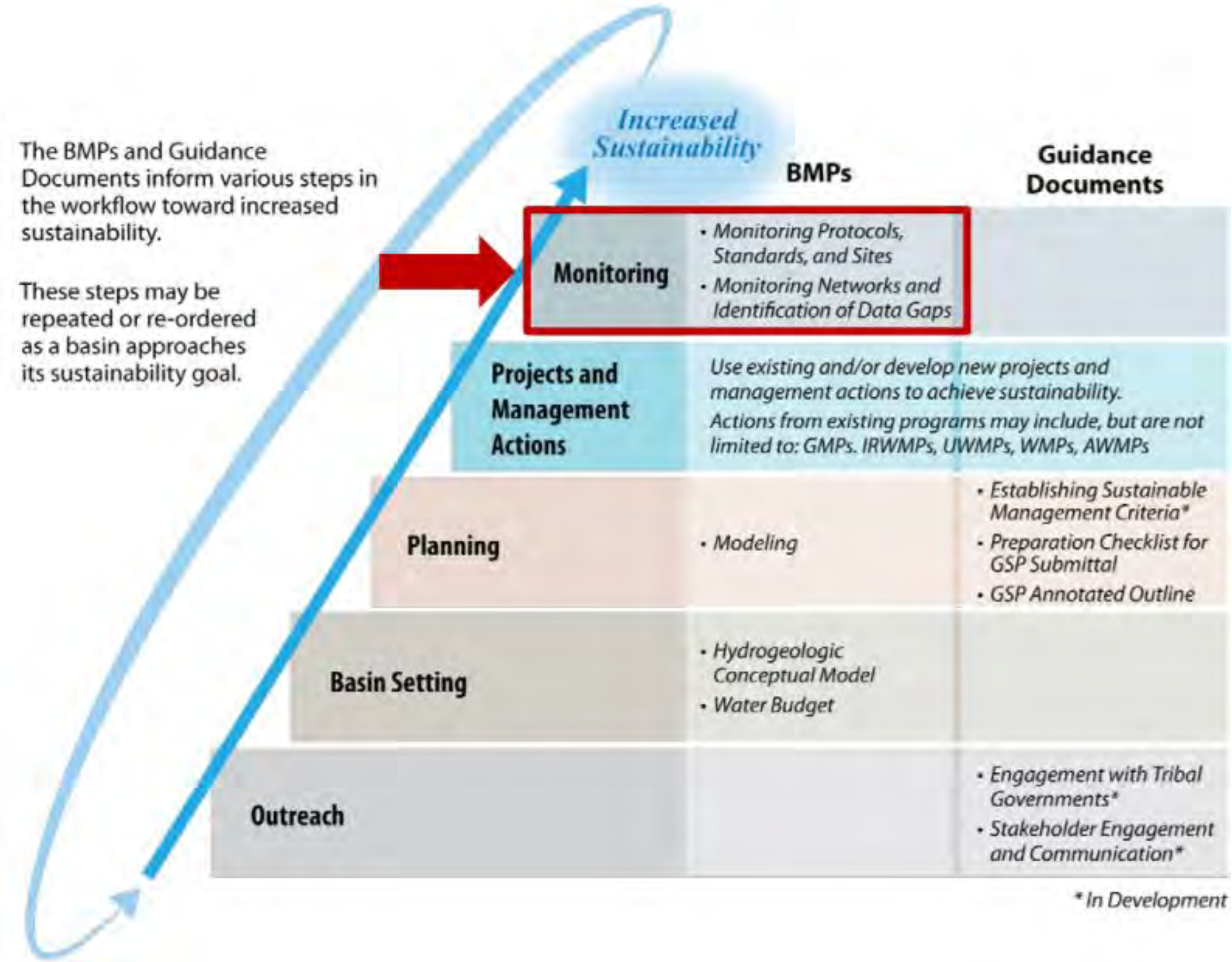

Figure 1 – Logical Progression of Basin Activities Needed to Increase Basin Sustainability

5. TECHNICAL ASSISTANCE

> *23 CCR §352.2. Monitoring Protocols. Each Plan shall include monitoring protocols adopted by the Agency for data collection and management, as follows:*
> *(a) Monitoring protocols shall be developed according to best management practices.*
> *(b) The Agency may rely on monitoring protocols included as part of the best management practices developed by the Department, or may adopt similar monitoring protocols that will yield comparable data.*
> *(c) Monitoring protocols shall be reviewed at least every five years as part of the periodic evaluation of the Plan, and modified as necessary.*

The GSP Regulations specifically call out the need to utilize protocols identified by DWR, or develop similar protocols. The following technical protocols provide guidance based upon existing professional standards and are commonly adopted in various groundwater-related programs. They provide clear techniques that yield quality data for use in the various components of the GSP. They can be further elaborated on by individual GSAs in the form of standard operating procedures which reflect specific local requirements and conditions. While many methodologies are suggested in this BMP, it should be understood that qualified professional judgment should be used to meet the specific monitoring needs.

The following BMPs may be incorporated into a GSP's monitoring protocols section for collecting groundwater elevation data. A GSP that adopts protocols that deviate from the DWR BMPs must demonstrate that they will yield comparable data.

PROTOCOLS FOR ESTABLISHING A MONITORING PROGRAM

The protocol for establishment of a monitoring program should be evaluated in conjunction with the Monitoring Network and Identification of Data Gaps BMP and other BMPs. Monitoring protocols must take into consideration the Hydrogeologic Conceptual Model, Water Budget, Modeling and Sustainable Management Criteria BMPs when considering the data needs to meet GSP objectives and the sustainability goal.

It is suggested that each GSP incorporate the Data Quality Objective (DQO) process following the U.S. EPA Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA, 2006). Although strict adherence to this method is not required, it does provide a robust approach to consider and assures that data is collected with a specific purpose in mind, and efforts for monitoring are as efficient as possible to achieve the objectives of the GSP and compliance with the GSP Regulations.

The steps of the DQO process should be used to guide GSAs to develop the most efficient monitoring process to meet the measurable objectives of the GSP and the sustainability goal. The DQO process is an iterative process and should be evaluated regularly to improve monitoring efficiencies and meet changing planning and project needs. Following the DQO process, GSAs should also include a data quality control and quality assurance plan to guide the collection of data.

Many monitoring programs already exist as part of ongoing groundwater management or other programs. To the extent possible, the use of existing monitoring data and programs should be utilized to meet the needs for characterization, historical record documentation, and continued monitoring for the

SGMA program. However, an evaluation of the existing monitoring data should be performed to assure the data being collected meets the DQOs, regulatory requirements, and data collection protocol described in this BMP. While this BMP provides guidance for collection of various regulatory based requirements, there is flexibility among the various methodologies available to meet the DQOs based upon professional judgment (local conditions or project needs).

At a minimum, for each monitoring site, the following information or procedure should be collected and documented:

- Long-term access agreements. Access agreements should include year-round site access to allow for increased monitoring frequency.
- A unique identifier that includes a general written description of the site location, date established, access instructions and point of contact (if necessary), type of information to be collected, latitude, longitude, and elevation. Each monitoring location should also track all modifications to the site in a modification log.

PROTOCOLS FOR MEASURING GROUNDWATER LEVELS

This section presents considerations for the methodology of collection of groundwater level data such that it meets the requirements of the GSP Regulations and the DQOs of the specific GSP. Groundwater levels are a fundamental measure of the status of groundwater conditions within a basin. In many cases, relationships of the sustainability indicators may be able to be correlated with groundwater levels. The quality of this data must consider the specific aquifer being monitored and the methodology for collecting these levels.

The following considerations for groundwater level measuring protocols should ensure the following:

- Groundwater level data are taken from the correct location, well ID, and screen interval depth
- Groundwater level data are accurate and reproducible
- Groundwater level data represent conditions that inform appropriate basin management DQOs
- All salient information is recorded to correct, if necessary, and compare data
- Data are handled in a way that ensures data integrity

General Well Monitoring Information

The following presents considerations for collection of water level data that include regulatory required components as well as those which are recommended.

- Groundwater elevation data will form the basis of basin-wide water-table and piezometric maps, and should approximate conditions at a discrete period in time. Therefore, all groundwater levels in a basin should be collected within as short a time as possible, preferably within a 1 to 2 week period.
- Depth to groundwater must be measured relative to an established Reference Point (RP) on the well casing. The RP is usually identified with a permanent marker, paint spot, or a notch in the lip of the well casing. By convention in open casing monitor wells, the RP reference point is located on the north side of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing.

- The elevation of the RP of each well must be surveyed to the North American Vertical Datum of 1988 (NAVD88), or a local datum that can be converted to NAVD88. The elevation of the RP must be accurate to within 0.5 foot. It is preferable for the RP elevation to be accurate to 0.1 foot or less. Survey grade global navigation satellite system (GNSS) global positioning system (GPS) equipment can achieve similar vertical accuracy when corrected. Guidance for use of GPS can be found at USGS http://water.usgs.gov/osw/gps/.
- The sampler should remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a release is observed, the measurement should follow a period of time to allow the water level to equilibrate.
- Depth to groundwater must be measured to an accuracy of 0.1 foot below the RP.
- The water level meter should be decontaminated after measuring each well.

Where existing wells do not meet the base standard as described in the GSP Regulations or the considerations provided above, new monitor wells may need to be constructed to meet the DQOs of the GSP. The design, installation, and documentation of new monitor wells must consider the following:

- Construction consistent with California Well Standards as described in Bulletins 74-81 and 74-90, and local permitting agency standards of practice.
- Logging of borehole cuttings under the supervision of a California Professional Geologist and described consistent with the Unified Soil Classification System methods according to ASTM standard D2487-11.
- Written criteria for logging of borehole cuttings for comparison to known geologic formations, principal aquifers and aquitards/aquicludes, or specific marker beds to aid in consistent stratigraphic correlation within and across basins.
- Geophysical surveys of boreholes to aid in consistency of logging practices. Methodologies should include resistivity, spontaneous potential, spectral gamma, or other methods as appropriate for the conditions. Selection of geophysical methods should be based upon the opinion of a professional geologist or professional engineer, and address the DQOs for the specific borehole and characterization needs.
- Prepare and submit State well completion reports according to the requirements of §13752. Well completion report documentation should include geophysical logs, detailed geologic log, and formation identification as attachments. An example well completion as-built log is illustrated in **Figure 2**. DWR well completion reports can be filed directly at the Online System for Well Completion Reports (OSWCR) http://water.ca.gov/oswcr/index.cfm.

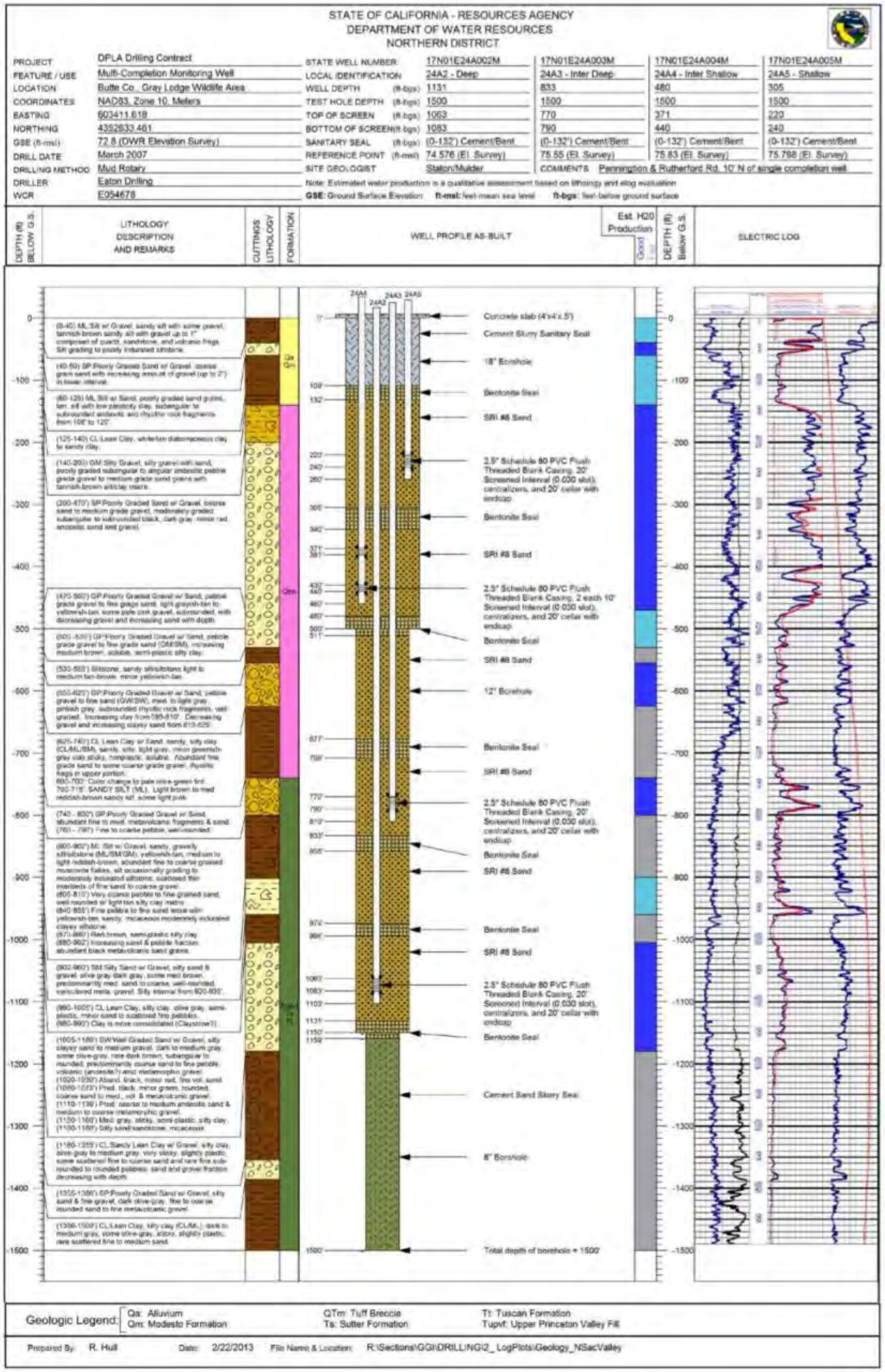

Figure 2 – Example As-Built Multi-Completion Monitor Well Log

Measuring Groundwater Levels

Well construction, anticipated groundwater level, groundwater level measuring equipment, field conditions, and well operations should be considered prior collection of the groundwater level measurement. The USGS Groundwater Technical Procedures (Cunningham and Schalk, 2011) provide a thorough set of procedures which can be used to establish specific Standard Operating Procedures (SOPs) for a local agency. **Figure 3** illustrates a typical groundwater level measuring event and simultaneous pressure transducer download.

Figure 3 – Collection of Water Level Measurement and Pressure Transducer Download

The following points provide a general approach for collecting groundwater level measurements:

- Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions.
- For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well has reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a questionable measurement. In the event that a well is artesian, site specific procedures should be developed to collect accurate information and be protective of safety conditions associated with a pressurized well. In many cases, an extension pipe may be adequate to stabilize head in the well. Record the dimension of the extension and document measurements and configuration.
- The sampler should calculate the groundwater elevation as:

$$\text{GWE} = R\text{PE} - D\text{TW}$$

Where:

GWE = Groundwater Elevation

RPE = Reference Point Elevation

DTW = Depth to Water

The sampler must ensure that all measurements are in consistent units of feet, tenths of feet, and hundredths of feet. Measurements and RPEs should not be recorded in feet and inches.

Recording Groundwater Levels

- To the greatest extent possible, the sampler should use the GPS locator in the SJREC GSA's DMS to ensure location accuracy. To limit data entry error, only date, time DTW and comments will be entered directly into the DMS. At sites not accessible to the DMS, the sampler should record the well identifier, date, time (24-hour format), DTW, and comments regarding any factors that may influence the depth to water readings such as weather, nearby irrigation, flooding, potential for tidal influence, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. An example of a field sheet with the required information is shown in **Figure 4**. It includes questionable measurement and no measurement codes that should be noted. This field sheet is provided as an example. Standardized field forms should be used for all data collection. The aforementioned USGS Groundwater Technical Procedures offers a number of example forms.
- The sampler should replace any well caps or plugs, and lock any well buildings or covers.
- All data should be entered into the GSA data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person for compliance with the DQOs

STATE OF CALIFORNA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WELL DATA

STATE WELL NUMBER	COUNTY	REFERENCE POINT ELEV.	MEASURING AGENCY
			DWR

NO MEASUREMENT	QUESTIONABLE MEASUREMENT
0. Measurement discontinued	0. Caved or deepened
1. Pumping	1. Pumping
2. Pump house locked	2. Nearby pump operating
3. Tape hung up	3. Casing leaky or wet
4. Can't get tape in casing	4. Pumped recently
5. Unable to locate well	5. Air or pressure gauge measurement
6. Well has been destroyed	6. Other
7. Special	7. Recharge operation at or nearby well
8. Casing leaky or wet	8. Oil in casing
9. Temporarily inaccessible	

DATE	N M	Q M	TAPE AT RP	TAPE AT WS	RP to WS	OBSR VR	COMMENTS

DWR 1213

Figure 4 – Example of Water Level Well Data Field Collection Form

Pressure Transducers

Groundwater levels and/or calculated groundwater elevations may be recorded using pressure transducers equipped with data loggers installed in monitor wells. When installing pressure transducers, care must be exercised to ensure that the data recorded by the transducers is confirmed with hand measurements.

The following general protocols must be followed when installing a pressure transducer in a monitor well:

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

PROTOCOLS FOR SAMPLING GROUNDWATER QUALITY

The following protocols can be incorporated into a GSP's monitoring protocols for collecting groundwater quality data. More detailed sampling procedures and protocols are included in the standards and guidance documents listed at the end of this BMP.

In general, the use of existing water quality data within the basin should be done to the greatest extent possible if it achieves the DQOs for the GSP. In some cases it may be necessary to collect additional water quality data to support monitoring programs or evaluate specific projects. The USGS National Field Manual for the Collection of Water Quality Data (Wilde, 2005) can be used as a guide for the collection of reliable data. **Figure 5** illustrates a typical groundwater quality sampling setup.

Figure 5 – Typical Groundwater Quality Sampling Event December 2016 Groundwater Monitoring Protocols, Standards, and Sites BM

All analyses should be performed by a laboratory certified under the State Environmental Laboratory Accreditation Program or by a certified technician when applicable. The specific analytical methods are beyond the scope of this BMP, but should be commiserate with other programs evaluating water quality within the basin for comparative purposes.

Groundwater quality sampling protocols should ensure that:

- Groundwater quality data are taken from the correct location
- Groundwater quality data are accurate and reproducible
- Groundwater quality data represent conditions that inform appropriate basin management and are consistent with the DQOs
- All salient information is recorded to normalize, if necessary, and compare data
- Data are handled in a way that ensures data integrity

The following points are general guidance in addition to the techniques presented in the previously mentioned USGS National Field Manual for the Collection of Water Quality Data.

Standardized protocols include the following:

- Prior to sampling, the sampler must contact the laboratory to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- To the greatest extent possible, the sampler should use the GPS locator in the SJREC GSA's DMS to ensure location accuracy. Each well used for groundwater quality monitoring must have a unique identifier. This identifier must appear on the well housing or the well casing to avoid confusion.
- In the case of wells with dedicated pumps, samples should be collected at or near the wellhead. Samples should not be collected from storage tanks, at the end of long pipe runs, or after any water treatment.
- The sampler should clean the sampling port and/or sampling equipment and the sampling port and/or sampling equipment must be free of any contaminants. The sampler must decontaminate sampling equipment between sampling locations or wells to avoid cross-contamination between samples.
- The groundwater elevation in the well should be measured following appropriate protocols described above in the groundwater level measuring protocols.
- For any well not equipped with low-flow or passive sampling equipment, an adequate volume of water should be purged from the well to ensure that the groundwater sample is representative of ambient groundwater and not stagnant water in the well casing. Purging three well casing volumes is generally considered adequate. Professional judgment should be used to determine the proper configuration of the sampling equipment with respect to well construction such that a representative ambient groundwater sample is collected. If pumping causes a well to be evacuated (go dry), document the condition and allow well to recover to within 90% of original level prior to sampling. Professional judgment should be exercised as to whether the sample will meet the DQOs and adjusted as necessary.
- Field parameters of pH, electrical conductivity, and temperature should be collected for each sample. Field parameters should be evaluated during the purging of the well and should stabilize prior to sampling. Measurements of pH should only be measured in the field, lab pH analysis are typically unachievable due to short hold times. Other parameters, such as oxidation-reduction potential (ORP), dissolved oxygen (DO) (in situ measurements preferable), or turbidity, may also be useful for meeting DQOs of GSP and assessing purge conditions. Where applicable, field instruments should be calibrated daily and evaluated for drift throughout the day.
- Sample containers should be labeled prior to sample collection. The sample label must include: sample ID (often well ID), sample date and time, sample personnel, sample location, preservative used, and analytes and analytical method.
- If possible, samples should be collected under laminar flow conditions.
- Samples should be collected according to appropriate standards such as those listed in the Standard Methods for the Examination of Water and Wastewater, USGS National Field Manual for the Collection of Water Quality Data, or other appropriate guidance. The specific sample collection procedure should reflect the type of analysis to be performed and DQOs.
- All samples requiring preservation must be preserved as soon as practically possible, ideally at the time of sample collection. Ensure that samples are appropriately filtered as recommended for the specific analyte. Entrained solids can be dissolved by preservative leading to inconsistent

results of dissolve analytes. Specifically, samples to be analyzed for metals should be field-filtered prior to preservation; do not collect an unfiltered sample in a preserved container.

- Samples should be chilled and maintained per recommendation to prevent degradation of the sample. The laboratory's Quality Assurance Management Plan should detail appropriate chilling and shipping requirements.
- Samples must be shipped under chain of custody documentation to the appropriate laboratory promptly to avoid violating holding time restrictions.
- Instruct the laboratory to use reporting limits that are equal to or less than the applicable DQOs, regional water quality objectives/screening levels, or recommendation of a licensed professional.

Special protocols for low-flow sampling equipment

In addition to the protocols listed above, sampling using low-flow sample equipment should adopt the following protocols derived from EPA's Low-flow (minimal drawdown) ground-water sampling procedures (Puls and Barcelona, 1996). These protocols apply to low-flow sampling equipment that generally pumps between 0.1 and 0.5 liters per minute. These protocols are not intended for bailers.

Special protocols for passive sampling equipment

In addition to the protocols listed above, passive diffusion samplers should follow protocols set forth in USGS Fact Sheet 088-00.

PROTOCOLS FOR MONITORING SEAWATER INTRUSION

The Delta-Mendota Subbasin is highly unlikely to have Significant and Unreasonable Seawater Intrusion. For that reason, monitoring protocols for seawater intrusion have not been developed. In the unlikely event that seawater intrusion must be monitored in the Delta-Mendota Subbasin, the SJREC GSA will review BMP's to address the concern.

+**PROTOCOLS FOR MEASURING STREAMFLOW**

Monitoring of streamflow is necessary for incorporation into water budget analysis and for use in evaluation of stream depletions associated with groundwater extractions. The use of existing monitoring locations should be incorporated to the greatest extent possible. Many of these streamflow monitoring locations currently follow the protocol described below.

Establishment of new streamflow discharge sites should consider the existing network and the objectives of the new location. Professional judgment should be used to determine the appropriate permitting that may be necessary for the installation of any monitoring locations along surface water bodies. Regular frequent access will be necessary to these sites for the development of ratings curves and maintenance of equipment.

To establish a new streamflow monitoring station special consideration must be made in the field to select an appropriate location for measuring discharge. Once a site is selected, development of a relationship of stream stage to discharge will be necessary to provide continuous estimates of streamflow. Several measurements of discharge at a variety of stream stages will be necessary to develop the ratings curve correlating stage to discharge. The use of Acoustic Doppler Current Profilers (ADCPs) can provide accurate estimates of discharge in the correct settings. Professional judgment must be exercised to determine the appropriate methodology. Following development of the ratings curve a simple stilling well and pressure transducer with data logger can be used to evaluate stage on a frequent basis. A simple stilling well and staff gage is illustrated in **Figure 6**.

Streamflow measurements should be collected, analyzed, and reported in accordance with the procedures outlined in USGS Water Supply Paper 2175, Volume 1. – Measurement of Stage Discharge and Volume 2. – Computation of Discharge. This methodology is currently being used by both the USGS and DWR for existing streamflow monitoring throughout the State.

Figure 6 – Simple Stilling Well and Staff Gage Setup

PROTOCOLS FOR MEASURING SUBSIDENCE

Evaluating and monitoring inelastic land subsidence can utilize multiple data sources to evaluate the specific conditions and associated causes. To the extent possible, the use of existing data should be utilized. Subsidence can be estimated from numerous techniques, they include: level surveying tied to known stable benchmarks or benchmarks located outside the area being studied for possible subsidence; installing and tracking changes in borehole extensometers; obtaining data from continuous GPS (CGPS) locations, static GPS surveys or Real-Time-Kinematic (RTK) surveys; or analyzing Interferometric Synthetic Aperture Radar (InSAR) data. No standard procedures exist for collecting data from the potential subsidence monitoring approaches. However, an approach may include:

- Identification of land subsidence conditions.
  - Evaluate existing regional long-term leveling surveys of regional infrastructure, i.e. roadways, railroads, canals, and levees.
  - Determine if significant fine-grained layers are present such that the potential for collapse of the units could occur should there be significant depressurization of the aquifer system.
  - Inspect geologic logs and the hydrogeologic conceptual model to aid in identification of specific units of concern.
  - Collect regional remote-sensing information such as InSAR, when and if available.
- Monitor regions of suspected subsidence where potential exists.
  - Use existing CGPS network to evaluate changes in land surface elevation. Review the need to establish new CGPS stations.
  - Establish leveling surveys transects to observe changes in land surface elevation.
  - Use existing extensometer network to observe land subsidence. An example of a typical extensometer design is illustrated in **Figure 7**. There are a variety of extensometer designs and they should be selected based on the specific DQOs. Review the need to establish new extensometer sites.

Various standards and guidance documents for collecting data include:

- Leveling surveys must follow surveying standards set out in the California Department of Transportation's Caltrans Surveys Manual. Any alternative shall be reviewed by a Professional Land Surveyor or Professional Civil Engineer registered in the State of California for accuracy and reasonableness.
- GPS surveys must follow surveying standards set out in the California Department of Transportation's Caltrans Surveys Manual. Any alternative shall be reviewed by a Professional Land Surveyor or Professional Civil Engineer registered in the State of California for accuracy and reasonableness.USGS has been performing subsidence surveys within several areas of California. These studies are sound examples for appropriate methods and should be utilized to the extent possible and where available:
  - http://ca.water.usgs.gov/land_subsidence/california-subsidencemeasuring.html
- Instruments installed in borehole extensometers must follow the manufacturer's instructions for installation, care, and calibration.
- Availability of InSAR data is improving and will increase as programs are developed. This method requires expertise in analysis of the raw data and will likely be made available as an interpretative report for specific regions.

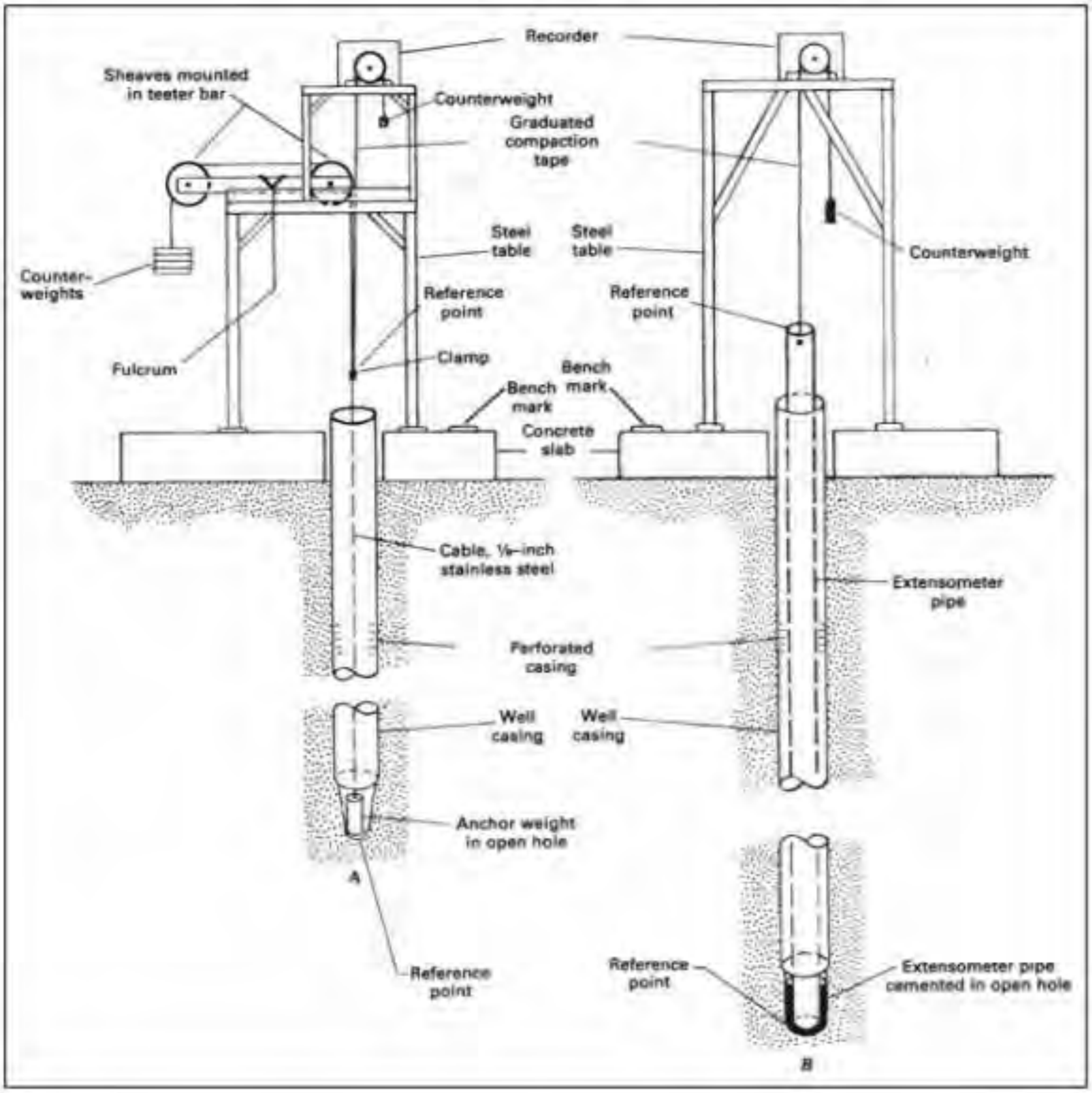

Figure 7 – Simplified Extensometer Diagram

6. KEY DEFINITIONS

The key definitions and sections related to Groundwater Monitoring Protocols, Standards, and Sites outlined in applicable SGMA code and regulations are provided below for reference.

Groundwater Sustainability Plan Regulations (California Code of Regulations §351)

- §351(h) "Best available science" refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.
- §351(i) "Best management practice" refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.

Monitoring Protocols Reference

§352.2. Monitoring Protocols

Each Plan shall include monitoring protocols adopted by the Agency for data collection and management, as follows:

(a) Monitoring protocols shall be developed according to best management practices.

(b) The Agency may rely on monitoring protocols included as part of the best management practices developed by the Department, or may adopt similar monitoring protocols that will yield comparable data.

(c) Monitoring protocols shall be reviewed at least every five years as part of the periodic evaluation of the Plan, and modified as necessary.

SGMA Reference

§10727.2. Required Plan Elements

(f) Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin. The monitoring protocols shall be designed to generate information that promotes efficient and effective groundwater management.

7. RELATED MATERIALS CASE STUDIES

Luhdorff & Scalmanini Consulting Engineers, J.W. Borchers, M. Carpenter. 2014. Land Subsidence from Groundwater Use in California. Full Report of Findings prepared for California Water Foundation. April 2014. 151 p. http://ca.water.usgs.gov/land_subsidence/california-subsidence-cause-effect.html

Faunt, C.C., M. Sneed, J. Traum, and J.T. Brandt, 2015. Water availability and land subsidence in the Central Valley, California, USA. Hydrogeol J (2016) 24: 675. doi:10.1007/s10040-015-1339-x. https://pubs.er.usgs.gov/publication/701605

Poland, J.F., B.E. Lofgren, R.L. Ireland, and R.G. Pugh, 1975. Land subsidence in the San Joaquin Valley, California, as of 1972; US Geological Survey Professional Paper 437-H; prepared in cooperation with the California Department of Water Resources, 87 p. http://pubs.usgs.gov/pp/0437h/report.pdf

Sneed, M., J.T. Brandt, and M. Solt, 2013. Land subsidence along the Delta-Mendota Canal in the northern part of the San Joaquin Valley, California, 2003-10; USGS Scientific Investigations Report 2013-5142, prepared in cooperation with U.S. Bureau of Reclamation and the San Luis and Delta-Mendota Water Authority. https://pubs.er.usgs.gov/publication/sir20135142

Sneed, M., J.T. Brandt, and M. Solt, 2014. Land subsidence, groundwater levels, and geology in the Coachella Valley, California, 1993–2010: U.S. Geological Survey, Scientific Investigations Report 2014–5075, 62 p. http://dx.doi.org/10.3133/sir20145075

STANDARDS

California Department of Transportation, various dates. Caltrans Surveys Manual. http://www.dot.ca.gov/hq/row/landsurveys/SurveysManual/Manual_TOC.html

U.S. Environmental Protection Agency, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4 https://www.epa.gov/sites/production/files/documents/guidance_systematic_planning_dqo_process.pdf

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Buchanan, T.J., and W.P. Somers, 1969. Discharge measurements at gaging stations; techniques of water-resources investigations of the United States Geologic Survey chapter A8, Washington D.C. http://pubs.usgs.gov/twri/twri3a8/html/pdf.html

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California Department of Water Resources, 2010. Groundwater elevation monitoring guidelines. http://www.water.ca.gov/groundwater/casgem/pdfs/CASGEM%20DWR%20GW%20Guidelines%20Final%20121510.pdf

Holmes, R.R. Jr., P.J. Terrio, M.A. Harris, and P.C. Mills, 2001. Introduction to field methods for hydrologic and environmental studies, open-file report 01-50, USGS, Urbana, Illinois, 241 p. https://pubs.er.usgs.gov/publication/ofr0150

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Vail, J., D. France, and B. Lewis. 2013. Operating Procedure: Groundwater Sampling SESDPROC-301-R3. https://www.epa.gov/sites/production/files/2015-06/documents/GroundwaterSampling.pdf

Wilde, F.D., January 2005. Preparations for water sampling (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A1, http://water.usgs.gov/owq/FieldManual/compiled/NFM_complete.pdf

ONLINE RESOURCES

Online System for Well Completion Reports (OSWCR). California Department of Water Resources. http://water.ca.gov/oswcr/index.cfm

Measuring Land Subsidence web page. U.S. Geological Survey. http://ca.water.usgs.gov/land_subsidence/california-subsidence-measuring.html

USGS Global Positioning Application and Practice web page. U.S. Geological Survey. http://water.usgs.gov/osw/gps/

Appendix O. Monitoring Network BMP

Monitoring Networks and Identification of Data Gaps Best Management Practice

1. OBJECTIVE

The objective of this Best Management Practice (BMP) is to assist in the development of Monitoring Networks and Identification of Data Gaps. The California Department of Water Resources (the Department or DWR) has developed a Best Management Practice for Monitoring Networks and Identification of Data Gaps, as part of the obligation in the Technical Assistance chapter (Chapter 7) of the Sustainable Groundwater Management Act (SGMA) to support the long-term sustainability of California's groundwater basins. The SJREC GSA has reviewed and updated this BMP for inclusion in the GSP. This BMP provides technical assistance to Groundwater Sustainability Agencies (GSAs) and other stakeholders to aid in the development of a monitoring network that is capable of providing sustainability indicator data of sufficient accuracy and quantity to demonstrate that the basin is being sustainably managed. In addition, this BMP is intended to provide information on how to identify and plan to resolve data gaps to reduce uncertainty that may be necessary to improve the ability of the GSP to achieve the sustainability goal for the basin.

This BMP includes the following sections:

1. Objective. A brief description of how and where monitoring networks are required under Sustainable Groundwater Management Act (SGMA) and the overall objective of this BMP.

2. Use and Limitations. A brief description of the use and limitations of this BMP.

3. Monitoring Network Fundamentals. A description of the general approach and background of groundwater monitoring networks.

4. Relationship of Monitoring Network to other BMPs. A description of how this BMP is connected with other BMPs.

5. Technical Assistance. Technical content of BMP providing guidance for regulatory sections.

6. Key Definitions. Descriptions of those definitions identified in the GSP Regulations, SGMA, or Basin Boundary Regulations.

7. Related Materials. References and other materials that provide supporting information related to the development of Groundwater Monitoring Networks.

2. USE AND LIMITATIONS

BMPs developed by the Department and revised by the SJREC GSA, provide technical guidance to GSAs and other stakeholders. Practices described in these BMPs do not replace the GSP Regulations, nor do they create new requirements or obligations for GSAs or other stakeholders. In addition, using this BMP to develop a GSP does not equate to an approval determination by the Department. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2. All references to SGMA relate to California Water Code sections in Division 6, Part 2.74.

3. MONITORING NETWORK FUNDAMENTALS

Monitoring is a fundamental component necessary to measure progress toward the achievement of any management goal. A monitoring network must have adequate spatial and temporal collection of multiple datasets, including groundwater levels, water quality information, land surface elevation, and surface water discharge conditions to demonstrate compliance with the GSP Regulations.

SGMA requires GSAs to establish and track locally defined significant and unreasonable conditions for each of the sustainability indicators. In addition, the collection of data from a robust network is required to ensure that uncertainty is appropriately reduced during the analysis of these datasets. Data collected in an organized and consistent manner will aid in ensuring that the interpretations of the data are as accurate as possible. Also, the consistency of the types, methods, and timing of data collection facilitate the sharing of data across basin boundaries or within basins.

Analyzing data from an adequate monitoring network within a basin can lead to refinement of the understanding of the dynamic flow conditions; this leads to the optimization of sustainable groundwater management.

4. RELATIONSHIP OF MONITORING NETWORKS TO OTHER BMPS

Groundwater monitoring is a fundamental component of SGMA as each GSP must include a sufficient network that provides data that demonstrate measured progress toward achievement of the sustainability goal for each basin. For this reason, a sufficient network will need to be developed and utilized to accomplish this component of SGMA.

It is important that data are developed in a manner consistent with the basin setting, planning, and projects/management actions steps identified on Figure 1 and the GSP Regulations. The inclusion of monitoring protocols in the GSP Regulations also emphasizes the importance of quality empirical data to support GSPs and provide comparable information from basin to basin.

Figure 1 provides a logical progression for the development of a GSP and illustrates how monitoring networks are linked to other related BMPs. This figure also shows the context of the BMPs as they relate to various steps to sustainability as outlined in the GSP Regulations. The monitoring protocol BMP is part of the Monitoring step identified in the logical progression illustration in **Figure 1**.

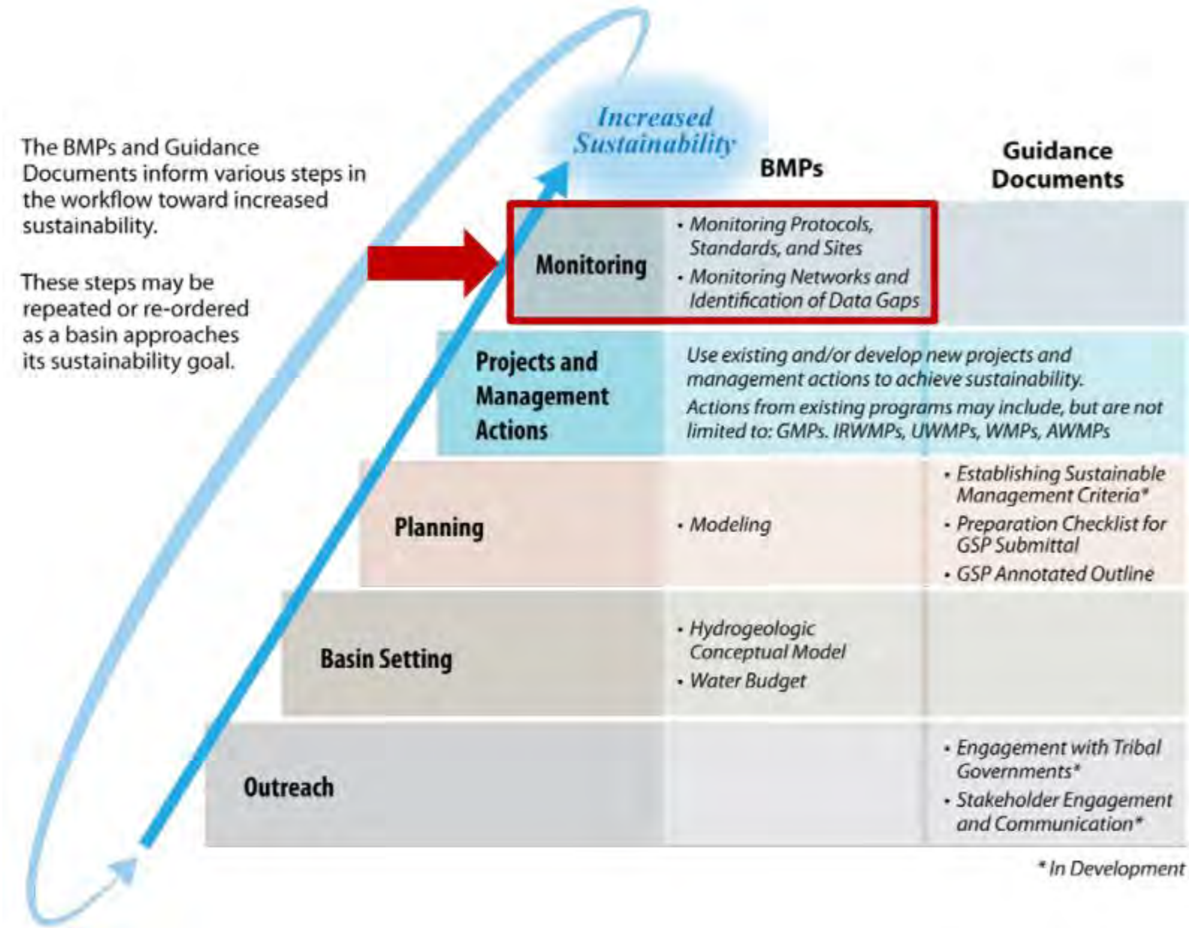


Figure 1 – Logical Progression of Basin Activities Needed to Increase Basin Sustainability

5. TECHNICAL ASSISTANCE

This section provides technical assistance to support the development monitoring networks and identification of data gaps.

GENERAL MONITORING NETWORKS

23 CCR §354.32 Introduction to Monitoring Networks and §354.34 (a) and (b) Monitoring Network

> ***23 CCR §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.*
>
> ***23 CCR §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 distribution to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:*
> *(1) Demonstrate progress toward achieving measurable objectives described in the Plan.*
> *(2) Monitor impacts to the beneficial uses or users of groundwater.*
> *(3) Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.*
> *(4) Quantify annual changes in water budget components.*

The GSP Regulations require GSAs to develop a monitoring network. The monitoring network must be capable of capturing data on a sufficient temporal frequency and spatial distribution to demonstrate short-term, seasonal, and long-term trends in basin conditions for each of the sustainability indicators, and provide enough information to evaluate GSP implementation. A monitoring network should be developed in such a way that it demonstrates progress toward achieving measurable objectives.

As described in the Monitoring Protocols, Standards, and Sites BMP, it is suggested that each GSP incorporate the Data Quality Objective (DQO) process following the US EPA Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA, 2006). Although strict adherence to this method is not required, it does provide a robust approach to ensuring data is collected with a specific purpose in mind, and efforts for monitoring are as efficient as possible to achieve the objectives of the GSP and compliance with the GSP Regulations.

The DQO process presents a method that can be applied directly to the sustainability criteria quantitative requirements through the following steps:

1. State the problem – define sustainability indicators and planning considerations of the GSP and sustainability goal

2. Identify the goal – describe the quantitative measurable objectives and minimum thresholds for each of the sustainability indicators

3. Identify the inputs – describe the data necessary to evaluate the sustainability indicators and other GSP requirements (i.e., water budget)

4. Define the boundaries of the study – This is commonly the extent of the Bulletin 118 groundwater basin or subbasin, unless multiple GSPs are prepared for a given basin. In that case, evaluation of the coordination plan and specifically how the monitoring will be comparable and meet the sustainability goals for the entire basin should be described

5. Develop an analytical approach – Determine how the quantitative sustainability indicators will be evaluated (i.e., are special analytical methods required that have specific data needs)

6. Specify performance or acceptance criteria – Determine what quality the data must have to achieve the objective and provide some assurance that the analysis is accurate and reliable

7. Develop a plan for obtaining data – Once the objectives are known determine how these data should be collected. Existing data sources should be used to the greatest extent possible

These steps of the DQO process should be used to guide GSAs to development of the most efficient monitoring process to meet the measurable objectives of the GSP and the sustainability goal. The DQO process is an iterative process and should be evaluated regularly to improve monitoring efficiencies and meet changing planning and project needs. Following the DQO process GSAs should also include a data quality control and quality assurance plan to guide the collection of data.

GSAs should first evaluate their existing monitoring network and existing datasets when developing the monitoring network for their GSP, such as the California Statewide Groundwater Elevation Monitoring (CASGEM) program. The Assessment and Improvement of Monitoring Network Section of the Regulations describes a process by which GSAs can identify and fill in gaps in their monitoring network. The existing monitoring networks may require evaluation to ensure they meet the DQOs necessary for the GSP. Other considerations for developing a monitoring network include:

- <u>Degree of monitoring.</u> The degree of monitoring should be consistent with the level of groundwater use and need for various levels of monitoring density and frequency. Areas that are subject to greater groundwater pumping, greater fluctuations in conditions, significant recharge areas, or specific projects may require more monitoring (temporal and/or spatial) than areas that experience less activity or are more static.
- <u>Access Issues.</u> GSAs may have to deal with access issues such as unwilling landowners, access agreements, destroyed wells, or other safety concerns with accessing a monitoring site.
- <u>Adjacent Basins.</u> Understanding conditions at or across basin boundaries is important. GSAs should coordinate with adjacent basins on monitoring efforts to be consistent both temporally and spatially. Coordinated efforts and shared data will help GSAs understand their basins' conditions better and potentially better understand groundwater flow conditions across boundaries.

- Consider all sustainability indicators. GSAs should look for ways to efficiently use monitoring sites to collect data for more than one or all of the sustainability indicators. Similarly, when installing a new monitoring site, GSAs should take that opportunity to gather as much information about the subsurface conditions as possible.

There are many other considerations that GSAs must understand when developing monitoring networks that are specific to the various sustainability indicators: chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, or depletions of interconnected surface waters. In addition, establishment of a monitoring network should be evaluated in conjunction with the Monitoring Protocols, Standards, and Sites; Hydrogeologic Conceptual Model (HCM); Water Budget; and Modeling BMPs when considering the data needs to meet GSP measurable objectives and the sustainability goal.

SPECIFIC MONITORING NETWORKS

23 CCR §354.34(d)-(j):

(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.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(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:

(1) Amount of current and projected groundwater use.

(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.

(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.

(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(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.

(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.

(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.

(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.

(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.

Monitoring data provide the basis for demonstrating that undesirable results are avoided and are necessary for adequately managing the basin. The undesirable result associated with each sustainability indicator is based on a unique set of representative monitoring points. Therefore, a single monitoring network may not be appropriate to address all sustainability indicators. The monitoring network will consist of an adequate magnitude of monitoring locations that will characterize the groundwater flow regime such that a GSA will have the ability to predict sustainability indicator responses to management actions and document those results. The data collected from these networks will be the foundation for communication to other connected basins as one may affect another. The transparent availability of data is intended to alleviate conflict by demonstrating conditions in a consistent manner such that assessment of the sustainability indicators is relatively consistent from basin to basin.

The use of existing monitoring networks established during implementation of CASGEM, Irrigated Lands Reporting Program (IRLP), Groundwater Ambient Monitoring and Assessment Program (GAMA), National Groundwater Monitoring Network, Existing Groundwater Management Planning, and other local programs could be used for a base monitoring network from which to build. These networks should be evaluated for compliance with GSP Regulations and DQOs.

This section addresses the design and installation of monitoring networks and sites. Agencies must address a number of issues prior to designing the monitoring site, including, but not limited to, establishing the reason for installing the monitoring site, obtaining access agreements, assessing how the monitoring site may improve the basin conceptual model, assessing how the monitoring site may reduce uncertainty, etc. Where management areas are established, each area must be considered when developing the monitoring network for each sustainability indicator.

Professional judgement will be essential to determine the degree of monitoring that will be necessary to meet the needs for the GSP. This BMP provides guidance, but should be coupled with site-specific monitoring needs to address the complexities of the groundwater basin and DQOs.

The following sections are organized by each of the sustainability indicators. These considerations should be applied to the network as a whole to ensure the quality of the data is consistent and reliable, and so that sound representative monitoring locations can be established, as described in the Representative Monitoring Points (RMP) section of this BMP.

A. Chronic Lowering of Groundwater Levels

§354.34(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.
(B) Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.

The observation and collection of groundwater level data is the cornerstone of data collected for SGMA compliance. Design of the groundwater level data monitoring network will be dependent upon the initial hydrogeologic conceptual model and will likely undergo refinement both temporally and spatially as management in the basin progresses. This isn't to say that the monitoring network will continually expand, but rather, through increased understanding, be more refined to gather the necessary information in the most efficient way possible to demonstrate sustainability, and exercise the basin to maintain conditions consistent with the sustainability goal and sustainable yield of the basin. The use of groundwater levels as a surrogate for other sustainability indicators will require reliable, consistent, high-quality, defendable data to demonstrate the relationship prior to use as a surrogate for other sustainability indicators.

It is preferable to use dedicated groundwater monitor wells with known construction information. The selection of wells should be aquifer-specific and wells that are screened across more than one aquifer should be avoided where possible. If existing wells are used, the perforated intervals should be known to be able to utilize water level or other data collected from that well. Development of the monitor well network must evaluate and consider both unconfined and confined aquifers, and assess where pumping wells are screened that affect monitoring at these locations. Agricultural or municipal wells can be used temporarily until either dedicated monitor wells can be installed or an existing well can be identified that meets the above criteria. If agricultural or municipal wells are used for monitoring, the wells must be screened across a single water-bearing unit, and care must be taken to ensure that pumping drawdown has sufficiently recovered before collecting data from a well.

Each well selected for inclusion in the monitoring network should be evaluated to ensure that water level data obtained meet the DQOs for that well. For example, some wells may be directly influenced by nearby pumping, or injection and observation of the aquifer response may be the purpose of the well. Otherwise, the network should contain an adequate number of wells to observe the overall static conditions and the specific project effects. Well construction details and pumping information for active and inactive wells located in the area of the selected monitor well location should be reviewed to determine whether construction details or pumping activity at those wells could affect water level or water quality data for the selected monitoring site.

There is no definitive rule for the density of groundwater monitoring points needed in a basin. **Table 1** was adopted from the CASGEM Groundwater Elevation Monitoring Guidelines (DWR, 2010). This table summarizes existing references to quantify the density of monitor wells per hundred square miles. While these estimates may provide guidance, the necessary monitoring point density for GSP depends on local geology, extent of groundwater use, and how the GSPs define undesirable results. The use of Hopkins (1984) analysis incorporates a relative well density based on the degree of groundwater use within a given area. Professional judgement will be essential to determining an adequate level of monitoring, frequency, and density based on the DQOs and the need to observe aquifer response to high pumping areas, cones of depression, significant recharge areas, and specific projects.

Table 1. Monitor Well Density Considerations

Reference	Monitor Well Density (wells per 100 miles^2)
Heath (1976)	0.2 - 10
Sophocleous (1983)	6.3
Hopkins (1984)	
Basins pumping more than 10,000 acre-feet/year per 100 miles^2	4.0

Basins pumping between 1,000 and 10,000 acre-feet/year per 100 miles^2	2.0
Basins pumping between 250 and 1,000 acre-feet/year per 100 miles^2	1.0
Basins pumping between 100 and 250 acre-feet/year per 100 miles^2	0.7

In addition to monitor well network density, the frequency of monitoring to characterize the groundwater dynamics within a basin or area is important. The discussion presented in the National Framework for Ground-water Monitoring in the United States (ACWI, 2013) utilizes a degree of groundwater use and aquifer characteristics to aid in determining an appropriate frequency. **Figure 2** (ACWI, 2013) and **Table 2** (ACWI, 2013) describe these considerations and provide recommended frequency of long-term monitoring. It should be noted that the initial characterization is not included; the initial characterization of a monitoring location will require more frequent monitoring to establish the dynamic range and identification of external stresses affecting the groundwater level. An understanding of the full range of monitor well conditions should be reached prior to establishing a long-term monitoring frequency. The considerations presented in **Figure 2** and **Table 2** should be evaluated to determine if the guidance meets the DQOs to support the GSP. Professional judgment should be used to refine the monitoring frequency and density.

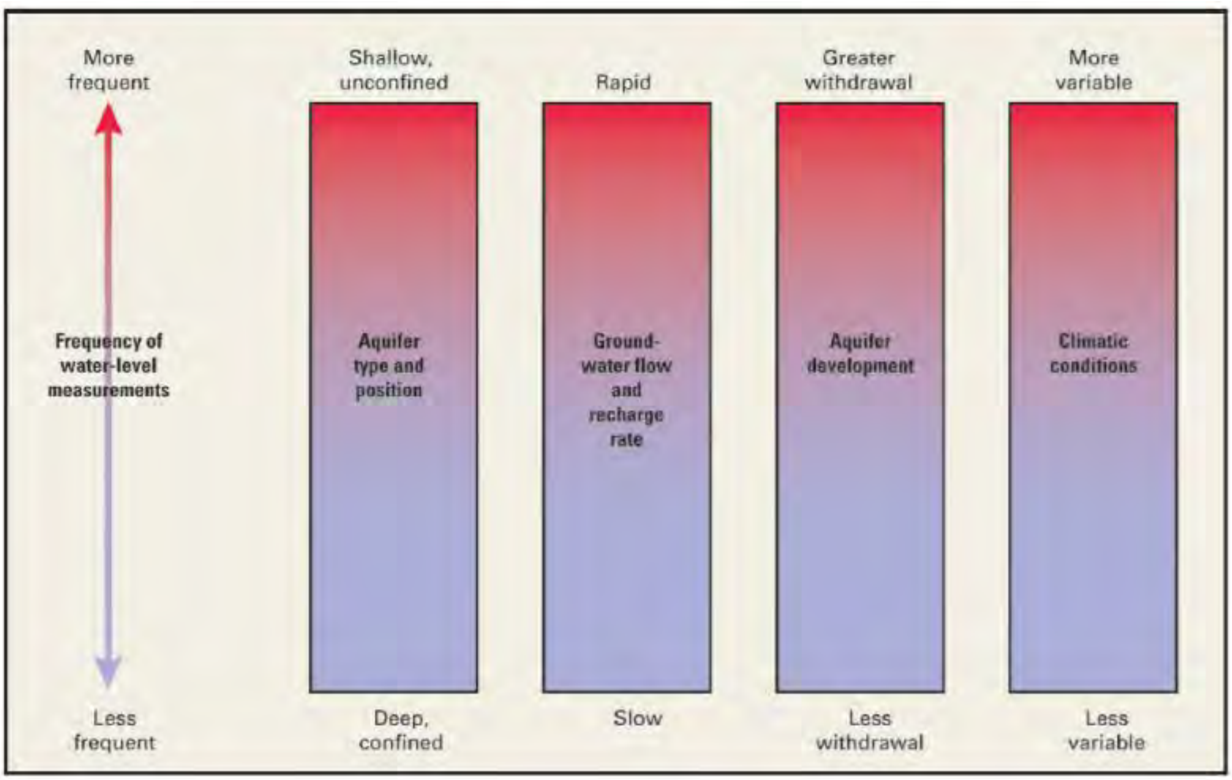


Figure 2. Factors Determining Frequency of Monitoring Groundwater Levels (Taylor and Alley, 2001, adapted from ACWI, 2013)

Table 2. Monitoring Frequency Based on Aquifer Properties and Degree of Use (adapted from ACWI, 2013)

Aquifer Type	Nearby Long-Term Aquifer Withdrawals		
	Small Withdrawals	Moderate Withdrawals	Large Withdrawals
Unconfined			
"low" recharge (<5 in/yr)	once per quarter	once per quarter	once per month
"high" recharge (>5 in/yr)	once per quarter	once per month	once per day
Confined			
"low" hydraulic conductivity (<200 ft/d)	once per quarter	once per quarter	once per month
"high" hydraulic conductivity (>200 ft/d)	once per quarter	once per month	once per day

The discussion below provides specific management practices for implementation of the GSP, where the general approaches for considering monitoring network density and frequency described above provide some guidance for the expectations for network design.

- New wells must meet applicable well installation standards set in California DWR Bulletin 74-81 and 74-90, or as updated.
- Groundwater level data will be collected from each principal aquifer in the basin.
- Groundwater level data must be sufficient to produce seasonal maps of potentiometric surfaces or water table surfaces throughout the basin that clearly identify changes in groundwater flow direction and gradient.
- Semi-annual groundwater levels will be collected to represent seasonal high and seasonal low values.
    - While semi-annual monitoring is required, more frequent, quarterly, monthly, or daily monitoring may be necessary to provide a more robust understanding of groundwater dynamics within the system.
    - Agencies will need to adjust the monitoring frequency to address uncertainty, such as in specific places where sustainability indicators are of concern, or to track specific management actions and projects as they are implemented.
    - Select wells should be monitored frequently enough to characterize the season high and low within the basin.
- Data must be sufficient for mapping groundwater depressions, recharge areas, and along margins of basins where groundwater flow is known to enter or leave a basin.
- Well density must be adequate to determine changes in storage.
- Data must be able to demonstrate the interconnectivity between shallow groundwater and surface water bodies, where appropriate.
- Data must be able to map the effects of management actions, i.e., managed aquifer recharge or hydraulic seawater intrusion barriers.
- Data must be able to demonstrate conditions at basin boundaries.

- Agencies may consider coordinating monitoring efforts with adjacent basins to provide consistent data across basin boundaries.
- Agencies may consider characterization and continued impacts of internal hydraulic boundary conditions, such as faults, disconformities, or other internal boundary types.

- Data must be able to characterize conditions and monitor adverse impacts as they may affect the beneficial uses and users identified within the basin.

Additional Information:

Ground-Water-Level Monitoring and the Importance of Long-Term Water-Level Data
http://pubs.usgs.gov/circ/circ1217/pdf/circ1217_final.pdf

A National Framework for Ground-Water Monitoring in the United States Fact Sheet:
http://acwi.gov/sogw/NGWMN_InfoSheet_final.pdf
Full Report: http://acwi.gov/sogw/ngwmn_framework_report_july2013.pdf

Statistical Design of Water-Level Monitoring Networks http://pubs.usgs.gov/circ/circ1217/pdf/pt4.pdf

Design of Ground-Water Level Observation-Well Programs
http://onlinelibrary.wiley.com/doi/10.1111/j.1745-6584.1976.tb03635.x/epdf

B. Reduction of Groundwater Storage

> ***23 CCR §354.34(c)(2):*** *Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.*

While reduction in groundwater storage is not a directly measurable condition, it does rely heavily on the collection of accurate groundwater levels, as described in the preceding section, and a robust understanding of the HCM and textural observations from boreholes. The identification in the HCM of discrete aquifer units and surrounding aquitards will be essential in assessing changes in groundwater storage. The changes in groundwater levels reflect changes in storage and can thus be estimated with assumptions of thickness of units, porosity, and connectivity. These observations will be essential for use in calculating the water budget; see the Water Budget BMP for more detail.

Estimates of changes in storage are available from remote sensing-based investigations, but should be used cautiously as they tend to be regional in nature and may not provide the level of accuracy necessary to fully determine the conditions within the basin. The National Aeronautics and Space Administration (NASA) mission, Gravity Recovery and Climate Experiment (GRACE) satellites provide analysis results of differential gravity response associated with changes in groundwater occurrence and terrestrial water storage, http://www.nasa.gov/mission_pages/Grace/#.WATU_fkrKUk.

C. Seawater Intrusion

23 CCR §354.34(c)(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.*

The Delta-Mendota Subbasin is highly unlikely to have Significant and Unreasonable Seawater Intrusion. For that reason, monitoring protocols for seawater intrusion have not been developed. In the unlikely event that seawater intrusion must be monitored in the Delta-Mendota Subbasin, the SJREC GSA will review BMP's to address the concern.

D. Degraded Water Quality

23 CCR §354.34(c)(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.*

Groundwater quality monitoring networks should be designed to demonstrate that the degraded water quality sustainability indicator is being observed for the purpose of meeting the sustainability goal. The monitoring network should consist largely as supplemental monitoring locations where known groundwater contamination plumes under existing regulatory management and monitoring exist, and additional safeguards for plume migration are necessary. In addition, some monitoring may be necessary to address other degraded water quality issues in which migration could impact beneficial uses of water, including, but not limited to, unregulated contaminant plumes and naturally occurring water quality impacts. Seawater intrusion and degraded water quality are naturally related, as many practices are interchangeable. The following represent specific practices to be employed in the execution of the GSP:

- Monitor groundwater quality data from each principal aquifer in the basin that is currently, or may be in the future, impacted by degraded water quality.
    - The spatial distribution must be adequate to map or supplement mapping of known contaminants.
    - Monitoring should occur based upon professional opinion, but generally correlate to the seasonal high and low, or more frequent as appropriate.
        - Where regulated plumes exist, monitoring should coincide with regulatory monitoring for plume migration comparison purposes.
        - Where unregulated degraded water quality occurs, monitoring should be consistent with the degree of groundwater use in the regions of the known impacts.
- Collect groundwater quality data from each principal aquifer in the basin that is currently, or may be in the future, impacted by degraded water quality.
    - Agencies should use existing water quality monitoring data as applicable. For example, these could include ILRP, GAMA, existing RWQCB monitoring and remediation programs, and drinking water source assessment programs.

- Define the three-dimensional extent of any existing degraded water quality impact.
- Data should be sufficient for mapping movement of degraded water quality.
- Data should be sufficient to assess groundwater quality impacts to beneficial uses and users.
- Data should be adequate to evaluate whether management activities are contributing to water quality degradation.

Additional References:

Framework for a ground-water quality monitoring and assessment program for California (GAMA) http://pubs.usgs.gov/wri/wri034166/

Estimation of aquifer scale proportion using equal area grids: Assessment of regional scale groundwater quality http://ca.water.usgs.gov/projects/gama/pdfs/Belitz_etal_2010_wrcr12701.pdf

E. Land Subsidence

23 CCR §354.34(c)(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.*

Inelastic land subsidence has been recognized in California for many decades. Observation of land subsidence sustainability indicators can utilize numerous techniques, including levelling surveying tied to known benchmarks, installing and tracking changes in borehole extensometers, monitoring continuous global position system (CGPS) locations, or analyzing interferometric synthetic aperture radar (InSAR) data. As with most sustainability indicators, conditions of subsidence, or lack thereof, can be correlated to groundwater levels as a surrogate. Each of these approaches uses different measuring points and techniques, and is tailored for specific data needs and geologic conditions.

Existing data should be used to the greatest extent. The USGS has conducted numerous studies and much of the data can be located through their webpage and reports: http://ca.water.usgs.gov/land_subsidence/index.html. DWR has compiled and uploaded subsidence data to the SGMA Data Viewer for use by GSA's: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer. In addition, DWR has developed supporting studies and data available in the Groundwater Information Center interactive maps and reports: http://www.water.ca.gov/groundwater/gwinfo/index.cfm. The use of existing regular surveys of state infrastructure may also present a record of historical changes in elevation along roadways and canals. Prior to development of a specific subsidence monitoring network a screening level analysis should be conducted. The screening of subsidence occurrence should include:

- Review of the HCM and understanding of grain-size distributions and potential for subsidence to occur.
- Review of any known regional or correlative geologic conditions where subsidence has been observed.
- Review of historic range of groundwater levels in the principal aquifers of the basin.

- Review of historic records of infrastructure impacts, including, but not limited to, damage to pipelines, canals, roadways, or bridges, or well collapse potentially associated with land surface elevation changes.
- Review of remote sensing results such as InSAR or other land surface monitoring data.
- Review of existing CGPS surveys.

In general, the network should be designed to provide consistent, accurate, and reproducible results. Where subsidence conditions are occurring or believed to occur, a specific monitoring network should be established to observe the sustainability indicator such that the sustainability goal can be met. The following approaches can be used independently or in coordination with multiple methods and should be evaluated with the specific conditions and objectives in mind. Various standards and guidance documents that must be adhered to when developing a monitoring network include:

- Leveling surveys must follow surveying standards set out in the California Department of Transportation's Caltrans Surveys Manual. Any alternative shall be reviewed by a Professional Land Surveyor or Professional Civil Engineer registered in the State of California for accuracy and reasonableness. Specific websites where additional information can be found include:
    - http://www.dot.ca.gov/hq/row/landsurveys/
    - http://www.ngs.noaa.gov/datasheets/
    - https://www.ngs.noaa.gov/FGCS/tech_pub/1984-stds-specs-geodeticcontrol-networks.htm#3.5
- CGPS surveys must follow surveying standards set out in the California Department of Transportation's Caltrans Surveys Manual. Specific websites where additional data can be found include:
    - http://www.dot.ca.gov/hq/row/landsurveys/
    - http://www.ngs.noaa.gov/CORS/
    - http://www.unavco.org/instrumentation/networks/status/pbo
    - http://www.dot.ca.gov/dist6/surveys/CVSRN/sitemap.htm
    - http://sopac.ucsd.edu/map.shtml
- The construction and use of borehole extensometers can yield information about total and unit-specific subsidence rates depending upon construction and purpose. Specific sites where additional data can be found include:
    - Extensometer methods commonly used by the USGS http://hydrologie.org/redbooks/a151/iahs_151_0169.pdf
    - Extensometry principles (p. 20-29) http://wwwrcamnl.wr.usgs.gov/rgws/Unesco/
    - Examples of extensometer construction, instrumentation, and data interpretation
        - Single-stage pipe extensometer (Edwards Air Force Base, CA; 1990), p. 20-23: http://pubs.usgs.gov/wri/2000/wri004015/
        - Dual-stage pipe extensometer (Lancaster, CA; 1995), p. 8-12: http://pubs.usgs.gov/of/2001/ofr01414/
        - Dual-stage pipe extensometer (San Lorenzo, CA; 2008), p. 12-13: https://pubs.er.usgs.gov/publication/ds890
- The use of InSAR data can be useful for screening and regular monitoring, especially as the technology becomes more widely available and usable. Specific sites where additional data can be found are listed below.

- Interferometric Synthetic Aperture Radar (InSAR) techniques are an effective way to measure changes in land-surface altitude over large areas. Some basic information about InSAR can be found here:
  - https://pubs.usgs.gov/fs/fs-051-00/pdf/fs-051-00.pdf
  - http://pubs.usgs.gov/fs/fs06903/pdf/fs06903.pdf
- Raw data (not processed into interferograms) are available from a variety of foreign space agencies or their distributors at variable costs (including free):
  - European Space Agency http://www.esa.int/ESA
  - Japanese Space Exploration Agency http://global.jaxa.jp/
  - Italian Space Agency http://www.asi.it/en
  - Canadian Space Agency http://www.asc-csa.gc.ca/eng/
  - German Aerospace Center http://www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10002/
- Data Processing: Processing raw data to high-quality InSAR data is not a trivial task.
  - Open source/research-grade software packages and commercially available software packages. A list of available software can be found here: http://www.unavco.org/software/data-processing/sarsoftware/sar-software.html
  - There are commercial companies that process InSAR data.
  - Processing raw data to quality-controlled InSAR data is an essential part of InSAR processing because of the numerous common sources of error. Discussions of these error sources are found here:
    - http://pubs.usgs.gov/sir/2014/5075/
    - https://pubs.er.usgs.gov/publication/sir20135142

F. Depletion of Interconnected Surface Water

23 CCR §354.34(c))(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.
(B) Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.
(C) Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.
(D) Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.

Monitoring of the interconnected surface water depletions requires the use of tools, commonly modeling approaches, to estimate the depletions associated with groundwater extraction. Models require assumptions be made to constrain the numerical model solutions. These assumptions should be based on empirical observations determining the extent of the connection of surface water and groundwater systems, the timing of those connections, the flow dynamics of both the surface water and groundwater systems, and hydrogeologic properties of the geologic framework connecting these systems.

The following components should be included in the establishment of a monitoring network:

- Use existing stream gaging and groundwater level monitoring networks to the extent possible.
- Establish stream gaging along sections of known surface water groundwater connection.
    - All streamflow measurements should be collected, analyzed, and reported in accordance with the procedures outlined in USGS Water Supply Paper 2175, Volume 1. - Measurement of Stage Discharge and Volume 2. - Computation of Discharge.
        - https://pubs.er.usgs.gov/publication/wsp2175_vol1
        - https://pubs.er.usgs.gov/publication/wsp2175
    - Specific websites where additional information can be found include:
        - General source: http://water.usgs.gov/nsip/
        - Standards for the Analysis and Processing of Surface-Water Data and Information Using Electronic Methods https://pubs.er.usgs.gov/publication/wri20014044
        - USGS Streamflow Information
            - Real-time Streamflow Data for the Nation
            - Historical Streamflow Data for the Nation
            - WaterWatch
            - StreamStats
    - Location selection must account for surface water diversions and return flows; or select gaging locations and reaches over which no diversions or return flows exist.
- Establish a shallow groundwater monitor well network, as necessary, to characterize groundwater levels adjacent to connected streams and hydrogeologic properties.
    - Network should extend perpendicular and parallel to stream flow to provide adequate characterization to constrain model development.
    - Monitor to capture seasonal pumping conditions in vicinity-connected surface water bodies.

It may be beneficial to conduct other initial characterization surveys to establish an appropriate monitoring method to develop assumptions for a model or other technique to estimate depletion of surface water. These may include:

- Stream bed conductance surveys
- Aquifer testing for hydrogeologic properties
- Isotopic studies to determine source areas
- Geochemical studies to determine source areas
- Geophysical techniques to determine connectivity to stream channels and preferential flow pathways.

REPRESENTATIVE MONITORING POINTS

The use of RMPs, which are a subset of a basin's complete monitoring network as demonstrated in **Figure 3**, can be used to consolidate reporting of quantitative observations of the sustainability indicators.

23 CCR §354.36. Representative Monitoring (a)-(c): *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.
(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:

(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.

(2) 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.

(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

In this figure, the complete monitoring network is represented by black dots. The RMPs for each sustainability indicator are represented by various colored bull's-eyes. In this example, the network of RMPs is unique for each sustainability indicator. Agencies can adopt a single network of RMPs or have a unique set of RMPs for each sustainability indicator.

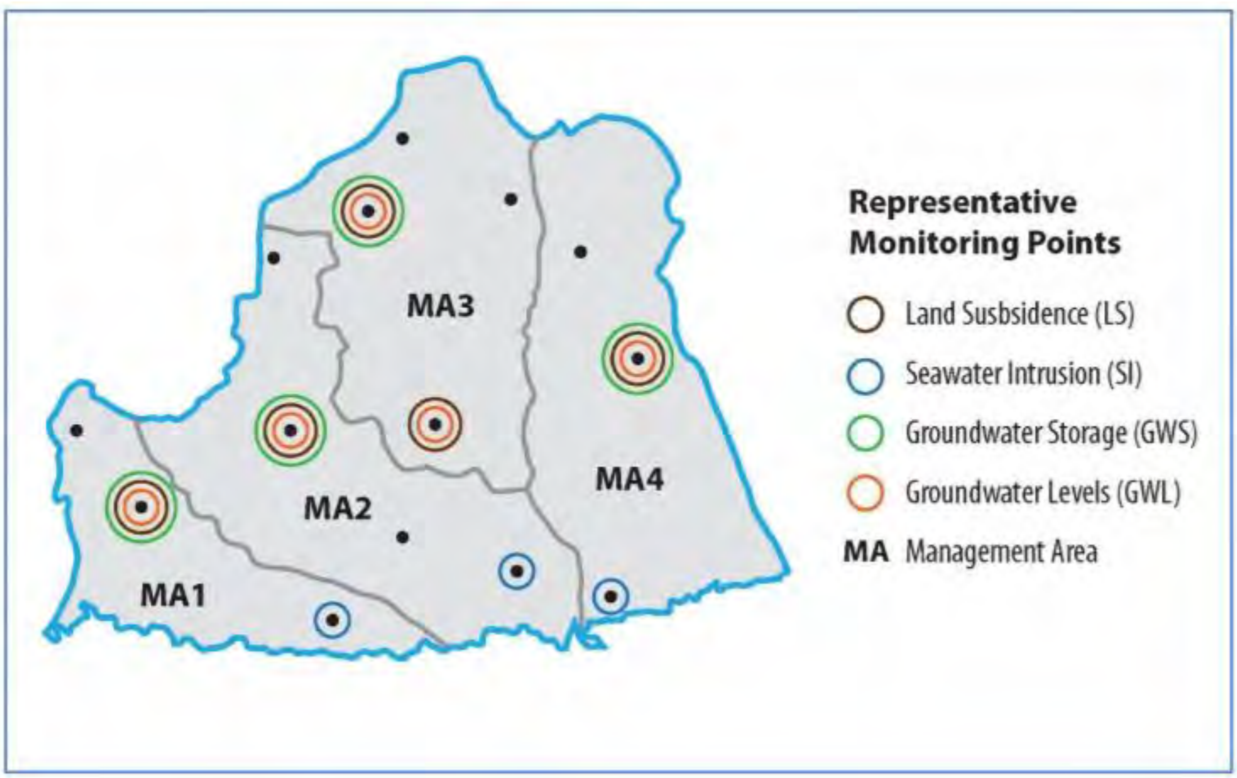


Figure 3: Representative Monitoring Points

If RMPs are used to represent groundwater elevations from a number of surrounding monitor wells, the GSP should demonstrate that each RMP's historical measured groundwater elevations, groundwater elevation trends, and seasonal fluctuations are similar to the historical measurements in the surrounding monitor wells. If RMPs are used to represent groundwater quality from a number of surrounding monitor wells, the GSP should demonstrate that each RMP's historical measured groundwater quality and groundwater quality trends are similar to historical measurements in the surrounding monitor wells.

The use of groundwater levels as a proxy may be utilized where clear correlation can be made for each sustainability indicator. The use of the proxy can facilitate the illustration of where minimum thresholds and measureable objectives occur. A series of RMPs or a single RMP may be adequate to characterize a management area or basin. Use of the RMP should include identification and description of possible interference with the monitoring objective.

NETWORK ASSESSMENT AND IMPROVEMENTS

23 CCR §354.38. Assessment and Improvement of Monitoring Network (a)-(e)
(a) 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.
(b) 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.
(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:
(1) The location and reason for data gaps in the monitoring network.
(2) Local issues and circumstances that limit or prevent monitoring.
(d) Each Agency shall describe steps that will be taken to fill data gaps before the next fiveyear assessment, including the location and purpose of newly added or installed monitoring sites.
(e) Each Agency shall adjust the monitoring frequency and distribution of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:
(1) Minimum threshold exceedances.
(2) Highly variable spatial or temporal conditions.
(3) Adverse impacts to beneficial uses and users of groundwater.
(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

Network assessment and improvements are commonly identified as 'data gaps' in the monitoring network and refer to "a lack of information that significantly affects the understanding of basin setting or evaluation of the efficacy of the Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed." The monitoring network is a key component in the development of GSPs and will influence the development and understanding of the basin setting, including the hydrogeologic conceptual model, groundwater conditions, and water budget; and proposed minimum thresholds and measurable objectives. GSAs should consider previous analyses of data gaps of their monitoring network through existing programs, such as CASGEM monitoring plans. **Figure 4** shows a flowchart that demonstrates a process that GSAs should use to identify and address data gaps.

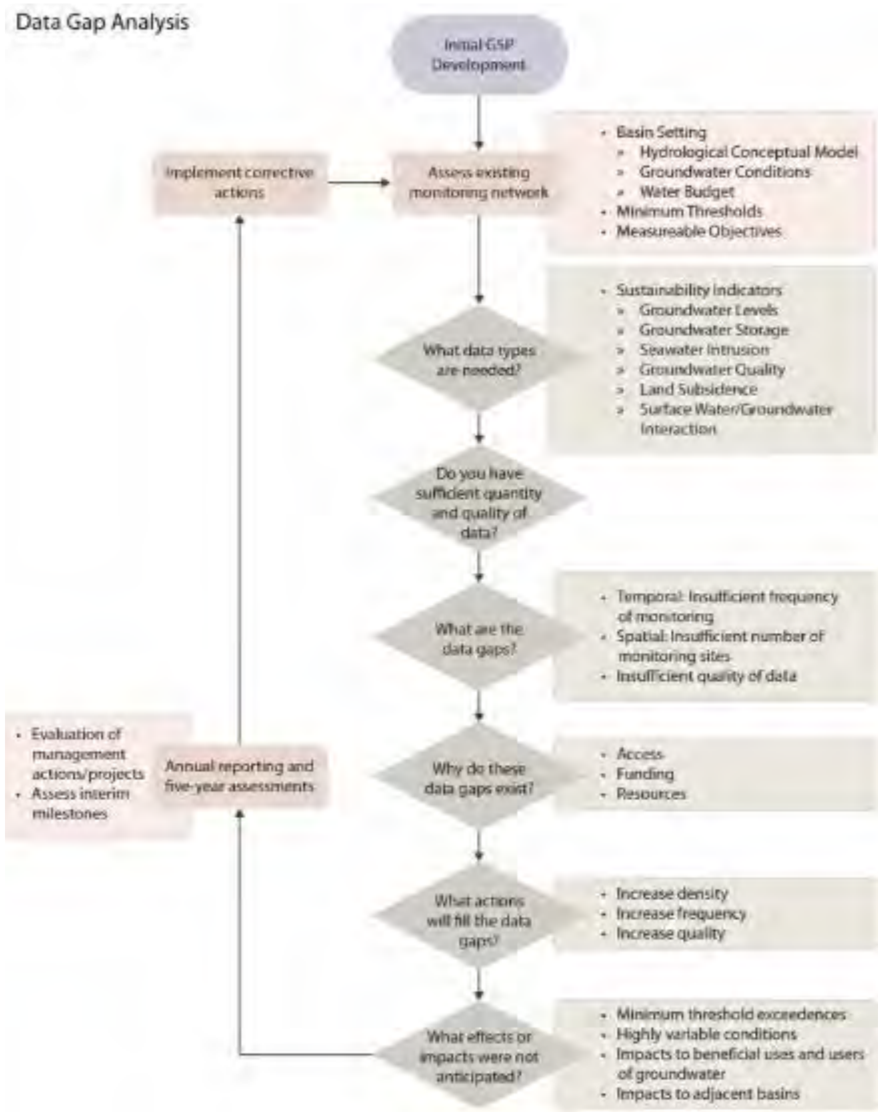


Figure 4. Data Gap Analysis Flow Chart

Professional judgment will be needed from GSAs to identify possible data gaps in their monitoring network of the sustainability indicators. Data gaps can result from monitoring information that is not of sufficient quantity or quality. Data of insufficient quantity typically result from missing or incomplete information, either temporally or spatially. Examples of temporal data gaps include a hydrograph with data that is too infrequent, has inconsistent intervals, or has a short historical record, as shown in **Figure 5**. Spatial data gaps may occur from a monitoring network with low or uneven density in three dimensions, as shown in **Figure 6.**

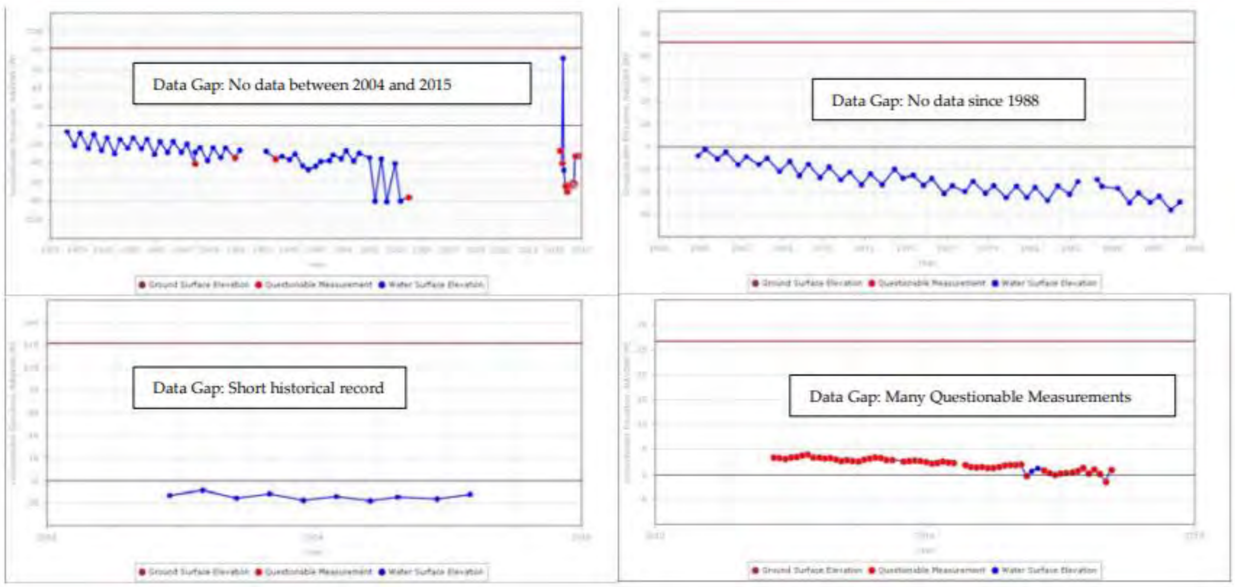


Figure 5. Examples of Hydrographs with Temporal Data Gaps

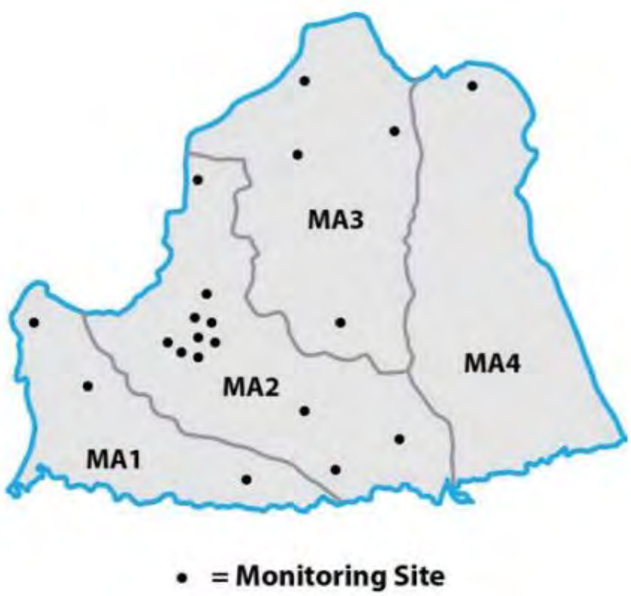


Figure 6. Example Monitoring Network with Spatial Data Gaps

Poor quality data may also be the cause of data gaps. Data must be of sufficient quality to enable scientifically defensible decisions. Poor quality data may at times be worse than no data because it could lead to incorrect assumptions or biases. Some things to consider when questioning the quality of data include: collection conditions and methods, sampling quality assurance/quality control, and proper calibration of meters/equipment. As part of the CASGEM program, DWR reports groundwater elevation data from local agencies, which include the option for “Questionable Measurement Codes.” These codes are one way of identifying poor quality data.

There may be various reasons for data gaps, including site access, funding, and lack of staffing resources. By identifying and correcting the reasons behind data gaps, GSAs may be able to avoid further data gaps.

Direct actions GSAs could take to fill data gaps include:

- Increasing the frequency of monitoring. For instance, some groundwater elevation measurements are taken twice a year in the spring and fall, but perhaps those measurements need to be increased to quarterly, monthly, or more frequently, if needed.
- Increasing the spatial distribution and density of the monitoring network.
- Increasing the quality of data through improved collection methods and data management methods.

As GSPs are implemented, GSAs may identify other data gaps, especially if there are minimum threshold exceedances, highly variable spatial or temporal conditions, adverse impacts to beneficial uses and users of groundwater, and impacts to adjacent basins' ability to achieve sustainability. Any or all of these conditions may indicate a need to refine the monitoring network.

Agencies are required to assess their monitoring networks every five years. During those assessments, data gaps may also be identified as agencies monitor the progress of their management actions/projects and the status of their interim milestones. These regular assessments will allow the GSAs to adaptively manage, focus, and prioritize future monitoring.

DATA REPORTING

> ***23 CCR §352.6. Data Management System***
> *Each Agency 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.*

The use of a Data Management System (DMS) is required for all GSPs. The DMS should include clear identification of all monitoring sites and a description of the quality assurance and quality control checks performed on the data being entered. Uploading of the collected data should occur immediately following collection to address any quality concerns in a timely manner and prevent the potential for development of data gaps. Coordination of data structures between adjacent basins will facilitate data sharing and increase data transparency.

DWR will be providing an updated information that may be used for this BMP as the suggested data structure is developed.

6. KEY DEFINITIONS

SGMA DEFINITIONS (CALIFORNIA WATER CODE §10721)

(r) "Planning and implementation horizon" means a 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.

(u) "Sustainability goal" means 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.

(v) "Sustainable groundwater management" means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) "Sustainable yield" means 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.

(x) "Undesirable result" means one or more of the following effects caused by groundwater conditions occurring throughout the basin:

(1) Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

(2) Significant and unreasonable reduction of groundwater storage.

(3) Significant and unreasonable seawater intrusion.

(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.

(6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

GSP REGULATIONS DEFINITIONS (CALIFORNIA CODE OF REGULATIONS §351)

(l) "Data gap" refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed.

(o) "Interconnected surface water" refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

(q) "Interim milestone" refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

(s) “Measurable objectives” refer to 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.

(t) “Minimum threshold” refers to a numeric value for each sustainability indicator used to define undesirable results.

(u) “NAD83” refers to the North American Datum of 1983 computed by the National Geodetic Survey, or as modified.

(v) “NAVD88” refers to the North American Vertical Datum of 1988 computed by the National Geodetic Survey, or as modified.

(y) “Plan implementation” refers to an 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.

(aa) “Principal aquifers” refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

(ab) “Reference point” refers to a permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.

(ac) “Representative monitoring” refers to a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

(ad) “Seasonal high” refers to the highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand

(ae) “Seasonal low” refers to the lowest annual static groundwater elevation that is typically measured in the Summer or Fall, and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

(ag) “Statutory deadline” refers to the date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.

(ah) “Sustainability indicator” refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

(ai) “Uncertainty” refers to a lack of understanding of the basin setting that significantly affects an Agency’s ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

7. RELATED MATERIALS

NETWORK DESIGN

- Design of a Real-Time Ground-Water Level Monitoring Network and Portrayal of Hydrologic Data in Southern Florida
    - http://fl.water.usgs.gov/PDF_files/wri01_4275_prinos.pdf
- Optimization of Water-Level Monitoring Networks in the Eastern Snake River Plain Aquifer Using a Kriging-Based Genetic Algorithm Method
    - http://pubs.usgs.gov/sir/2013/5120/pdf/sir20135120.pdf

GUIDANCE

California Department of Water Resources, 2010. California statewide groundwater elevation monitoring (CASGEM) groundwater elevation monitoring guidelines, December, 36 p. http://www.water.ca.gov/groundwater/casgem/documents.cfm

Heath, R. C., 1976. Design of ground-water level observation-well programs: Ground Water, V. 14, no. 2, p. 71-77.

Hopkins, J., 1994. Explanation of the Texas Water Development Board groundwater level monitoring program and water-level measuring manual: UM-52, 53 p. http://www.twdb.texas.gov/groundwater/docs/UMs/UM-52.pdf

Sophocleous, M., 1983. Groundwater observation network design for the Kansas groundwater management districts, USA: Journal of Hydrology, vol.61, pp 371-389.

Subcommittee on ground water of the advisory committee on water information, 2013. A National Framework for Ground-Water Monitoring in the United States, 168 p. http://acwi.gov/sogw/ngwmn_framework_report_july2013.pdf

Appendix P. Grassland Bypass Project Summary

Grassland Bypass Project

Project Summary

June 2017

Grassland Bypass Project – Background and Description.

The Grassland Bypass Project has reduced agricultural drainage discharge from the Grassland Drainage Area to the San Joaquin River by 89% since the project started in 1996. The has resulted in a reduction of 97% of the selenium load and 83% of the salt load discharged to the San Joaquin River compared to pre-project discharges.

The Grassland Drainage Area (see **Figure 1**) is a highly productive agricultural region on the Westside of the San Joaquin Valley. The region is approximately 100,000 acres lying generally south of Los Banos, between the San Joaquin River and Interstate 5. The region is overlain by coastal range sediments that are generally heavy clays and contain a variety of dissolved minerals including boron and selenium. These soil conditions have contributed to a healthy and productive agricultural environment but their heavy clay nature has also created a perched water table that threatens this productivity. The perched water table is managed with subsurface (tile) drain systems and deep earthen channels which provide an outlet for the shallow groundwater. However, the subsurface drain water is high in dissolved minerals including salt and selenium, which pose an environmental risk to wildlife. In the past, this drain water was discharge through channels that also supplied fresh water to the Grasslands. Because of the risk to wildlife, these wetland supply channels could not deliver water to Grasslands while carrying tile drainage, and ultimately the Grassland Bypass Project was developed.

The Grassland Bypass Project is an innovative project designed to improve water quality in drainage channels used to deliver water to wetland areas. The Grassland Bypass Project consolidated regional subsurface flows into a single channel, removing drain water from nearly 100 miles of wetland supply canals. Selenium load allocations (total maximum monthly loads or TMMLs) were also incorporated into the project, which reduce annually (see **Figure 2**). The Grassland Area Farmers have developed a plan to eliminate agricultural drainage discharge from the region. This plan has evolved into the Westside Regional Drainage Plan (Westside Plan).

The Westside Plan is intended to 1) identify scientifically sound projects proven to be effective in reducing drainage; 2) develop an aggressive implementation plan initially utilizing existing projects documented to be environmentally sound; and 3) curtail discharges to the San Joaquin River in accordance with impending regulatory constraints while maintaining the ability to farm.

The plan focuses on regional drainage projects that can be implemented on a short timeline. Drainage must be addressed on a regional basis but must allow for each sub-area's specific needs and resources. The Plan's key management components for the Grassland Drainage Area are: 1) Source Control, 2) Groundwater Management, 3) Drainage Reuse Projects, and 4) Drain Water Treatment and/or Salt Disposal. As drainage projects are implemented, they will be evaluated for long-term sustainability of the complete solution.

Figure 2
Grassland Drainage Area
Selenium Discharge and Targets

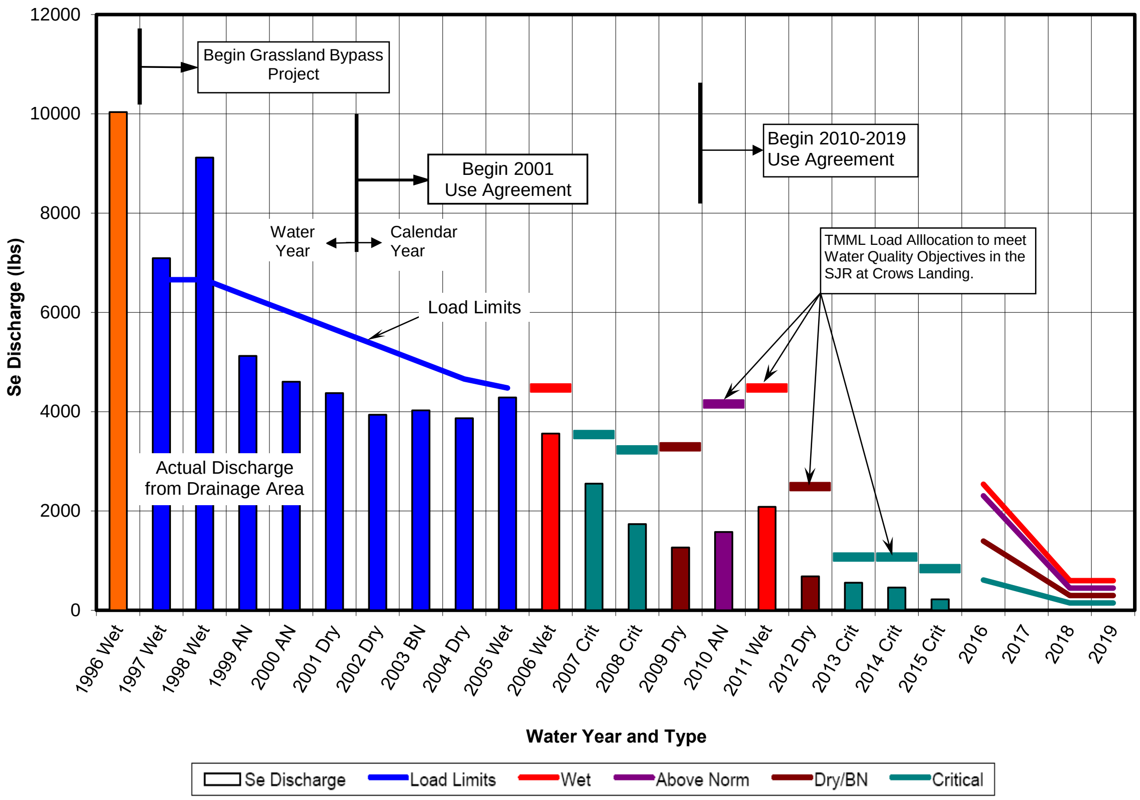
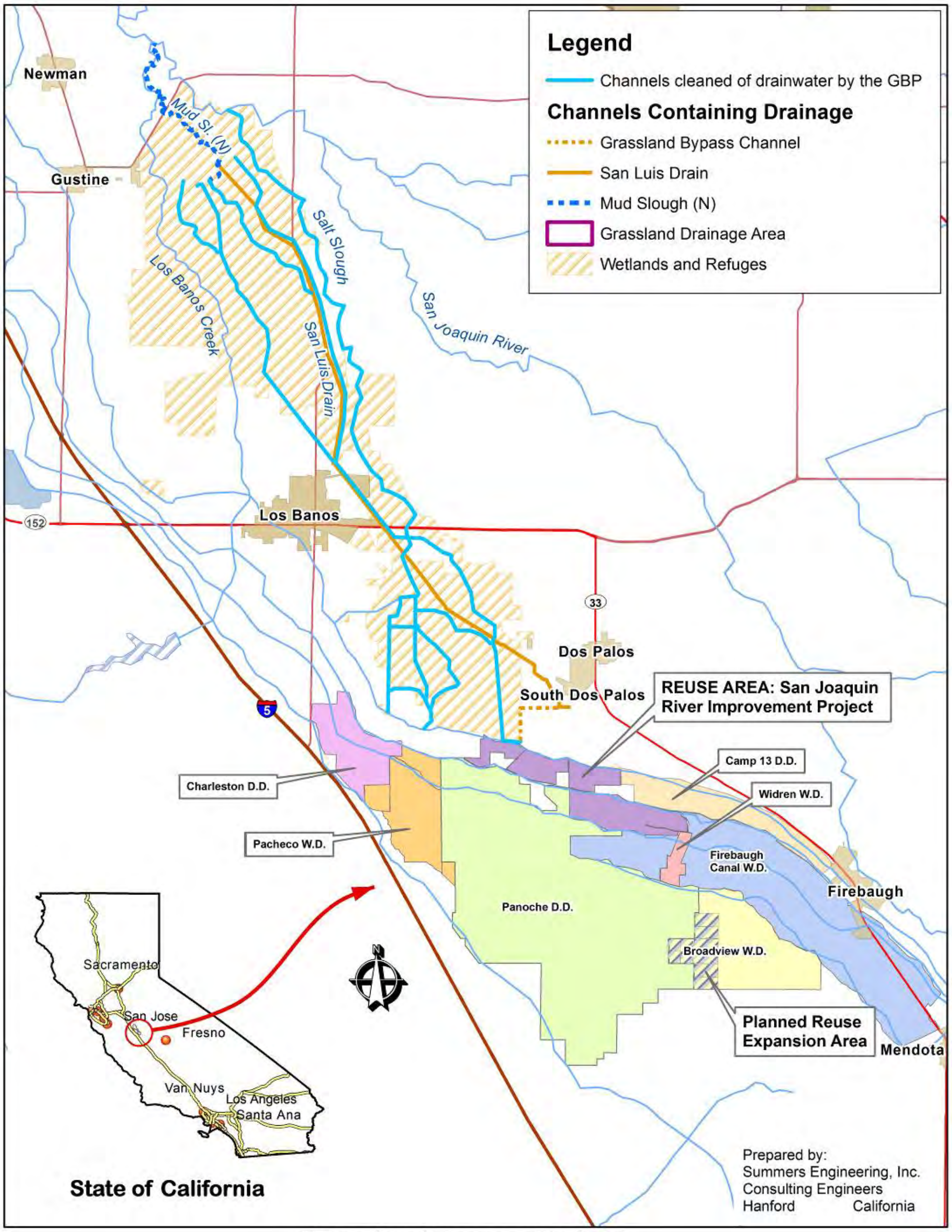


Figure 1

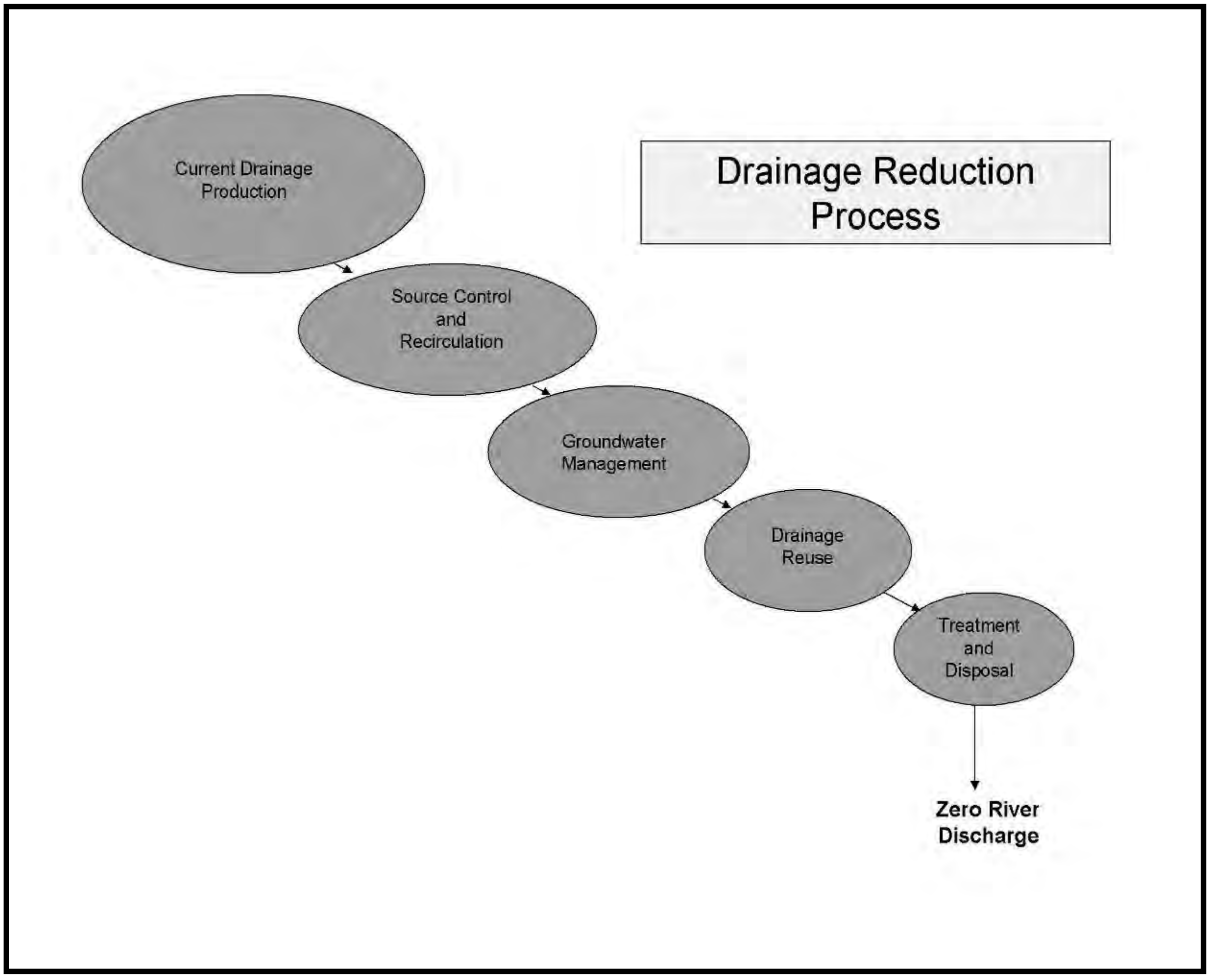


Grassland Bypass Project
Location Map

Drainage Management Components

The Westside Plan identified four effective projects to manage and reduce drainage discharge through the Grassland Bypass Project. These include source control projects such as irrigation and infrastructure improvements to reduce the overall subsurface drainage production, groundwater management to lower the perched water level, drainage reuse to reduce the volume of drain water through the irrigation of salt tolerant crops, and drainage treatment to remove the salt and dissolved minerals. The ultimate goal of this plan will be to eliminate agricultural drainage discharge from the Grassland Drainage Area. **Figure 3** shows the drainage solution components.

Figure 3: Drainage Solution Components



Source Control Projects. Source control projects are projects that can reduce the volume of water contributing to subsurface drainage production usually by reducing deep percolation. Source control projects can usually be divided into two categories: irrigation improvements and distribution infrastructure improvements.

Irrigation improvement projects include converting from a low efficiency irrigation system (such as furrow irrigation) to a high efficiency system (such as drip or micro sprinklers). The State of California and the local districts have made financial assistance (in the form of low interest loans) available to growers as an incentive to convert from conventional irrigation practices to high efficiency drip irrigation (and similar systems). As of 2016, approximately 75% of the irrigated acreage within the Grassland Drainage Area ha systems.


Microsprinklers

Distribution infrastructure improvement projects typically include the replacement of an unlined irrigation canals with a concrete lined channel or pipeline. Unlined channels within the Grassland Drainage Area can contribute more than 200 acre feet of seepage per year for each unlined mile. More than 30 miles of unlined canals have been lined or converted to pipelines since the beginning of the Grassland Bypass Project.


Canal Lining

Drainage Recirculation. Drainage recirculation is the process of redirecting drain water back into the irrigation system and it is one of the first drainage management tools implemented by the Grassland Area Farmers. Virtually all of the districts within the Grassland Drainage Area have some capacity for recirculation. Drainage recirculation is carefully monitored to maintain a blended water quality sufficient for agricultural use.

Panoche Drainage District Recirculation Plant

Groundwater Management. A study performed in 2002, by the San Joaquin River Exchange Contractor's Water Authority (Exchange Contractor's) and the U.S. Bureau of Reclamation indicated that the pumping of strategically placed wells (pumping above the Corcoran Clay) could lower the perched water table and reduce the discharge of nearby subsurface drainage systems. A portion of the funding provided through the Proposition 50 grant has been allocated for some of this work and 18 wells have been installed.

Drainage Reuse. In order to meet the selenium load requirements, Panoche Drainage District began diverting subsurface drain water on to pasture fields as a source of irrigation water in 1998. Over the next few years, trials, experiments, and research helped identify the salt tolerant crops that would best consume the saline drain water. Funding assistance from California Proposition 13 allowed for the purchase of 4,000 acres of marginal land that was developed to salt tolerant crops and became the San Joaquin River Improvement Project (SJRIP). Today, the SJRIP has expanded to 6,000 acres, with approximately 350 acres of pistachios and the remaining land planted to salt tolerant forage grasses (mostly Jose Tall Wheatgrass). The SJRIP has provided a key tool to manage almost all of the subsurface drainwater produced by conventional agriculture. By 2014, reuse on the SJRIP eliminated discharge through the San Luis Drain to the San Joaquin River during the summer months. **Table 1**, below shows the volume of subsurface drain water diverted to the SJRIP since its inception in 1998.

Table 1: SJRIP Drainage Reuse.

Water Year	Reused Drain Water	Reused Selenium	Reused Boron	Reused Salt
	(acre feet)	(pounds)	(pounds)	(tons)
1998¥	1,211	329	NA	4,608
1999¥	2,612	321	NA	10,230
2000¥	2,020	423	NA	7,699
2001	2,850	1,025	61,847	14,491
2002	3,711	1,119	77,134	17,715
2003	5,376	1,626	141,299	27,728
2004	7,890	2,417	193,956	41,444
2005	8,143	2,150	210,627	40,492
2006	9,139	2,825	184,289	51,882
2007	11,233	3,441	210,582	61,412
2008	14,955	3,844	238,435	80,900
2009	11,595	2,807	198,362	60,502
2010	13,119	3,298	370,752	75,362
2011	21,623	4,394	454,675	102,417
2012	23,735	3,293	545,180	118,445
2013	26,170	3,527	568,907	118,883
2014	30,870	3,711	879,800	179,560
2015	31,460	2,644	969,640	178,620
2016	24,573	2,401	886,770	162,421

Jose Tall Wheatgrass on the SJRIP

Pistachio on the SJRIP

Salt Balance: Drainage reuse has been an extremely effective tool in reducing drainage volume discharged from the Grassland Drainage Area but it is not without challenges. Because of the saline nature of the water applied, soil salinity needs to be carefully managed to prevent salt buildup in the root zone. To provide for a salt balance, subsurface drainage systems have been installed on 1,700 acres and ultimately will be installed on most the SJRIP lands. These subsurface drainage systems (or "tile" systems) will allow up to 25% leaching for the saltiest applied water. The long term salt balance and viability will be provided by the drainage systems and appropriate regular leaching including annual rainfall.

Drainage Treatment/Disposal. Conventional wisdom implies that some mechanical system will be required to from the salts from the drainwater leached from the SJRIP. While it is unclear if this conventional wisdom is indeed fact, the Grassland Basin Drainers have supported many treatment tests over the past two decades. Many different methods have been tested and none of these approaches have resulted in a viable and affordable treatment process. Until an effective treatment process is discovered, the Grassland Area Farmers will rely on the continued operation of the SJRIP and drainage reuse in order to manage drainwater and prevent discharge to the San Joaquin River. Portions of the SJRIP have received drainwater for irrigation continuously since 1998 with no reduction in crop production so there is reason to expect successful operation of the SJRIP far into the future.

Project Impacts

The Grassland Bypass Project has been successful in reducing the volume of subsurface drain water discharged from the 100,000 acre Grassland Drainage Area which maintaining viable farming within the region. In 1995, prior to the Grassland Bypass Project, more than 57,000 acre feet of drain water was discharged through the wetland channels. This not only impacted the water quality of the San Joaquin River system but exposed waterfowl attracted to the Grassland area wetlands to elevated levels of selenium and other constituents. The Grassland Bypass Project eliminated drainage discharge into the wetland channels[1] and consolidated all of the drainage within the Grassland Drainage Area into one channel. By 2016, the volume of discharged drain water was reduced from 57,574 acre feet to about 7,670 (an 87% reduction in discharge). Similar reductions occur in the discharged load of selenium, salt, and boron. **Table 2** shows the annual reduction in drainage discharge and associated constituent load. The concentrations of selenium in the San Joaquin River have reduced with the project. **Figure 4** shows the selenium concentrations at Crows Landing downstream of the Merced River which is the TMML compliance point.

Table 2: Grassland Bypass project Annual Discharge and Loads

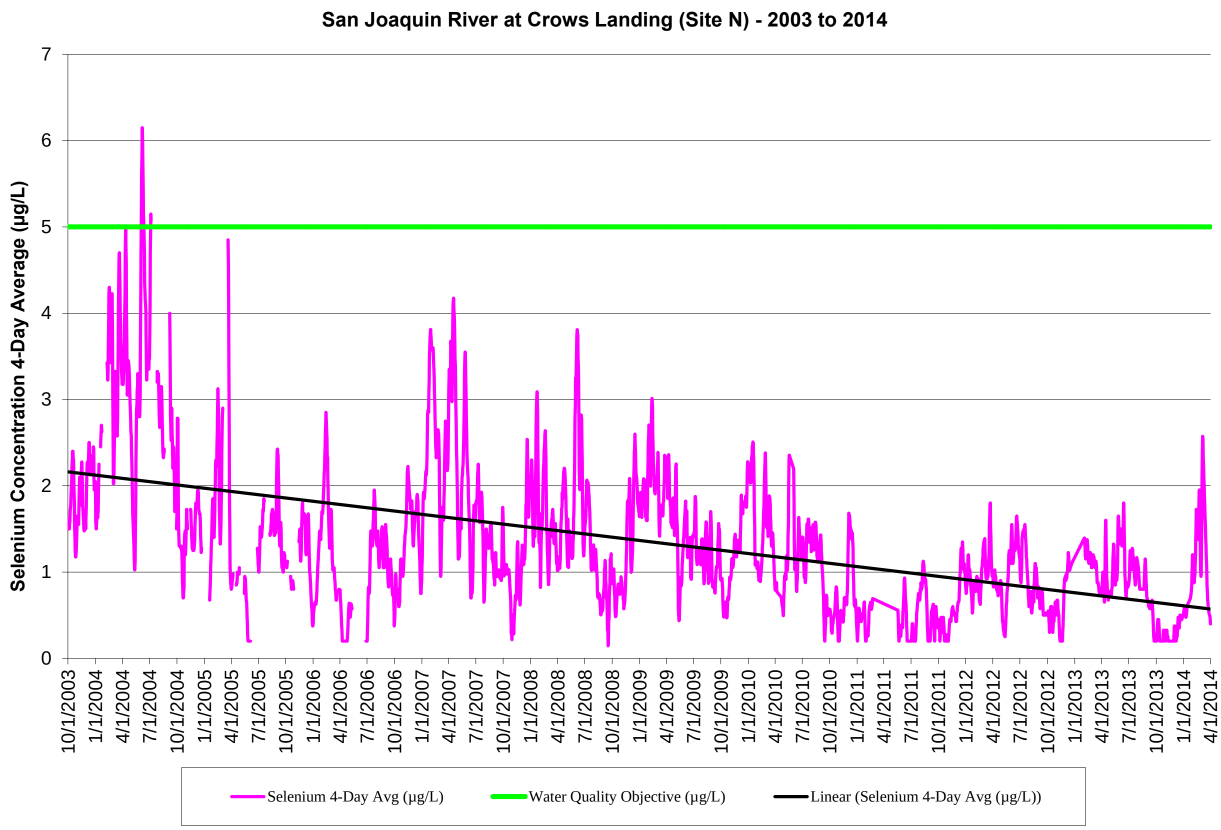
Discharge Comparison from Grassland Drainage Area

	WY 95	WY 96	WY 97	WY 98	WY 99	WY 00	WY 01	WY 02	WY 03	WY 04	WY 05
Volume (AF)	57,574	52,978	39,856	49,289	32,317	31,342	28,235	28,358	27,345	27,640	29,957
Se (lbs)	11,875	10,034	7,096	9,118	5,124	4,603	4,377	3,939	4,032	3,860	4,305
Salt (tons)	237,530	197,526	172,602	213,533	149,081	139,303	142,415	128,411	126,500	121,138	138,908
B (1,000 lbs)	868	723	753	983	630	619	423	544	554	530	585
Se (ppm)	0.076	0.070	0.066	0.068	0.058	0.054	0.057	0.051	0.054	0.051	0.053
Salt (µmhos/cm)	4,102	3,707	4,306	4,308	4,587	4,420	5,016	4,503	4,600	4,358	4,611
Boron (ppm)	5.5	5.0	7.0	7.3	7.2	7.3	5.5	7.1	7.5	7.1	7.2

	WY 06	WY 07	WY 08	WY 09	WY 10	WY 11	WY 12	WY 13	WY 14	WY 15	WY 16	Reduction from WY 95 to WY 16
Volume (AF)	25,995	18,531	15,665	13,166	14,529	18,513	10,486	10,258	7,125	6,079	7,670	87%
Se (lbs)	3,563	2,554	1,736	1,264	1,577	2,067	733	638	317	354	385	97%
Salt (tons)	119,646	79,094	66,254	55,556	67,661	87,537	38,398	54,663	44,834	40,779	46,207	81%
B (1,000 lbs)	539	278	269	233	315	440	245	309	244	212	215	76%
Se (ppm)	0.050	0.051	0.041	0.035	0.040	0.041	0.026	0.023	0.016	0.021	0.018	
Salt (µmhos/cm)	4,577	4,244	4,206	4,196	4,631	4,702	3,641	5,299	6,257	6,670	5,990	
Boron (ppm)	7.6	5.5	6.3	6.5	8.0	8.7	8.6	11.1	12.6	12.8	10.3	

[1] Except for during extreme storm events.

Figure 4 – Selenium Concentrations in the San Joaquin River downstream of the Merced



Appendix Q. Update on Groundwater Conditions in the Newman Sub-Area of the SJREC GSP

UPDATE ON GROUNDWATER CONDITIONS IN THE NEWMAN SUB-AREA OF THE SJREC GSP

prepared for
San Joaquin River Exchange
Contractors GSA
Los Banos, California

and
City of Newman GSA
Newman, California

by
Kenneth D. Schmidt & Associates
Groundwater Quality Consultants
Fresno, California

May 2019

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May 31, 2019

Mr. Chris White, Executive Director
San Joaquin River Exchange
Contractors GSA
P. O. Box 2115
Los Banos, CA 93635

Re: Newman Sub-Area of the
SJREC GSP

Dear Chris:

Submitted herewith is our report on groundwater conditions in the Newman Sub-area of the SJREC GSP. We appreciate the cooperation of the CCID and City of Newman in providing information for this report.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist 176

REGISTERED GEOLOGIST · KENNETH D. SCHMIDT · NO. 1578 · STATE OF CALIFORNIA

REGISTERED GEOLOGIST · KENNETH D. SCHMIDT · NO. 176 · CERTIFIED HYDROGEOLOGIST · STATE OF CALIFORNIA

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UPDATE ON GROUNDWATER CONDITIONS IN THE NEWMAN SUB-AREA OF THE SJREC GSP

INTRODUCTION

As part of the Groundwater Sustainability Plan (GSP) for the San Joaquin River Exchange Contractors (SJREC) service area, GSPs for a number of cities, including Newman, are being incorporated into the SJREC GSP. Kenneth D. Schmidt and Associates (KDSA, 1992 and 2001) prepared two reports on groundwater conditions in the vicinity of the City of Newman for the Central California Irrigation District (CCID) and the City.

This report is intended to provide an update on groundwater conditions within the Newman Study Area boundary (Figure 1). This boundary encompasses lands that are planned for future urban development. This study area is generally bounded by Stuhr Road on the north, the CCID Main Canal on the west, Hallowell Road on the south, and includes land east of the Canal School Road and southwest of the San Joaquin River, where the City effluent is handled. Lands west of the Main Canal and near Hills Ferry Road in Stanislaus County are within the Northwestern Delta Mendota GSA. Lands in a fairly large area east of Canal School Road and in Merced County are in the Merced County Delta Mendota GSA. Lands surrounding most of the City are in the SJREC GSA.

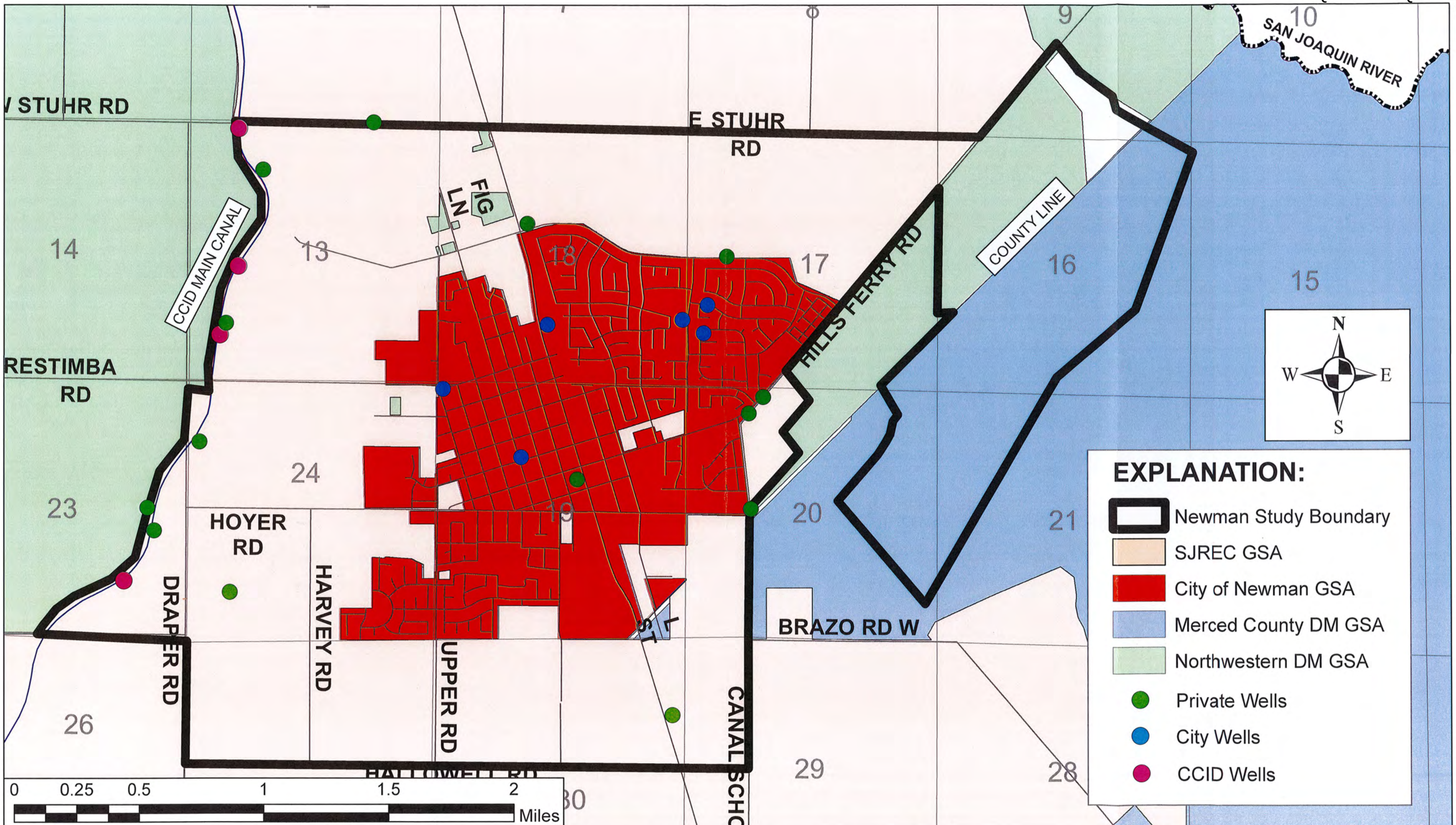

FIGURE 1 - LOCATION OF NEWMAN SUB-AREA, STUDY AREA BOUNDARY, AND SELECTED WELLS

Of particular interest in this update are: 1) the extent of groundwater overdraft, 2) land subsidence, 3) the historical water budget and that for future urban development of the study area, and 4) groundwater quality issues.

SUBSURFACE GEOLOGIC CONDITIONS

Alluvial deposits comprise the aquifer in the Newman area. Subsurface deposits near Newman are termed the older alluvium and the Tulare Formation. Page (1986) indicated that the base of the fresh groundwater (electrical conductivity less than 3,000 micromhos per centimeter at 25°C) was about 900 feet deep near Newman. KDSA (2018) indicated that the base of the usable aquifer in the vicinity, or bottom of the basin in SGMA terminology, was greater than 800 feet deep. A major confining bed is present beneath much of the west side of the San Joaquin Valley, including the Newman area. This clay is termed the Corcoran Clay (E-clay), and divides the aquifer system into upper and lower aquifers. The Corcoran Clay is readily discernible from the drillers logs for most wells in the area, due to its blue color. The over-lying and under-lying deposits are usually tan or brown in color.

Most groundwater near Newman is pumped from relatively shallow wells tapping the upper aquifer, but active City wells and some irrigation wells tap the lower aquifer. Information on the lower aquifer is available from at least four wells or test holes that have been drilled in the City to a depth of more than 500 feet.

KDSA developed two subsurface geologic cross sections extending through the City (Figure 2). Drillers and electric logs for water wells and test holes were obtained from the City, the CCID, and the California Department of Water Resources in Fresno for use in developing these cross sections. A test hole (No. 7) was done by the City in the northeast part of the City and Well No. 8 was subsequently constructed at this site. No CCID wells have been drilled in the area since the 2001 report.

Subsurface Geologic Cross Section A-A′ (Figure 3) extends from near Orestimba Road and the Main Canal on the west through City Wells No. 6, No. 1, No. 4, a test hole near Hills Ferry Road and Canal School Road, to a private well (17R1) near the extension of Hunt Road, about one-half mile west of the Newman Wasteway. Electric logs are available for three wells or test holes along this section. One of these is a 712-foot deep test hole (20D) that was drilled for the City near Hills Ferry Road and Canal School Road. Another is a 500-foot deep test hole that was drilled near City Well No. 6. Another is for CCID Well No. 3, which is 422 feet deep. Drillers logs are available for the other three wells along this section. All of the wells and test holes along this section penetrated the Corcoran Clay. The top of this clay ranges from about 220 feet deep near CCID Well No. 3 to about 275 feet at City Well No. 4. The Corcoran Clay thickens sub-

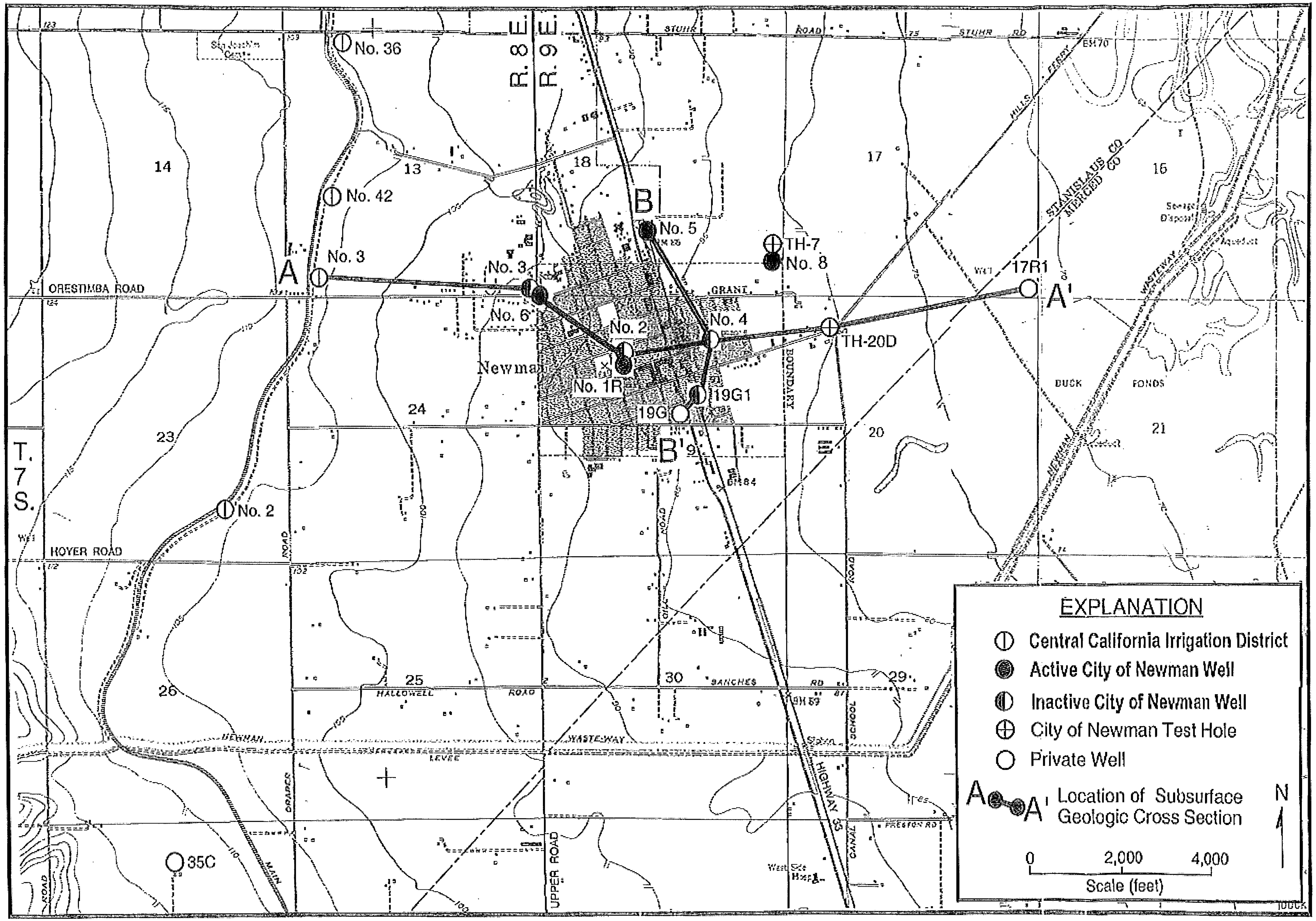

FIGURE 2-LOCATION OF SELECTED TEST HOLES AND WELLS
AND SUB-SURFACE GEOLOGIC CROSS SECTIONS

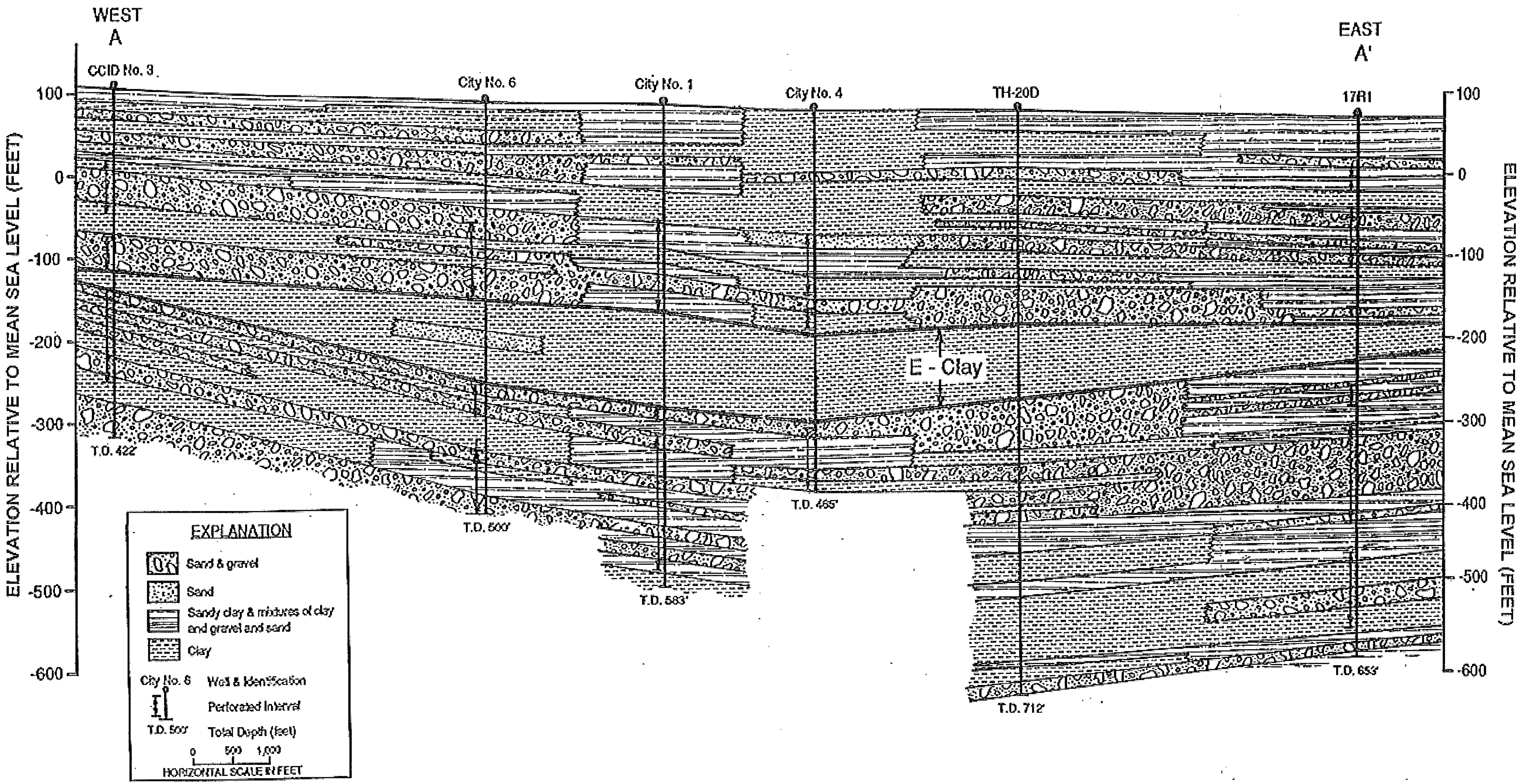

FIGURE 3 - SUBSURFACE GEOLOGIC CROSS SECTION A - A'

stantially toward Highway 33, from about 20 feet at CCID Well No. 3 to about 115 feet at City Well No. 1. Along Cross Section A-A′, the clay is thickest and deepest beneath the area near Highway 33.

Sand and gravel layers are more common in the upper aquifer beneath the west part of the study area (i.e., at CCID Well No. 3). Some of the coarsest deposits in the upper aquifer are within the lower 100 feet, just above the Corcoran Clay. In contrast, fine-grained layers are more predominant in the upper aquifer near Highway 33 (City Well No. 4). Information at Test Hole 20D indicates that below a depth of about 500 feet, sand and gravel layers are uncommon in the lower aquifer. In general, deposits of the lower aquifer appear to be coarsest immediately beneath the E-clay, and to become finer with increasing depth. Two former City wells along this section (Nos. 1 and 4) primarily drew and CCID Well No. 3 draws water from these two widespread, coarse-grained zones above and below the Corcoran Clay. In contrast, City Well No. 1R produces water exclusively from the lower aquifer.

Cross Section B-B′ (Figure 4) extends from north to south, from City Well No. 5 through City Well No. 4 and then two private wells. This section is based entirely on drillers logs, and was correlated with information from Section A-A′, which intersects Cross Section B-B′ at City Well No. 4. Coarse-grained

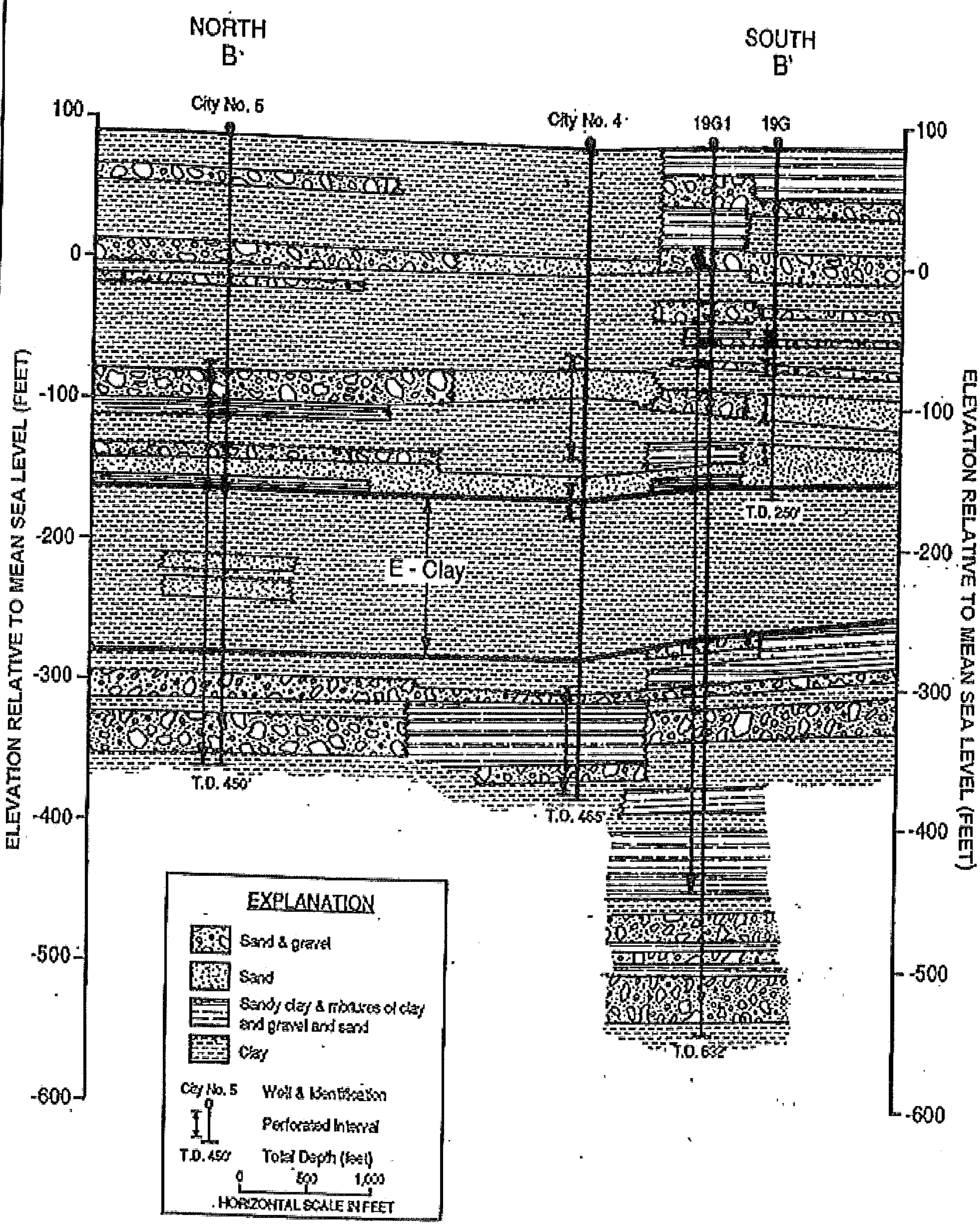

FIGURE 4 - SUBSURFACE GEOLOGIC CROSS SECTION B - B'

strata were found at a depth of more than 600 feet at Well 19G1, which is the deepest well along this section. Well 19G1 was drilled to a depth of 632 feet at the Golden Valley Creamery in 1947. This section also shows a predominance of coarse-grained strata within the lower 100 feet of the upper aquifer and just below the Corcoran Clay.

Test Hole No. 7 was drilled to a depth of 505 feet by Maggiora Brothers, Inc. of Watsonville in September 1992 (Figure 1). The Corcoran Clay was indicated to be present for about 260 to 354 feet in depth. A number of permeable strata were found both above and below the Corcoran Clay at this site. City Well No. 8 was subsequently completed near this test hole.

WELL CONSTRUCTION DATA

City Wells

There are presently four active City Wells. Table 1 provides information on dates drilled, depths, and perforated intervals for these wells.

Drillers logs are available for Well Nos. 1R, 5, 6, and 8 and electric logs are available for Wells No. 5, 6, and 8. Cased depths of the active wells range from 450 to 635 feet. Wells No. 1R and 6 tap strata only in the lower aquifer, whereas Wells No. 5 and 8 are composite wells that tap both aquifers.

TABLE 1-CONSTRUCTION DATA FOR CITY OF NEWMAN WELLS

No.	Date Drilled	Drilled Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
1R	08/94	645	635	16	340-620	0-50
5	62/69	465	450	14	162-450	0-50
6	09/90	510	500	16	350-500	0-50
8	03/04	498	485	16	180-480	0-100

CCID Wells

Table 2 provides construction data for four CCID wells west and northwest of Newman, along the Main Canal. Depths of these wells range from 350 to 432 feet, and all are composite wells, tapping both the upper and lower aquifer.

WATER LEVELS

Near Newman, most of the available water-level measurements are for wells tapping the upper aquifer, but some measurements are for composite wells that also tap the lower aquifer. In general, water levels are deeper in deeper wells, which indicates a downward direction of groundwater flow in the area. This is common in much of the San Joaquin Valley.

Water-Level Elevations

KDSA (2001, Figure 4) presented a water-level elevation contour map for the upper aquifer in Spring 2000. Water-level contours for the upper aquifer beneath most of the urban area were not provided due to a lack of measurements. Water-level elevations in the upper aquifer west of Newman ranged from 86 to 108 feet above mean sea level, and the direction of groundwater flow was primarily to the east. Water-level elevations in the upper aquifer in the area southeast of Newman ranged from 68 to 78 feet

TABLE 2-CONSTRUCTION DATA FOR CCID WELLS

No.	Date Drilled	Drilled Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)
2	02/54	350	341	16	90-152
				14	157-337
3	02/54	422	360	16	85-150
					180-225
					245-355
36	01/65	-	398	16	90-132
				14	132-393
42	01/67	-	391	16	90-391

above mean sea level in Spring 2000, and the direction of groundwater flow was to the northeast. Near Newman, the average water-level slope in the upper aquifer was about eight feet per mile.

Water-level elevations of less than about 75 feet in the area west of Newman appeared to have been representative of the lower aquifer. KDSA (2001, Figure 5) showed water-level elevations for the lower aquifer in Spring 2000. Water-level elevations for wells apparently tapping the lower aquifer at and west of Newman ranged from about 66 to 75 feet above mean sea level, and the direction of groundwater flow was to the northeast in Spring 2000. A cone of depression was present beneath the Newman urban area, where water-level elevations ranged from 52 to 56 feet southwest of Newman. The average slope of the piezometric surface of the lower aquifer upgradient of Newman was about 17 feet per mile in Spring 2000.

Figure 5 shows water-level elevations and the direction of groundwater flow for the upper aquifer in Spring 2011. An upper aquifer map for Spring 2017 or other years after 2011 could not be prepared, due to a lack of data in the DWR data base. Limited data for Spring 2017 indicate a water-level elevation of 86 feet above mean sea level near the Main Canal south of Preston Road and 57 feet north of Stuhr Road and average water-level slope of about 8.8 feet per mile. In Spring 2011, the average water-level

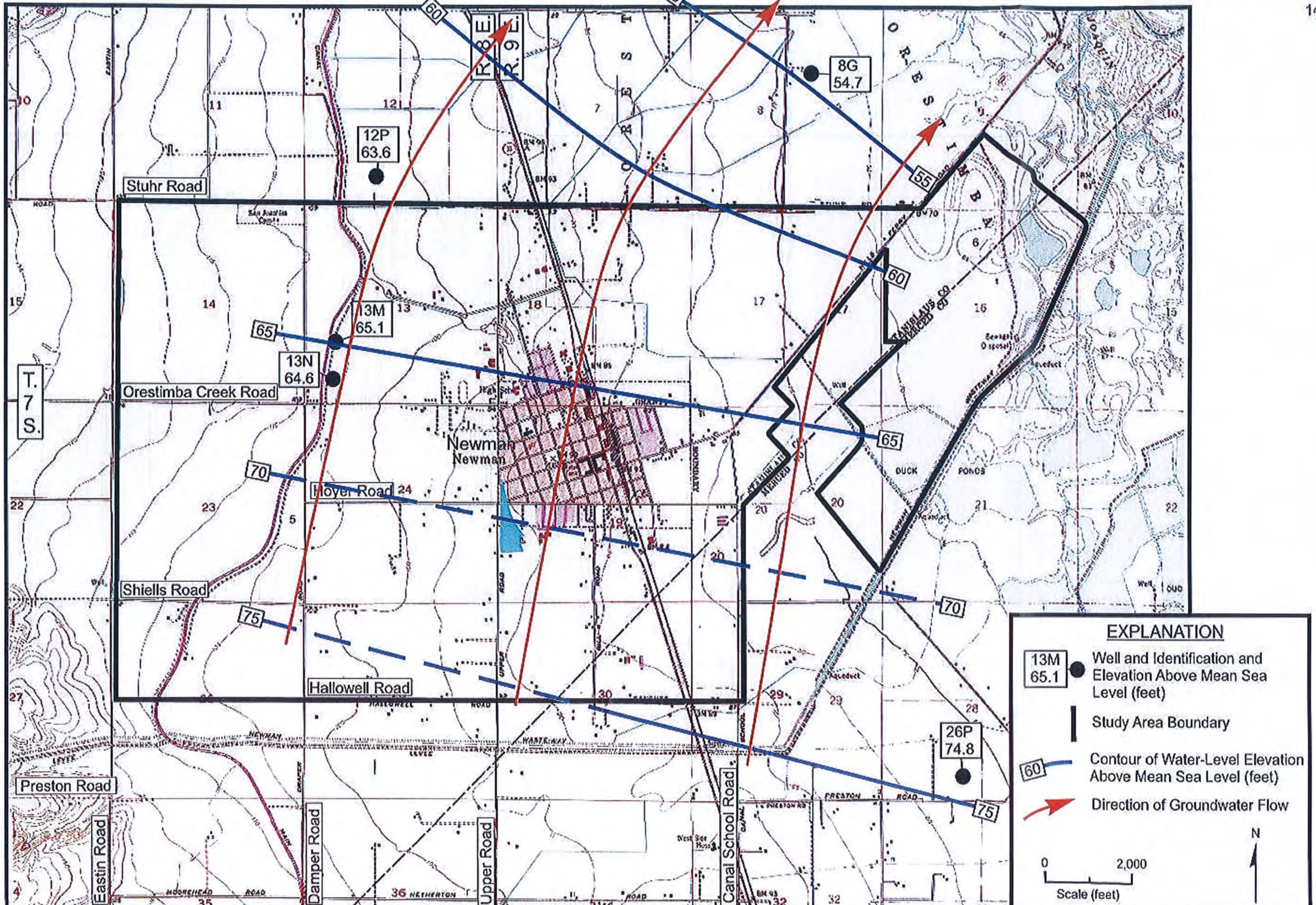

FIGURE 5 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR UPPER AQUIFER (SPRING 2011)

slope was about 8.4 feet per mile. The direction of groundwater flow was to the north-northeast.

Figure 6 shows water-level elevations and the direction of groundwater flow for lower aquifer in Spring 2017. Some of the water-level elevations are for measurements in composite wells, and these values may be somewhat higher than actual elevations in the lower aquifer. Water-level elevations ranged from 49 feet above mean sea level at CCID wells near No. 3 the Main Canal to less than 20 feet at City Well No. 8. An easterly direction of groundwater flow was indicated.

Time Trends

The hydrologic base period utilized for the SJREC GSA is from 2003 to 2012. Thus Spring 2003-Spring 2013 water-level measurements were reviewed in terms of time trends.

City Wells

Water-level measurements for Well 1-R are only available for 2001-04, which is too short of a period to be utilized in this evaluation. Figure 7 is a water-level hydrograph for Well No. 5. The spring water levels in this well have slightly declined since 2001. Between Spring 2003 and Spring 2013, the water level in this well fell an average of about 0.7 foot per year. Figure 8 is a water-level hydrograph for Well No. 6. The spring water levels in

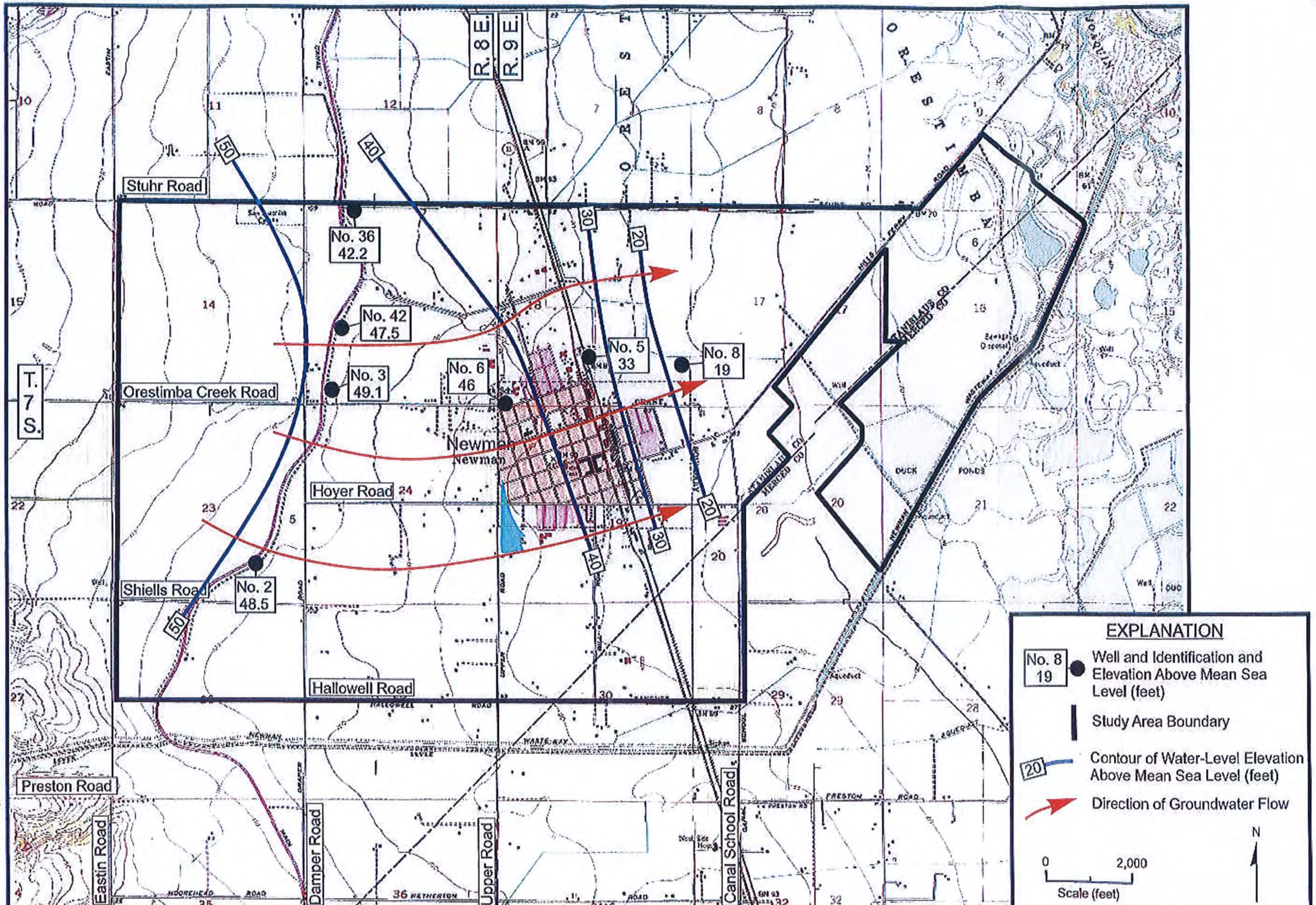

FIGURE 6 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR LOWER AQUIFER (SPRING 2017)

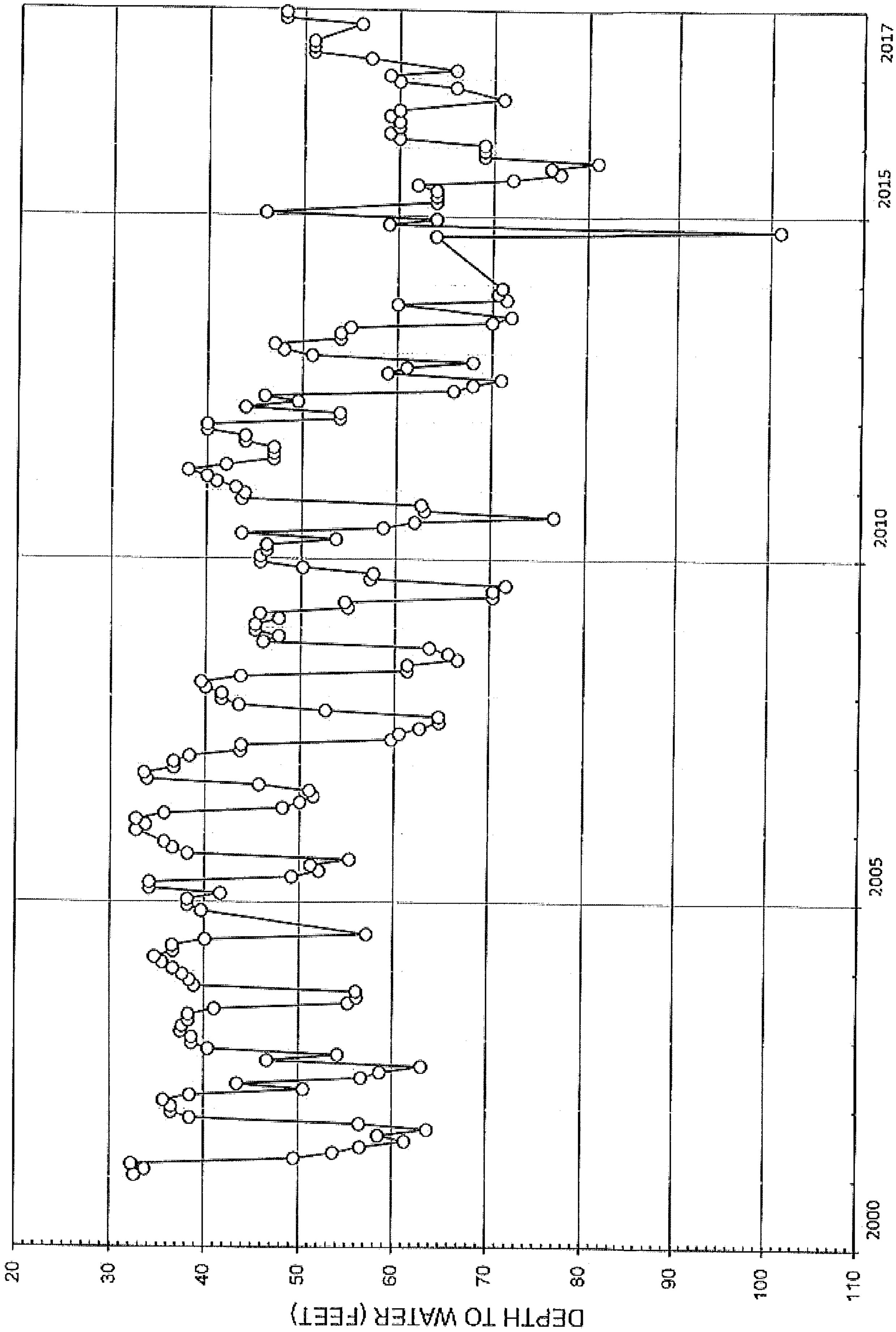

FIGURE 7- WATER-LEVEL HYDROGRAPH FOR CITY OF NEWMAN WELL NO. 5

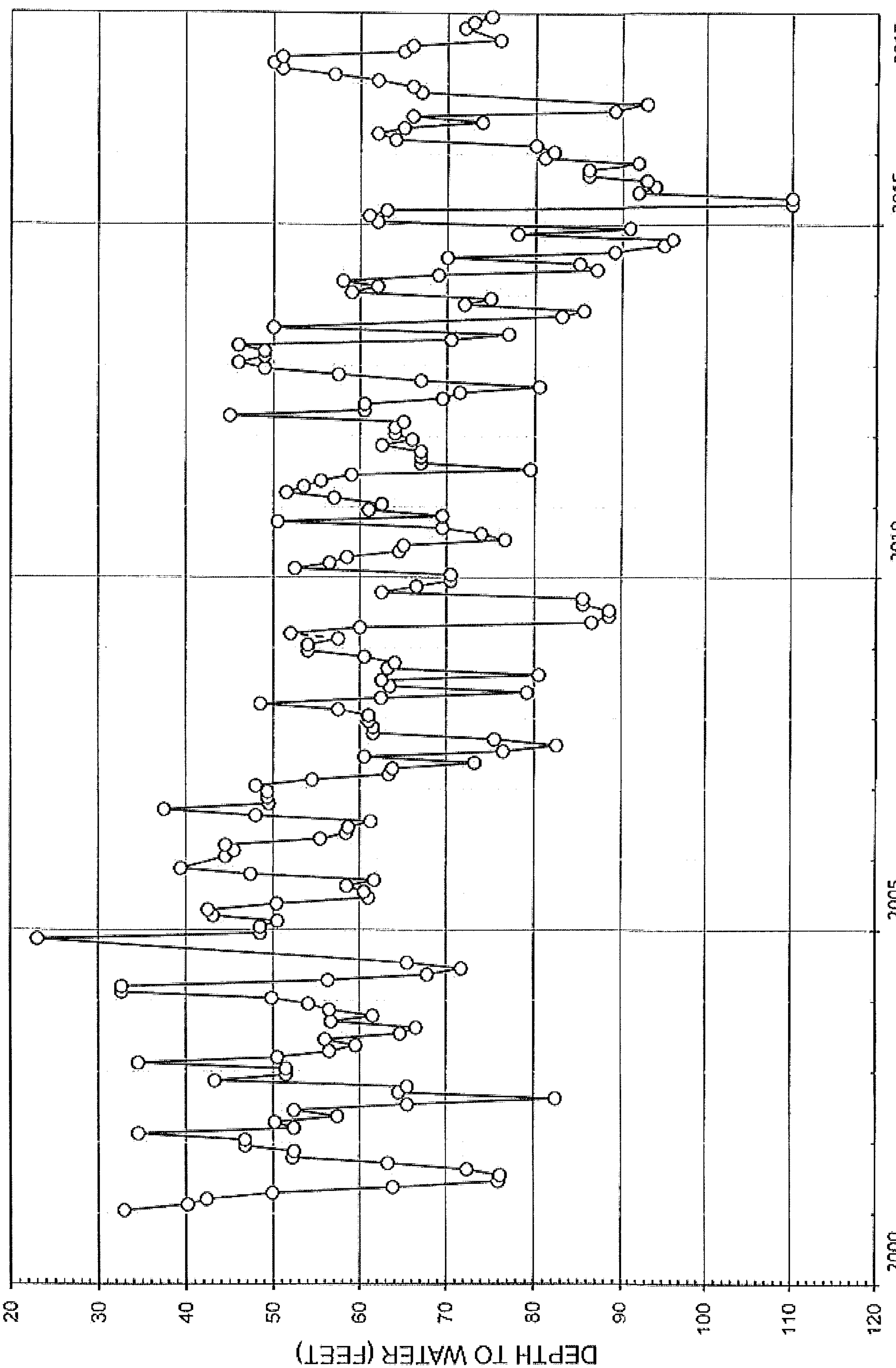

FIGURE 8- WATER-LEVEL HYDROGRAPH FOR CITY OF NEWMAN WELL NO. 6

this well have also declined since 2001. Between Spring 2003 and Spring 2013, the water level in this well fell an average of 1.3 feet per year. Both Wells No. 5 and 6 are composite wells. Figure 9 shows a water-level hydrograph for Well No. 8, which is a lower aquifer well. Measurements for this well prior to 2005 aren't available. Spring water levels fell from 21 feet in 2005 to 40 feet in 2012, or an average decline of 2.1 feet per year. This decline is considered representative of the lower aquifer in the City.

CCID Wells

Long-term water-level hydrographs for the four CCID wells are provided in Figure 10, 11, 12, and 13. Since 1965, water levels in these wells were relatively stable prior to 2013. Water levels in all of these wells fell during 2013-16, and had partially recovered by Spring 2018. Between Spring 2003 and Spring 2013, water levels in two of these wells (No. 3 and 42) were essentially stable. Water levels in the other two wells (No. 2 and No. 36) fell at average rates ranging from 0.2 to 0.8 foot per year. Overall, records for the four CCID wells indicate an average water-level decline of 0.25 foot per year. All of these wells are composite wells, tapping both aquifers.

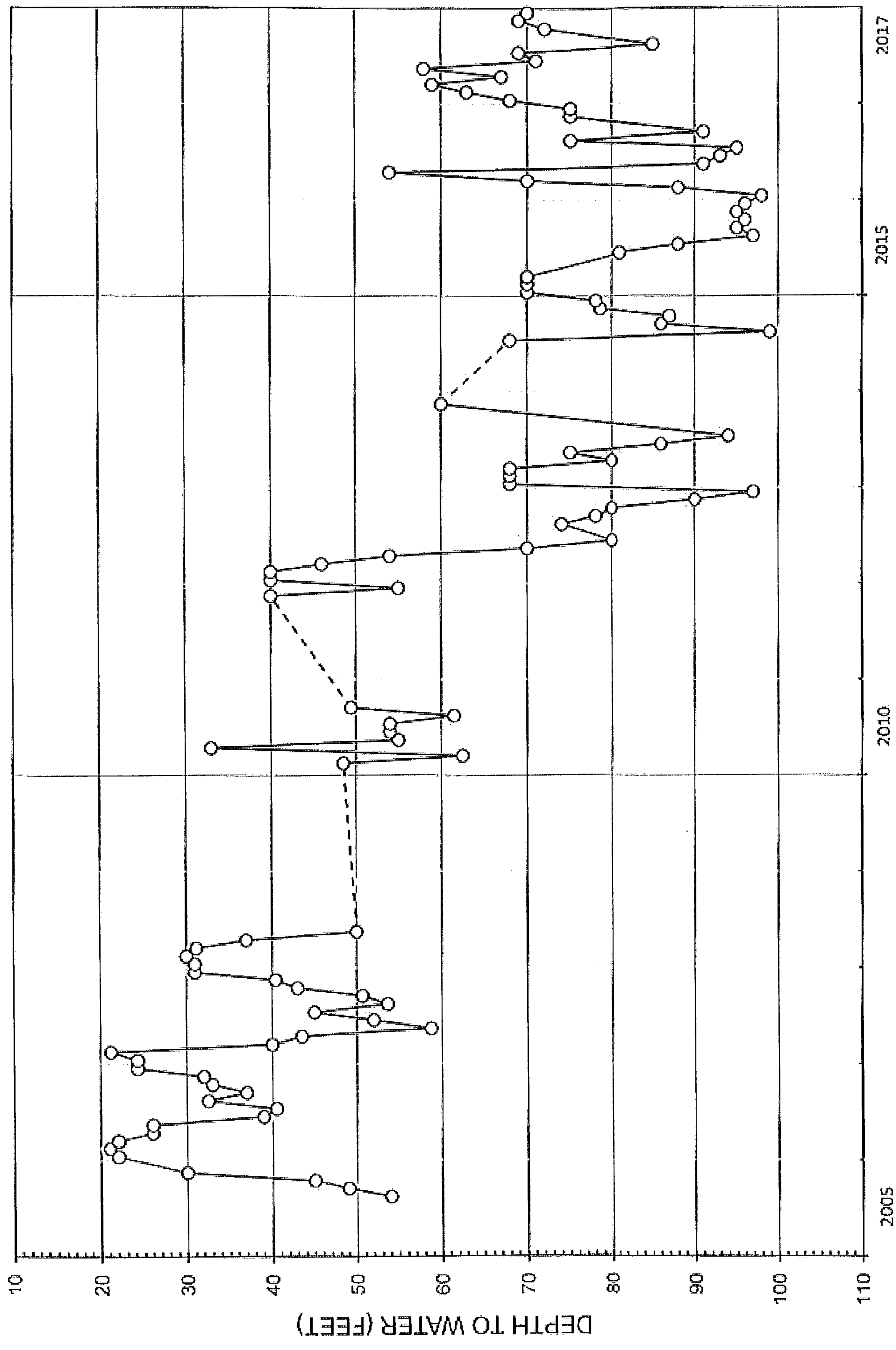

FIGURE 9- WATER-LEVEL HYDROGRAPH FOR CITY OF NEWMAN WELL NO. 8

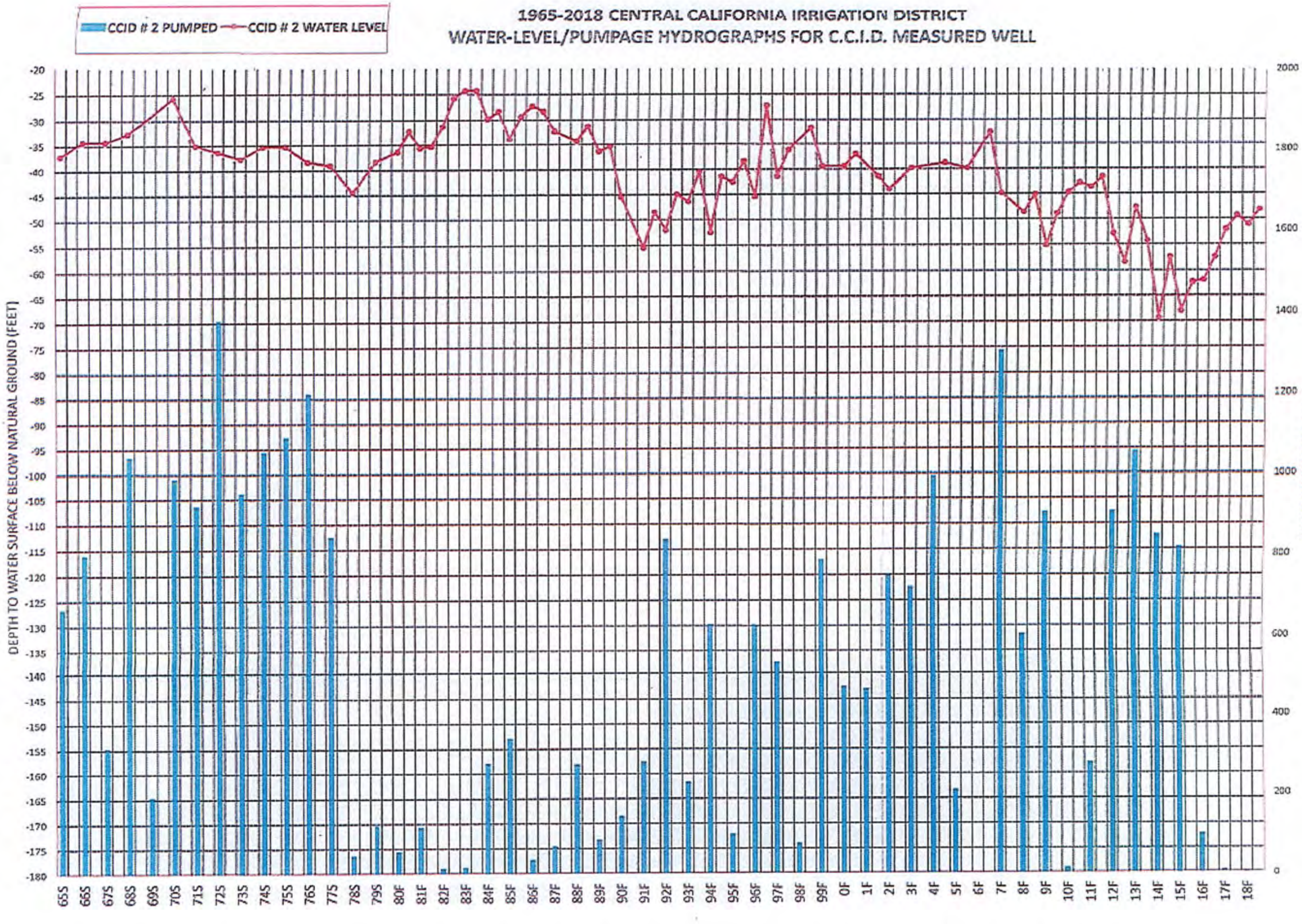

FIGURE 10 - LONG-TERM WATER LEVEL AND PUMPAGE HYDROGRAPHS FOR COMPOSITE DISTRICT WELL NO. 2 IN THE NEWMAN WELL FIELD

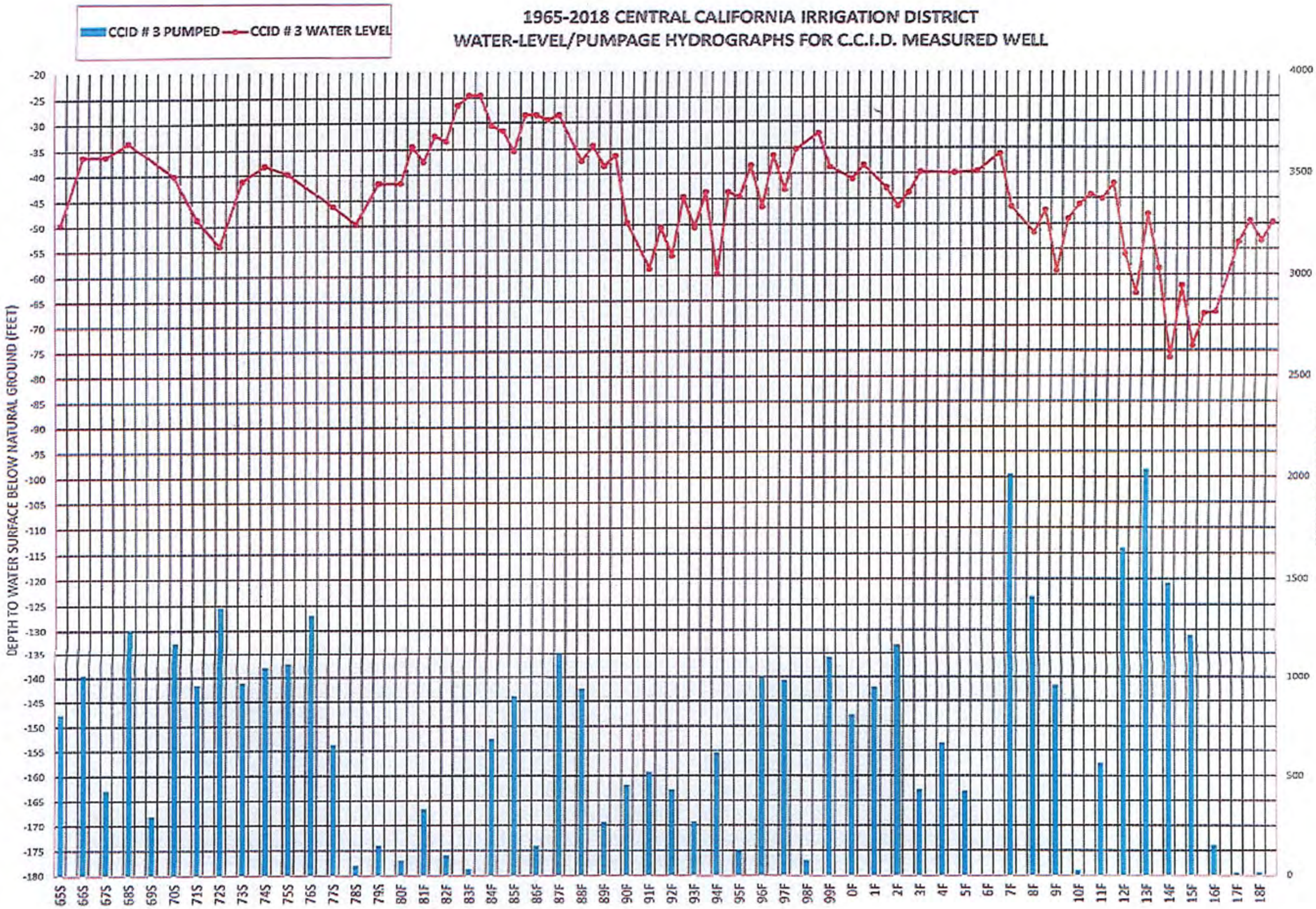

FIGURE 11 - LONG-TERM WATER LEVEL AND PUMPAGE HYDROGRAPHS FOR THE DISTRICT WELL NO. 3 IN THE NEWMAN WELL FIELD

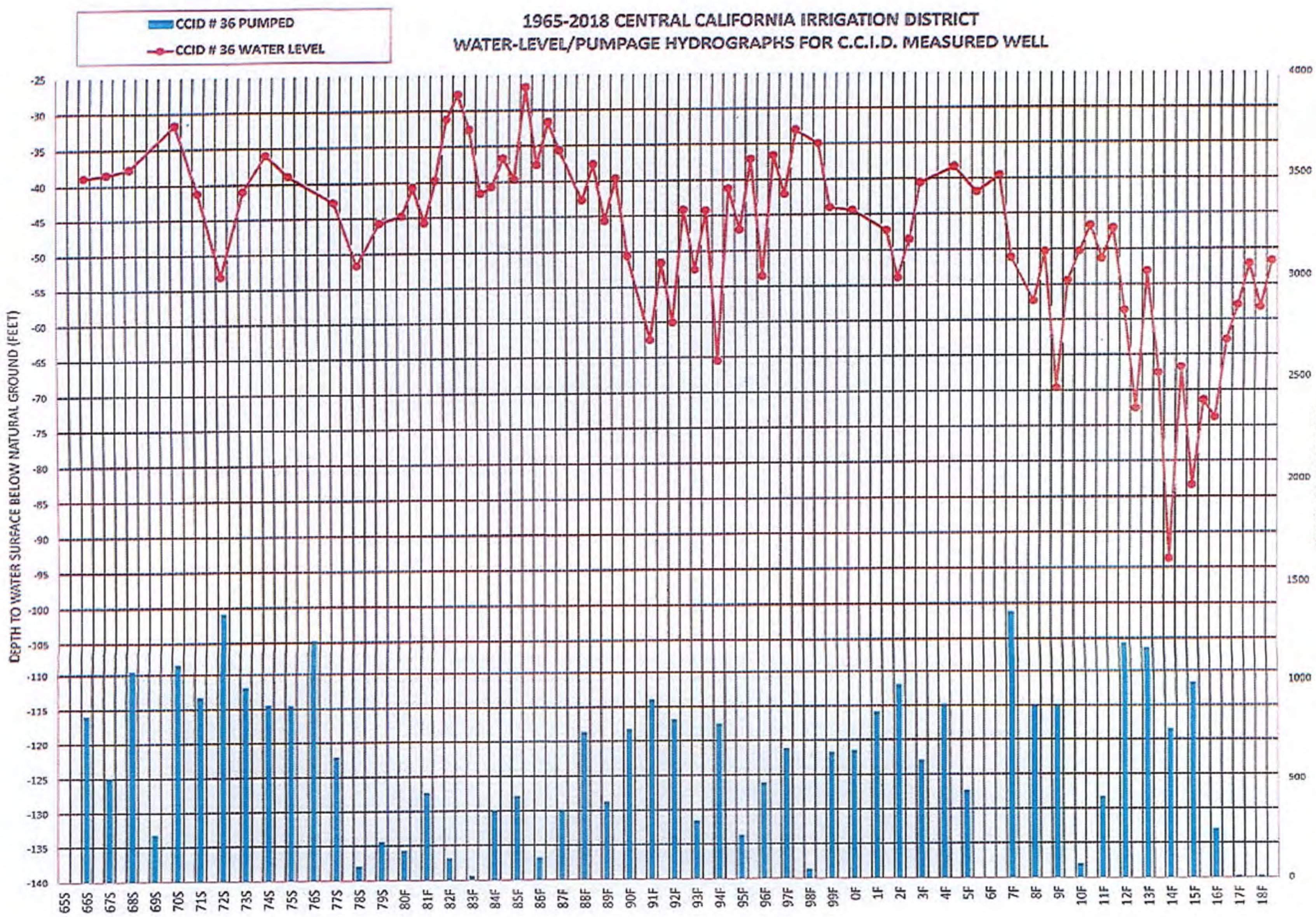

FIGURE 12 - LONG-TERM WATER LEVEL AND PUMPAGE HYDROGRAPHS FOR THE DISTRICT WELL NO. 36 IN THE NEWMAN WELL FIELD

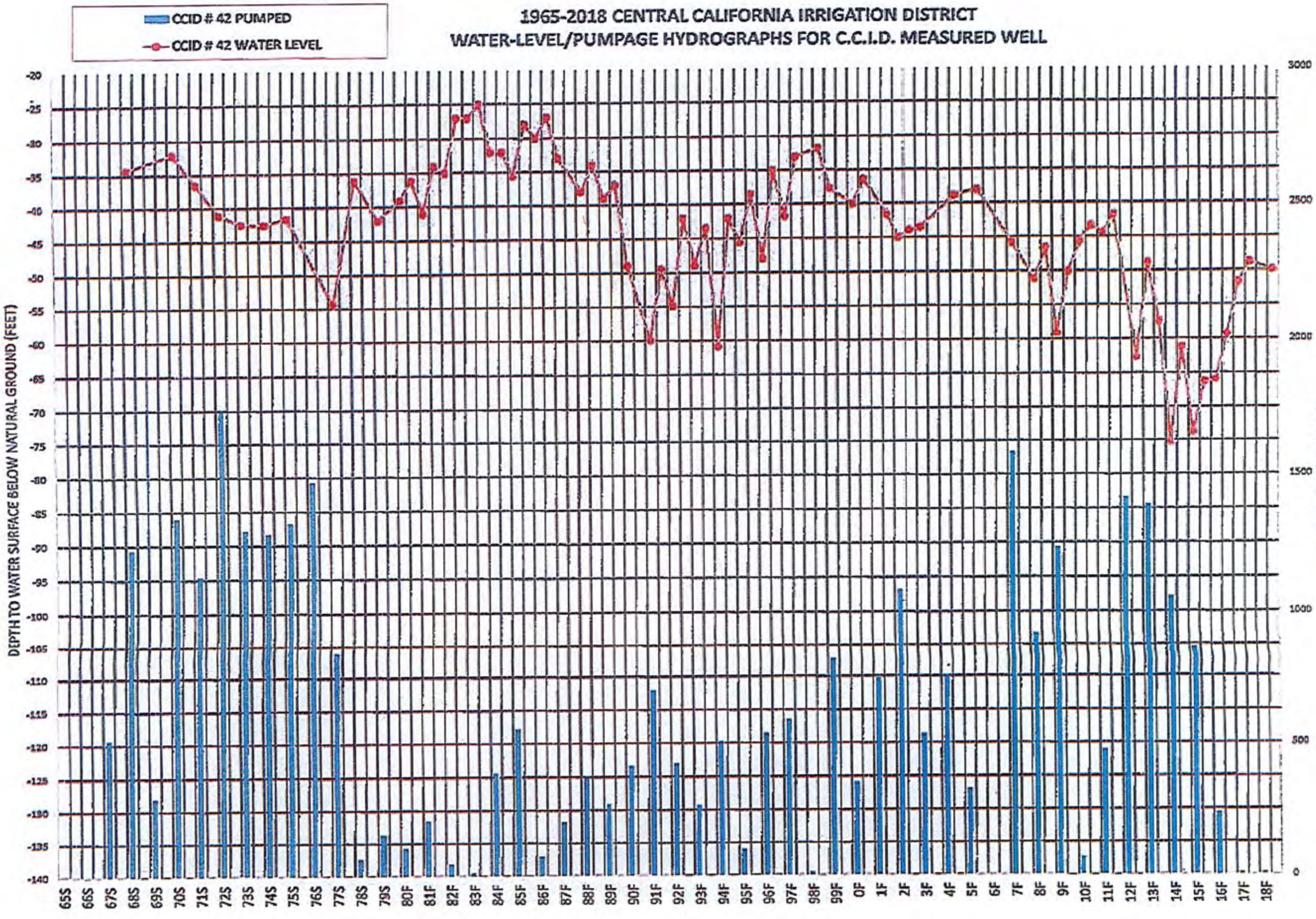

FIGURE 13 - LONG-TERM WATER LEVEL AND PUMPAGE HYDROGRAPHS FOR THE DISTRICT WELL NO. 42 IN THE NEWMAN WELL FIELD

AQUIFER CHARACTERISTICS

Table 3 summarizes pump test data for three of the active City wells for the 1990's. Recent pump test have not been provided. Pumping rates of the City wells ranged from about 1,200 to 1,600 gpm, and specific capacities ranged from 30 to 73 gpm per foot. The highest specific capacity was for Well No. 6. Table 4 shows pump test results for four CCID wells in October 2016. Pumping rates ranged from about 1,380 to 1,740 gpm. Except for one well, specific capacity values ranged from 62 to 68 gpm per foot. Based on information in the 1992 KDSA report, the transmissivity of the upper aquifer beneath the City is estimated to be about 23,000 gpd per foot. The combined transmissivity of the upper and lower aquifers above a depth of about 550 feet at Newman is estimated to average about 90,000 gpd per foot. This indicates the high productivity of the lower aquifer at Newman. The combined transmissivity of the upper and lower aquifers above a depth of about 420 feet near the Main Canal is estimated to be about 120,000 gpd per day per foot.

Darcy's Law can be used to estimate groundwater flow into the urban area. Using a transmissivity of 23,000 gpd per foot, a width of flow of about 2.6 miles (using general Plan boundaries) in Spring 2011, and an average water-level slope of about 8.4 feet per mile, the amount of groundwater flow in the upper aquifer

TABLE 3-PUMP TEST DATA FOR CITY OF NEWMAN WELLS

No.	Date Tested	Pumping Rate (feet)	Static Level (feet)	Pumping Level (inches)	Drawdown (feet)	Specific Capacity (gpm/ft)
1R	8/27/94	1,600	77.0	130.0	53.0	30.2
5	7/06/92	1,600	47.0	95.1	48.1	33.3
6	10/05/90	1,200	47.0	63.5	16.5	72.7

Data from City of Newman records.

TABLE 4-PUMP TEST DATA FOR CCID WELLS

No.	Date Tested	Pumping Rate (feet)	Static Level (feet)	Pumping Level (inches)	Drawdown (feet)	Specific Capacity (gpm/ft)
2	10/15/16	1,378	65.8	85.8	20.1	62.4
3	10/15/16	1,744	71.6	78.8	7.2	200.0
36	10/15/16	1,520	78.8	100.3	21.5	67.5
42	10/15/16	1,603	69.9	91.9	22.1	66.6

Records from CCID.

was calculated to be about 560 acre-feet per year. For the lower aquifer, using a transmissivity of 67,000 gpd per foot, a width of flow of 2.75 miles, and an average water-level slope of about 10 feet per mile, there were about 2,100 acre-feet per year of groundwater inflow for Spring 2017. As discussed in the following section, about 2,100 acre-feet of groundwater were pumped in the urban area in 2017. An estimated 1,750 acre-feet per year of this pumpage was from the lower aquifer. The amount of groundwater flow into the General Plan was greater than the net consumptive use of groundwater pumped in the urban area (i.e., pumpage minus incidental recharge).

PUMPAGE

Table 5 provides a summary of annual pumpage by the City of Newman, the CCID, and from private wells in the study area from 2003-2017. City pumpage increased from about 1,000 acre-feet per year in 1991, to 1,800 acre-feet per year in 2000, and 2,700 acre-feet per year in 2007. After 2007, City pumping decreased to about 2,200 acre-feet in 2011 due to water conservation measures. City pumpage was 2,600 acre-feet in 2012, and then decreased due to water conservation measures to about 1,900 acre-feet in 2015. The average City pumpage during 2002-17 was 2,340 acre-feet per year. The average CCID well pumpage during 2003-17 was about 3,260 acre-feet per year. Total pumpage by CCID from their

TABLE 5-ANNUAL PUMPAGE (1989-2017)
(ACRE FEET PER YEAR)

Year	City Wells	CCID Wells	Private Wells
2002	2,038	-	-
2003	2,089	2,552	1,493
2004	2,381	3,356	1,808
2005	2,498	1,399	1,920
2006	2,670	-	527
2007	2,716	4,802	1,957
2008	2,682	4,862	1,883
2009	2,470	3,956	1,459
2010	2,275	163	255
2011	2,208	1,716	1,021
2012	2,593	5,078	784
2013	2,534	4,857	2,516
2014	2,324	4,719	2,338
2015	1,918	4,055	6,687
2016	2,004	834	698
2017	2,083	-	756
Average	2,343	3,258	1,690

wells varies substantially, depending on canal water supplies. For example, only about 160 acre-feet were pumped in 2010, whereas about 5,080 acre-feet were pumped in 2012. There are also a number of private irrigation wells in the study area, and CCID provided estimates of pumpage from these wells. Pumpage from these wells ranged from about 260 acre-feet in 2010 to 6,690 acre-feet in 2015. The average pumpage from these private wells was 1,690 acre-feet per year for 2003-2017. The average total pumpage in the study area was thus about 7,300 acre-feet from 2003-17.

CITY EFFLUENT

Table 6 shows amounts of City effluent for 2003-2016. About 300 acres of pasture, alfalfa, oats and corn have normally been irrigated with the effluent, and this has been supplemented by well pumpage. There are 135 acres of holding ponds for the effluent. The amount of effluent used for irrigation ranged from about 600 acre-feet per year to 1,300 acre-feet per year during 2003-16. The average amount of effluent applied during this period was 900 acre-feet per year. Of this amount, an estimated 70 percent, or 630 acre-feet per year was consumed by evapotranspiration. The total amount of effluent during this period is estimated to have been about half of the City pumpage, or about 1,200 acre feet per year. This indicates that an average of

TABLE 6-AMOUNTS OF CITY EFFLUENT
USED FOR IRRIGATION

Year	Amount (acre-feet)
2003	800
2004	800
2005	800
2006	1,100
2007	1,400
2008	1,400
2009	1,100
2010	800
2011	900
2012	1,600
2013	1,700
2014	1,500
2015	1,300
2016	1,000
Average	1,200

An estimated 300 acre-feet per year of effluent was evaporated from holding ponds.

about 300 acre-feet per year of effluent was probably lost to evaporation from the holding ponds. An average of about 360 acre-feet per year of well pumpage has been used to supplement the effluent for irrigation.

CANAL WATER DELIVERIES

Table 7 shows CCID canal water deliveries to lands in the study area for 2003-16. Canal water was delivered to 2,600 acres of land each year during this period. The amount of canal water ranged from 450 acre-feet in 2004 to 9,600 acre-feet in 2009. The average amount of canal water delivered was 7,500 acre-feet per year during this period, or an average of 2.9 acre-feet per acre per year.

CONSUMPTIVE USE

Urban

Urban consumptive use includes evapotranspiration of water from outside water use (lawns, parks, etc), and evapotranspiration and evaporation of City effluent. The outside water use is estimated by subtracting the amount of effluent from the City pumpage. The average City pumpage from 2002-17 was 2,340 acre-feet per year and the average amount of City effluent was about 1,200 acre-feet per year. This indicates that an average of about 300 acre-feet per year was probably lost due to pond

TABLE 7-CCID CANAL WATER DELIVERIES
TO LANDS IN STUDY AREA

Year	Amount (acre-feet)
2003	8,200
2004	8,300
2005	7,200
2006	7,700
2007	9,300
2008	8,900
2009	9,600
2010	7,500
2011	6,500
2012	7,800
2013	7,600
2014	4,500
2015	5,800
2016	5,600

The canal water was used for irrigation of 2,600 acres of land.

evaporation. An average of about 360 acre-feet per year of well pumpage has been used to supplement the effluent for irrigation. The average City outside water use would be 1,140 acre-feet per year. The evapotranspiration for the outside water use is estimated to be 70 percent of this, or 800 acre-feet per year. For the effluent, it is estimated that an average of 630 acre-feet per year was consumed by evapotranspiration of irrigated crops and 300 acre-feet per year was lost due to evaporation from the holding ponds. The total urban consumptive use was thus about 1,700 acre-feet per year (rounded).

Rural

CCID estimated the evapotranspiration of applied water to crops in the study area. The ITRC water use study report for 1997-2008 was used to determine the evapotranspiration of applied water to crops (ET_{IW}) for 2003-08. For 2009-16, the total evapotranspiration (ETc) was determined from the IRRC metric report (landsat data). ET_{IW} values averaged 80 percent of the ETc values. Thus where ET_{IW} valued weren't available, the ETc values were multiplied by 80 percent to estimate the ET_{IW} values. The evapotranspiration of applied water to crops in the study area averaged about 7,700 acre feet per year for 2003-2016.

Total

The average urban and rural consumptive in the study area was 9,400 acre-feet per year for 2003-16.

LAND SUBSIDENCE

Records of land subsidence are available for the DMC, about 3.5 miles west of the study area. At that location there was about 0.5 foot of subsidence during 2014-16. Records of land subsidence along the San Joaquin River east of Newman indicate minimal subsidence. Land subsidence in the Newman urban area has not been measured.

CHANGE IN GROUNDWATER IN STORAGE

Water levels in wells tapping the upper unconfined aquifer in the Newman area have indicated no long-term change in storage. There has also been no significant change in storage in the confined aquifer, as it has remained full of water. However, there has been a one time decrease in storage for the confining beds, due to compaction of these beds, which has resulted in land subsidence. Assuming and average subsidence of about 0.1 foot per year over the 3,800 acre area, this amount of water for 2003-12 averaged about 40 acre-feet per year.

GROUNDWATER QUALITY

Inorganic Chemical Constituents

City Wells

Table 8 provides the results of chemical analyses of water from active City wells in recent years.

Composite Wells. Wells No. 5 and 8 are composite wells. The total dissolved solids (TDS) concentrations in July 2017 ranged from 812 to 901 mg/l. Nitrate concentrations ranged from 11 to 32 mg/l, less than the MCL of 45 mg/l. Chloride concentrations ranged from 150 to 197 mg/l, less than the recommended of 250 mg/l. Concentrations or iron, manganese, arsenic, and selenium were less than the respective MCLs. Hexavalent chromium concentrations in water from Well No. 5 have ranged considerably in recent years, from non-detectable to 16 ppb. This is probably associated with varying pumping durations prior to when the water samples were collected for analyses. Hexavalent chromium concentrations in water from Well No. 8 have ranged from 4 to 10 ppb from 2015 to 2018, and decreased during this period. Alpha activities have been below the MCL of 15 picocuries per liter.

Lower Aquifer Wells. Wells No. 1R and 6 are lower aquifer wells. TDS concentrations in water from these wells ranged from 764 to 847 mg/l in July 2016. Nitrate concentrations ranged from 20 to

TABLE 8-CHEMICAL QUALITY OF WATER FROM CITY OF NEWMAN WELLS

Constituent (mg/l)	No. 1R	No. 5	No. 6	No. 8
Calcium	110	110	99	63
Magnesium	48	52	43	34
Sodium	104	115	86	138
Potassium	-	4	-	-
Bicarbonate	340	442	383	304
Sulfate	166	168	176	168
Chloride	222	150	136	197
Nitrate	22	32	20	11
Fluoride	0.2	0.2	0.2	0.2
pH	7.4	7.6	7.5	7.4
Electrical Conductivity (micromhos/cm @ 25°C)	1,530	1,440	1,300	1,390
Total Dissolved Solids (@ 180°C)	847	901	764	812
Iron	<0.1	<0.1	<0.1	<0.1
Manganese	<0.02	<0.02	<0.02	<0.02
Arsenic (ppb)	<2	<2	<2	<2
Hexavalent Chromium (ppb)	<1	0.1-16	5	4
Selenium (ppb)	<5	<5	<5	-
Alpha Activity (picocuries per liter)	6	-	5	<3
Date	7/6/16	7/2/13	7/6/16	7/6/17
Perforated Interval (feet)	340-620	162-450	351-500	180-480

22 mg/l, less than the MCL of 45 mg/l. Chloride concentrations ranged from 136 to 222 mg/l, less than the MCL of 250 mg/l. Concentrations of iron, manganese, arsenic, and selenium were below the respective MCLs. Hexavalent chromium concentrations in water from Well No. 1R have been about 1 ppb or less, well below the MCL of 10 ppb. Concentrations of hexavalent chromium in water from Well No. 6 have ranged from about 5 to 9.6 ppb in recent years, and have decreased since 2015. Alpha activities have ranged from about 4.5 to 5.6 picocuries per liter in water from Well No. 1R, and from about 3.1 to 9.9 picocuries per liter in water from Well No. 6, below the MCL of 15 picocuries per liter.

CCID Wells

Table 9 provides the results of inorganic chemical analyses of water from the four CCID wells in the study area for July 2017. All of these are composite wells. The perforated intervals shown are for the tops and bottoms of the perforations. TDS concentrations ranged from 870 to 1,200 mg/l and nitrate concentrations ranged from 7 to 11 mg/l, below the MCL of 45 mg/l. Chloride concentrations ranged from 190 to 250 mg/l, compared to the recommended MCL of 250 mg/l. Sulfate concentrations ranged from 120 to 220 mg/l, less than the recommended MCL of 250 mg/l. Boron concentrations ranged from 0.45 to 0.69 mg/l, high enough to affect boron sensitive crops, if the proposed water was used

TABLE 9-CHEMICAL QUALITY OF WATER FROM CCID WELLS

Constituent (mg/l)	No. 2	No. 3	No. 36	No. 42
Calcium	100	110	44	54
Magnesium	50	56	58	70
Sodium	130	130	120	170
Potassium	3	3	3	4
Bicarbonate	366	439	427	488
Sulfate	120	170	180	220
Chloride	210	170	190	250
Nitrate	7	7	10	11
pH	7.8	7.8	7.9	7.8
Electrical Conductivity (micromhos/cm @ 25°C)	1,400	1,500	1,600	1,900
Total Dissolved Solids (@ 180°C)	870	910	980	1,200
Boron	0.5	0.5	0.5	0.7
Date	7/25/17	7/25/17	7/25/17	7/25/17
Perforated Interval (feet)	90-337	85-337	90-393	90-391

without mixing. The pumpage from CCID wells is mixed with canal water before use, and the resulting boron concentrations are acceptable for irrigation.

HISTORICAL WATER BUDGET

The average canal water delivery to lands in the study area was 7,500 acre-feet per year for 2003-16. The total consumptive use averaged 9,200 acre-feet per year during this period. The average groundwater inflow was 2,660 acre-feet per year. The change in groundwater storage was 40 acre-feet per year. In order to maintain a water budget, the groundwater outflow averaged about 1,010 acre-feet per year.

REFERENCES

Kenneth D. Schmidt & Associates, 1992, "Groundwater Conditions in the Vicinity of the City of Newman" report prepared for CCID and City of Newman, 30p

Kenneth D. Schmidt & Associates, 2001, "Groundwater Conditions in the Vicinity of the City of Newman" report prepared for CCID and City of Newman, 33p

Page, R. L., 1986, "Geology of the Fresh Groundwater Basin of the San Joaquin Valley, California", U.S. Geological Survey Professional Paper 1401-C.

Appendix R. Update on Groundwater Conditions in the Gustine Sub-Area of the SJREC GSP

UPDATE ON GROUNDWATER CONDITIONS IN THE GUSTINE SUB-AREA OF THE SJREC GSP

prepared for
San Joaquin River Exchange
Contractors GSA
Los Banos, California

and
City of Gustine GSA
Gustine, California

by
Kenneth D. Schmidt & Associates
Groundwater Quality Consultants
Fresno, California

May 2019

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TELEPHONE (559) 224-4412

May 31, 2019

Mr. Chris White, Executive Director
San Joaquin River Exchange
Contractors GSA
P. O. Box 2115
Los Banos, CA 93635

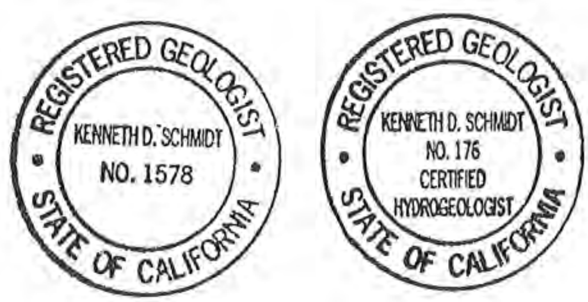
Re: Gustine Sub-Area of the SJREC GSP

Dear Chris:

Submitted herewith is our report on groundwater conditions in the Gustine Sub-area of the SJREC GSP. We appreciate the cooperation of the CCID and City of Gustine in providing information for this report.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist 176



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INTRODUCTION

As part of the Groundwater Sustainability Plan (GSP) for the San Joaquin River Exchange Contractors (SJREC) service area, GSPs for a number of cities, including Gustine, are being incorporated into the SJREC GSP. Kenneth D. Schmidt and Associates (KDSA, 1992 and 2001) prepared two reports on groundwater conditions in the vicinity of the City of Gustine for the Central California Irrigation District (CCID) and the City.

This report is intended to provide an update on groundwater conditions within the Gustine Study Area boundary (Figure 1). This boundary encompasses lands that are planned for future urban development. This study area is generally bounded by Jensen Road or Highway 140 on the north, Whitworth Road on the west, Gun Club Road on the south, and includes lands to the east where the City effluent is handled. Lands around the City of Gustine are in the SJREC GSA, and some lands to the north and south of the WWTF are in the Merced County Delta-Mendota GSA.

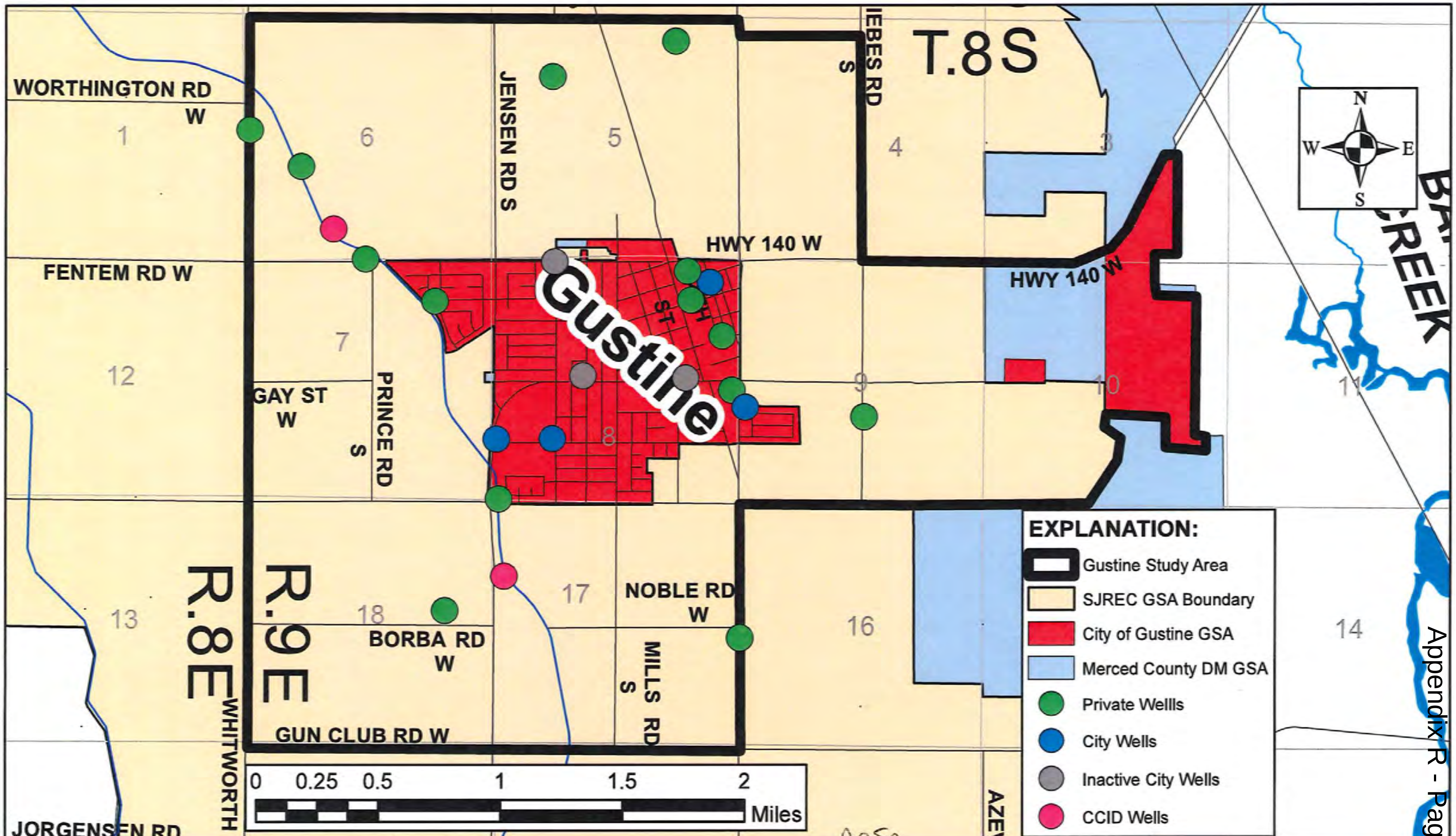


FIGURE 1-LOCATION OF GUSTINE SUB-AREA, STUDY AREA BOUNDARY, AND SELECTED WELLS

SUBSURFACE GEOLOGIC CONDITIONS

Alluvial deposits comprise the aquifer system beneath the western part of the San Joaquin Valley. Deposits near Gustine are termed the older alluvium and the Tulare Formation. Page (1986) indicated that the base of the fresh groundwater (electrical conductivity less than 3,000 micromhos per centimeter at 25°C) was about 900 feet deep near Gustine. This is considered the base of the usable groundwater in the vicinity. A major confining bed is present beneath much of the west side of the San Joaquin Valley, including Gustine. This clay is termed the Corcoran Clay, and divides the aquifer system into upper and lower aquifers. The Corcoran Clay is readily discernible from the drillers logs for most wells in the area, due to its blue color. The over-lying and under-lying deposits are usually tan or brown in color.

Most of the groundwater near Gustine is pumped from the upper aquifer (above the Corcoran Clay). One City well and some industrial and irrigation wells in the area were drilled to depths exceeding 450 feet, and tap the lower aquifer. As part of the previous investigations, three subsurface geologic cross sections extending through the City of Gustine were developed (Figure 2).

Subsurface Geologic Cross Section C-C' (Figure 3) extends from near Whitworth Road, between Sullivan and Gun Club Roads on

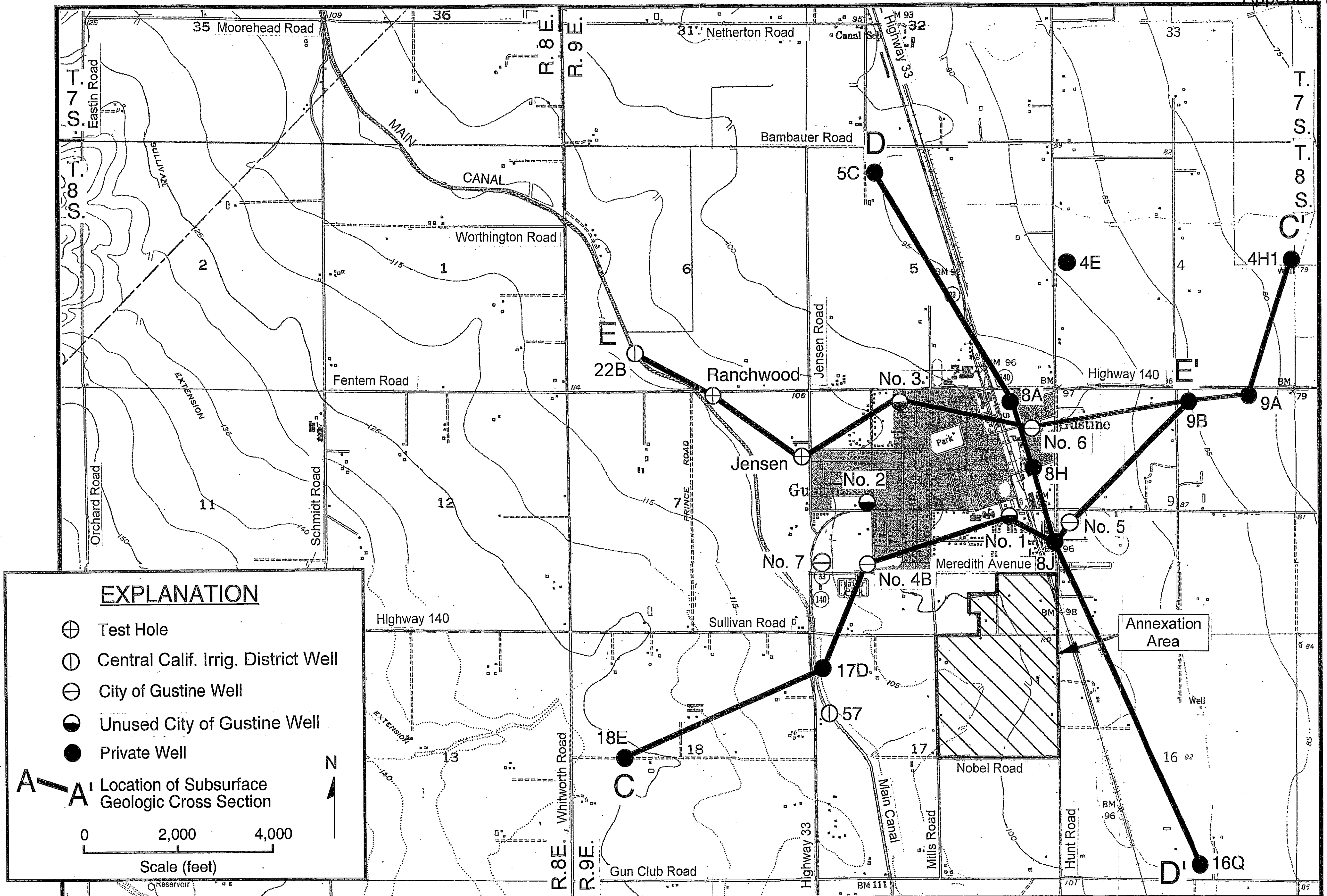


FIGURE 2-LOCATION OF SELECTED TEST HOLES AND WELLS AND SUBSURFACE GEOLOGIC CROSS SECTIONS

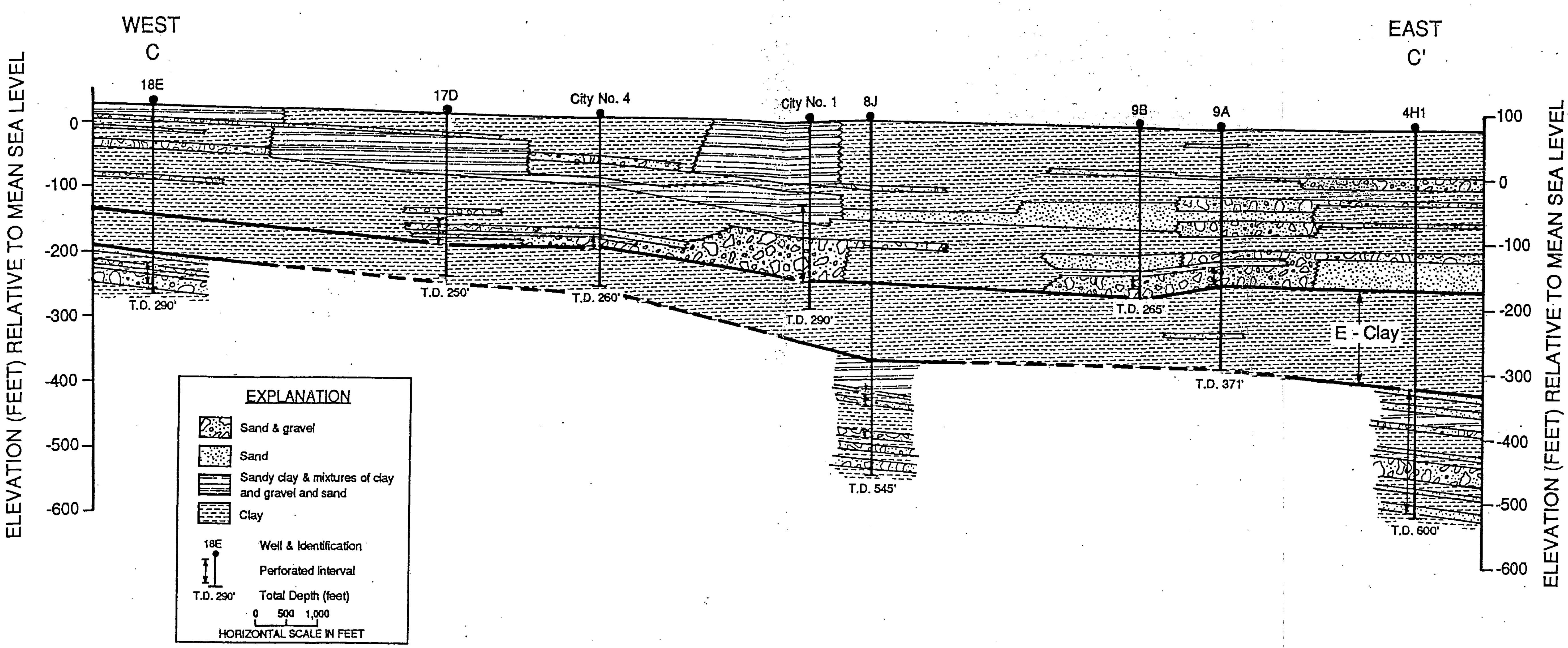


FIGURE 3-SUBSURFACE GEOLOGIC CROSS SECTION C-C'

the southwest, to the northeast through City Wells No. 1 and 4, thence northeast for about one and one-half miles. An electric log is available for City Well No. 1 and the other information was obtained from drillers logs. Two wells along this section (8J and 4H1) exceeded 540 feet in depth. Most of the wells along this section penetrated the Corcoran Clay, the top of which ranges from about 170 feet in depth at Well 18E to about 250 feet at Well 8J. The Corcoran Clay thickens to the north-east along this section, from about 60 feet at Well 18E to about 150 feet at Well 4H1. Beneath and northeast of the City, sand and gravel layers are common within the lower 100 feet of the upper aquifer. Below the Corcoran Clay, sand and gravel layers are relatively thin along this cross section.

Cross Section D-D' (Figure 4) extends from the northwest near Jensen and Baumbauer Roads, along Highway 33, through three in-dustrial wells, to a point near Gun Club Road and half a mile east of Hunt Road. The top of the Corcoran Clay ranges from about 225 feet deep at Well 5C to 260 feet deep at Well 8A. The Corcoran Clay appears to be relatively flat along this section, because the section is perpendicular to the inferred dip of the alluvial deposits. The thickness of the Corcoran Clay along this section ranges from about 85 feet at Well 8A to 120 feet at Well 8J. The sand and gravel layers in the lower part of the upper aquifer are thickest at Well 8H, and appear to thin

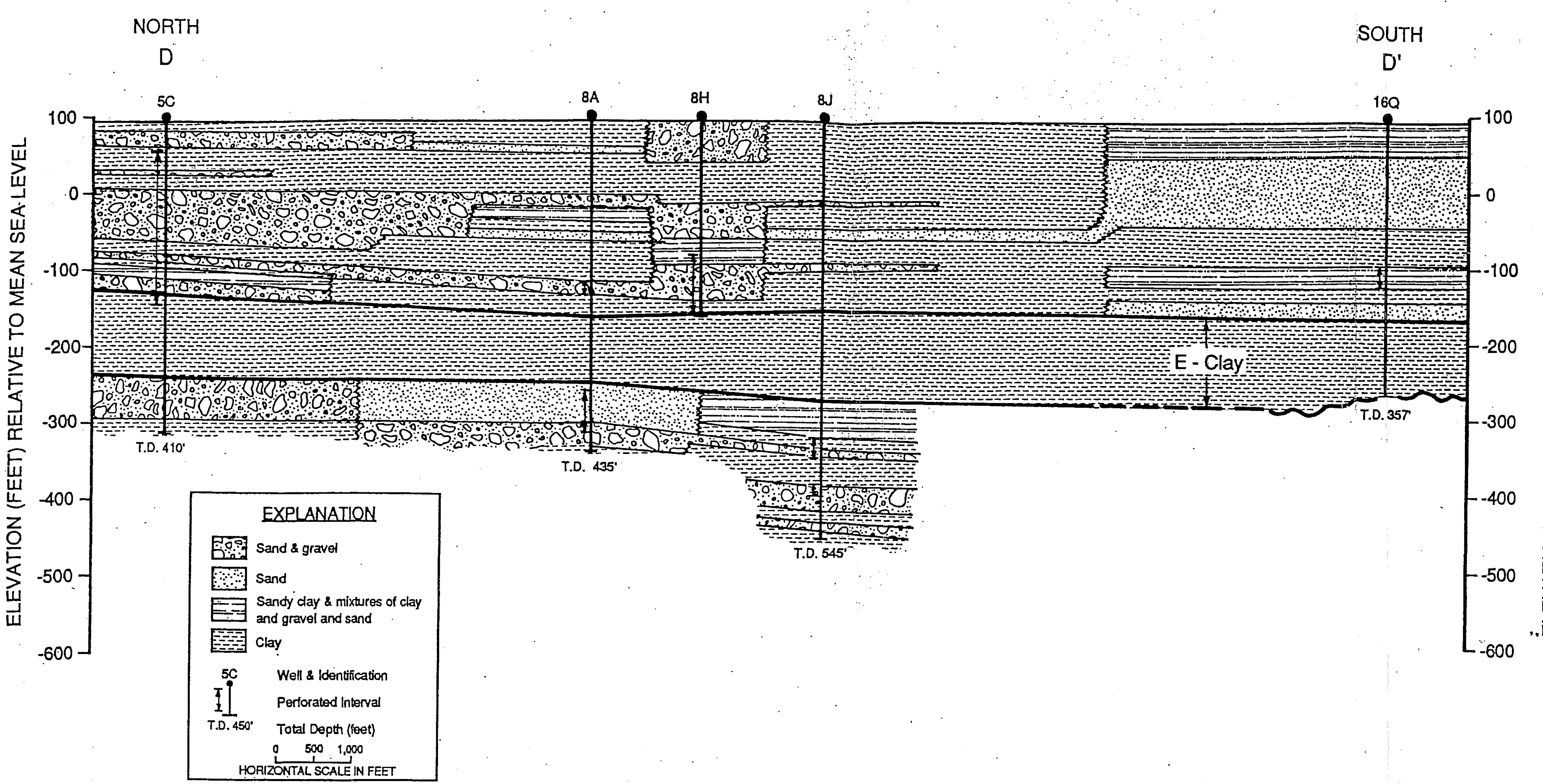


FIGURE 4-SUBSURFACE GEOLOGIC CROSS SECTION D-D'

to the south (at Well 16Q). Sand and gravel layers immediately below the Corcoran Clay are thickest to the northwest (Wells 5C and 8A). At Well 8J, sand and gravel layers in the lower aquifer are relatively thick and extend to a depth below 500 feet.

Cross Section E-E' (Figure 5) extends from CCID Well 22B adjacent to the Outside Canal, to the southeast and east, through City Wells No. 3 and 6. The top of the Corcoran Clay ranges from about 170 to 265 feet deep along this section. The Corcoran Clay along this section ranges from about 90 to 130 feet thick. Two thick, well developed sand and gravel strata were encountered above this clay along the northwest part of this section. Several thinner coarse-grained strata were also encountered below the clay at the Jensen test hole and City Well No. 6.

WELL CONSTRUCTION DATA

City

There are presently four active City wells (No. 4B, 5, 6, and 7). Table 1 provides information on dates drilled, depths, and perforated intervals for these wells. Drillers logs are available for all of these active wells and electric logs are available for Wells No. 1, 5, 6, and 7. Except for Well No. 5, cased depths range from 204 to 240 feet, and these wells tap water-

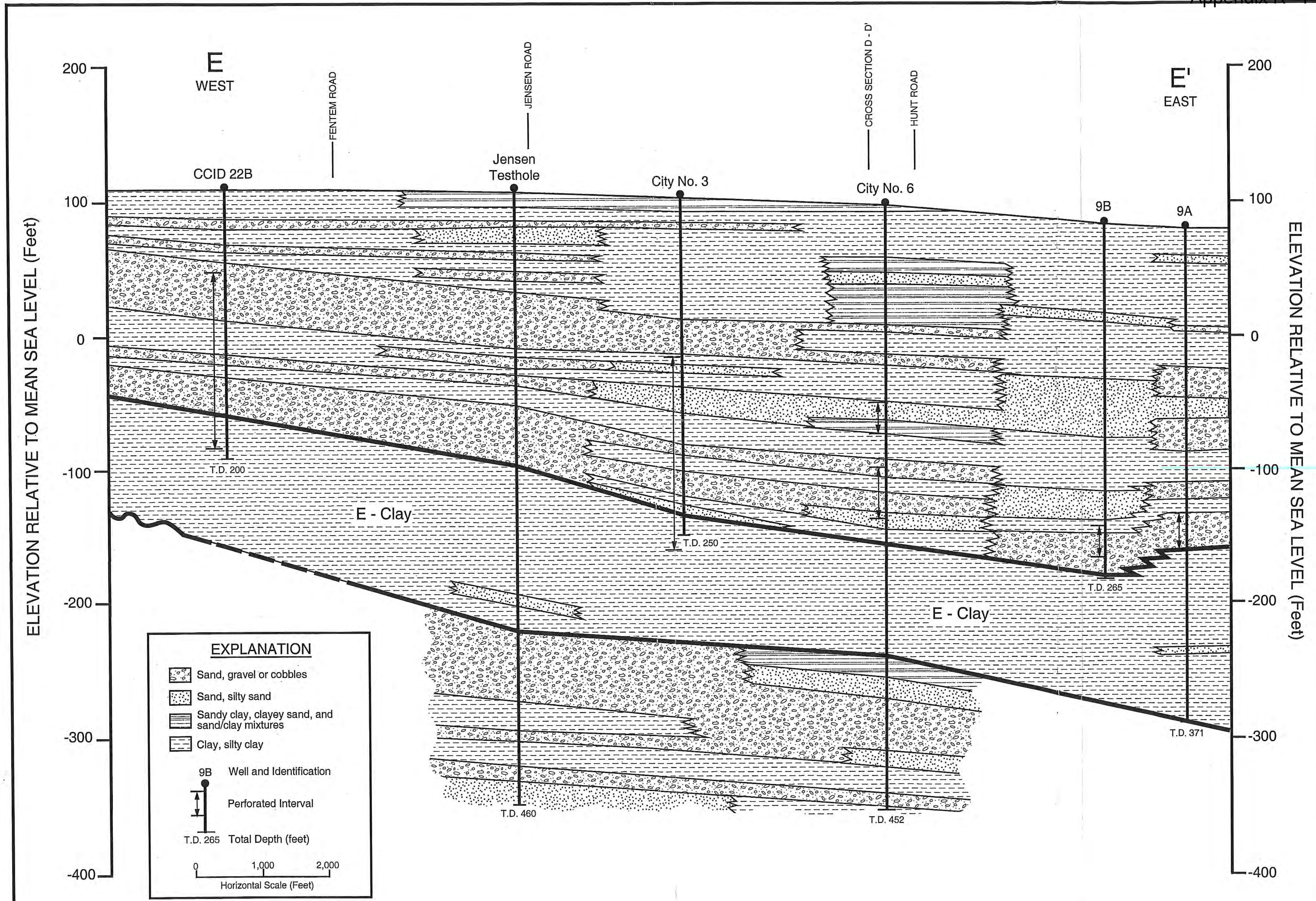


FIGURE 5-SUBSURFACE GEOLOGIC CROSS SECTION E-E’

TABLE 1-CONSTRUCTION DATA FOR CITY OF GUSTINE AND INDUSTRIAL WELLS

Well No.	State Location	Date Completed	Drilled Depth (feet)	Cased Depth (feet)	Diam. Casing (inches)	Perf. Int. feet)	Annular Seal (feet)
4B	8M2	09/93	250	200	16	167-200	0-167
5	9M	11/98	451	450	16	370-444	0-350
6	8A	12/98	250	240	16	145-230	0-130
7	4M	5/11	209	204	16	165-194	0-110
Formerly Beatrice Cheese	8A	05/73	435	200	16 414	- 12	0-50 210-410
Saputo	8H	12/56	254	254	14	174-254	0-60
Hillview Packing	8J	04/73	545	100	16	100-490	0-50

All of the wells are in T8S/R9E. Data from drillers logs, City of Gustine files, Avoset Foods, and Balding, Scott and Hotchkiss (1969). The perforated intervals are for the tops and bottoms of the perforated interval.

producing strata above the Corcoran Clay. Well No. 5 was perforated from 370 to 444 feet in depth and taps strata below the Corcoran Clay. This well has an annular seal extending to a depth of 350 feet.

CCID

The CCID has two wells along the Main Canal in the Gustine area. Table 2 shows construction data for these wells. Well No. 22B was completed in January 1999. Perforated casing was installed from 60 to 190 feet in depth in this well. Well No. 57 was installed in August 2000 and the casing is perforated from 70 to 190 feet in depth. Both wells tap strata above the Corcoran Clay.

Industrial

Drillers logs are available for three industrial wells in the City (Table 1). All of these wells are still active. Well 8a is cased to a depth of 414 feet and is a composite well (tapping both aquifers). Well 8H is 254 feet deep and taps only the upper aquifer. Well 8J is cased to a depth of 490 feet and is a composite well.

Gustine Drainage District

Table 3 contains construction data for Gustine Drainage District wells in the vicinity of Gustine. Depths of wells for which records are available and range from about 90 to 140 feet.

TABLE 2-CONSTRUCTION DATA FOR CCID WELLS

Well No.	Date Drilled	Drilled Depth(feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal feet)
22B	01/99	200	190	18	60-190	0-52
57	08/00	210	210	16	70-190	0-50

Data from drillers logs and Balding, Scott and Hotchkiss (1969).

TABLE 3-CONSTRUCTION DATA FOR GUSTINE DRAINAGE DISTRICT WELLS (T8S/R9E)

Well No.	State Location	Date Completed	Drilled Dept (feet)	Cased Depth (feet)	Casing Diam. (inches)	Perf.Int. (feet)
3	T8S/R9E-8N1	1953	136	136	16	130-250
14	5A2	1913	140	140	16	-
15	16M1	-	105	105	14	30-105
16	T7S/R9E-30H	1943	-	93	-	-

Data from drillers logs and Balding, Scott and Hotchkiss (1969).

The wells generally have shallow perforations, and were designed to tap the upper part of the upper aquifer. Water from one of these wells (No. 3) was used for irrigation at the Harry P. Schmidt Park in the City. Since 2001, tile drain systems have been installed beneath a number of irrigated fields. The tile drain systems have proven to be more effective to address sub-surface drainage problems, and drainage well pumping has gradually been replaced.

WATER LEVELS

Depth to Water

Near Gustine, most of the available water-level measurements are for wells tapping the upper aquifer. J.M. Lord, Inc. (1990) reported on depth to the shallow groundwater in the Gustine Drainage District, which surrounds the City of Gustine. In June 1989, depth to water ranged from less than five feet northeast and southeast of Gustine, to more than ten feet beneath parts of Gustine.

Water-Level Elevations

Water-level measurements for wells in the area were obtained from the California Department of Water Resources and CCID. The previous evaluation provided a water-level elevation contour map for Spring 2000, which was primarily based on large-capacity wells that tap the upper aquifer. A cone of depression beneath Gustine was indicated by those measurements. Water-level elevations in this depression ranged from about 70 to 80 feet above mean sea level, about 10 to 15 feet lower than those beneath the surrounding lands. Southwest of Gustine, water-level elevations ranged from about 100 to 120 feet above mean sea level. Northeast of Gustine, water-level elevations ranged from about 75 to 85 feet. The regional direction of groundwater flow in the upper aquifer near Gustine was to the northeast in Spring 2000. Limited data for the lower aquifer indicated a northerly direction of groundwater flow, toward Newman. Water-level elevations in the lower aquifer were indicated to be about 20 feet below the upper aquifer in Spring 2000.

Figure 6 shows water-level elevations and the direction of groundwater flow for March 2011. Water-level elevations ranged from 108 feet above mean sea level near Gun Club Road, about three miles southwest of the City to 78 feet about a mile northeast of the City. Southwest of Gustine, March 2011 water levels were about 20 feet lower than in Spring 2000. North of Gustine, water levels were close to those in Spring 2000. The direction of groundwater flow was to the northeast. A cone of depression was not indicated beneath the City, but that was due to a lack of water-level measurements for City wells.

Water-Level Trends

Frequent water-level measurements are available for several wells near Gustine during recent decades. Figure 7 shows water-

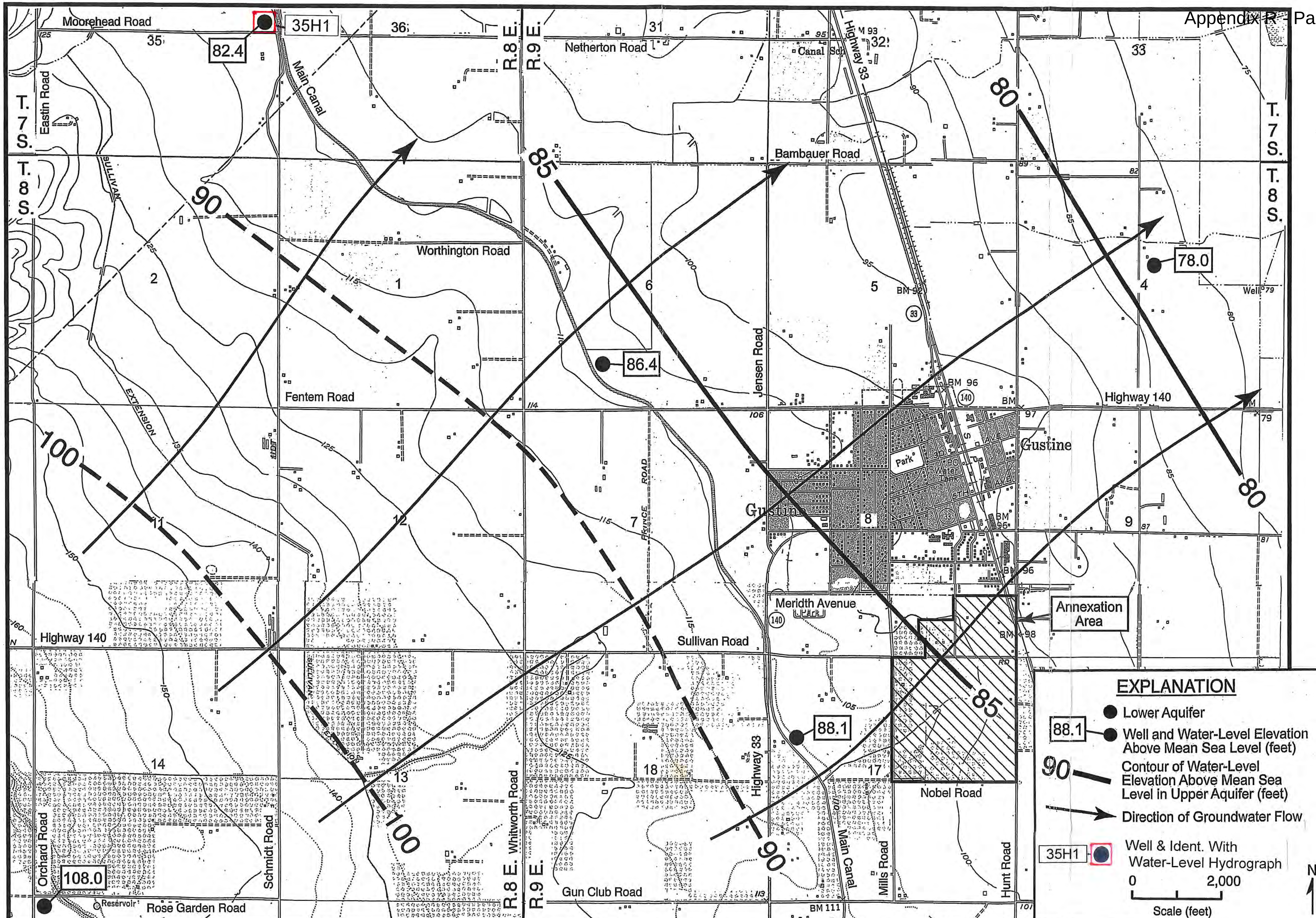
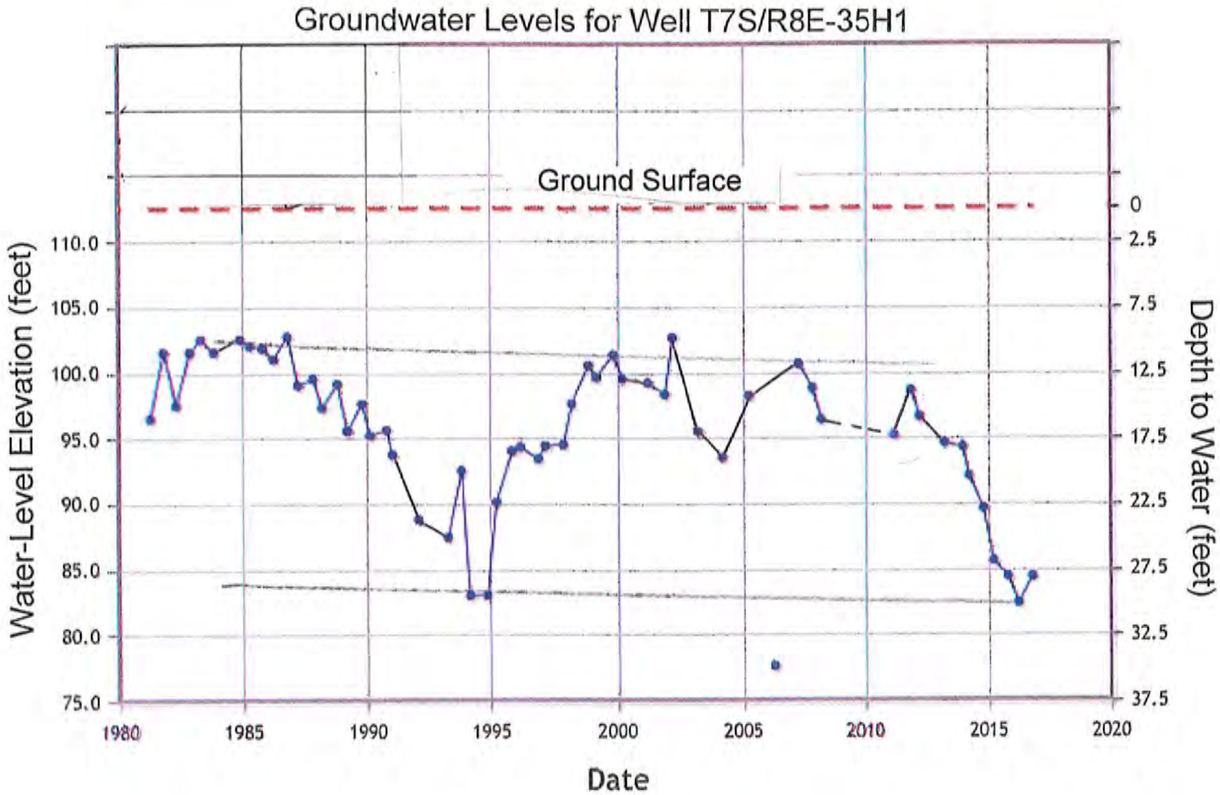
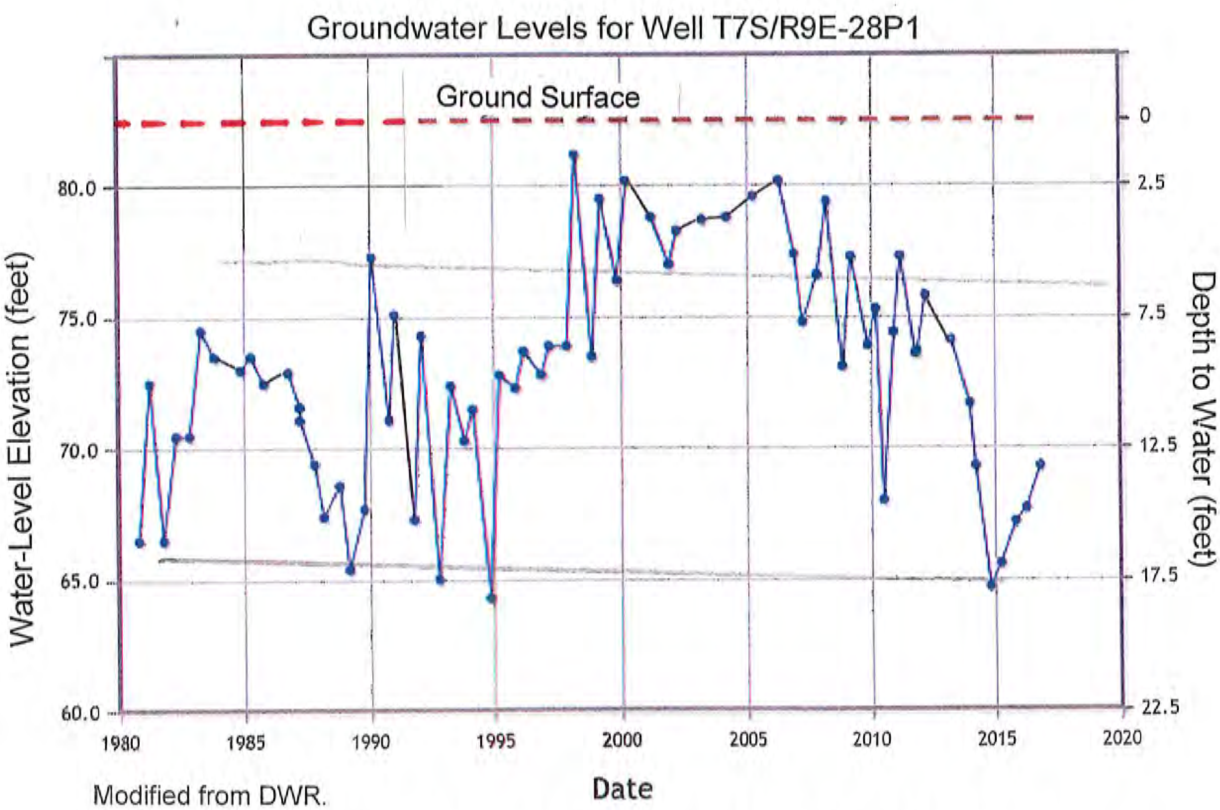


FIGURE 6-WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR THE UPPER AQUIFER (SPRING 2011)

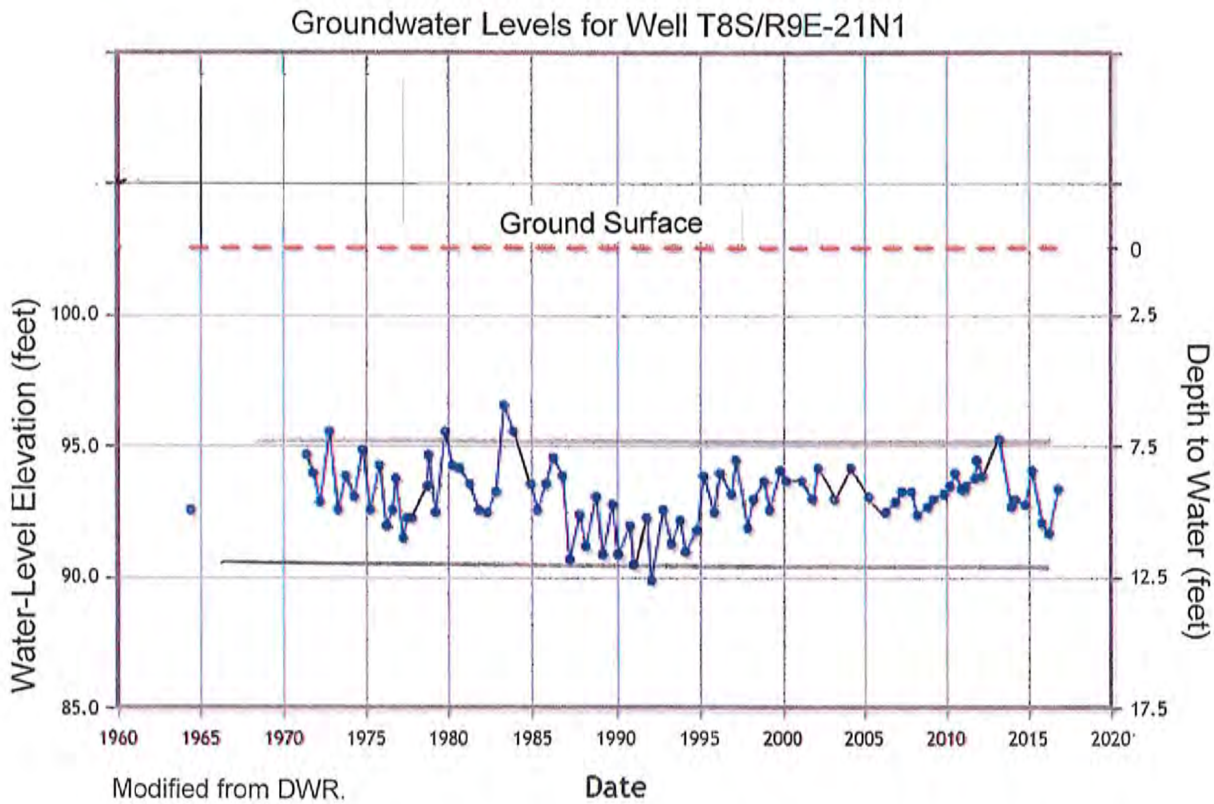




Modified from DWR.

FIGURE 7-WATER-LEVEL HYDROGRAPHS FOR UPPER AQUIFER WELLS

(Continued)



Modified from DWR.

FIGURE 7-WATER-LEVEL HYDROGRAPHS FOR UPPER AQUIFER WELLS (CONTINUED)

level hydrographs for three of these wells. T7S/R8E-35H1 is located near Netherton Road and Schmidt Road. Depth to water usually ranged from about 12 to 22 feet. Overall, the water levels in this well slightly declined between 1982 and 2016, at an average rate of less than 0.1 foot per year. Well T7S/R9E-28P, is located near Kniebes Road and Preston Road, northeast of Gustine. Depth to water in this well has ranged from about 2 to 18 feet. Water levels in this well were stable from 1981 through 2016, except for the temporary declines during drought periods. Well T8S/R9E-21N is located near Taglio Road and Hunt Road, south of Gustine. Depth to water has ranged from about 7 to 12 feet. Water levels in this well were stable from 1964 through 2016.

Figure 8 shows water-level hydrographs for CCID Wells No. 22B and 57. Records for Well No. 22B extend from 1965 to 2018. Records for Well No. 57 extend from 2001 to 2018. The seasonally shallowest levels fell from early 2005 through early 2009, then rose through early 2013 to the shallowest levels during the period of record. The shallowest seasonal levels then fell through 2015, and partially recovered during 2016. Over the long term, the water levels fell about 6.5 feet over a 16-year period, or an average of 0.4 foot per year. As of early 2018, the water level still hadn't fully recovered. This decline was highly influenced by drought conditions in 2014-15. A shorter period of records is available for Well 57, but similar trends are indicated.

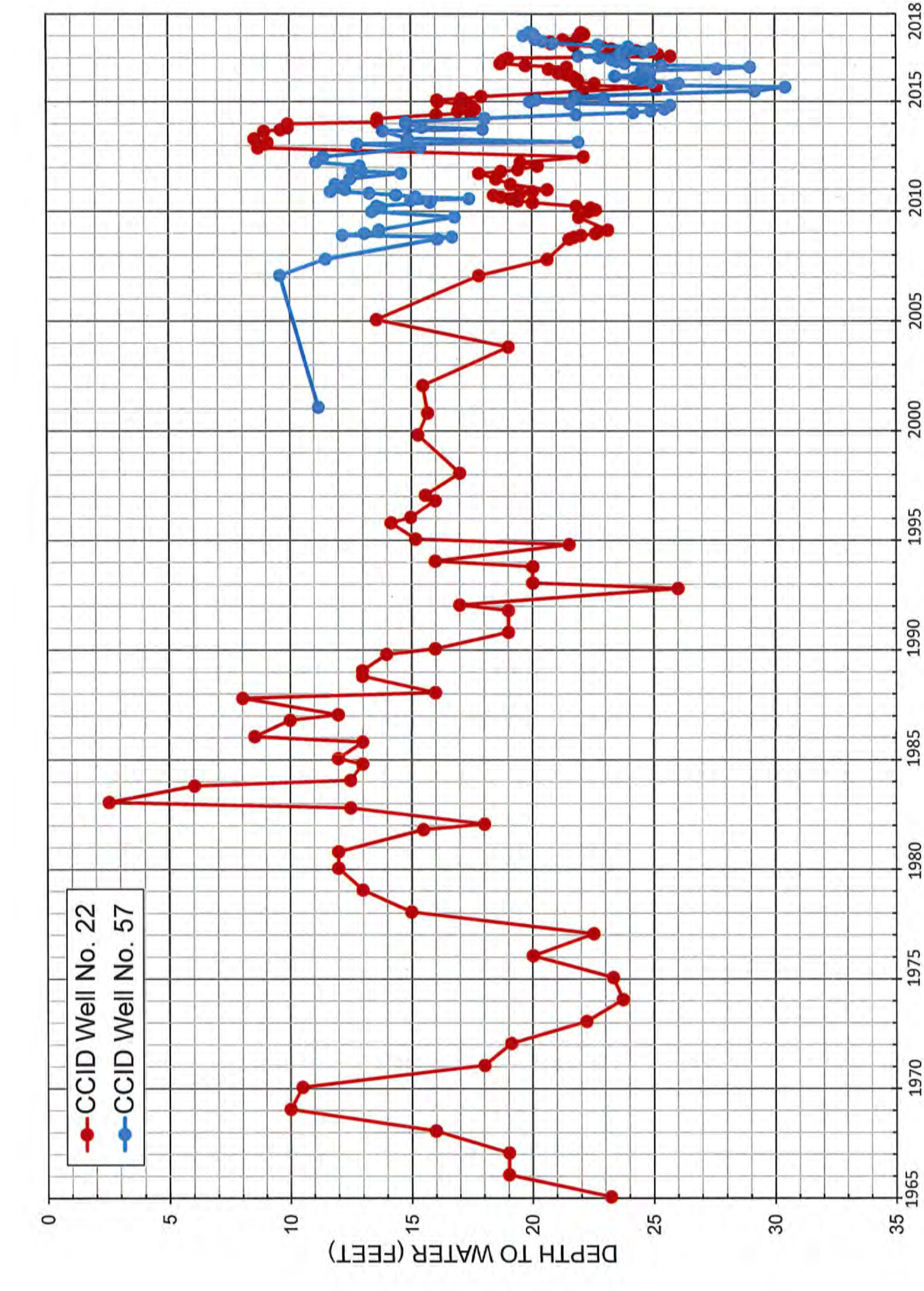


FIGURE 8 - WATER-LEVEL HYDROGRAPHS FOR CCID WELLS

Overall, there is no indication of groundwater overdraft in or near Gustine. In fact, the shallow groundwater levels are considered a problem in the surrounding irrigated areas. The evidence for this is the existence and ongoing activities of the Gustine Drainage District, which was developed to address this problem.

AQUIFER CHARACTERISTICS

Table 4 summarizes pump test data for City wells for the 1990's. More recent pump tests aren't available. Pumping rates for active City wells ranged from about 650 to 2,000 gpm. Specific capacities of these wells ranged from about 6 to 67 gpm per foot.

Table 5 summarizes recent pump test data for the two CCID wells for 2015-16. Pumping rates ranged from about 1,220 to 1,570 gpm and specific capacities ranged from about 14 to 40 gpm per foot.

Transmissivity was determined based on a nine-hour constant discharge test on City Well No. 5 on January 19, 1999. The average transmissivity based on drawdown and recovery data was 54,000 gpd per foot for strata below the Corcoran Clay. Transmissivity was also determined from a 24-hour pump test on City Well No. 6 during February 8-9, 1999. Recovery measurements indicated a transmissivity of 34,000 gpd per foot for strata above the Corcoran Clay. Specific capacities for wells tapping strata

TABLE 4-PUMP TEST DATA FOR CITY OF GUSTINE WELLS

Well No.	Date Tested	Pumping Rate (gpm)	Static Level (feet)	Pumping Level (feet)	Drawdown (feet)	Specific Capacity (gpm/ft)
4B	9/1/93	900	30.0	154	124	7.3
5	1/99	2,010	34.3	133.2	98.9	20.3
6	2/99	1,060	16.8	199.2	182.4	5.8
7		650				

Data for Well No. 4B from drillers log. Data for Wells No. 5, 6, and 7 from pump tests at end of well development.

TABLE 5-PUMP TEST DATA FOR CCID WELLS

Well No.	Date Tested	Pumping Rate (gpm)	Static Level (feet)	Pumping Level (feet)	Drawdown (feet)	Specific Capacity (gpm/ft)
22	10/15/16	1,568	26.0	65.7	39.7	39.5
57	06/15/15	1,219	69.0	157.0	88.0	13.7

Records from CCID.

above the clay indicate that values for Well No. 6 are less than the average for all of the upper aquifer wells. The transmissivity of the upper aquifer beneath the City can be estimated from specific capacity values. Using an average specific capacity of 50 gpm per foot and a conversion of 1,500, the transmissivity is estimated to be about 75,000 gpd per foot.

Darcy's law can be used to estimate groundwater inflow into the urban depression cone. Darcy's law is the fundamental equation for determining lateral groundwater flow in the aquifer. The flow is equal to the transmissivity times the water-level slope times the width of flow.

$Q = TIL$, where

Q = groundwater inflow (gpd)

I = water-level slope (feet per mile)

L = width of flow (miles).

Darcy's law is applicable in all such evaluations. The water-level map for Spring 2000 was used to determine the gradient because it shows the urban cone of depression. Using a width of flow of about 1.9 miles in Spring 2000, and an average water-level slope of about five feet per mile for the upper aquifer, the amount of inflow above the Corcoran Clay would be about 2,850 acre-feet per year. Additional amounts of groundwater inflow are also available from below the Corcoran Clay, but this can't presently be estimated, due to a lack of water-level measurements for deep wells in the area. The City of Gustine needs to measure static water levels in all City wells in the spring of each year.

PUMPAGE

Table 6 provides a summary of annual pumpage by the City of Gustine, the CCID, and private wells in the study area from 2003-2016. The City pumpage decreased after 2013, associated with water conservation measures undertaken during the drought. The annual pumpage in 2015 was 217 acre-feet less than in 2013, a reduction of about 17 percent. The average pumpage by the City during 2003-11 was about 1,250 acre-feet per year. Annual pumpage from the CCID wells in the study area ranged from 22 acre-feet in 2006 to 2,359 acre-feet in 2018. The average pumpage from these wells during 2003-16 was about 1,610 acre-feet per year. There are also a number of private wells in the study area (Figure 1). CCID provided estimates of pumpage from these wells. Pumpage from private wells ranged from about 40 to 2,658 acre-feet per year during 2003-16. The average pumpage from these wells was about 1,060 acre-feet per year. The average pumpage from all of the wells in the study area was thus about 3,900 acre-feet per year from 2003-16.

TABLE 6-ANNUAL PUMPAGE IN STUDY AREA

Year	Pumpage (Acre-feet per year)		
	City of Gustine Wells	CCID Wells	Private Wells
2003	1,350	1,705	1,216
2004	1,410	2,073	1,321
2005	1,290	502	288
2006	1,330	22	703
2007	1,466	2,206	1,834
2008	1,338	2,359	1,495
2009	1,043	2,149	1,601
2010	1,163	488	490
2011	1,156	896	806
2012	1,260	2,278	51
2013	1,271	2,231	598
2014	1,149	2,039	1,249
2015	1,054	2,003	2,658
2016	1,203	365	521
Average	1,249	1,610	1,060

Values are from City of Gustine and CCID records.

CITY EFFLUENT

There were about 625 acre-feet of City effluent discharged in 2015. About 140 acre-feet per year of this was used to irrigate hay and pasture. The remainder (485 acre-feet per year) percolated or was lost to evaporation from ponds and evapotranspiration from a marsh area. The consumptive use of City effluent is estimated to have been about 80 percent of the amount of effluent, or about 500 acre-feet per year.

CANAL WATER DELIVERIES

Table 7 shows CCID canal water deliveries to 3,600 acres of land in the study area for 2003-16. Canal water deliveries during 2003-2013 ranged from 9,800 acre-feet in 2013 to 13,800 acre-feet in 2013. The average delivery was 11,600 acre-feet per year during 2003-13. CCID canal water deliveries during 2014-16 ranged from 8,700 to 9,300 acre-feet year and averaged 9,000 acre-feet per year, reflective of drought conditions. For the entire period from 2003-16, the CCID average canal water delivery was about 11,000 acre-feet per year.

CONSUMPTIVE USE

Rural

The CCID provided estimates of the evapotranspiration of water applied for irrigation of crops in the study area. For

TABLE 7-CCID CANAL WATER DELIVERIES

Year	Acre-Feet per Year
2003	9,800
2004	11,500
2005	10,000
2006	10,700
2007	12,000
2008	11,800
2009	12,700
2010	10,600
2011	11,100
2012	13,400
2013	13,800
2014	8,900
2015	9,300
2016	8,700

consumptive use of crops, ITRC data for the evapotranspiration of applied water (ET_{IW}) was used for 2003-2008. Total evapotranspiration (ETc) for 2009-16 was based on the ITRC metric report (landsat data). The average ETc for 2003-16 was 10,300 acre-feet per year. The average ratio of ET_{IW} to ETc was 82%. Thus the estimated average ET_{IW} for 2003-16 was 8,450 acre-feet per year.

Urban

The City pumpage from 2003-16 averaged about 1,250 acre-feet per year and the effluent flow was about 625 acre-feet per year. The residual, or outside water use, was thus about 625 acre-feet per year. Assuming an irrigation efficiency of 70 percent, the consumptive use due to outside water use in the City was about 450 acre-feet. Combined with an estimated 500 acre-feet of evapotranspiration of effluent, the total urban consumptive use was 950 acre-feet per year.

Total

The total consumptive use in the study area was about this 8,450 + 950 or 9,400 acre-feet per year. This was about 1,600 feet less than the average canal water deliveries in the study area. This indicates a positive balance in the study area, without considering groundwater flows.

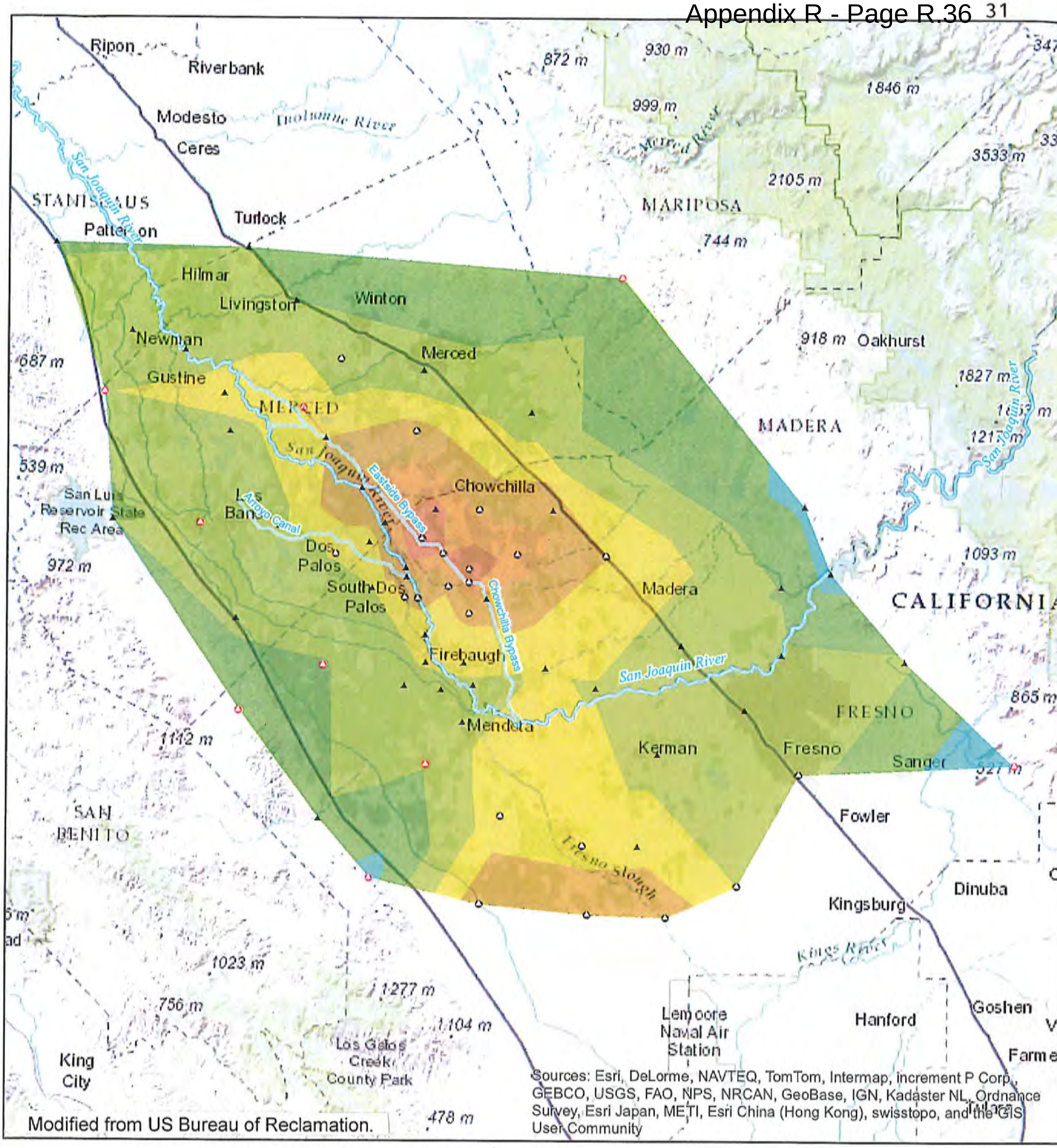
LAND SUBSIDENCE

Measurements at compaction recorders in the San Joaquin Valley have indicated that almost all of the historical land subsidence due to groundwater pumping has come from pumpage from the lower aquifer (below the Corcoran Clay). The nearest compaction recorder to Gustine with long-term records is the Oro Loma or Russell Avenue recorder, located near the Delta-Mendota Canal (DMC) and Russell Avenue. Pumpage from the lower aquifer at and near Gustine is indicated to be small. Most of the City pumpage and all of the CCID pumpage has been from the upper aquifer. Because of the limited pumpage from the lower aquifer in and near the City of Gustine and the lack of long-term water-level declines, land subsidence is expected to be small (less than 0.1 foot per year).

Periodic surveys of land subsidence have been done along the DMC, which is located about three and a half miles west of Gustine. Little subsidence was indicated west of Gustine. Recent (2012-15) measurements of land subsidence are available for the area near and southeast of Gustine from Reclamation (Figure 9). Less than 0.15 foot of subsidence was indicated near Gustine.

CHANGE IN GROUNDWATER STORAGE

Over the long-term, no significant change in groundwater storage is indicated for the study area.



Subsidence Rates (feet/year)
July12 to July15-Free
July 2012 to July 2015

- 0.15 to 0.3
- 0 to 0.15
- -0.15 to 0
- -0.3 to -0.15
- -0.45 to -0.3
- -0.6 to -0.45
- -0.75 to -0.6
- -0.9 to -0.75

GPS Coordinates

- GPS Point-December 2011
- GPS Point-added July 2012
- GPS Point-added December 2013

N

RECLAMATION
Managing Water in the West

FIGURE 9-RECENT LAND SUBSIDENCE

0 7 14 21 Miles

Subsidence rates calculated by comparing survey values a
GPS Stations for the dates specified in the legend.

GROUNDWATER QUALITY

City Wells

Table 8 contains the result of recent inorganic chemical analyses of water from the four active City of Gustine wells. Total dissolved solids (TDS) concentrations in water from these wells ranged from 621 mg/l to 840 mg/l in 2016-17. The highest TDS concentration was in water from Well No. 6. Nitrate concentrations in water from these wells ranged from 15 to 42 mg/l, below the MCL of 45 mg/l. The highest nitrate concentration was in water from Well No. 6, which is the most northeasterly upper aquifer City well. Nitrate concentrations in water from this well ranged from 2 to 42 mg/l during 2011-15. The lowest nitrate concentration was in water from Well No. 5, which taps the lower aquifer. Concentrations of iron, manganese, arsenic, fluoride, and selenium in water from the active City wells were below the respective MCLs.

The highest manganese concentrations were in water from Well No. 5. Manganese concentrations in water from this well were variable between 1999 and 2017, but were frequently between 0.02 and 0.03 mg/l, less than the secondary MCL of 0.05 mg/l.

The hexavalent chromium concentration in water from Well No. 5 was 2 ppb, less than the MCL of 10 ppb. This well taps the lower aquifer. Hexavalent chromium concentrations in water from

TABLE 8- CHEMICAL QUALITY OF WATER FROM CITY OF GUSTINE WELLS

Constituent (mg/l)	No. 4B	No. 5	No. 6	No. 7
Calcium	58	60	110	131
Magnesium	26	31	46	35
Sodium	73	240	110	80
Potassium	3	2	2	2
Bicarbonate	315	317	342	378
Sulfate	110	200	156	127
Chloride	98	270	180	118
Nitrate	21	15	42	18
Fluoride	<0.1	0.2	0.2	0.1
pH	7.4	7.3	7.8	7.2
Electrical Conductivity (micromhos/cm @ 25°C)	945	1,100	1,300	1,043
Total Dissolved Solids (@ 180°C)	621	660	840	716
Iron	<0.1	<0.1	<0.1	<0.1
Manganese	<0.02	<0.02	<0.02	<0.02
Arsenic (ppb)	<2	<2	<2	<2
Hexavalent Chromium (ppb)	8.3	2	9.6	9.7
Selenium (ppb)	<5	7.3	<5	<5
Alpha Activity (picocuries/l)	8	3	<3	<3
Date	7/13/16	10/8/14	10/8/14	1/9/14
Perforated Interval (feet)	167-200	370-400 410-444	145-165 190-230	165-194

Samples for analysis of hexavalent chromium were collected between 8/10/14 and 10/15/14. Samples for analysis of alpha activity were collected between 10/8/14 and 10/15/14 the other wells were much higher (8.3 to 9.7 ppb), and in water from Wells No. 6 and 7 were near the MCL of 10 ppb.

Alpha activities were determined in water from the active City wells in February 2014. Values ranged from less than 3 to 8 picocuries per liter, below the MCL of 15 picocuries per liter.

Samples of water collected from the active City of Gustine wells in December 2016 were analyzed for numerous trace organic chemical constituents. No trace organic chemical constituent problem was indicated for these wells.

CCID Wells

Table 9 provides the results of inorganic chemical analyses of water from CCID Wells No. 22B and 57 for samples collected in July 2017. TDS concentrations ranged from 820 to 950 mg/l and the waters were of the mixed calcium bicarbonate-chloride or bicarbonate types. Nitrate concentrations ranged from 10 to 15 mg/l, less than the MCL of 45 mg/l for public water supplies. Boron concentrations ranged from about 0.4 to 0.5 mg/l, suitable for irrigation of most crops.

HISTORICAL WATER BUDGET

CCID canal water deliveries to 3,600 acres of crops in the study area averaged 11,000 acre-feet per year during 2003-16. The estimated average urban and rural consumptive use for the

TABLE 9- CHEMICAL QUALITY OF WATER FROM CCID WELLS

Constituent (mg/l)	Well No. 22B	Well No. 57
Calcium	75	120
Magnesium	46	50
Sodium	100	120
Potassium	3	<1
Bicarbonate	380	330
Sulfate	99	170
Chloride	130	180
Nitrate	15	10
pH	7.6	7.7
Electrical Conductivity (micromhos/cm @ 25°C)	1,400	1,500
Total Dissolved Solids (@ 180°C)	820	950
Boron	0.38	0.51
Date	7/25/17	7/25/17
Perforate Interval (feet)	60-190	70-190

Chemical analyses by BSK Associates.

period was 9,400 acre-feet per year. There was an estimated canal seepage of 1,100 acre-feet per year from a 2.5-mile long reach of the Main Canal (average of 0.68 cfs for 330 days a year). There was an estimated 1,600 acre-feet per year of deep percolation from irrigated crops in the CCID (11,000 minus 9,400 acre-feet per year). The amount of groundwater inflow above the Corcoran Clay was previously estimated to be about 2,850 acre-feet per year. The average deep percolation from urban irrigation is estimated to have been about (625 minus 450 acre-feet per year, or about 175 acre-feet per year. The pond seepage and deep percolation associated with City effluent averaged 20 percent of the effluent amount, or about 125 acre-feet per year.

The total recharge (excluding groundwater inflow below the Corcoran Clay) thus averaged about 5,950 acre-feet per year for 2003-16. The average pumpage in the study area was about 3,900 acre-feet per year for 2003-16. There was no significant change in groundwater storage in the study area during 2003-20016. The difference between 5,850 and 3,900, or 1,950 acre-feet per year, was made up by the groundwater outflow above the Corcoran Clay and the difference between the groundwater inflow and outflow below the Corcoran Clay.

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Appendix S. Hydrogeologic Conceptual Model, Groundwater Conditions, and Water Budget for the City of Los Banos GSA

HYDROGEOLOGIC CONCEPTUAL MODEL, GROUNDWATER CONDITIONS, AND WATER BUDGET FOR THE CITY OF LOS BANOS GSA

prepared for
Central California Irrigation District
City of Los Banos
Grassland W.D.
San Joaquin River Exchange Contractors
Water Authority
San Luis Water District
Los Banos, California

by
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Mr. Chris White, General Manager
Central California Irrigation District
P.O. Box 1231
Los Banos, CA 93635

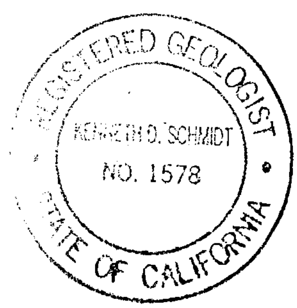
Re: City of Los Banos GSA

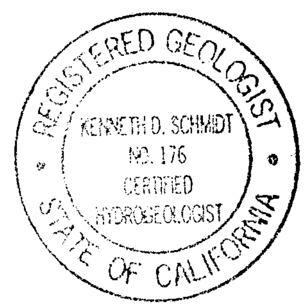
Dear Chris:

Submitted herewith is our hydrogeologic report on the City of Los Banos GSA. We appreciate the cooperation of the City of Los Banos, CCID, Grassland Water District, and San Luis Water District in providing information for this report.

Sincerely yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist
No. 176





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HYDROGEOLOGIC CONCEPTUAL MODEL, GROUNDWATER CONDITIONS, AND WATER BUDGET FOR THE CITY OF LOS BANOS GSA

INTRODUCTION

This report is intended to satisfy Sections 354.14 (Hydrologic Conceptual Model), Section 354.16 (Groundwater Conditions), and Section 354.18 (Water Budget) of a Groundwater Sustainability Plan (GSP) for the City of Los Banos Study Area. This area includes a study area previously developed for an evaluation of the City of Los Banos groundwater conditions. This area extends beyond the City Urban Growth boundary, and includes an upgradient area termed the Los Banos Subarea (Figure 1). The area includes lands in the City, the Central California Irrigation District (CCID), the Grassland Water District (GWD), the San Luis Water District (SLWD), and in white areas of Merced County.

The City of Los Banos is an expanding urban area that relies entirely on groundwater. Hexavalent chromium concentrations in water from City wells exceed the proposed maximum contaminant level (MCL), of 10 parts per billion (ppb). Also, there are concerns about this supply in terms of adequacy for future growth. This evaluation is the result of a cooperative effort between the CCID, the San Joaquin River Exchange Contractors Water Authority, the City of Los Banos, the GWD, and the SLWD to further evaluate the sustainable groundwater supply for the urban area and adjacent areas. There are three districts that provide water to the rural part of the study area. The CCID extends from near Mendota northward to near Crows Landing,

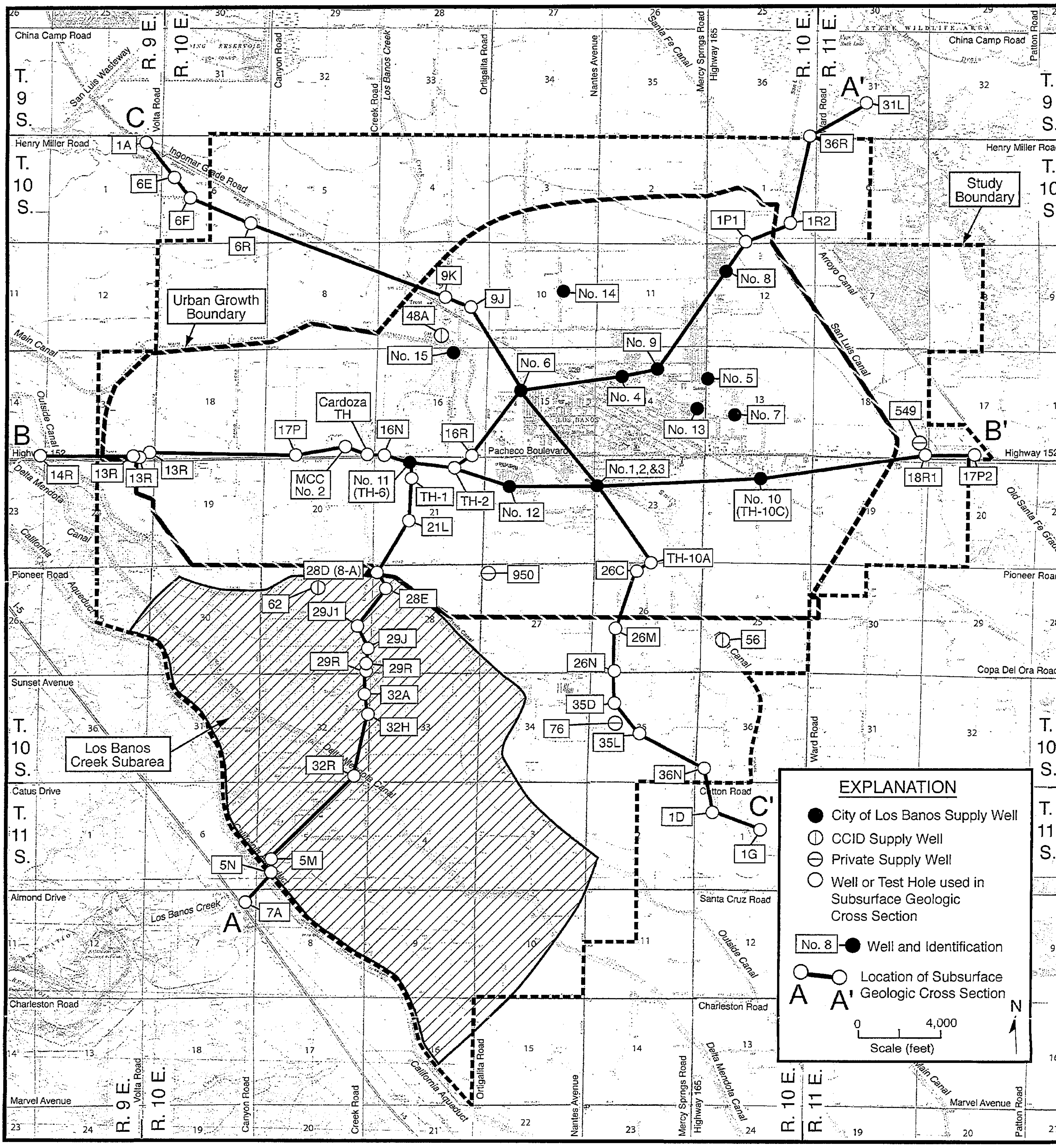

FIGURE 1 - TOPOGRAPHIC MAP OF STUDY AREA AND LOCATION OF SUBSURFACE GEOLOGIC CROSS SECTIONS

and surrounds a number of urban areas, including the City of Los Banos. Both District (CCID) and private wells are used in the CCID to supplement San Joaquin River water and imported water from the Delta Mendota Canal (DMC) that is used for crop irrigation. The GWD has two divisions, one essentially north of Highway 152 and the other south of this highway. The GWD supplies imported water from the DMC to numerous duck clubs. The CCID wheels water through its facilities to the GWD. The SLWD extends from near Santa Nella south to south of Little Panoche Creek and delivers water from the California Aqueduct and DMC. Private wells are used to supplement this water for irrigation in the part of the District near Los Banos.

Part of this study is an update of three earlier hydrogeologic evaluations prepared by Kenneth D. Schmidt and Associates (KDSA). The first two were for the CCID and City in 1991 and in 1998. The third evaluation was done in 2010 for the CCID, City of Los Banos, and U.S. Bureau of Reclamation. The latter report also focused on water transfers in the area upgradient (southwest) of the City.

Information on regional groundwater conditions in the vicinity was provided by Hotchkiss and Balding (1971), Swanson (1990), and KDSA (1997). The latter of these references described a detailed evaluation of the groundwater conditions in the CCID.

The study area for this evaluation includes lands within the City of Los Banos Urban Growth Boundary (UGB), upgradient lands to the southwest, and adjacent lands to the northeast in the GWD. In the 2010 evaluation, the Los Banos Creek subarea was delineated. This subarea is primarily outside of the CCID and up-gradient of the City (Figure 1). Groundwater pumpage from private irrigation wells in this subarea provides most of the water supply, and this subarea has experienced significant water-level declines during dry periods. Due to the upsloping topography and thinner alluvium to the southwest, changes in groundwater elevation are amplified within the western part of this area. Historically, minor amounts of groundwater have been transferred out of this subarea.

SURFICIAL CHARACTERISTICS OF THE LOS BANOS STUDY AREA

Topography

Figure 1 shows the topography of the study area. Lands southwest of Interstate 5 (I-5) are primarily in the foothills of the east edge of the Coast Range. Lands in and southwest of Los Banos and east of I-5 are on the alluvial fan of Los Banos Creek. Land surface elevations range from about 220 feet above mean sea level near I-5 to less than 100 feet above sea level near the northeast edge of the area. Lands slope gently in the northeast in the GSA.

Surficial Geology

Figure 2 is a surficial geologic map, modified from the California Division of Mines, San Jose Sheet (Rogers, 1966). Three types of alluvial deposits are shown. The older deposits are to the southwest near I-5 and are termed the Pleistocene non-marine (Qc). The deposits near

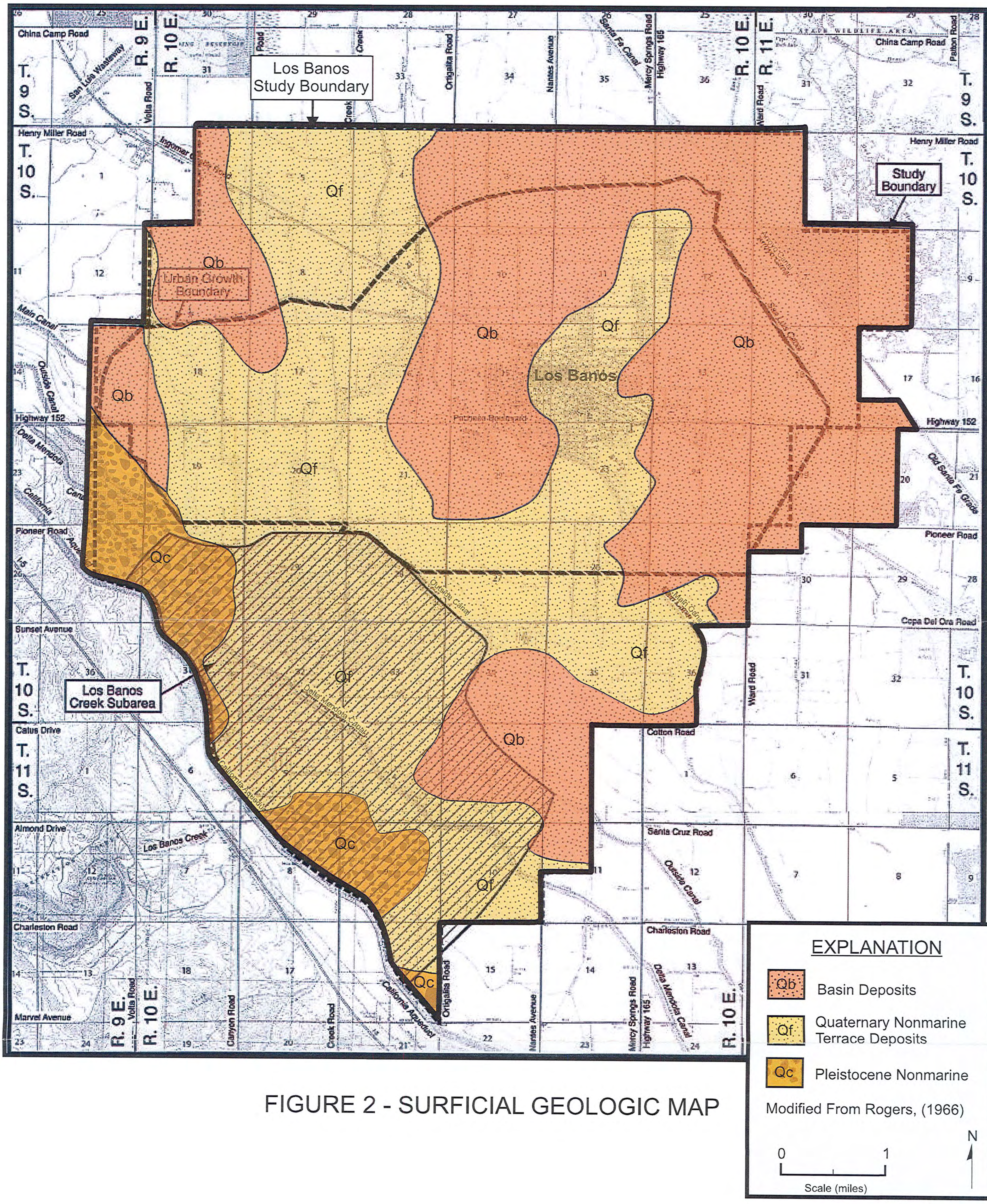

FIGURE 2 - SURFICIAL GEOLOGIC MAP

Los Banos Creek and its alluvial fan are termed Quaternary non-marine terrace (Qf). The deposits away from the creek are termed basin (Qb).

Topsoils

Figure 3 shows the major types of topsoils in the area. The U.S. Soils Conservation Service map of soils in the Los Banos area (Cole, 1952) was modified. The topsoils have been grouped into: 1) coarse-grained (sand), 2) fine-grained (clay and silty clay), and 3) intermediate texture (sand clay and clayey sand). Coarse-grained soils are limited to along Los Banos Creek, south of Sunset Avenue. The fine-grained soils are predominant in the rest of the area. Intermediate topsoils are present both to the northwest and southeast of the coarse-grained soils, and along Los Banos Creek in the area north of Highway 152. They are also present south and southeast of Los Banos.

Surface Water Bodies

Figure 4 shows surface water bodies in the area. Los Banos Creek passes through the area from the southwest near the California Aqueduct to the north at the Henry Miller Road crossing. The Los Banos Creek Detention Reservoir is located upstream and to the southwest of the area. The California Aqueduct, DMC, and CCID Main and Outside Canals are all southwest of Los Banos. The Arroyo Canal (Santa Fe Canal), Mud Slough, and former San Luis Drain are northeast of Los Banos. Extensive water bodies are

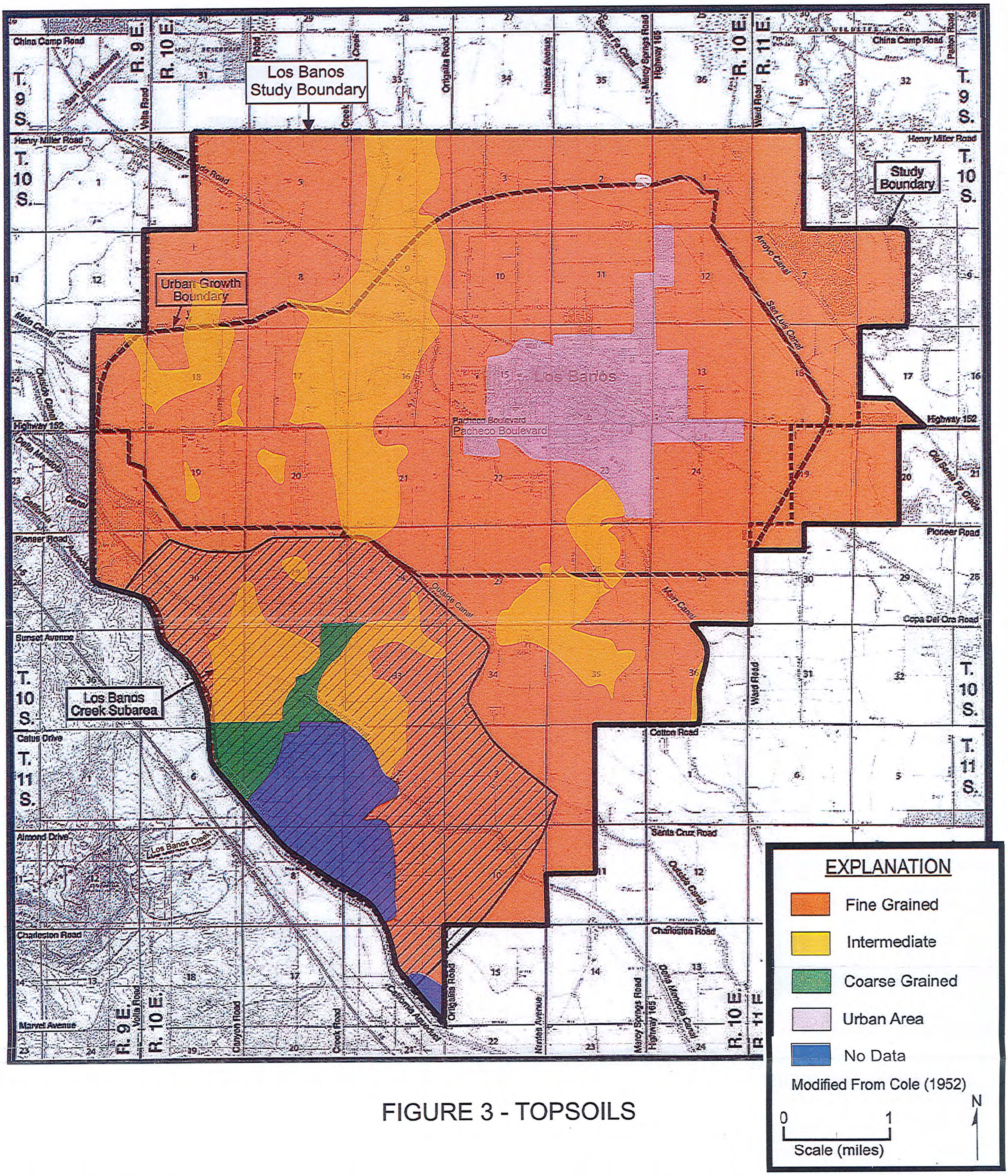

FIGURE 3 - TOPSOILS

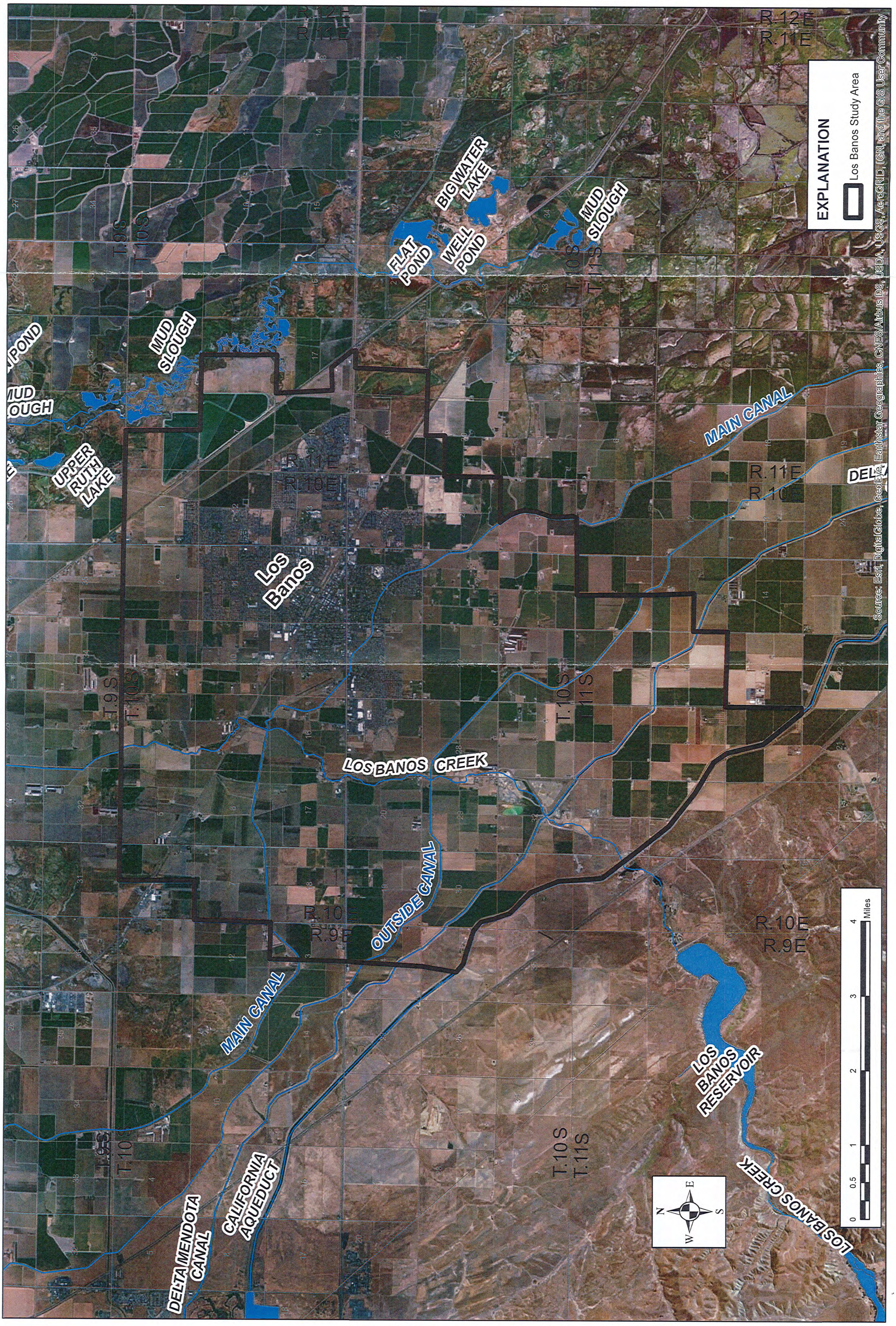

FIGURE 4 - SURFACE WATER BODIES

created seasonally in the GWD for duck clubs.

SUBSURFACE GEOLOGIC CONDITIONS

Regional Geologic and Structural Setting

The GSA is within west part of the San Joaquin Valley, which is a topographic and structural trough bounded on the east by the Sierra Nevada fault block and on the west by the folded and faulted Coast Ranges. Both mountains blocks have contributed to marine and continental deposits in the Valley. In the west-central part of the valley, more than 12,000 feet of sediments are present. In the Los Banos vicinity, groundwater is present in alluvial deposits that dip slightly toward the trough of the valley (the San Joaquin River).

Lateral Basin Boundaries

Figure 5 shows the study area boundaries and various GSAs. The north, west, and south boundaries of the study area were determined for the 2010 cooperative study of the Los Banos Area by KDSA. The northeast boundary was subsequently extended to cover additional land in part of the GWD. This Los Banos GSA is located within the San Luis-Delta Mendota Sub-basin. Land of the southwest in the study area (green color) are in the San Luis Water District. Lands in the area west and south of Los Banos Area are in the CCID (yellow color) and in the SJREC GSA boundary. White areas near Los Banos, particularly to the northwest and southeast (blue in color) are

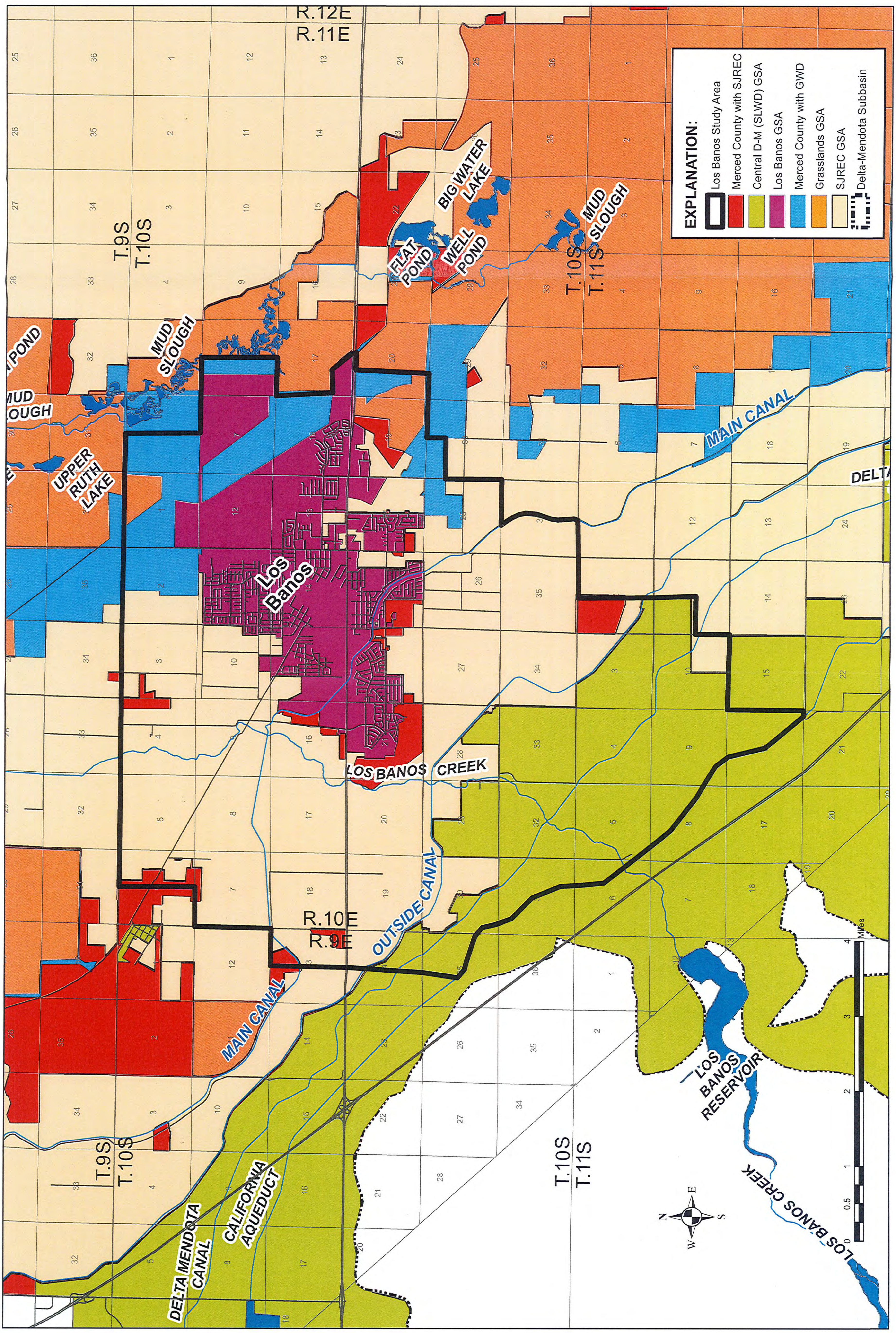

FIGURE 5 - LOCATION OF VARIOUS GSA's

in the Merced County GSA.

Definable Bottom of the Basin

Figure 6 shows the definable bottom of the area. Historically, the U.S. Geological Survey (Page, 1973) used an electrical conductivity of 3,000 micromhos per centimeter at 25°C to delineate the regional base of the fresh groundwater in the San Joaquin Valley. The underlying groundwater is termed "connate water" and is of higher salinity. Page indicated that the base of the fresh groundwater ranged from about 600 to 800 feet deep in most of the area. As part of this evaluation, electric logs for a number of deep holes were obtained from the California Division of Oil, Gas, & Geothermal Resources and interpreted to determine the bottom of the basin in more detail. The bottom of the basin in the area ranges from about 500 to 800 feet deep, and is generally deeper beneath Los Banos and the central part of the area.

Formation Names

Hotchkiss and Balding (1971) divided the unconsolidated deposits in the Tracy-Dos Palos area (west of the San Joaquin River) into flood basin deposits (normally less than 50 feet thick), Quaternary alluvium (usually less than 200 feet thick), and the Tulare Formation (up to almost 1,000 feet thick). The

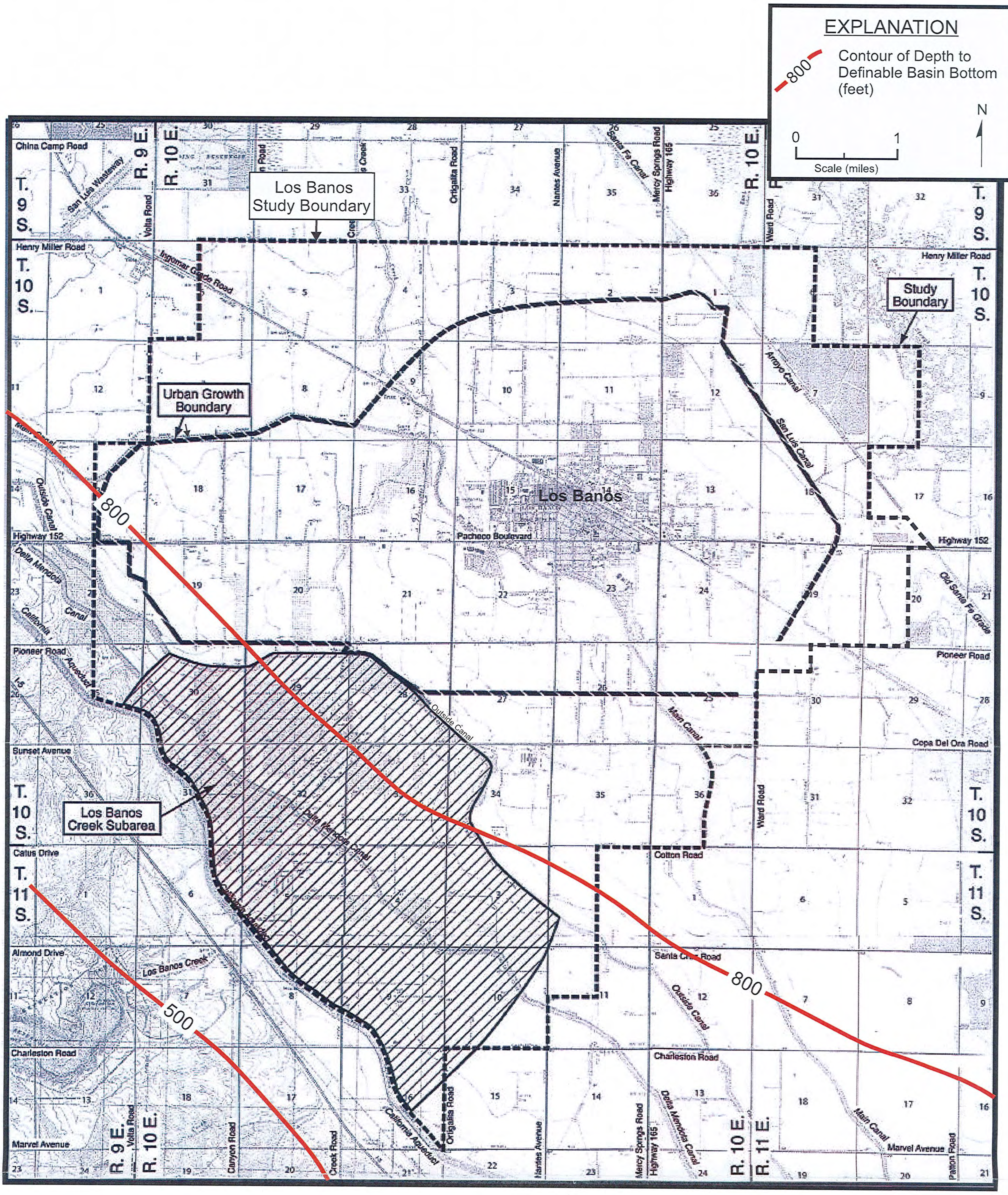

FIGURE 6 - DEFINABLE BOTTOM OF BASIN

Tulare Formation has an upper, thinner section which is above the Corcoran Clay, and a thicker, lower section below the clay. The Corcoran Clay is a regional confining bed, which divides the groundwater into an upper aquifer and lower aquifer. Deposits in most of the area are generally tan in color and are termed the Diablo Range deposits. These deposits are shown on several subsurface geologic cross sections that are presented later in this report.

Confining Beds

There is only one confining bed that is important beneath the area: the Corcoran Clay (also termed the E-Clay). Figure 7 shows the depth to the top of the Corcoran Clay, which was mapped by KDSA (1997a). The Corcoran Clay has been deformed since its deposition. The top of the clay in the area is shallowest (about 50 feet deep) near I-5 and deepest (about 300 feet) near Los Banos. The Corcoran Clay thickens to the northeast in the area. The clay is about 40 feet thick near the California Aqueduct and about 120 feet thick near the northeast edge of the area.

Principal Aquifers

The principal aquifer tapped by most wells in the area is the upper aquifer (above the Corcoran Clay). A secondary aquifer is the lower aquifer (below the Corcoran Clay). One City well,

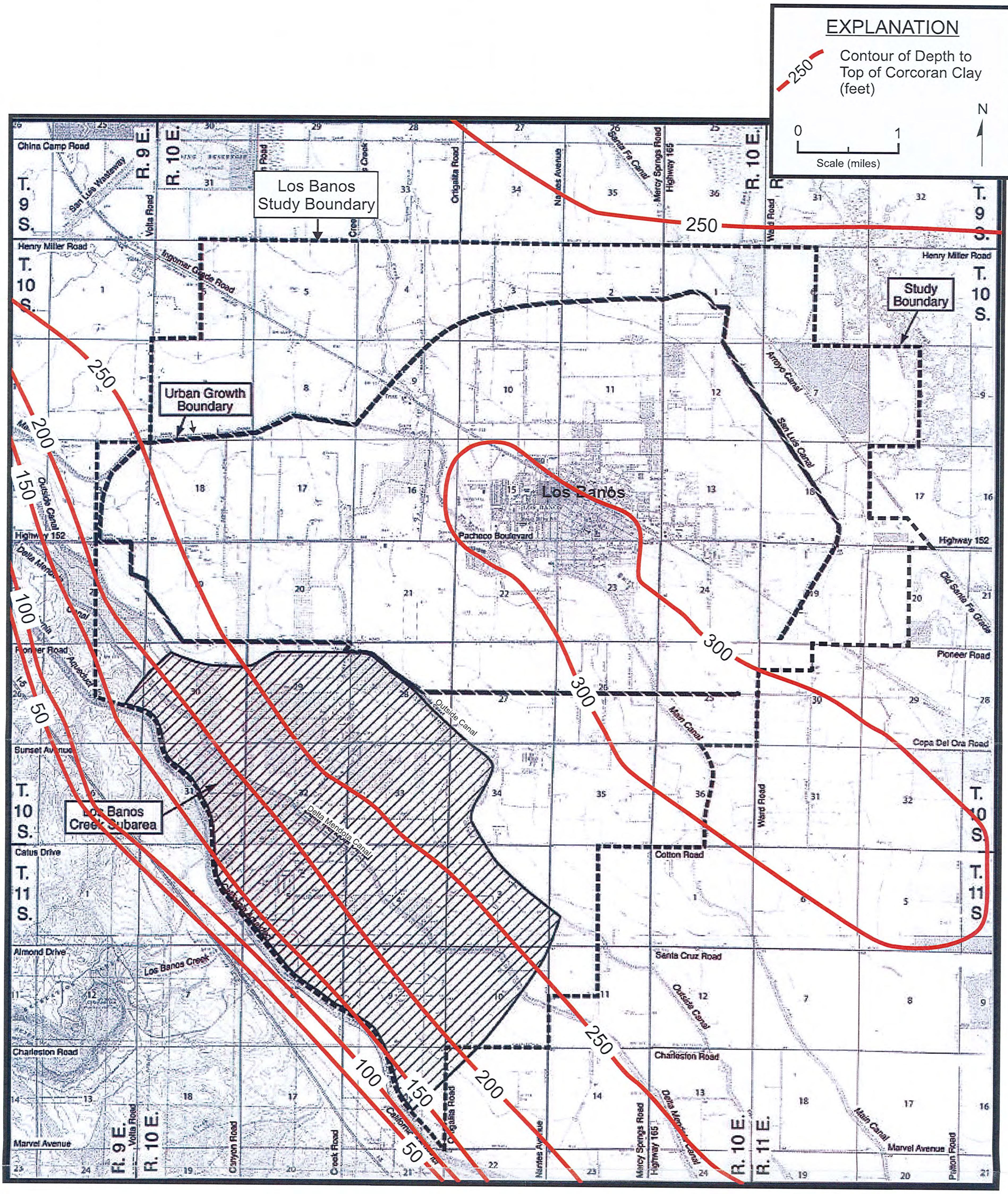

FIGURE 7 - DEPTH TO TOP OF CORCORAN CLAY

one CCID well, and a number of private irrigation wells in the study area tap the lower aquifer.

Subsurface Geologic Cross Sections

Figure 1 shows the locations of wells and test holes for which geologic information is available, and the locations of these cross sections. Besides electric logs, drillers logs for water wells were obtained from the California Department of Water Resources (DWR) in Fresno for use in developing these cross sections. Non City wells are identified by their 40-acre designation in a section, following the convention of the U.S. Geological Survey.

Subsurface Geologic Cross Section A-A' (Figure 8) extends from near I-5 on the southwest to near Henry Miller Avenue and Ward Road on the northeast. This section generally extends along the inferred dip of the alluvial deposits (to the northeast). Electric logs are available for six wells or test holes along this section. Included are a 710-foot deep test hole that was drilled near City Well No. 4, a 425-foot deep test hole that was drilled near Well No. 8, Well No. 9, which is 300 feet deep, and a 528-foot deep test hole drilled near Well No. 11. Drillers logs are available for the remaining wells along this section. Twenty-two of the wells or test holes along this section appear to have reach the top of the Corcoran Clay. The top of this clay ranges from about 60 feet deep near Well 5N to about

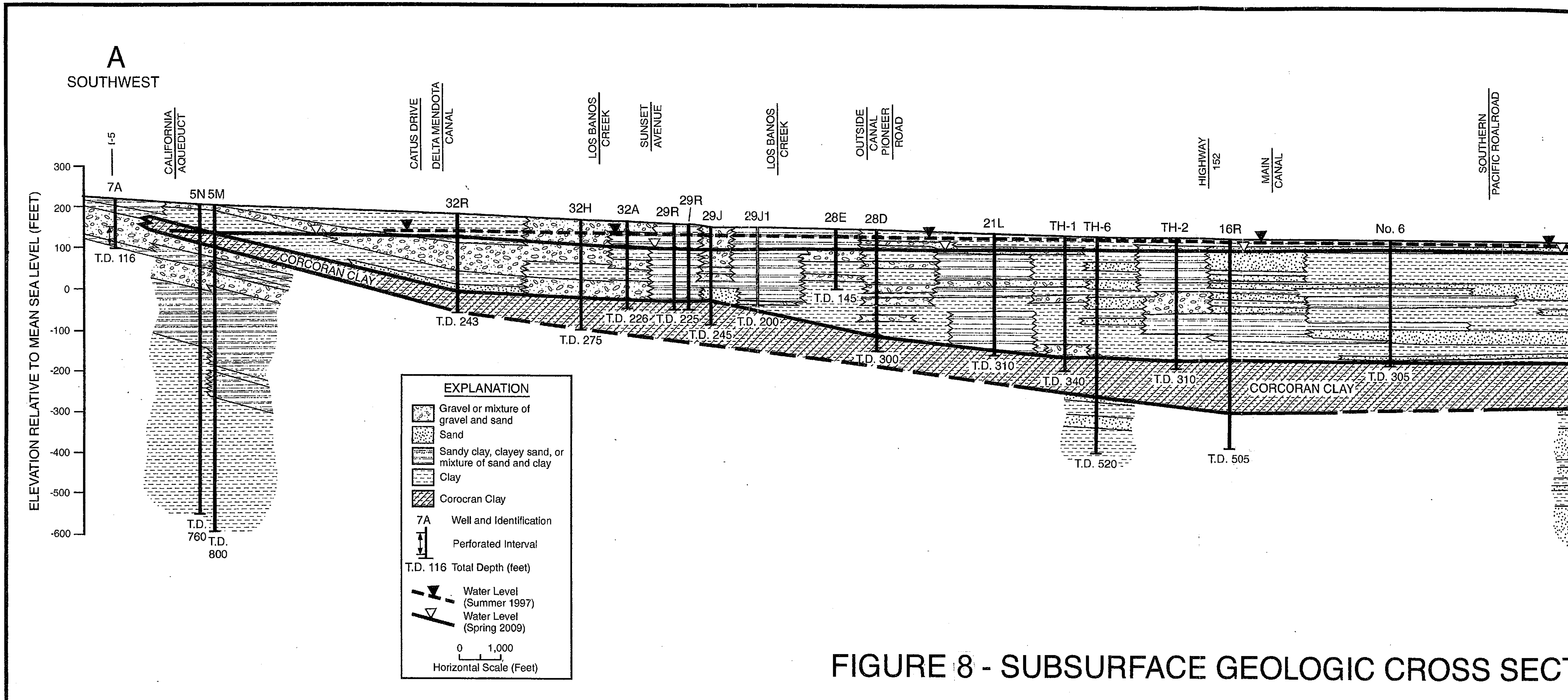

FIGURE 8 - SUBSURFACE GEOLOGIC CROSS SECT

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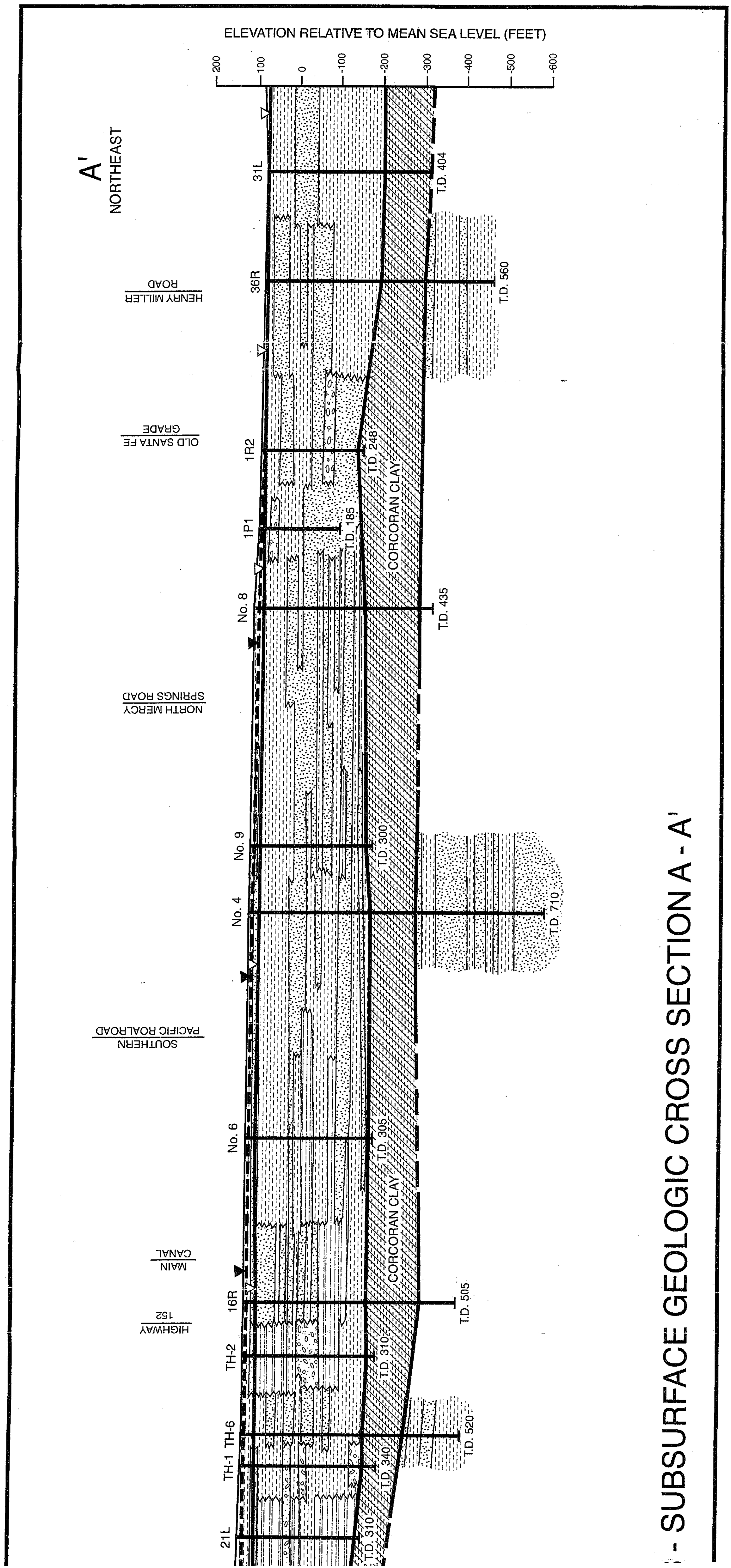


- SUBSURFACE GEOLOGIC CROSS SECTION A - A' about 310 feet at Well 31L. The test holes near City Wells No. 4, 8, and 11 and Wells 5M, 16R, and 36R penetrated the base of the Corcoran Clay. The Corcoran Clay is about 90 feet thick near City Well No. 11, 110 feet thick near Well No. 4, and almost 130 feet thick near Well No. 8. The clay thins toward the southwest along this section and apparently pinches out between I-5 and the California Aqueduct.

Sand and gravel layers are more common in the upper aquifer beneath the southwest part of the study area (i.e., at Wells 32H and 32R). The permeable strata tapped by most City Wells are primarily in the interval between 100 and 300 feet in depth. City Wells No. 4, 9, 8, and 11 all appear to tap a laterally extensive coarse-grained layer about forty feet thick, the top of which is about 100 feet deep. Another a really extensive coarse-grained layer appears to be present at a depth of about 220 to 230 feet along the central part of this cross section. This layer ranges from about 10 to 20 feet in thickness. A coarse-grained layer about ten feet thick and just above the Corcoran Clay is fairly extensive along this section. Fine-grained strata are more predominant to the northeast along this section (i.e. Wells 31L and 36R).

The base of the Corcoran Clay is 415 feet deep at Well T10S/R10E-16R, 402 feet deep near City Wells No. 4 and 11, and 394 feet deep near City Well No. 8. Thick coarse-grained, permeable deposits are present below the Corcoran Clay near City Well No. 4 to a depth of 710 feet. More than 200 feet of such deposits are present below the Corcoran Clay at this location. City Well No. 11 encountered three permeable layers between 407 and 514 feet in depth, totaling about 60 feet in thickness. Well 5M encountered several sand and gravel layers below the Corcoran Clay.

Subsurface Geologic Cross Section B-B′ (Figure 9) extends from the west, near Highway 52 and the Outside Canal, generally along Highway 152 to the east near the Old Santa Fe Grade. The strata along the Corcoran Clay are predominantly clay along the part of the section west of Los Banos Creek. Between the creek and Ortigalita Road, interbedded coarse-grained strata are more common, including stream channel deposits (coarser than sand). Clay strata are predominant above the Corcoran Clay beneath much of the City. However, the relatively thin interbedded coarse-grained strata at some locations produce adequate amounts of water for City wells. Sand strata above the Corcoran Clay thicken to the east along this section, particularly east of Mercy Springs Road. A number of coarse-grained stream channel deposits were encountered at City Well No. 1, near Center Avenue.

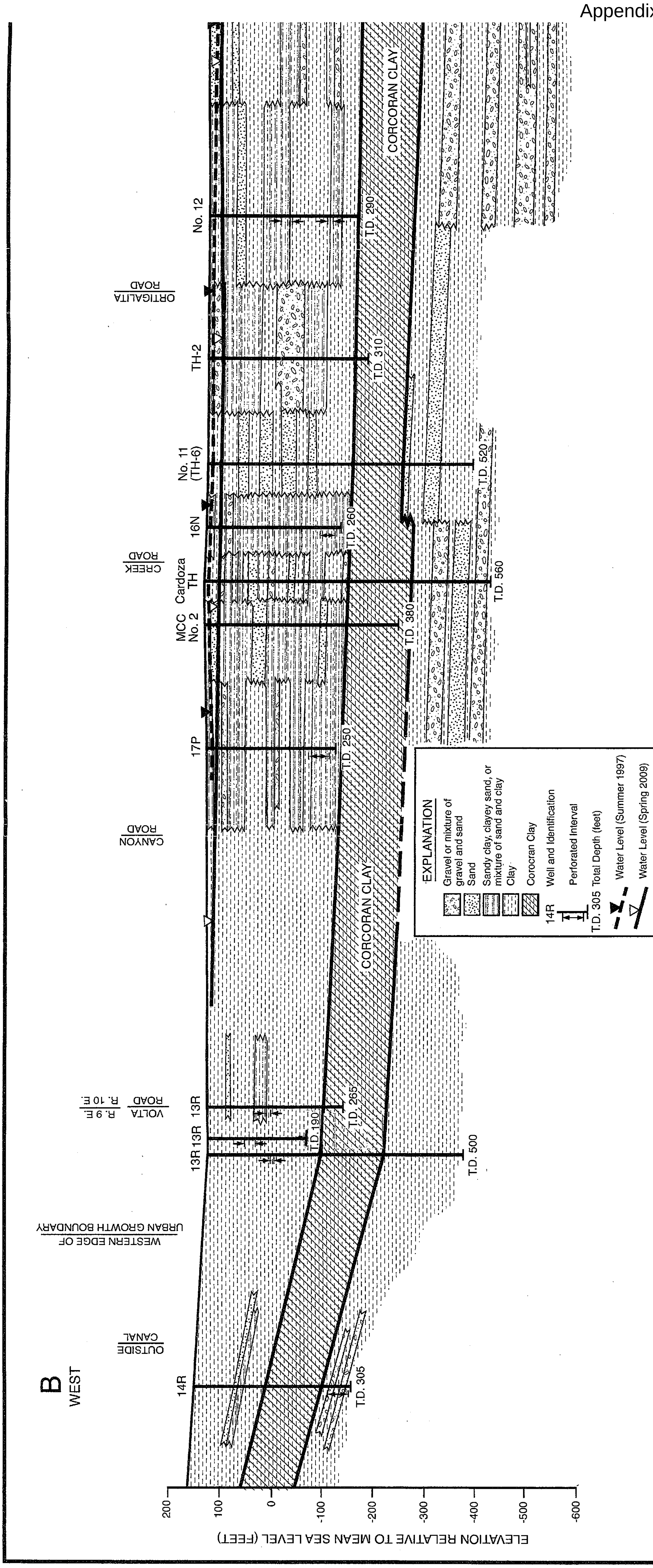
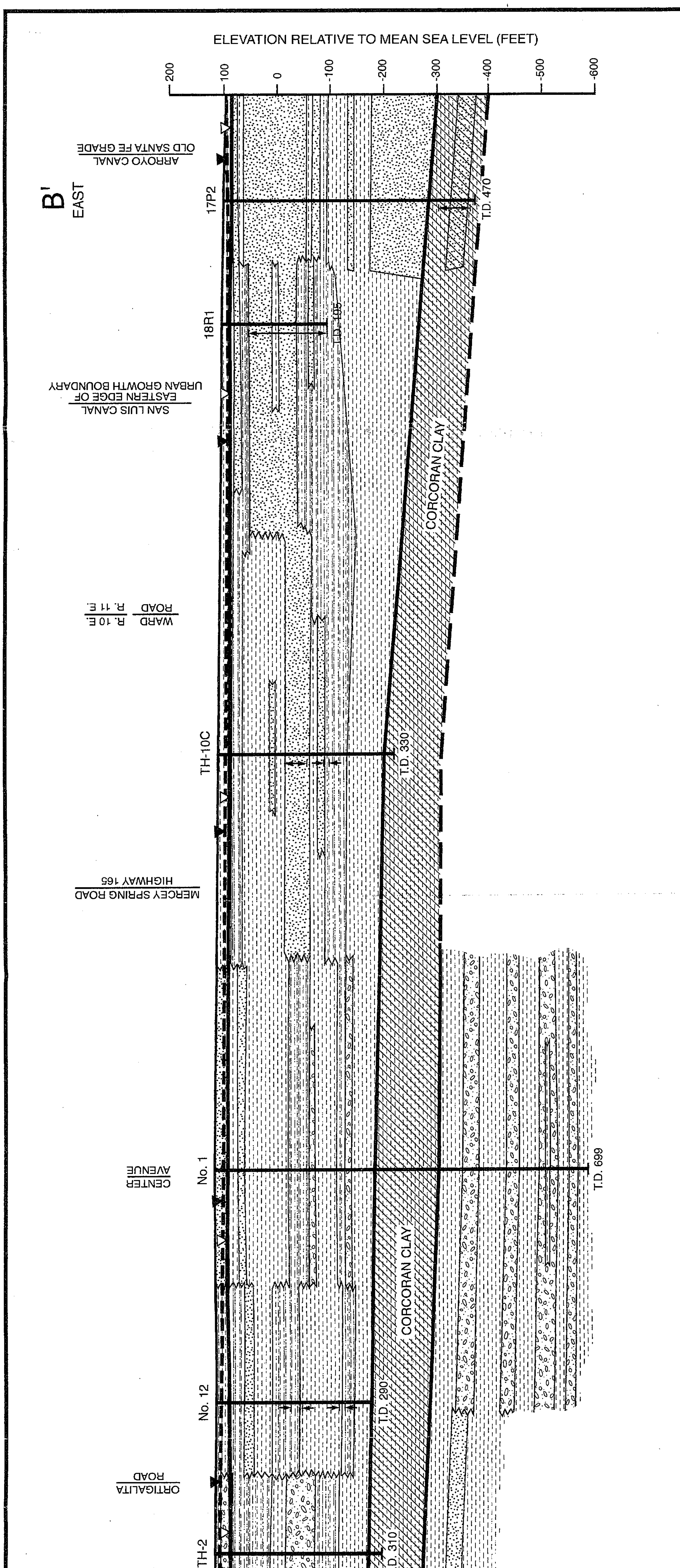


FIGURE 9 - SUBSURFACE GEOLOGIC CRO



URFACE GEOLOGIC CROSS SECTION B - B'

Subsurface Geologic Section C-C' (Figure 10) extends from Volta on the northwest (Well 1A), through City Wells No. 6, 1, and Test Hole No. 10-A, to Well 1G, near the southeast boundary of the GSA. This section is generally oriented perpendicular to the inferred dip of the alluvial deposits, and thus the strata appear relatively flat. Well No. 1 was drilled to a depth of 697 feet. The top of the Corcoran Clay ranges from about 280 feet in depth at Test Hole No. 9 to 306 feet at Well No. 1. City Well No. 1 and Well 35L along this section penetrated the base of the Corcoran Clay. The Corcoran Clay is about 110 feet thick at City Well No. 1 and about 120 feet thick at Well 35L. Test Hole No. 10-A encountered five relatively thin and poorly developed water-producing strata between 95 and 280 feet in depth, and a production well was not completed at this site. The coarse-grained permeable deposits in the lower aquifer appear to be much thinner at Well No. 1 than at Well No. 4. Fine-grained deposits are predominant along this section between the northerly extension of Canyon Road and City Well No. 6.

CONSTRUCTION DATA FOR WELLS

City of Los Banos Wells

There are presently 13 active City Wells, all of which tap strata above the Corcoran Clay. Well No. 14 is the only active City

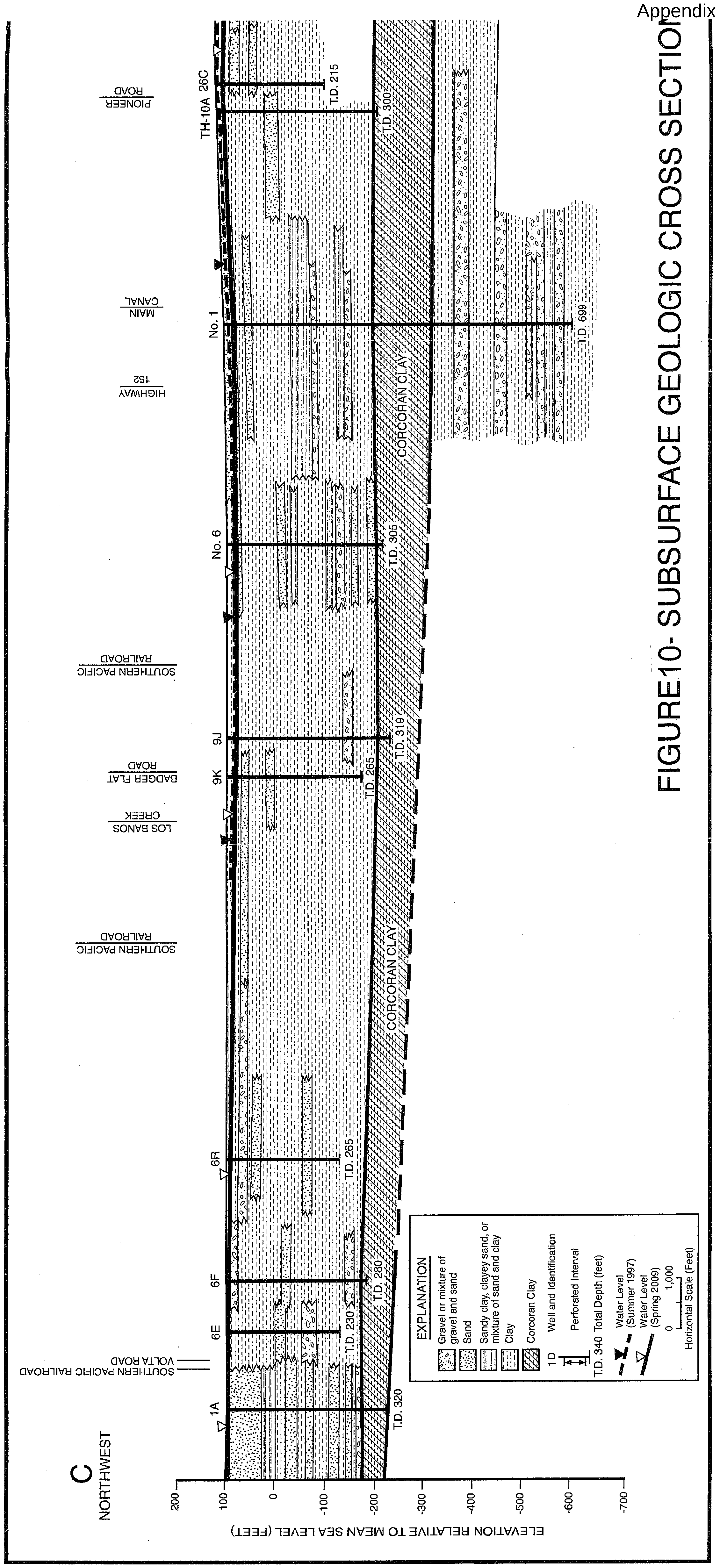
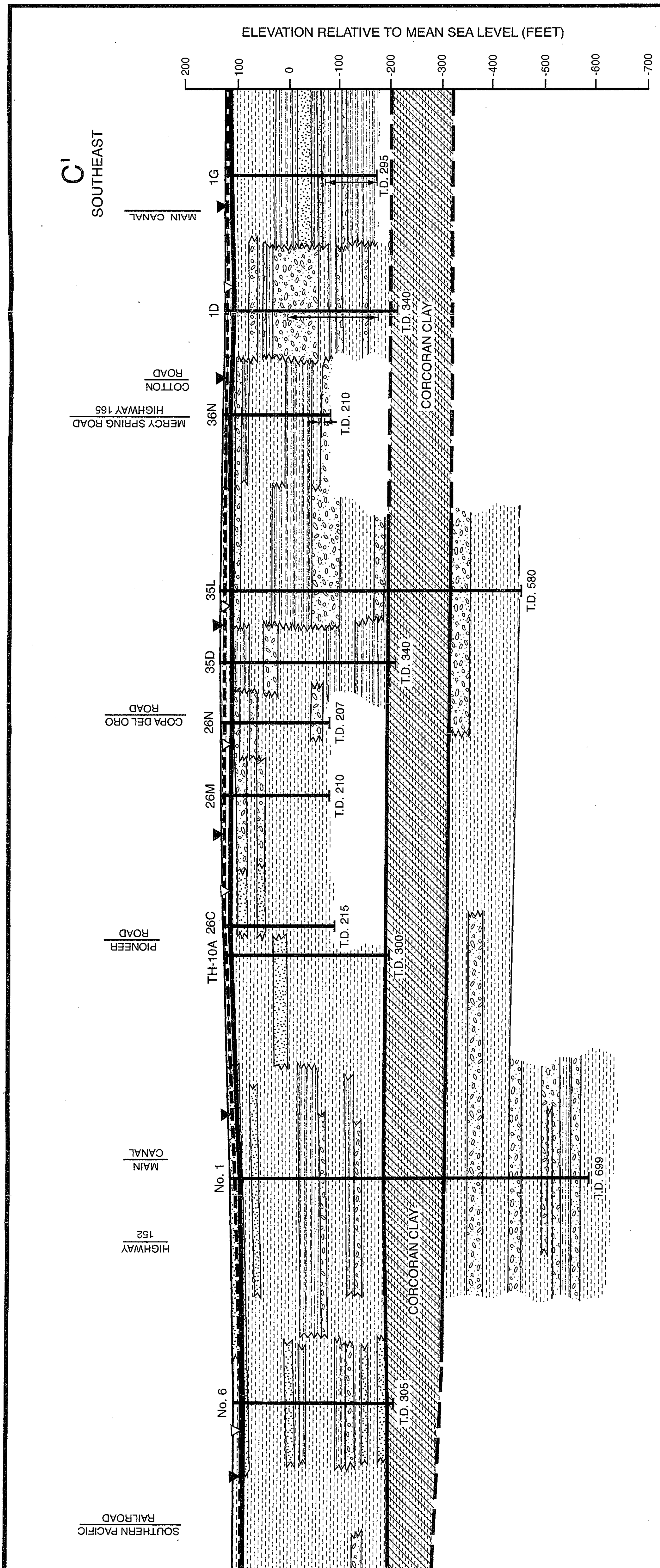


FIGURE10- SUBSURFACE GEOLOGIC CROSS SECTION



RE10- SUBSURFACE GEOLOGIC CROSS SECTION C - C' well with perforations extending below the Corcoran Clay. Table 1 provides information on dates drilled, depth, and perforated intervals for these wells. Drillers logs are available for all of these wells. Electric logs are available for Old Well No. 1, Wells No. 1 and No. 4, and Wells No. 7 through 15.

CCID Wells

Table 2 shows construction data for the four CCID supply wells in the Los Banos area. Cased depths of three of these wells range from 220 to 300 feet and the tops of the perforations range from 25 to 220 feet deep. These wells tap strata above the Corcoran Clay. Well No. 56 is 600 feet deep and is perforated from 400 to 600 feet deep. This well taps strata below the Corcoran Clay.

GROUNDWATER USE AND WELL DATA

Primary Uses of Each Aquifer

The primary use of the upper aquifer is for public supply and irrigation, and a secondary use is for wetlands and domestic use. The primary use of the lower aquifer is for irrigation use. A secondary use in for public supply and wetlands.

TABLE 1-CONSTRUCTION DATA FOR ACTIVE CITY OF LOS BANOS WELLS

No.	Date Drilled	Drilled Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
1	03/51	699	310	16	-	-
2	01/58	310	310	16	164-310	0-70
3	07/63	310	310	16	115-134 145-305	0-60
5	06/64	302	159 301	16 14	108-154 223-270	0-61
6	04/76	305	302	-	205-235 240-245 290-295	0-50
7	11/77	300	180	16	104-114 140-170	0-50
9	09/90	300	255	16	180-190 225-245	0-163
10	03/91	242	218	16	125-165 198-208	0-50
11	09/94	290	265	16	130-140 170-185 215-225 245-255	0-50

Continued:

TABLE 1-CONSTRUCTION DATA FOR ACTIVE CITY OF LOS BANOS WELLS
(Continued:)

No.	Date Drilled	Drilled Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
12	10/95	290	266	16	140-160 230-240 250-256	0-75
13	01/99	300	261	16	135-160 193-203 241-251 134-154 180-200	0-60
14	08/98	555	470	16	134-154 180-200 260-270 440-460	0-70
15	02/02	540	285	16	135-160 175-185 240-275	0-90

TABLE 2-CONSTRUCTION DATA FOR CCID WELLS

No.	Date Drilled	Drilled Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
8-A	03/94	230	220	16	75-220	0-50
48-A	11/96	305	300	18	220-260 280-295	0-50
56	01/99	610	600	18	400-600	0-50
62	04/03	255	250	21 16	25-125 150-240	0-25

Data from well completion reports.

Depths of Water Supply Wells

City of Los Banos Wells

Cased depth of the City upper aquifer wells range from 180 to 310 feet. Except for Wells No. 7 and 10, the cased depths of these wells range from 255 to 310 feet. The only active City well tapping the lower aquifer (No. 14) is a composite well, cased to a depth of 555 feet. This well is perforated from 134 to 460 feet in depth (top and bottom of perforations).

CCID Wells

Cased depths of the CCID upper aquifer wells range from 220 to 300 feet. Well No. 56 taps only the lower aquifer, and the cased depth is 600 feet and the casing is perforated from 400 to 600 feet in depth.

Other Wells

Most private irrigation well in the study area tap only the upper aquifer, and are thus generally cased above a depth of about 300 feet. There are some shallow private domestic wells that are cased to depths of less than 150 feet, and thus tap the upper part of the upper aquifer. Some irrigation wells are composite wells (tapping both aquifers), and others only tap the lower aquifer. The composite and lower aquifer wells are generally cased to depths ranging from about 450 to 700 feet.

WATER LEVELS

Water-Level Depths

KDSA (1998, Figure 4) provided a depth to water map for Spring-Summer 1997. Many of the measurements were for shallow observation wells measured by the CCID. Several were for shallow monitor wells at the City Wastewater Treatment Facility. There are less such wells southwest of the Outside Canal, and in part of that area, measurements for water supply wells were used. In addition, water-level measurements were obtained for six monitor wells for the Triangle Rock gravel plant. Depth to water ranged from less than five feet beneath the northwest and southeast parts of the study area in Spring-Summer 1997, to more than 20 feet in most of the area southwest of the Outside Canal. In most of the City of Los Banos, depth to the shallowest groundwater ranged from 10 to 15 feet. The depths that were shown for the urban area were more representative of the shallowest groundwater, as opposed to those for City supply wells, many of which aren't perforated near the water level, but much deeper.

KDSA (2010, Figure 5) provided a depth to water map for Spring 2009. This map showed the greater depth to water during a dry period, particularly in the Los Banos Creek subarea. Depth to water ranged from less than 10 feet beneath the northwest, northeast, and southeast part of the area, to more than 80 feet in the area west of the DMC and south of Los Banos Creek. Depth to water exceeded about 40 feet in most of the Los Banos Creek sub-area.

Water-Level Elevations and Direction of Groundwater Flow

Upper Aquifer

KDSA (1998, Figure 5) provided a water-level elevation and direction of groundwater flow map for Spring-Summer, 1997. This map was also based on shallow wells in some areas. The highest water-level elevations (exceeding 140 feet above mean sea level) were southwest of the DMC. The lowest water-level elevations (less than 90 feet) were to the northeast. Recharge mounds were indicated near Los Banos Creek (southwest of the Outside Canal) and near the City WWTF to the northeast. This water-level map indicated that most of the lateral groundwater inflow into the City came from the southwest.

KDSA (2010, Figure 6) prepared a water-level elevation and direction of groundwater flow map for Spring 2009. This was based on data in the DWR water-level data base and CCID data. At this time this map was prepared, water-level measurements weren't available for City wells. Since that time they have become available, and the map has been revised to include water-level elevations for City wells (Figure 11). Water-level elevations

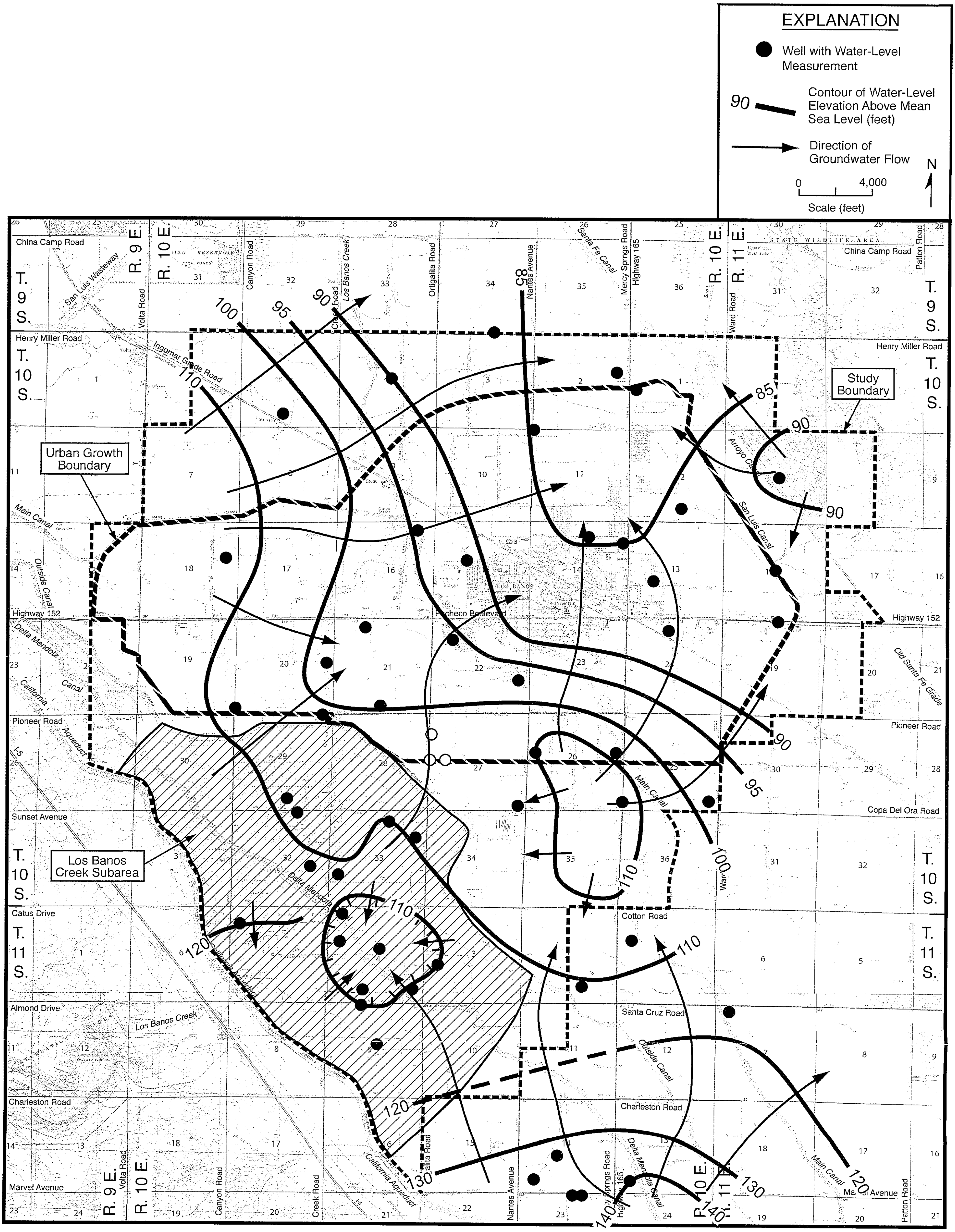


FIGURE 11 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW ABOVE CORCORAN CLAY (SPRING 2009)

ranged from more than 140 feet near the DMC and Merced Avenue to less than 85 feet northeast of Los Banos. A cone of depression was indicated beneath the City, and this depression extended at least two miles to the north of the City. A similar overall direction of groundwater flow was generally indicated as in 1997. However, the most significant change was the lack of a recharge mound along most of the reach of Los Banos Creek for the Spring 2009 map. This was due to minimal streamflow in the creek prior to and during Spring 2009, and also due to the use of measurements for deeper wells (i.e. supply wells). The recharge mound associated with the WWTF (east of the San Luis Canal) was indicated to still be present in Spring 2009. There was a localized cone of depression in Spring 2009 in the area southeast of Los Banos Creek along the DMC. This area coincided with a number of private wells that were used for irrigation of land in the study area.

Figure 12 shows water-level elevations and the direction of groundwater flow for the upper aquifer in Spring 2017. This map is based on measurements for water supply wells as opposed to shallow monitor wells. For this map, measurements were also available for the City wells. Water-level elevations ranged from more than 115 feet above mean sea level to the southwest to less than 80 feet to the northeast. A well developed cone of depression was present beneath the Los Banos urban area. Otherwise, the direction of groundwater

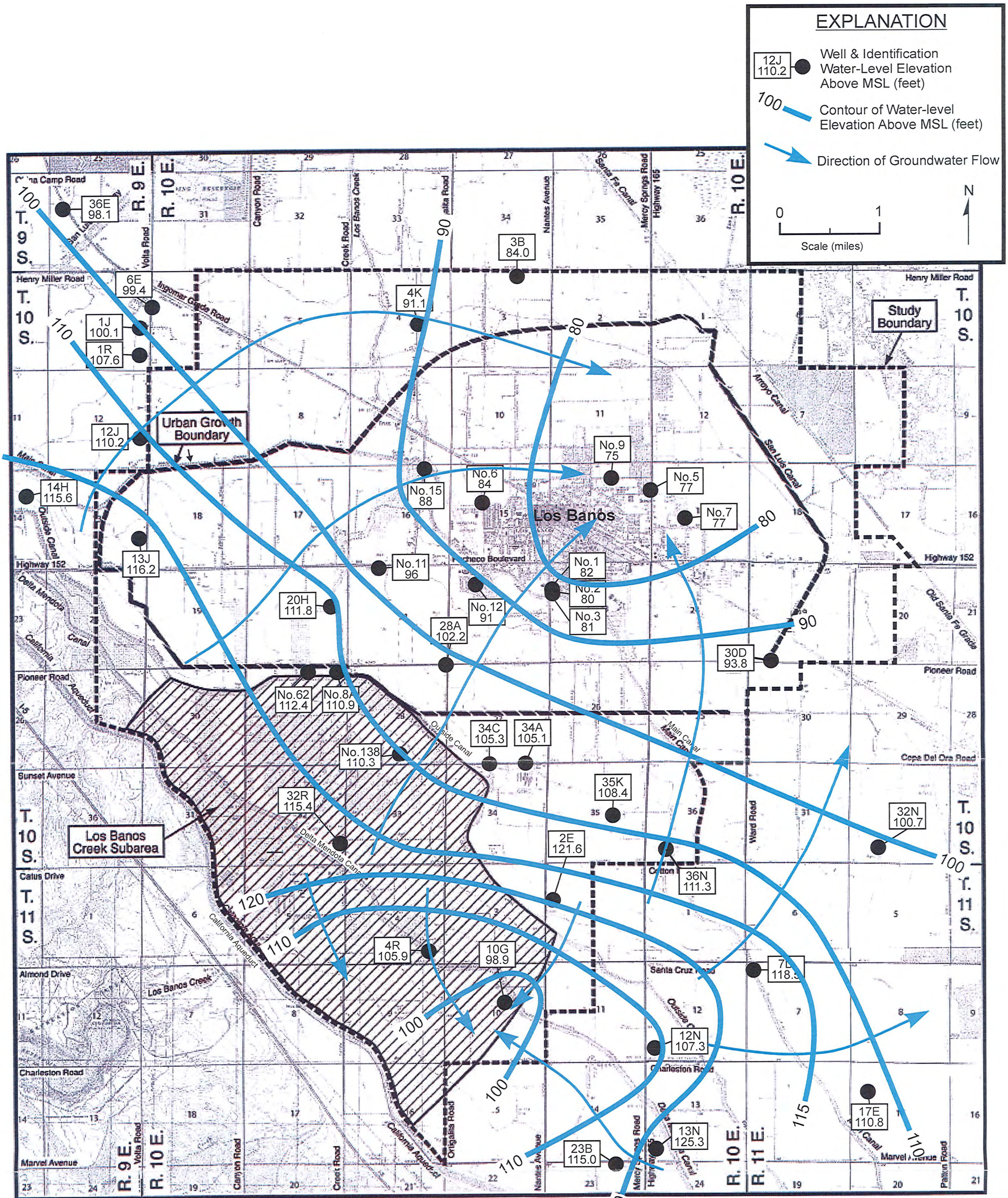


FIGURE 12 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW ABOVE CORCORAN CLAY (SPRING 2017)

flow was to the northeast, except in an area southeast of Los Banos Creek and upslope of the Outside Canal, where groundwater was flowing toward a depression in the area south of Cactus Drive in the SLWD. Little indication of a recharge ridge was indicated along Los Banos Creek by the supply well water-level measurements. Such a ridge would be indicated by water-level measurements for shallow observation wells or monitor wells.

Lower Aquifer

Water-level measurements for wells tapping the lower aquifer in the area are inadequate to determine the direction of groundwater flow. However, regional maps prepared for the San Joaquin River Exchange Contractors Water Authority (SJRECWA) have indicated a southeasterly direction of flow toward the Panoche W.D.

Water-Level Fluctuations

Upper Aquifer

KDSA (2010) evaluated water-level hydrographs for wells in the area from the DWR website (presented in Appendix A of that report). Water levels in wells in most of the area were stable or rising through Spring 2009. However, in the area near and southwest of the Outside Canal, and east of the south part of the canal in the study area, water levels fell between 2006 and 2009. Records for twelve wells in Sections 19, 20, 22, 26, 29, 33, 34, and 36 of T10S/R10E showed this decline, which ranged from seven to 29 feet. The greatest declines (20 feet or more) were in Wells 19R1, 29A1, 29N2, 29Q2, 33H1, 34A1, and 34C1.

Updated water-level hydrographs (through early 2017) are provided in Appendix A of this report. Figure 13 is a representative long-term water-level hydrograph for the part of the study area northeast of the Outside Canal. Well T10S/R10E-12Q1 is located in the northeast part of Los Banos. Water levels in this well generally rose between 1975 and 1987, then fell during 1988-1994 during the drought. The water level then rose from 1996-1999 and was stable through 2006. The water level fell about nine feet during 2006-08, rose about five feet by 2010, then fell about 13 feet in 2015. Overall, water levels have been stable except for temporary declines during dry periods. Figure 14 is an updated water-level hydrograph for a well in the Los Banos Creek subarea. Well T10S/R10E-33H1 is located about a mile east of Los Banos Creek. The water level in this well fell about 20 feet between 1987 and 1993. The water level then rose about 24 feet by 2002. The water level fell about 27 feet between 2007 and 2009, then rose about 18 feet by 2012. The water level then fell about 78 feet by the end of 2014, and more recent measurements aren't available. Water-levels in this well were relatively stable prior to 2009. Water levels declined between 2009 and 2015.

Appendix A also contains water-level hydrographs for 12 City of Los

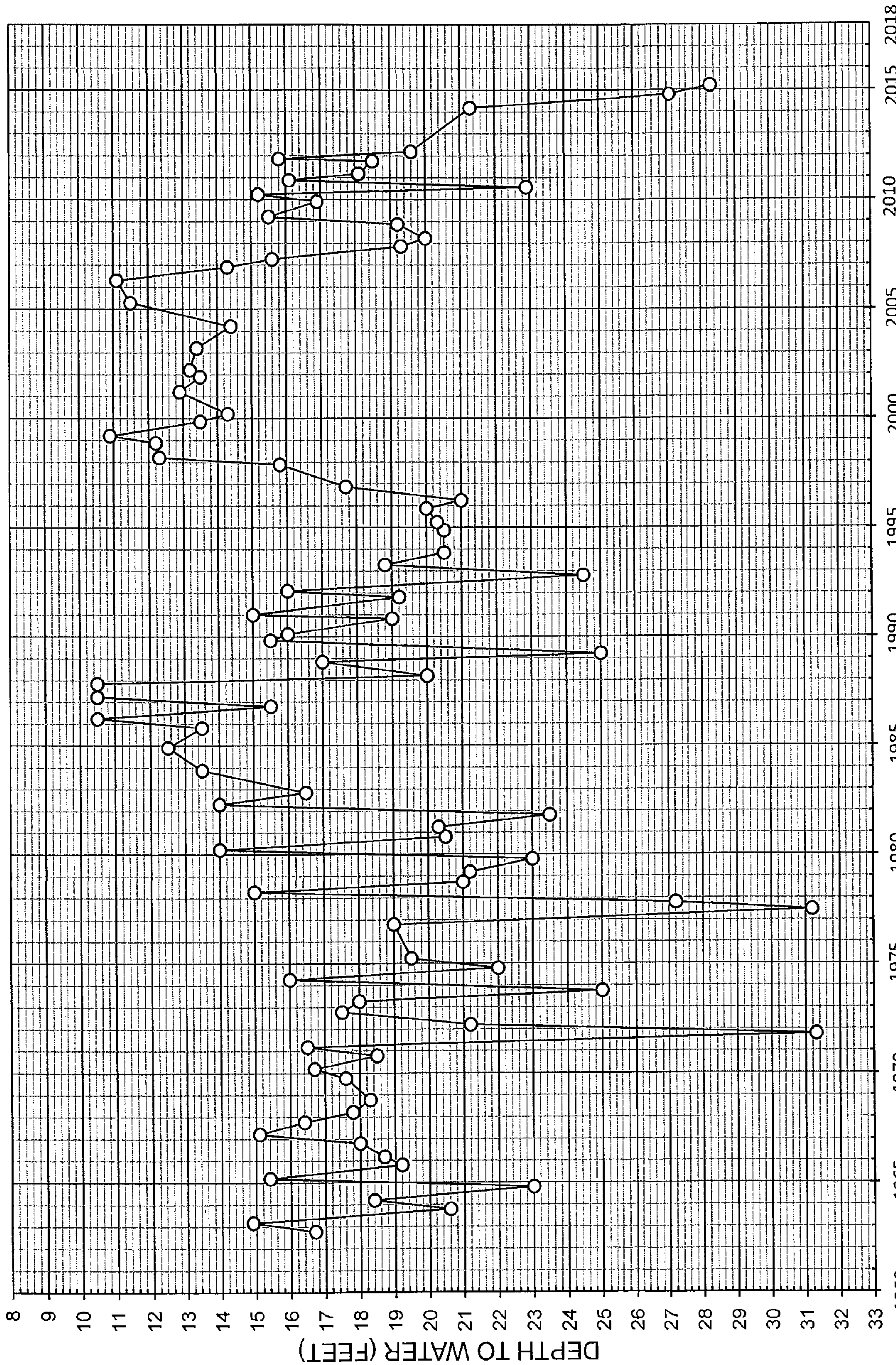


FIGURE 13 - LONG-TERM WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-12Q1

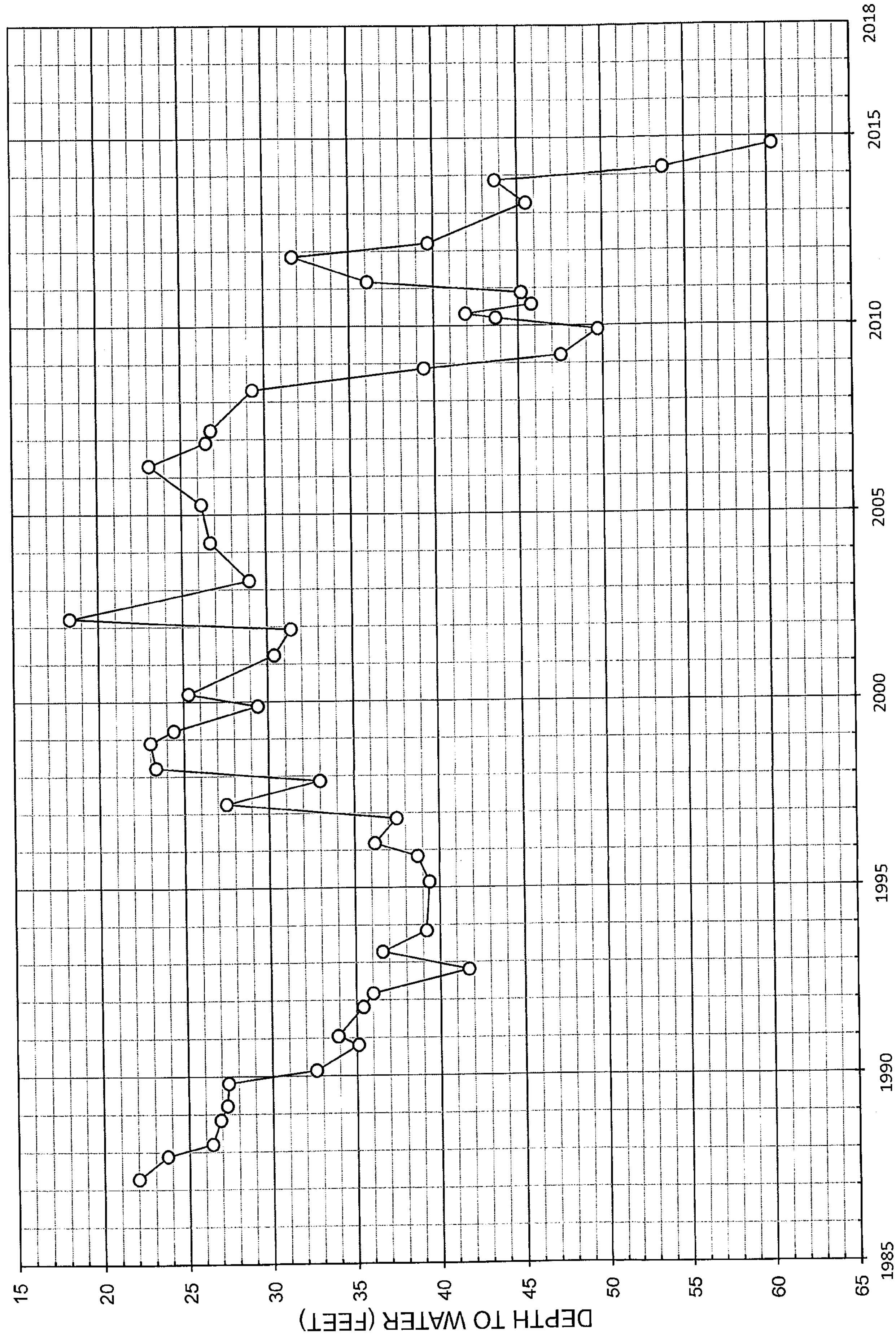


FIGURE 14 - LONG-TERM WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-33H1

Banos wells for Spring 1997-Spring 2017. The City measures static (standing) water levels in the wells on a monthly basis when possible. Well No. 14, which is perforated above and below the Corcoran Clay, is included, because its water-level trends are consistent with those for the other wells. Figure 15 is a water-level hydrograph for Well No. 5, which is considered representative of average trends. Water levels were shallower during the winter and deeper during the summer, and seasonal variations often ranged from about 20 to 30 feet. A review of these hydrographs indicates water-level declines, ranging from no decline in two wells to 0.7 foot per year (at the well No. 1 site) between 1997 and 2012-14. The average water-level decline in the City wells during this period was 0.2 foot per year. Water-levels declines during 2013-17 ranged from 0.9 to 3.8 feet per year and averaged 2.0 feet per year.

The most frequent long-term water-level records available near Los Banos Creek and upstream of the Outside Canal are for six shallow monitor wells for the Triangle Rock facility near Pioneer Road and the creek. Water levels in these monitor wells were frequently measured during 1990-99 and from 2006-2017 (Figure 16). Records of outflow from the Los Banos Creek detention dam since 1967 are provided in Appendix B. In part of 2017, water was also discharged to the creek from the DMC, as part of a pilot recharge project. Water levels in these monitor wells

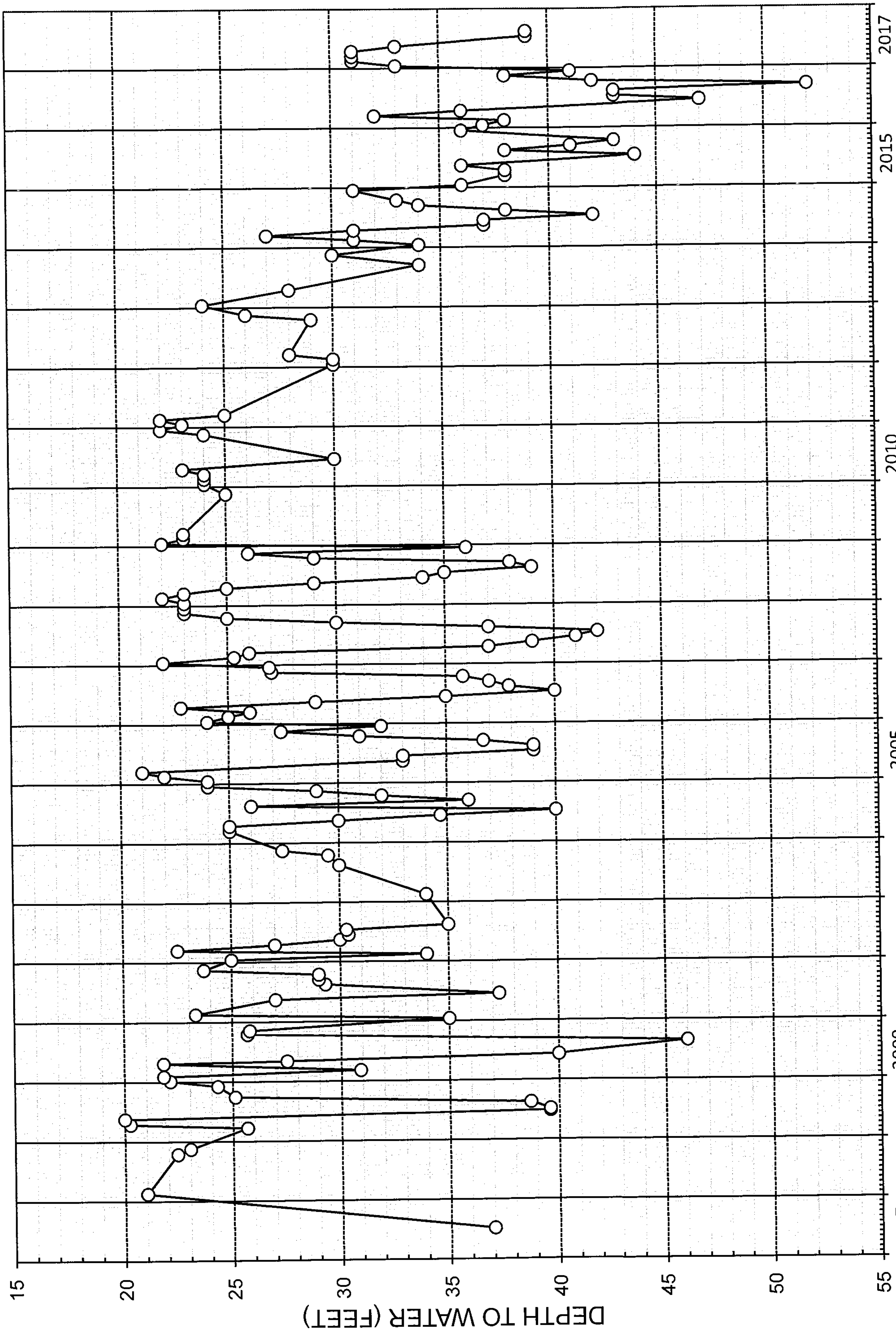


FIGURE 15 - WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 5

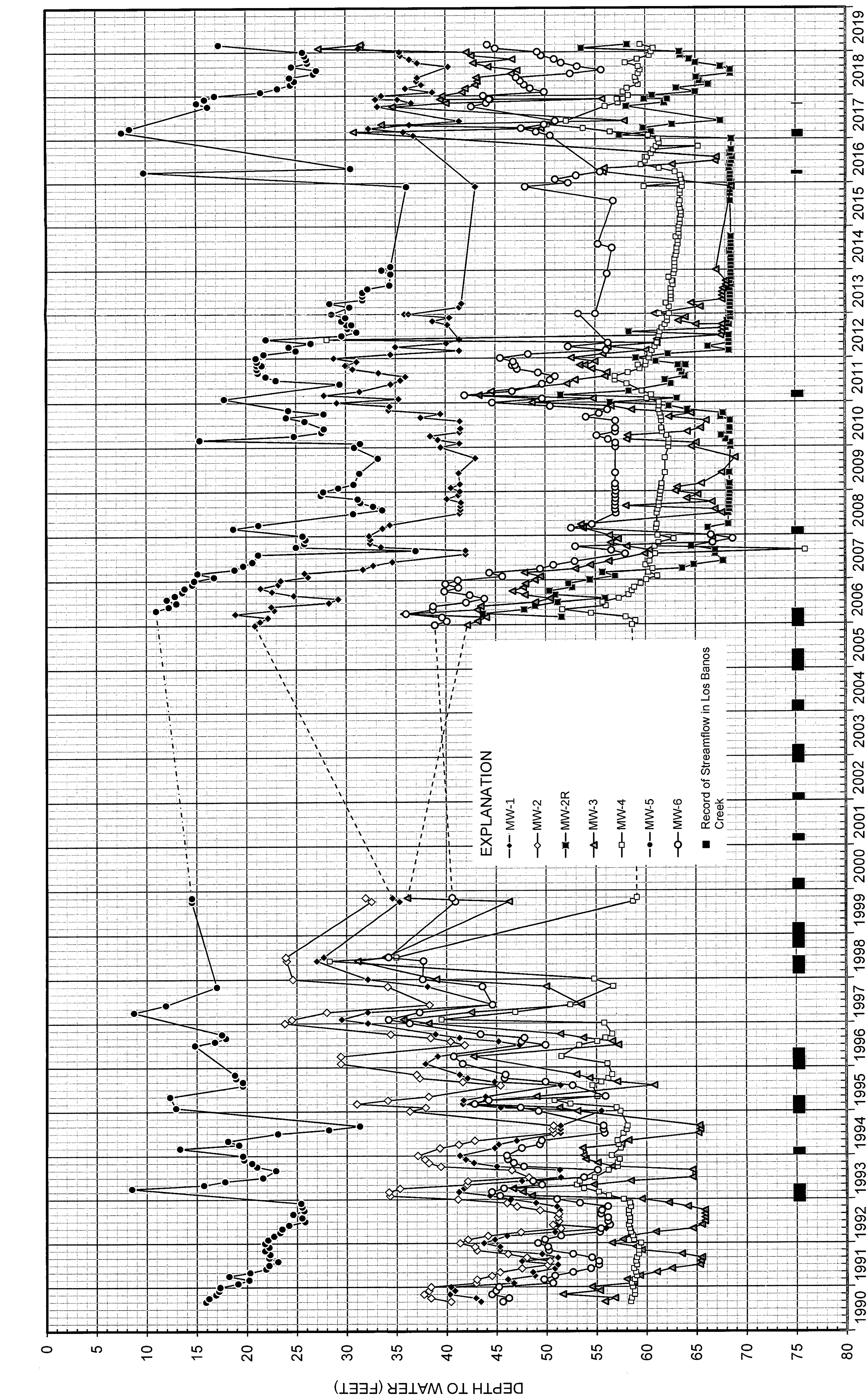


FIGURE 16-WATER-LEVEL HYDROGRAPHS FOR TRIANGLE ROCK MONITOR WELLS

have risen during and following periods of significant flow in Los Banos Creek, and have fallen during non-streamflow periods. Some of the deepest water levels in these monitor wells were during the drought of the early 1990's, and during 2006-09 and 2014-16. Average water-level declines in the monitor wells in the absence of streamflow in Los Banos Creek were about eight feet per year during May 2006-January 2009. Records for Los Banos Creek streamflow indicate that the longest period of no outflow from the Dam was between March 1987 and January 1993, or almost six years.

During the more recent drought, water levels in most of these shallow monitor wells were dry for several years, prior to early 2017. However, when there was flow in Los Banos Creek during 2017, the water levels in those wells rose significantly.

Nested monitor well T10S/R10E-32L is located near the DMC and Los Banos Creek. Figure 17 shows water-level hydrographs for two of the monitor wells at this site (32L5 and L6) that are perforated above the Corcoran Clay. The shallowest spring water levels for the upper aquifer at this site have normally ranged from about 48 to 52 feet. The deepest spring water levels have normally ranged from about 65 to 70 feet. In Spring 2017 depth to water in Well 32L6 was about 37 feet, the shallowest of record. Depth to water in Well 32L5 was 64 feet in Spring 2017,

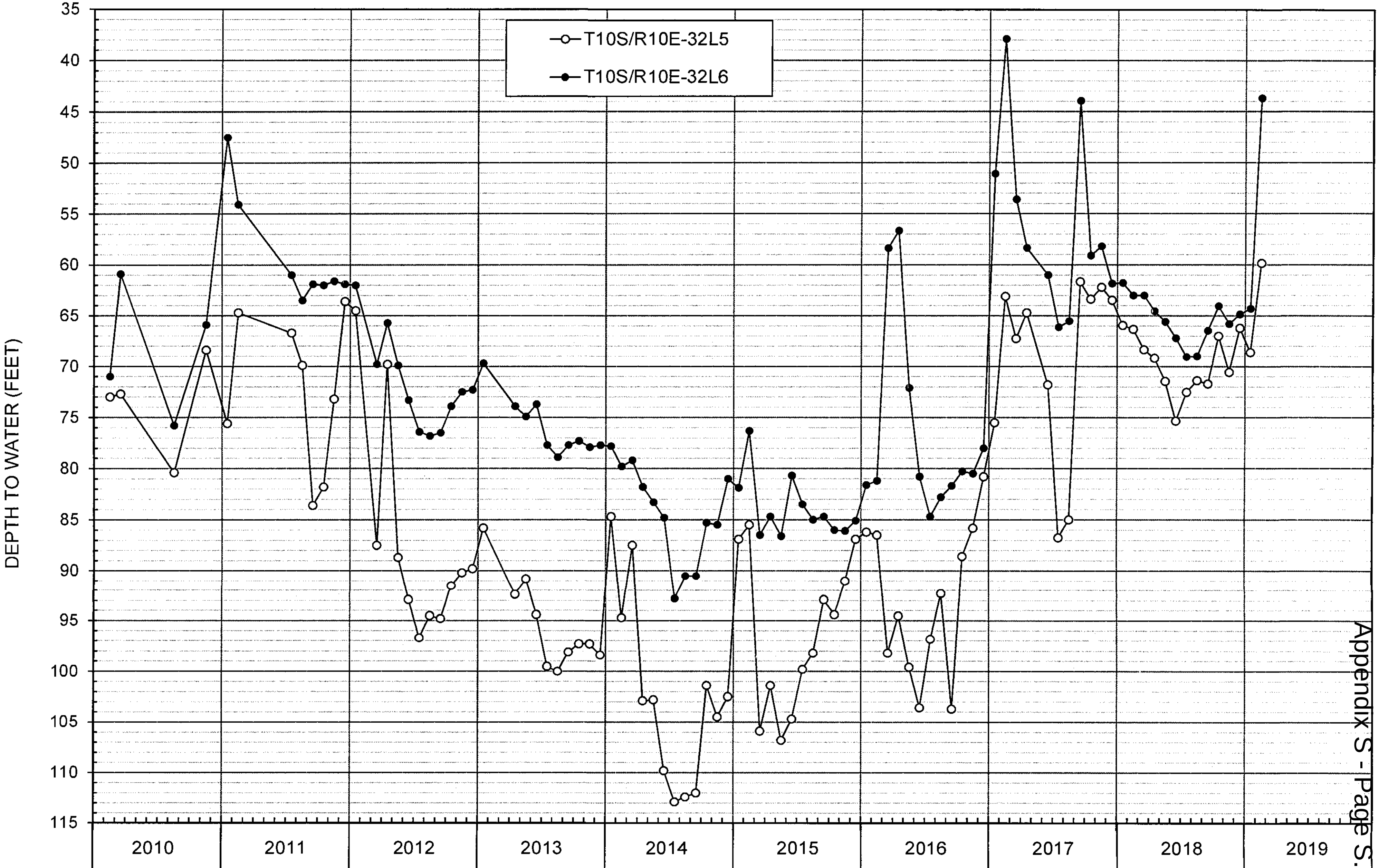


FIGURE 17 - WATER-LEVEL HYDROGRAPHS FOR OBSERVATION WELLS NEAR LOS BANOS CREEK AND THE DMC

near the shallowest of record. These shallow levels were during streamflow in the creek.

Lower Aquifer

One of the DMC monitor wells (T10S/R10E-32L4) is perforated only below the Corcoran Clay. Water levels in this well are much deeper than those in Wells 32L5 and L6, and have ranged from about 129 feet deep in Summer 2011 to 175 feet in July 2015. Water levels in this well are influenced by streamflow in the creek and by pumpage. There has been only limited pumpage below the Corcoran Clay in the immediate area. The nearest area where there is extensive lower aquifer pumpage is in the area northeast and east of the City.

SOURCES OF RECHARGE

The primary sources of recharge to groundwater in the Los Banos study area are deep percolation of irrigation return flow in areas irrigated with canal water, canal seepage, seepage of streamflow from Los Banos Creek, intentional recharge ponds, and seepage of water from wetlands supplied by DMC water (Figure 18).

Los Banos Creek Seepage

Historical streamflow records for the outflow from Los Banos Dam are provided in Appendix B. The annual flows since 1965

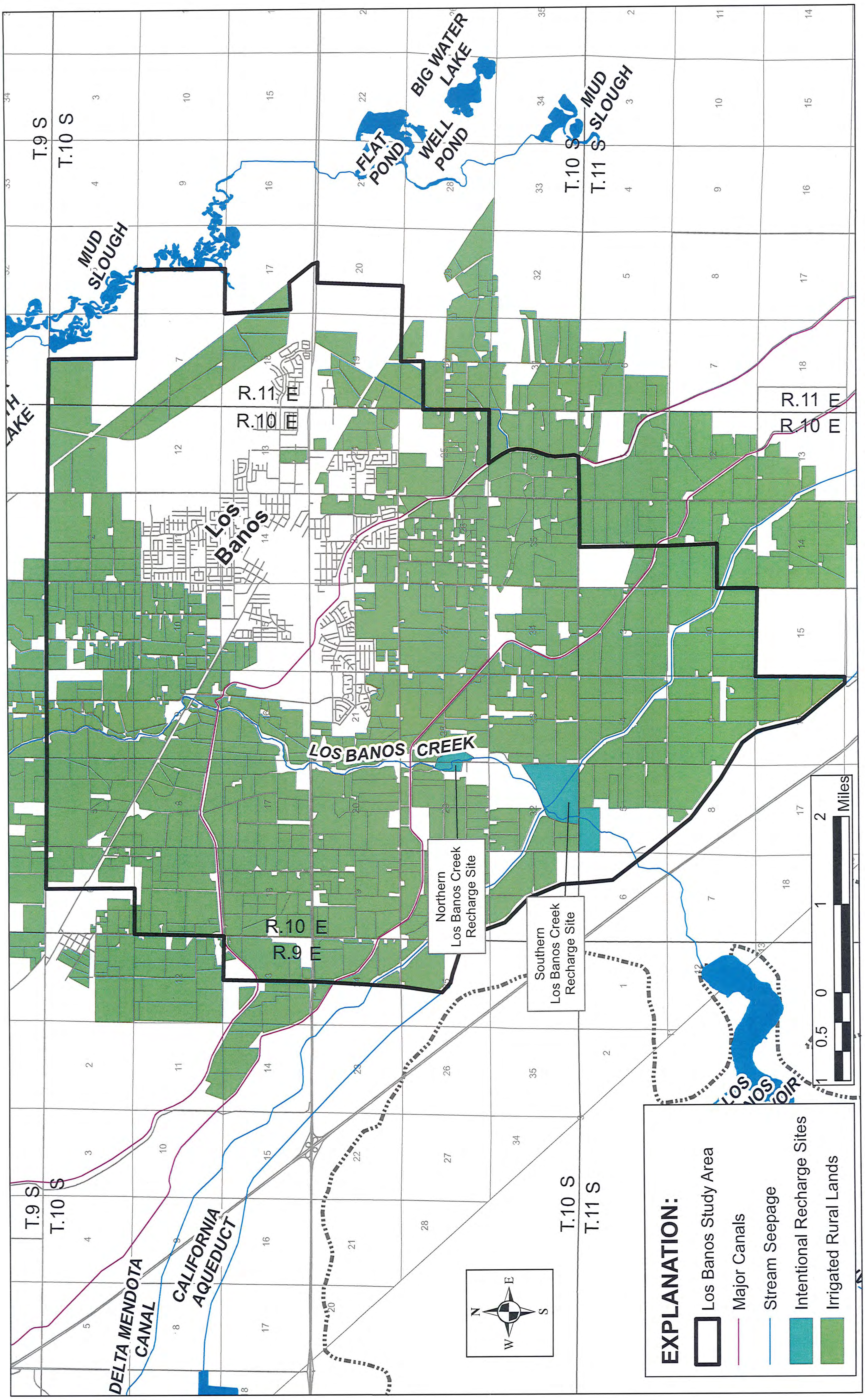


FIGURE 18 - POTENTIAL LOS BANOS GROUNDWATER RECHARGE AREAS

CCID estimated canal seepage as 0.68 cfs per mile during an average canal run of 330 days. Canal seepage is discussed in more detail later under the water budget section of this report. Seepage from wetlands in the GSA varies significantly depending on the soil type, and has been estimated to average about 0.5 acre-foot per year (Swanson, verbal communication, 2019).

Groundwater Inflow

Water-level elevation contour maps for the upper aquifer indicate that there has been groundwater inflow into the study area from the south and from the west, particularly in the area north of Los Banos Creek.

In Spring 2017, northeasterly groundwater inflow was occurring along the entire length of the study area at a location near the DMC, where the water-level elevation was about 115 feet above mean sea level. The average water-level slope along this nine-mile long segment was about seven feet per mile. Specific capacities have previously been mapped in the Los Banos area for the SJRECWA service area. Recent specific capacities for City upper aquifer wells averaged about 43 gpm per foot. Using a conversion factor of 1,500, the estimated average transmissivity in the City of Los Banos is about 65,000 gpd per foot. Transmissivities have been determined for aquifer tests in five upper aquifer sites within

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Using an average transmissivity of 65,000 gpd per foot along the nine-mile segment, the annual lateral groundwater inflow was about 4,600 acre-feet per year. Another calculation was made for the groundwater inflow into the City of Los Banos. The average water-level slope was about seven feet per mile along a segment of flow of five and a half miles. The groundwater inflow from upgradient areas was about 2,800 acre-feet per year.

SOURCES OF DISCHARGE

The primary sources of groundwater discharge are well pumpage and groundwater outflow. Figure 19 shows the potential groundwater discharge area.

Pumpage

Pumpage in the area is from City wells, CCID wells, private irrigation wells, and other wells. The City of Los Banos provided records of City pumpage. As part of this evaluation, the CCID determined pumpage from CCID wells and private landowner wells in the study area. In addition, they estimated well pumpage in the Los Banos Creek subarea. Historical pumpage records are provided in Appendix C.

City Wells

Table 3 provides pumpage from the City of Los Banos wells for

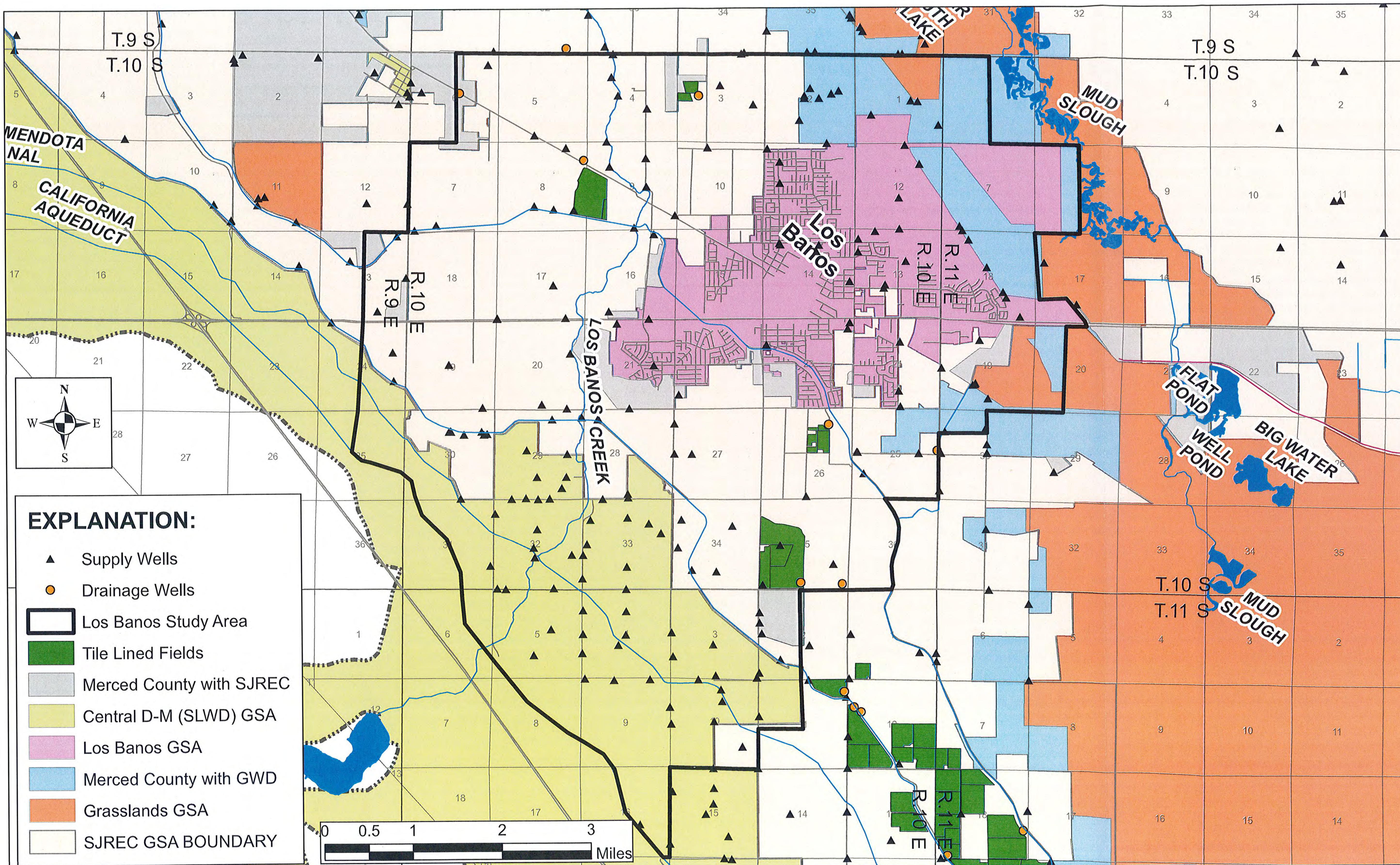


FIGURE 19 - POTENTIAL LOS BANOS GROUNDWATER DISCHARGE AREAS

TABLE 3-ANNUAL PUMPAGE FROM CITY OF LOS BANOS WELLS (1993-2016)

Year	Pumpage (Acre-Feet)
1993	5,073
1994	5,631
1995	5,307
1996	5,185
1997	6,045
1998	5,287
1999	5,343
2000	4,688
2001	5,461
2002	6,923
2003	6,434
2004	6,914
2005	7,152
2006	7,465
2007	9,113
2008	8,876
2009	8,258
2010	7,712
2011	7,776
2012	8,312
2013	8,486
2014	7,894
2015	6,657
2016	6,121
Average	6,715

1993-2016. Annual pumping gradually increased from about 5,100 acre feet in 1993 to about 9,100 acre-feet in 2007. The pumpage then decreased and was lower in 2010-11 and significantly lower during 2015-16, due to water conservation measures implemented during the recent drought. The average pumpage from City wells during 1993-2016 was about 6,700 acre-feet per year.

CCID Wells

Table 4 provides pumpage from CCID wells in the area for 1993-2016. The average pumpage of these wells was about 2,600 acre-feet per year. Of this, an average of 670 acre-feet per year was from wells inside the UGB.

Private Wells

Table 5 shows pumpage from private wells in the area for 1993-2016. An average of about 11,300 acre-feet per year was pumped from these wells. Of this amount, about 6,000 acre-feet per year were pumped from wells inside the UGB. An average of 4,900 acre-feet per year was pumped from private wells in the Los Banos Creek subarea, excluding water pumped for transfer, during 2007-16.

Records indicate that pumpage from private wells into the DMC/San Luis Canal for transfer of water out of the area ranged from about 1,300 to 5,200 acre-feet per year during 2007-16. The average pumpage

TABLE 4-ANNUAL PUMPAGE FROM CCID WELLS
IN GSA (1993-2016)

Year	Pumpage (Acre-Feet) Inside UGB	Outside UGB	Total
1993	0	0	0
1994	0	1,008	1,008
1995	0	0	0
1996	0	841	841
1997	706	1,069	1,775
1998	0	0	0
1999	650	1,436	2,086
2000	859	2,112	2,971
2001	918	2,426	3,344
2002	637	2,396	3,033
2003	1,016	2,272	3,288
2004	1,247	2,590	3,437
2005	329	1,086	1,415
2006	21	0	21
2007	1,463	5,326	6,789
2008	922	3,720	4,642
2009	1,291	2,394	3,685
2010	589	685	1,274
2011	435	1,565	2,000
2012	1,490	4,851	6,341
2013	1,517	4,529	6,046
2014	1,093	3,245	4,338
2015	870	3,143	4,013
2016	130	174	304
Average	674		2,610

TABLE 5-ANNUAL PUMPAGE FROM PRIVATE WELLS IN STUDY AREA (1993-2016)

	Pumpage (Acre-Feet)		
Year	Inside UGB	Outside UGB	Total
1993	12,818	14,201	14,812
1994	15,279	16,356	22,230
1995	11,081	11,967	16,782
1996	4,657	7,733	9,060
1997	4,289	9,479	8,586
1998	2,982	3,424	4,391
1999	6,923	8,317	8,660
2000	6,183	7,168	8,426
2001	6,923	8,317	12,031
2002	2,330	4,607	5,682
2003	5,595	8,439	11,872
2004	5,143	9,280	11,133
2005	4,104	6,006	8,882
2006	4,127	6,170	7,031
2007	4,221	10,142	9,970
2008	3,064	11,803	10,999
2009	6,460	5,127	14,887
2010	6,916	4,509	14,240
2011	6,000	5,125	14,017
2012	6,058	2,966	12,722
2013	2,161	6,444	9,251
2014	5,971	4,777	14,572
2015	6,852	4,012	13,585
2016	2,789	844	6,350
Average	5,955		11,257

was about 2,900 acre-feet per year during this period. The maximum annual pumpage from these wells during this period was in 2008. Pumpage from private wells in the CCID for transfer of water out of the area ranged from 0 to 1,654 acre-feet per year during 2000-16. The average pumpage from these wells was 990 acre-feet per year. Since 2010, transfers were curtailed when triggers for water levels were exceeded and new monitoring requirements were added to the Warren Act contract.

Groundwater Outflow

The Spring 2009 water-level elevation map shows groundwater outflow from the study area along the north boundary, between Volta Road and Ortigalita Road. The width of flow was about 1.5 miles and the average water-level slope was about 12 feet per mile. Using a transmissivity of about 65,000 gpd per foot, an outflow of about 1,300 acre-feet per year was calculated. The Spring 2017 water-level elevation map shows no lateral groundwater outflow from the study area. The average groundwater outflow for these two years was thus about 700 acre-feet per year (rounded).

AQUIFER CHARACTERISTICS

Pump Tests

Table 6 summarizes short-term pump test data for City wells in March 2015. Pumping rates ranged from about 490 to 2,140 gpm. The highest pumping rates were for Wells No. 5, 7, 10, 13,

TABLE 6-PUMP TEST DATA FOR CITY OF LOS BANOS WELLS

Well No.	Date Tested	Pumping Rate (gpm)	Static Level (feet)*	Pumping Level (feet)	Drawdown (feet)	Approximate Specific Capacity (gpm/ft)
1	3/3/15	852	35	56	21	41
2	3/3/15	887	38	63	25	35
3	3/3/15	660	36	65	29	23
5	3/2/15	1,243	38	69	31	40
6	3/2/15	490	-	168	-	-
7	3/2/15	1,430	39	60	21	68
9	3/2/15	910	-	129	-	-
10	3/2/15	2,140	43	88	45	48
11	3/2/15	945	-	171	-	-
12	3/2/15	820	-	95	-	-
13	3/2/15	1,500	-	101	-	-
14	3/2/15	1,300	-	128	-	-
15	3/2/15	911	47	-	-	-

* Static levels are for five or ten minutes of recovery after pumping stopped, and do not represent true static levels. Because of this, the actual values for specific capacity would be smaller, particularly for wells with large drawdowns.

and 14. Approximate specific capacities ranged from 23 to 68 gpm per foot. Short-term water-level recovery was measured, and opposed to true static levels (i.e., prior to pumping). True specific capacities are expected to be significantly greater for wells with pumping levels exceeding about 70 feet.

Table 7 summarizes short-term pump tests for CCID wells in 2015-16. Pumping rates ranged from about 1,147 to 1,909 gpm. Specific capacities ranged from about 22 to 161 gpm per foot. The highest specific capacity was for Well No. 8A, which is located near Los Banos Creek and the Outside Canal.

Aquifer Tests

During 1996-98, the CCID conducted aquifer tests on four wells in the study area. Locations of the tested wells are shown on Figure 1. In November 1996, a 24-hour constant discharge test was conducted on CCID Well No. 8-A. This well is located near Los Banos Creek and Pioneer Road, and is perforated from 75 to 220 feet in depth. The static level prior to pumping was 35.5 feet. The average pumping rate was 2,415 gpm. The drawdown at the end of pumping was 25.5 feet, and the specific capacity was 94.7 feet. Corrected recovery measurements indicated a transmissivity of 168,000 gpd per foot.

TABLE 7-PUMP TEST DATA FOR CCID WELLS

Well No.	Date Tested	Pumping Rate (gpm)	Static Level (feet)*	Pumping Level (feet)	Drawdown (feet)	Approximate Specific Capacity (gpm/ft)
8-A	10/15/16	1,856	61.9	73.4	11.5	161.4
48-A	10/15/16	1,862	31.5	116.8	85.3	21.8
56	8/12/15	1,147	143.3	180	36.7	31.3
62	6/15/15	1,909	50.0	80.0	30.0	63.6

Records from CCID. Well No. 56 taps strata only below the Corcoran Clay. The other three wells tap strata only above the Corcoran Clay.

As part of the 1998 evaluation, 24-hour aquifer tests were conducted on three other wells by the CCID in April 1998. CCID Well No. 48-A is located west of Lovers Lane or Badger Flat Road and adjacent to the Main Canal and Los Banos Creek, northwest of the City. The well is perforated from 50 to 80 feet and 100 to 180 feet in depth. The static water level prior to pumping was 11.0 feet. The average pumping rate was 1,960 gpm. The drawdown at the end of pumping was 77.0 feet, and the specific capacity was 25.5 feet. Corrected recovery measurements indicated a transmissivity of 56,000 gpd per foot.

Private Well No. 549 (T10S/R11E-18R), located east of the City and north of State Highway 152, is perforated from 166 to 256 feet in depth. The static level prior to pumping was 11.8 feet below the measuring point. The average pumping rate was 1,450 gpm. The drawdown at the end of pumping was 74.9 feet, and the specific capacity was 19.3 gpm per foot. Corrected recovery measurements indicate a transmissivity of 70,000 gpd per foot.

Private well No. 76 (T10S/R10E-35L) is located near the south boundary of the study area and is perforated from 86 to 306 feet in depth. The static level prior to pumping was 8.6 feet below the measuring point. The average pumping rate was 1,570 gpm.

The drawdown at the end of pumping was 74.2 feet and the specific capacity was 22 gpm per foot. Uncorrected recovery measurements indicated a transmissivity of 35,000 gpd per foot.

In cooperation with CCID staff, a 24-hour constant discharge test was conducted on Hostetler Well No. 950 during May 20-21, 2009. According to the completion report, this well is screened in the following depth intervals:

140 to 164 feet	264 to 310 feet
181 to 226 feet	416 to 446 feet.

The Corcoran Clay was reportedly encountered between 312 and 425 feet in depth at this well. The static level in the pumped well was 61.7 feet prior to pumping. The average pumping rate was 1,315 gpm. The pumping level at the end of pumping was 140.6 feet and the specific capacity was 17 gpm per foot. Another comparably perforated well was used as an observation well for the test. The completion report for Hostetler Well No. 964 indicates that it is screened in the following depth intervals:

101 to 129 feet	194 to 209 feet
140 to 154 feet	224 to 236 feet
161 to 176 feet	431 to 453 feet.

The well is located 1,700 feet from Well No. 950. The best value of transmissivity from the drawdown measurements for this test was for Well No. 964. The static level in Well No. 964 prior to pumping of Well No. 950 was 46.2 feet. By the end of the pumping period, depth to water in this well was 49.2 feet, and the drawdown was 3.0 feet. A transmissivity of 143,000 gpd per foot was indicated by these measurements.

The best value for transmissivity from the recovery measurements for this test was also for Well No. 964. After about six hours of recovery, depth to water was 48.3 feet, or about two feet below the static level prior to pumping. A transmissivity of 177,000 gpd per foot was indicated by recovery measurements for this well.

A recovery test was conducted on Hostetler Well No. 121 on May 28, 2009. A completion report is not available for Well No. 121, but the reported depth is 217 feet. The well had been pumping at an average rate of about 1,300 gpm for a prolonged period before pumping was stopped for this test. The pumping level was 86.9 feet prior to the cessation of pumping, and the specific capacity was 25 gpm per foot. The water level fully recovered to a static level of 36.0 feet within 20 minutes after pumping stopped. Recovery measurements indicate a transmissivity of 37,000 gpd per foot, in good agreement with the specific capacity value. Well No. 364 was used as an observation well for the test. The water level in Well No. 364 rose from 47.1 feet before pumping of Well No. 121 stopped to 43.3 feet after about six and three-fourths hours of recovery. A transmissivity of 56,000 gpd per foot was indicated by the recovery measurements for this well.

In summary, for the two Hostetler Well tests, the transmissivity of strata above the Corcoran Clay (above 300 feet in depth) tapped by these wells was 114,000 gpd per foot. The transmissivity of deposits above a depth of 220 feet was indicated to be about 56,000 gpd per foot.

Aquifer tests were done in late August 2017 on two small pits in the area bounded by Los Banos Creek on the northwest, the DMC on the southwest, and South Creek Road on the east. Each pit was dug through a local clay layer, into about 10 to 20 feet of saturated coarse-grained deposits of the upper aquifer. Each pit was dewatered, then the water level allowed to recover. For the East Pit, the average pumping rate was about 595 gpm. For the West Pit, the average pumping rate was 885 gpm.

The static level prior to pumping the East Pit was 41.5 feet deep and the specific capacity was 45.8 gpm per foot. Uncorrected recovery measurements for the Eat Pit indicated a transmissivity of 105,000 gpd per foot. For the West Pit, the static level prior to pumping was 34.8 feet deep, and the specific capacity was 36.5 per foot. Uncorrected recovery measurements for the West Pit indicated a transmissivity of 106,000 gpd per foot.

Table 8 summarizes the aquifer test results for wells and pits in the study area. Transmissivities ranged from 35,000 to

TABLE 8-SUMMARY OF AQUIFER TEST RESULTS

Well	Date of Test	Pumping Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)	Transmissivity (gpd per foot)	Perf. Int. (feet)
CCID No. 8-A	11/96	2,415	25.5	94.7	168,000	75-220
CCID No. 48	04/98	1,960	77.0	25.5	56,000	50-180
Well No. 549	04/98	1,450	74.9	19.3	70,000	166-256
Well No. 76	04/98	1,570	74.2	22	35,000	86-306
Well No. 950	05/09	1,315	78.9	17	177,000	140-310 416-446
Well No. 121	05/09	1,300	50.9	25	37,000	T.D. 217
East Pit near Creek and DMC	08/17	595	12.4	48.0	105,000	N.A.
West Pit near Creek and DMC	08/17	885	24.2	36.5	106,000	N.A.

177,000 gpd per foot, and were generally higher for deeper wells and for wells tapping stream channel deposits. Transmissivity values in the range of 70,000 to 168,000 gpd per foot appear to be representative of the entire upper aquifer in the area.

LAND SUBSIDENCE

Subsidence was measured extensively in the area south of the Los Banos study area by the U.S. Geological Survey for many decades. The total land subsidence between 1926 and 1972 (taken from U.S. Geological Survey Professional Paper 437-F) ranged from one to 12 feet in the part of the area that was south of Los Banos in Fresno County.

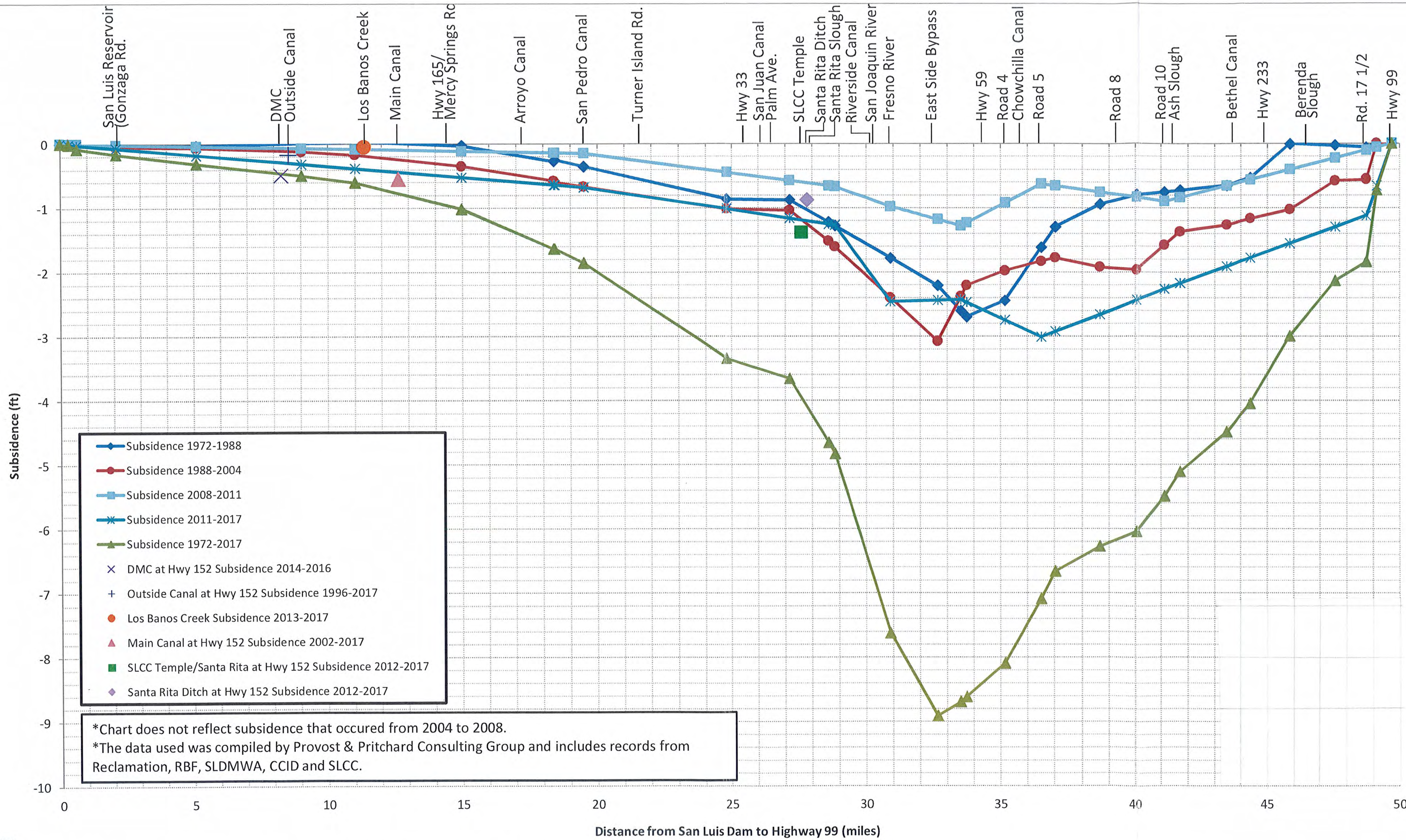
From 1972 until the early 2000's, much less information was available on land subsidence than for the previous decades. This was because once water from the California Aqueduct became available, it was thought that the subsequent decrease in pumpage would essentially eliminate overdraft and land subsidence. However, by the drought of the early 1990's, it had become apparent that subsidence was continuing. Some information has been available for the settling of some canals and other features. The Delta-Mendota and Outside Canals required extensive repairs due to subsidence in 1974. Surveys have indicated a subsidence ranging from 1.76 to 2.75 feet along the Outside Canal between 1991 and 2017. Subsidence along the Main Canal in the study area ranged from 0.31 to 0.70 foot from 2002 to 2017. Subsidence along the DMC in the study area ranged from about 0.8 to 1.5 feet during 1984 to 2016.

Highway 152 Transect

Periodic surveys of land surface elevations were done along Highway 152 between I-5 and Highway 99. Figure 20 shows land surface subsidence along this section between 1972 and 2017. The maximum subsidence (about nine feet) occurred near the Eastside Bypass. In the area west of Highway 33, most of the subsidence apparently occurred after 1988. Subsidence along Highway 152 in the Los Banos study area ranged from about 0.5 to 1.0 foot during 1998 to 2017, and generally increased to the east.

GROUNDWATER QUALITY

Groundwater quality in the Los Banos area was discussed in some detail by KDSA (2010). The primary chemical constituents of concern in terms of drinking water quality in the groundwater at and near Los Banos were hexavalent chromium, TDS, sulfate, uranium (alpha activity), and selenium. Although nitrate concentrations in strata tapped by City wells have been below the maximum contaminant level (MCL) of 45 mg/l, concentrations in water from four of these wells were elevated (exceeding 38 mg/l) in 2017.



Source:
Elevation change computed from report geodetic surveys along Highway 152 from Caltrans, edtied by Bureau of Reclamation.

FIGURE 20- HISTORICAL LAND SUBSIDENCE ALONG HIGHWAY 152 TRANSECT

Once a MCL was developed for hexavalent chromium, this made hexavalent chromium potentially the most important chemical constituent in terms of the chemical quality of water from City wells. However, enforcement of this MCL is temporarily on hold due to litigation. Appendix D contains the results of recent chemical analyses of water from City wells.

Inorganic Chemical Constituents

Table 9 shows the results of chemical analyses for water samples collected from City wells in July 2017. Total dissolved solids (TDS) concentrations ranged from 380 to 1,100 mg/l. The lowest TDS concentrations (400 mg/l or less) were in water from Wells No. 6, 11, and 12. These wells are in the west part of the City. In contrast, the highest TDS concentrations (exceeding 850 mg/l) were in water from Wells No. 5, 7, 10, and 14. The first three of these wells are all located in the east part of the City, and Well No. 14 is the only active City well tapping strata below the Corcoran Clay.

Nitrate concentrations in water from the City wells ranged from 10 to 35 mg/l, below the MCL of 45 mg/l, in July 2017. The highest nitrate concentrations (31 mg/l or greater) were in water from Wells No. 5, 7, and 10. These three wells are in the east part of the City, have casings perforated above a depth of 130 feet, and have annular seals of about 60 feet deep or less.

TABLE 9-CHEMICAL QUALITY OF WATER FROM CITY OF LOS BANOS WELLS

Constituent (mg/l)	No. 1	No. 2	No. 3	No. 5	No. 6
Calcium	54	50	66	120	47
Magnesium	27	26	34	67	23
Sodium	68	66	83	160	47
Potassium	3	3	3	3	2
Bicarbonate	232	220	256	403	146
Sulfate	73	64	91	240	50
Chloride	97	86	120	230	100
Nitrate	18	18	28	35	15
Fluoride	0.2	0.2	0.2	0.2	0.2
pH	7.9	8.0	7.9	8.0	8.1
Electrical Conductivity (micromhos/cm @ 25°C)	820	770	970	1,800	680
Total Dissolved Solids (@ 180°C)	480	440	580	1,100	380
Iron	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic (ppb)	6.1	5.3	4.7	5.9	5.7
Hexavalent Chromium (ppb)	27	30	28	40	26
Selenium (ppb)	0.62	0.87	0.77	0.87	0.69
Alpha Activity (pc/l)	<3.0	<3.0	<3.0	9.1	<3.0
Date	7/12/17	7/12/17	7/12/17	7/12/17	7/12/17

Continued:

TABLE 9-CHEMICAL QUALITY OF WATER FROM CITY OF LOS BANOS WELLS
(Continued:)

Constituent (mg/l)	No. 7	No. 9	No. 10	No. 11
Calcium	110	48	95	49
Magnesium	63	27	53	23
Sodium	160	63	120	45
Potassium	3	3	3	2
Bicarbonate	415	207	329	195
Sulfate	240	78	190	47
Chloride	220	84	170	84
Nitrate	33	10	31	18
Fluoride	0.2	0.2	0.2	0.2
pH	8.0	8.0	8.0	8.1
Electrical Conductivity (micromhos/cm @ 25°C)	1,700	760	1,400	690
Total Dissolved Solids (@ 180°C)	1,100	440	860	400
Iron	<0.1	<0.1	<0.1	<0.1
Manganese	<0.02	<0.02	<0.02	<0.02
Arsenic (ppb)	5.3	7.2	5.0	3.8
Hexavalent Chromium (ppb)	38	32	31	21
Selenium (ppb)	<0.4	3.2	0.70	1.95
Alpha Activity (pc/l)	12.6	3.5	10.6	3.0
Date	7/12/17	7/12/17	7/12/17	7/12/17

Continued:

TABLE 9-CHEMICAL QUALITY OF WATER FROM CITY OF LOS BANOS WELLS
(Continued:)

Constituent (mg/l)	No. 12	No. 13	No. 14	No. 15
Calcium	50	92	96	53
Magnesium	22	49	54	30
Sodium	47	98	190	47
Potassium	2	3	3	2
Bicarbonate	183	342	366	183
Sulfate	51	140	310	72
Chloride	75	170	190	96
Nitrate	16	26	24	21
Fluoride	0.2	0.2	0.2	0.1
pH	8.1	8.0	8.0	8.1
Electrical Conductivity (micromhos/cm @ 25°C)	660	1,300	1,700	770
Total Dissolved Solids (@ 180°C)	380	780	1,100	480
Iron	<0.1	<0.1	<0.1	<0.1
Manganese	<0.02	<0.02	<0.02	<0.02
Arsenic (ppb)	4.3	4.9	6.0	7.8
Hexavalent Chromium (ppb)	22	34	38	20
Selenium (ppb)	0.49	-	0.55	2.46
Alpha Activity (pc/l)	<3.0	4.0	8.6	<3.0
Date	7/12/17	7/12/17	7/12/17	7/12/17

Records from City of Los Banos. Laboratory analyses by BSK Associates of Fresno. Hexavalent chromium concentrations are recent average values from Provost & Pritchard Consulting Group.

The lowest nitrate concentrations (16 mg/l or less) were in water from Wells No. 6, 9, and 12. The first two of these wells are in the north part of the City, and Wells No. 6 and 9 have perforations only below a depth of 180 feet.

Chloride concentrations in water from City wells ranged from 75 to 230 mg/l, below the recommended MCL of 250 mg/l. The highest chloride concentrations (170 mg/l or greater) were in water from Wells No. 5, 7, 10, 13, and 14. These were the same wells with the highest TDS concentrations. The lowest chloride concentrations (less than 90 mg/l) were in water from Wells No. 2, 9, 11, and 12. These wells also produced water with relatively low TDS concentrations. Sulfate concentrations in water from City wells ranged from 47 to 310 mg/l. The highest sulfate concentration (190 mg/l or more) were in water from Wells No. 5, 7, 10, and 14. These wells also had high chloride concentrations. Water from Well No. 14 had a sulfate concentration exceeding the recommended MCL of 250 mg/l. The lowest sulfate concentrations (less than 70 mg/l) were in water from Wells No. 2, 11, and 12. These wells also had relatively low chloride concentrations.

Iron and manganese concentrations in water from all of the wells were less than 0.1 mg/l and 0.02 mg/l, below the respective recommended MCLs of 0.3 mg/l and 0.05 mg/l. Well No. 15 had an arsenic concentration of 12 ppb, exceeding the MCL, and this well has been on standby. Water from two other active City wells (No. 5 and 9) had arsenic concentrations between 9.3 and 9.5 ppb, just below the MCL. Arsenic concentrations in water from the remaining active City wells in 2017 ranged from about 6 to 8 ppb. Hexavalent chromium concentrations in water from City wells ranged from 21 to 40 mg/l, exceeding the new MCL of 10 ppb. The lowest hexavalent chromium concentrations were generally in the more westerly City wells, whereas higher concentrations were to the east and northwest (Wells No. 5, 7, and 14). The City is exploring various options to address the hexavalent chromium issue.

Additional information on some inorganic constituents is available for water from CCID wells. Irrigation analyses are generally done on water samples collected from these wells annually. Table 10 provides the results of water samples collected from the four CCID wells in the study area in July 2017. TDS concentrations ranged from 560 to 1,200 mg/l. The highest TDS concentrations were in water from Wells No. 48-A and 56. The latter of these wells taps strata below the Corcoran Clay. Nitrate concentrations in water from these wells ranged from less than 1 to 30 mg/l, less than the MCL of 45 mg/l for drinking water. Nitrate concentrations in water from the three upper aquifer wells ranged from 20 to 30 mg/l. The nitrate concentration

TABLE 10-CHEMICAL QUALITY OF WATER FROM CCID WELLS

Constituent (mg/l)	No. 8-A	No. 48-A	No. 56	No. 62
Calcium	93	83	67	79
Magnesium	47	45	28	33
Sodium	69	99	139	93
Potassium	3	3	3	3
Bicarbonate	290	280	150	260
Sulfate	95	130	260	120
Chloride	120	150	130	120
Nitrate	25	30	<1	20
pH	7.7	7.8	8.1	7.7
Electrical Conductivity (micromhos/cm @ 25°C)	1,100	1,200	1,200	1,100
Total Dissolved Solids (@ 180°C)	670	770	740	670
Boron	0.47	0.81	1.7	0.5
Date	7/25/17	7/25/17	7/25/17	7/25/17

Analyses by BSK Analytical Laboratory.

in water from Well No. 56 was undetectable. This well taps the lower aquifer. Boron concentrations ranged from 0.5 to 1.7 mg/l, and the highest concentration was in water from Well No. 56. The boron concentration in water from Well No. 56 was unsuitable for irrigation of most crops, except pistachios. Boron concentrations in water from the other three wells were near or exceeded the recommended MCL of 0.5 mg/l for boron-sensitive crops. Water from the CCID wells is pumped into canals and blended before use for crop irrigation.

Radiological Constituents

Alpha activities in water from most City wells have been less than 7 picocuries per liter, below the MCL of 15 picocuries per liter. Associated uranium activities have been well below the MCL of 20 picocuries per liter. Alpha activities in July 2017 ranged from less than 3 to 12.6 picocuries per liter. The highest activities were in water from Wells No. 5, 7, and 10. All of these wells are in the east part of the City and have shallow perforations (tops range from 104 to 125 feet) in depth. In contrast, the lowest alpha activities in July 2017 (3 picocuries per liter or less) were in water from Wells No. 1, 2, 3, 6, 11, 12, and 15. This group of wells is in the west or central part of the City. The highest alpha and uranium activities thus appear to be in the shallower groundwater beneath the east part of the City.

Trace Organic Chemical Constituents

Results of historical analyses for trace organics in water from City wells were provided by the City. Concentrations of these constituents have usually been non-detectable, except for tetrachloroethylene (PCE) in water from City Well No. 13. Detectable concentrations of PCE have been consistently found in water from this well since 2001. The concentrations have ranged from 0.8 to 1.6 ppb, less than the MCL of 5.0 ppb. Well No. 13 is located west of Mercy Springs Road and north of Pacheco Boulevard. Trihalomethanes (disinfection by-products) have been found in water from most City wells at concentrations well below the respective MCLs. These low concentrations are likely due to well disinfection practices. Overall, representative concentrations of trace organic constituents in water from City wells have been well below the respective MCLs.

INTERCONNECTED SURFACE AND GROUNDWATER SYSTEMS

There are no known locations in the Los Banos study area where the surface water and shallow groundwater are interconnected. That is, the shallowest water levels have been below the bottom of the adjacent stream channel or other water body.

Along Los Banos Creek, this is documented by historical water-level measurements for shallow monitor wells.

KNOWN GROUNDWATER CONTAMINATION SITES

Figure 21 shows what are considered to possibly be significant groundwater contamination sites in the study area, all of which are all in the City vicinity. Most of the information was taken from the California Regional Water Quality Control Board's GEOTRACKER website. Most of these sites involve petroleum, and no known impacts to City wells have resulted. In the Los Banos urban area, solvent related trace organics have been found in shallow groundwater at the former City landfill (dump), located near Mercy Springs and Del Rio Roads. Low concentrations of solvent related trace organics have also been found in shallow groundwater near City Well No. 13, from an unidentified source.

GROUNDWATER BUDGET FOR CITY OF LOS BANOS

The City includes the urban area and the WWTF and associated effluent use area. The sources of recharge to the groundwater in the City of Los Banos include urban storm runoff, canal seepage, and lateral groundwater inflow. The sources of groundwater discharge in the City include consumptive use. The water-level elevation maps for Spring 2009 and 2017 indicated no significant groundwater outflow. The difference between the recharge and

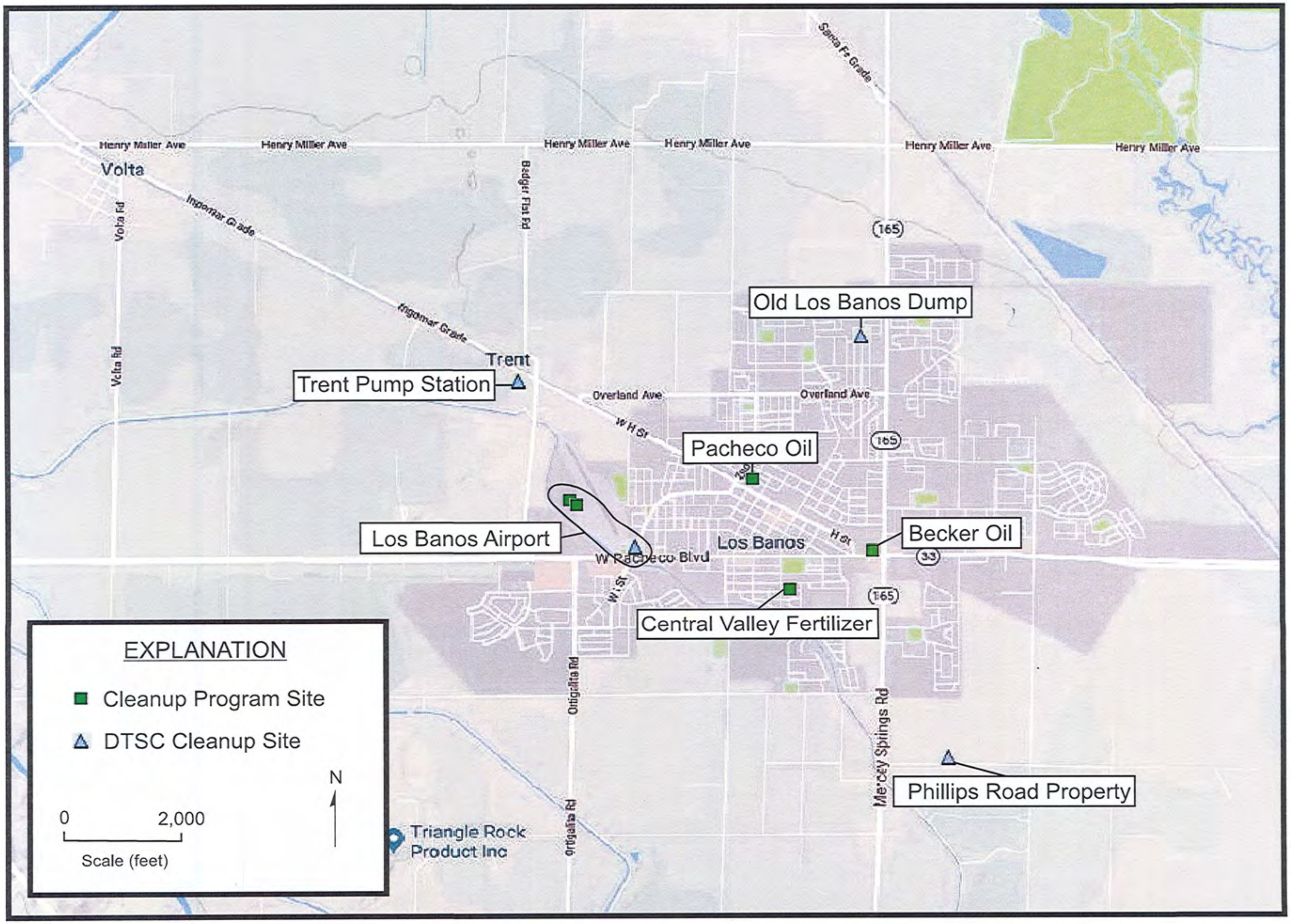


FIGURE 21- KNOWN GROUNDWATER CONTAMINATION SITES

discharge is the change in groundwater storage. The period selected for the water budget is 2003-12, which comprises a near normal hydrologic base period, based on CCID water deliveries.

Recharge

Much of the Los Banos urban storm runoff is presently discharged to canals or channels. An estimated 200 acre-feet per year is percolated to the groundwater in the City. The lateral groundwater inflow was estimated based on the Spring 2009 and 2017 water-level elevation maps. There was a width of groundwater inflow into the City of about five and a half miles, and the average water-level slope was about seven-feet per mile.

Darcy's Law is $Q = TIL$, where

- Q : groundwater flow (gpd)
- T : transmissivity (gpd/ft)
- I : water-level slope (ft/mile)
- L : width of flow (miles)

Using a transmissivity of 65,000 gpd per foot, and the previously indicated water-level slope and width of inflow, there was an estimated lateral groundwater inflow into the City of 2,800 acre-feet per year. Most of this inflow came from seepage from the Main and Outside Canals, deep percolation beneath lands in the CCID irrigated with canal water, and from seepage from Los Banos Creek streamflow.

The reach of the Main Canal in the City is about three miles long. The average canal seepage estimated by the CCID is 0.68 cfs per mile during an average canal run of 330 days. This equals a canal seepage of about 1,300 acre-feet per year. Although this value is entered into the City water budget, the water came from the CCID. The total recharge to groundwater in the City was thus about 4,300 acre feet per year.

Discharge

Groundwater discharge in the City is due to consumptive use and groundwater outflow. The consumptive use in the City is due to evapotranspiration from outside water use, evaporation from the effluent ponds, and evapotranspiration of effluent by crops irrigated with effluent. The amount of effluent is estimated to be about half of the groundwater pumpage, or about 3,900 acre-feet per year for 2003-12. The outside water use was also about 3,900 acre-feet per year. Assuming an irrigation efficiency of 70 percent, this equals about 2,730 acre-feet per year of consumptive use from outside water use. An average of about 345 acres of pasture have been irrigated with effluent. Using a consumptive use of applied water of 3.3 acre-feet per acre per year from DWR Bulletin 113-3, this equals about 1,140 acre-feet per year. The nearest pan evaporation records were used to estimate evaporation from the effluent ponds. These records indicate a pan evaporation of 65 inches per year. Using an average wetted effluent pond area of 200 acres and a pan factor of 0.8, and deducting the average annual rainfall of 10 inches, yields a net annual evaporation of effluent from the ponds of 580 acre-feet per year.

The total consumptive use for the City was thus 2,730 plus 1,140 plus 580, or about 4,450 acre-feet per year.

Lateral groundwater outflow from the City, based on the water-level elevation and direction of groundwater flow in Spring 2009 and Spring 2017, was indicted to be insignificant. Table 11 shows the water budget components for the City of Los Banos part of the study area.

Change in Storage

The difference between the recharge and discharge is about -150 acre-feet per year. Water-level records for the City wells were reviewed to determine the average water-level change between Spring 2003 and Spring 2013. The average water-level decline was about 0.55 foot per year. Using a specific yield of 15 percent and an area of 5,900 acres, this yields a change in storage of about 490 acre-feet per year. The average of the two values for change in storage, or about 300 acre-feet per year

TABLE 11-GROUNDWATER BUDGET FOR
CITY OF LOS BANOS (2003-12)

	Acre-feet per Year
RECHARGE	
Canal Seepage	1,300
Groundwater Inflow	2,800
Urban Storm Runoff	200
Subtotal:	4,300
DISCHARGE	
Outside Water Consumption	2,730
Crop Consumptive Use of Effluent	1,140
Pond Evaporation of Effluent	580
Subtotal:	4,450
DIFFERENCE	-150
CALCULATED CHANGE IN GROUNDWATER STORAGE	-490
GROUNDWATER OVERDRAFT	300

Note: If the CCID contribution to recharge is excluded, the total recharge would be 700 acre-feet per year and the City water deficit would be 3,750 acre-feet per year.

(rounded), is indicated to be the groundwater overdraft beneath the City for 2003-13.

Summary

Assuming that about 500 acre-feet per year of the groundwater inflow to the City was from Los Banos Creek streamflow, the total groundwater replenishment within the City was about 700 acre-feet per year, compared to a total consumptive use of about 4,450 acre-feet per year. This leaves a net deficit of about 3,750 acre-feet per year for 2003-12.

GROUNDWATER BUDGET FOR CCID AND SLWD PART OF STUDY AREA

Recharge

Sources of recharge to the groundwater in the CCID part of the study area for 2003-12 included deep percolation from lands irrigated with CCID water, canal seepage, streamflow seepage, and groundwater inflow. Sources of recharge to the groundwater in the SLWD part of the study area included deep percolation from lands irrigated with Aqueduct or DMC water and streamflow seepage.

The average delivered canal water for 18,700 acres in the CCID and SLWD was 51,000 acre-feet per year from 2003-12. The evapotranspiration of applied water averaged 37,500 acre-feet per year for 2003-12. The difference between the delivered water and evapotranspiration was 13,500 acre-feet per year, which was the deep percolation for this period.

There are 7.9 miles of the Main Canal and 7.1 miles of the Outside Canal in the CCID part of the study area, or a total of 15.0 miles. Using an average canal seepage of 0.68 cfs per mile from the CCID, the seepage was 10.2 cfs or 20.19 acre-feet per day canal run. This equals a canal seepage of 6,650 acre-feet over a 330-day canal run. Seepage from other canals in the area is considered insignificant.

The estimated average seepage from Los Banos Creek in the CCID, and SLWD is estimated to be about 1,500 acre-feet per year.

Almost all of the groundwater inflow into the CCID and SLWD part of the study area as of 2017 was derived from Los Banos Creek seepage and seepage from the Outside Canal, which have already been accounted for. However, an average of about 500 acre-feet of other groundwater inflow was estimated.

The total recharge to the groundwater in the CCID and SLWD part of the study area thus averaged about 21,650 acre-feet per year for 2003-12.

Discharge

The discharge from the groundwater in the CCID and SLWD part of the study area is from pumpage of CCID and private wells and groundwater outflow. Pumpage from CCID wells was 2,600 acre-feet per year and from private wells was 11,300 acre-feet per year, or a total of 13,900 acre-feet per year in the area. Groundwater outflow from the CCID to the northeast occurred along a 7.1 mile long segment. Using the Spring 2017 water-level elevation map, the average water-level slope was about eight feet per mile. The average transmissivity along and near the Outside canal is about 140,000 gpd per foot. Using Darcy's Law, the lateral groundwater outflow was about 8,900 acre-feet per year. There is additional groundwater outflow from the study area upper aquifer downward through the Corcoran Clay. Based on a previous evaluation for the SJRECWA (KDSA 1989), the downward flow in the GSA would be about 1,600 acre-feet per year. The total groundwater discharge would be about 24,400 acre-feet per year. The difference between the recharge and discharge was thus -2,750 acre-feet per year. Table 12 shows water-level budget values for the CCID and SLWD part of the study area.

Change in Storage

Water-level changes between Spring 2003 and Spring 2013 were determined for 23 wells in the study area. Average water-level declines in the CCID part of the area were 0.5 foot per year.

TABLE 12-GROUNDWATER BUDGET FOR CCID
AND SLWD PART OF STUDY AREA (2003-12)

	Acre-feet per Year
RECHARGE	
Groundwater Inflow	500
Deep Percolation from Irrigation	13,500
Canal Seepage	6,650
Los Banos Creek Seepage	1,500
Subtotal:	22,150
DISCHARGE	
Pumpage	13,900
Groundwater Outflow (lateral)	8,900
Groundwater outflow (downward)	1,600
Subtotal:	24,400
DIFFERENCE	-2,250
CALCULATED CHANGE IN GROUNDWATER STORAGE	-2,450
GROUNDWATER OVERDRAFT	-2,350

Average water-level declines in the SLWD part of the area were 2.1 feet per year. Using an average specific yield of 0.2 the storage change in the upper aquifer beneath the CCID was 12,090 acres x 0.5 foot per year x 0.12 or -700 acre-feet per year (rounded). The storage change beneath the SLWD was 5,783 acres x 2.1 feet per year x 0.12 or -1,500 acre-feet per year. The combined storage change for both districts was -2,200 acre-feet per year. There was some additional storage change due to compaction of the Corcoran Clay and deeper clay layers. This is estimated to be several hundred acre-feet per year. This value for total groundwater overdraft was thus about 2,600 acre-feet per year.

GROUNDWATER BUDGET FOR THE GWD PART OF STUDY AREA

There are 800 acres of irrigated land in the GWD part of the study area. Provost & Pritchard has indicated that the average water delivery by the GWD to this property has been 1,080 acre-feet per year. They also determined the consumptive use of applied water, which averaged 1,980 acre-feet per year. The remainder of the consumptive use (900 acre-feet per year) was provided by groundwater pumping, and is considered the net deficit for this area.

GROUNDWATER BUDGET FOR MERCED COUNTY WHITE AREAS IN THE STUDY AREA

Provost & Pritchard has indicated that there are 2,170 acres of land in the white areas. They estimated that the consumptive use of applied water was about 6,700 acre-feet per year. No surface water was delivered to this area, and the applied water came from groundwater pumpage. The net deficit was thus 6,700 acre-feet per year.

GROUNDWATER BUDGET FOR THE LOS BANOS STUDY AREA

Table 13 provides a groundwater budget for the Los Banos Study Area for 2003-12. This budget combines information from the water budget values for the City of Los Banos, CCID and SLWD, GWD, and the Merced County white areas in the area. The largest items of groundwater recharge are deep percolation from irrigation and canal seepage, which comprises an average of 21,450 acre-feet per year, or 92 percent of the recharge. The total average recharge was 23,650 feet per year. The largest source of groundwater discharge was pumpage from irrigation (21,500 acre-feet per year). This comprised 77 percent of the groundwater discharge. The difference between the groundwater recharge and discharge was an average of -4,250 acre-feet per year. The calculated average decrease in groundwater storage was 490 acre-feet per year in the City, 2450 acre-feet per year in the CCID and SLWD, and 260 acre-feet per year in the white

TABLE 13-GROUNDWATER BUDGET FOR
LOS BANOS STUDY AREA (2003-12)

	Acre-feet per Year
RECHARGE	
Groundwater Inflow	500
Deep Percolation from Irrigation	13,500
Canal Seepage	7,950
Los Banos Creek Seepage	1,500
Urban Storm Runoff	200
Subtotal:	23,650
DISCHARGE	
Pumpage for Irrigation	21,500
Groundwater Outflow (mostly in alluvial form)	2,000
Urban Outside Consumption	2,700
Effluent Evaporation and Evapotranspiration	1,700
Subtotal:	27,900
DIFFERENCE	-4,250
CALCULATED CHANGE IN GROUNDWATER STORAGE	-3,200

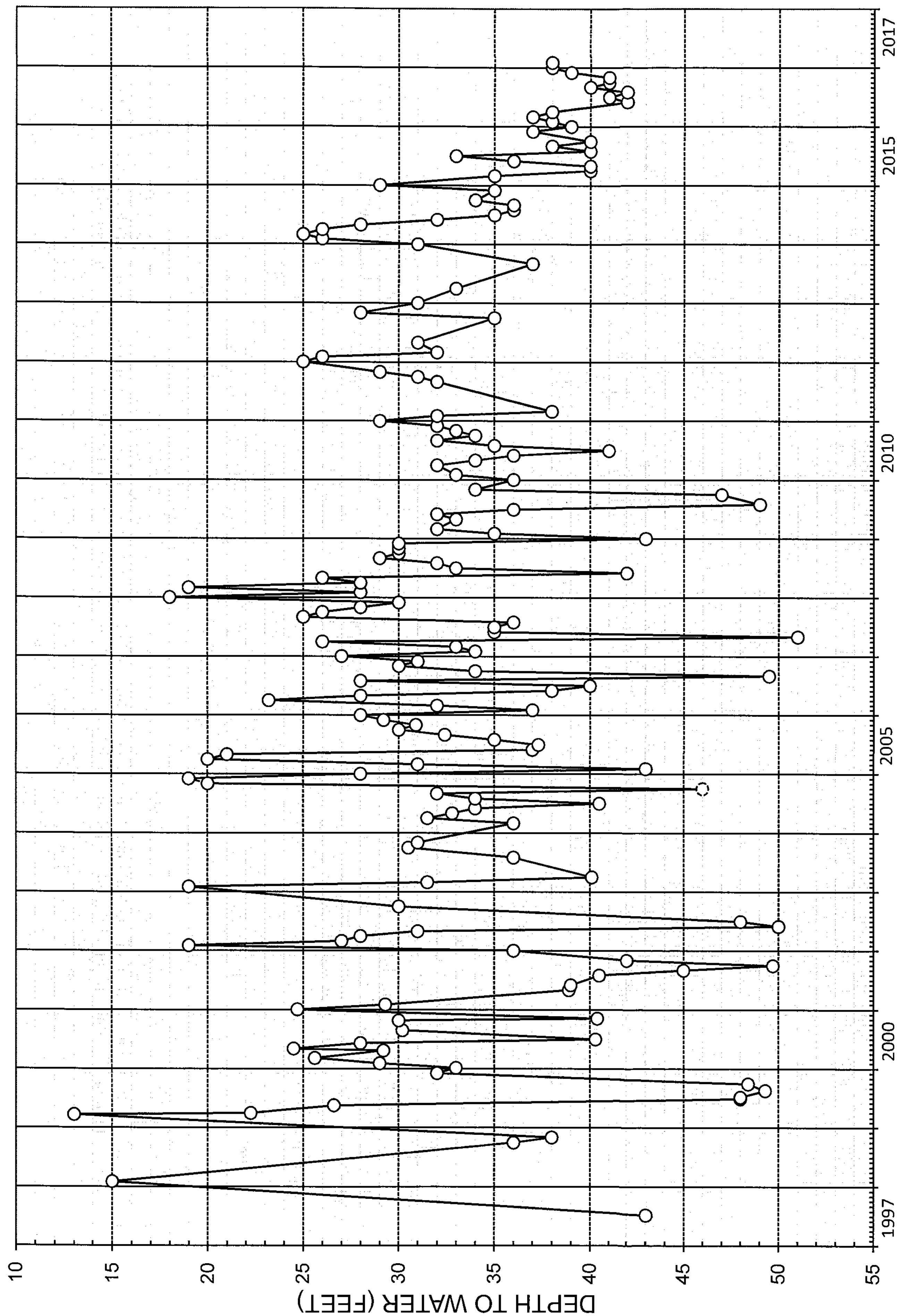
areas, or a total of 3,200 acre-feet per year. This is considered a reasonable agreement, considering the accuracy of the various items in the water budget.

TABLE 13-GROUNDWATER BUDGET FOR
LOS BANOS STUDY AREA (2003-12)

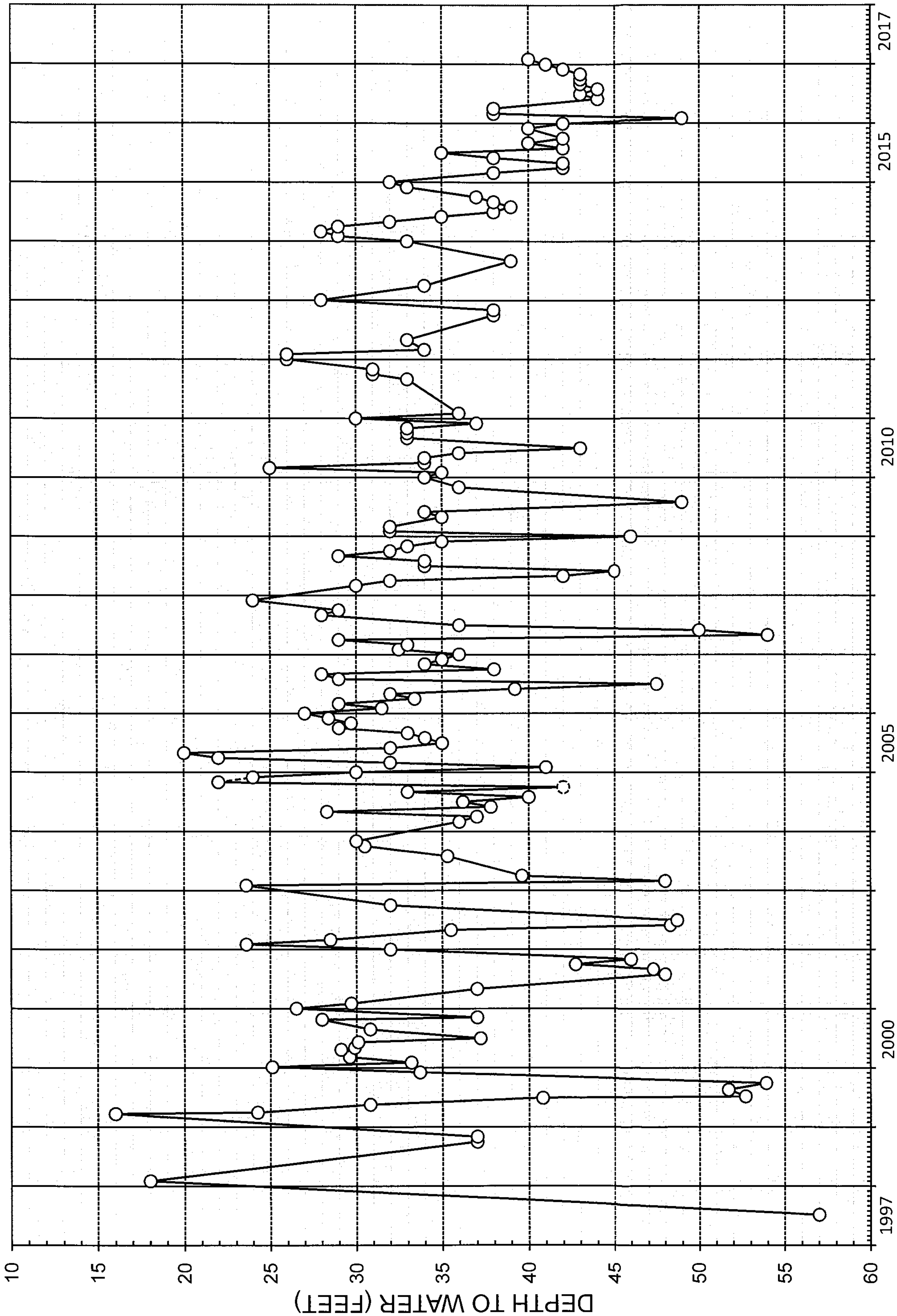
	Acre-feet per Year
RECHARGE	
Groundwater Inflow	500
Deep Percolation from Irrigation	13,500
Canal Seepage	7,950
Los Banos Creek Seepage	1,500
Urban Storm Runoff	200
Subtotal:	23,650
DISCHARGE	
Pumpage for Irrigation	21,500
Groundwater Outflow (mostly in alluvial form)	2,000
Urban Outside Consumption	2,700
Effluent Evaporation and Evapotranspiration	1,700
Subtotal:	27,900
DIFFERENCE	-4,250
CALCULATED CHANGE IN GROUNDWATER STORAGE	-3,200

APPENDIX A

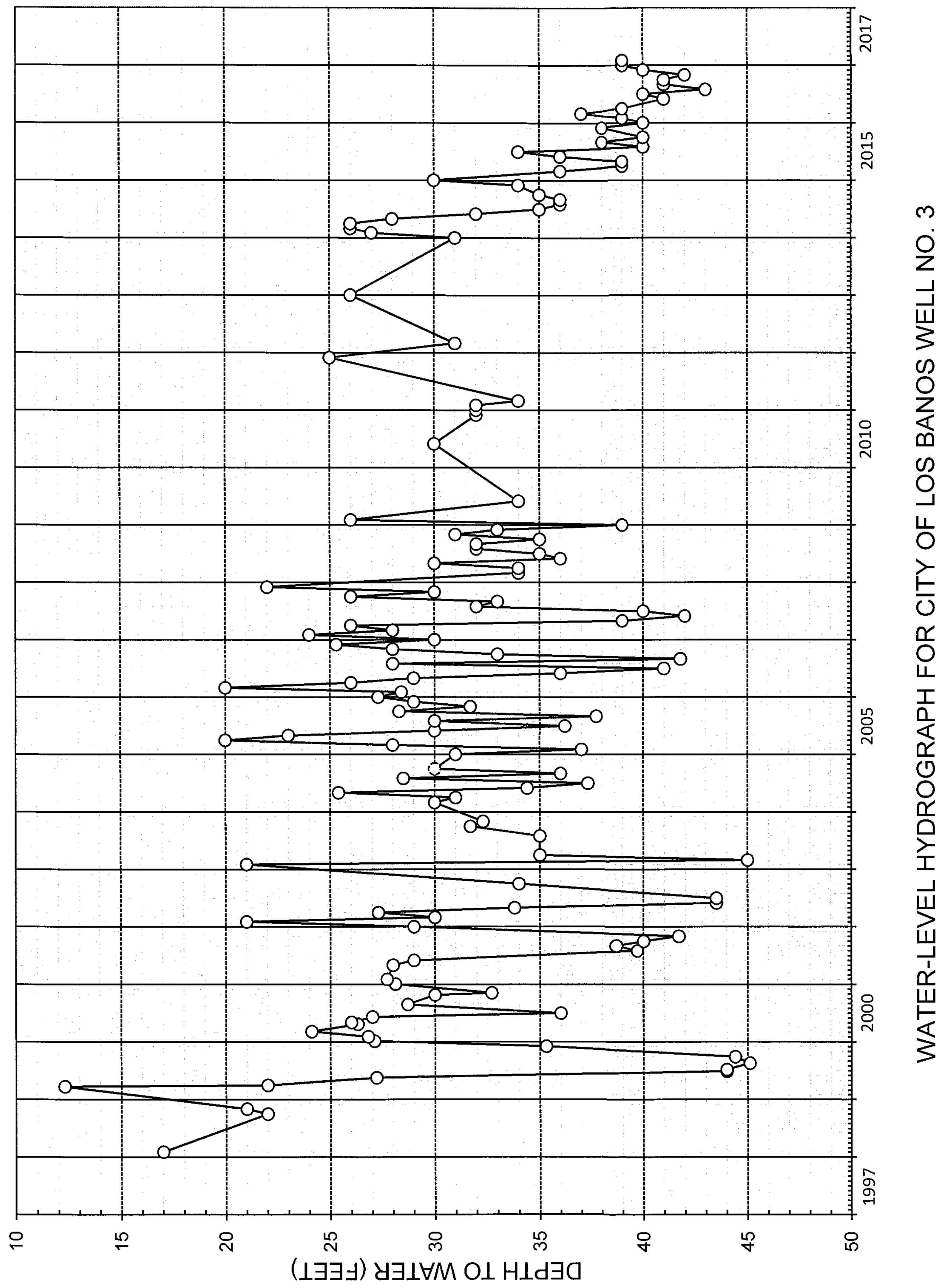
WATER-LEVEL HYDROGRAPHS FOR WELLS

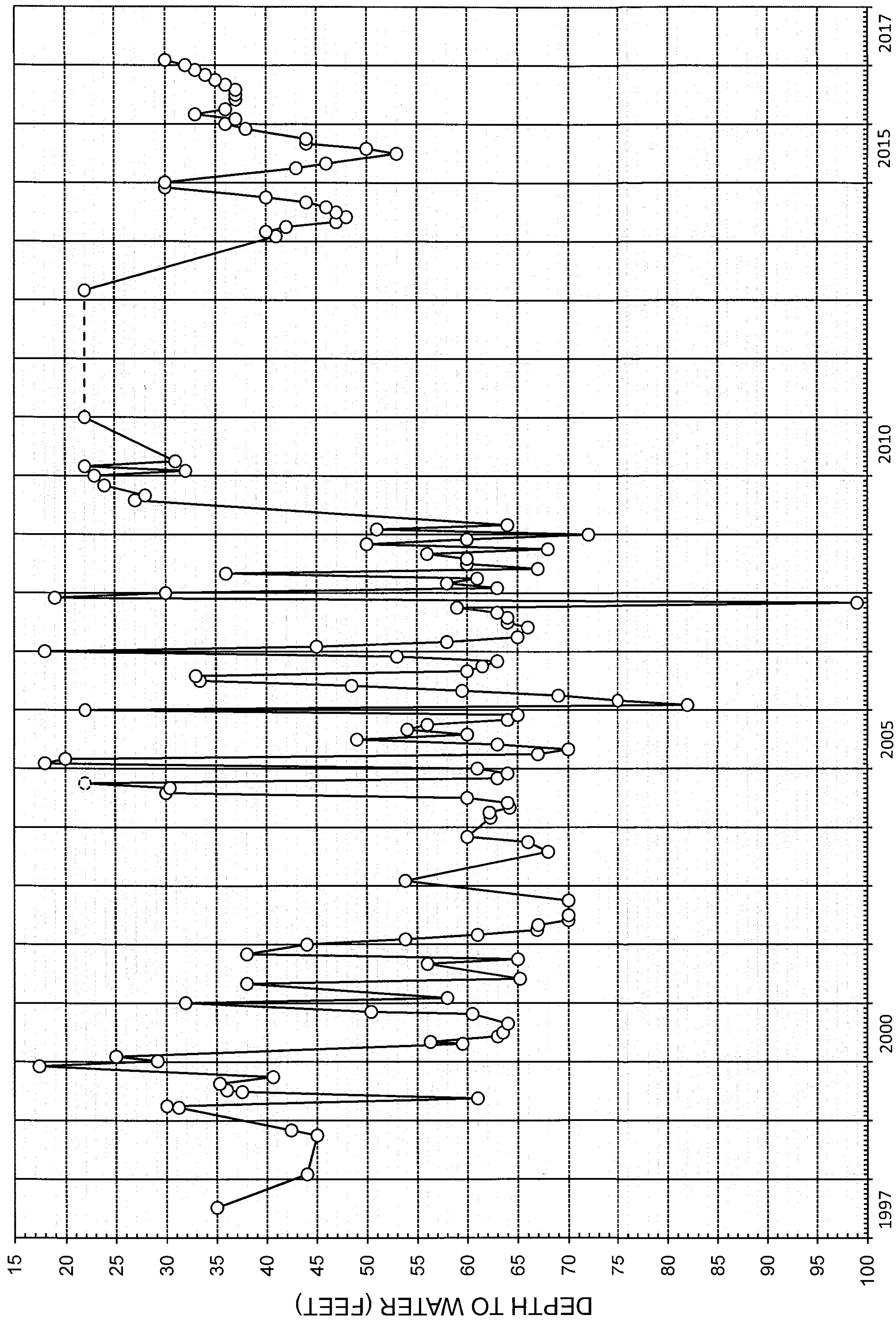


WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 1

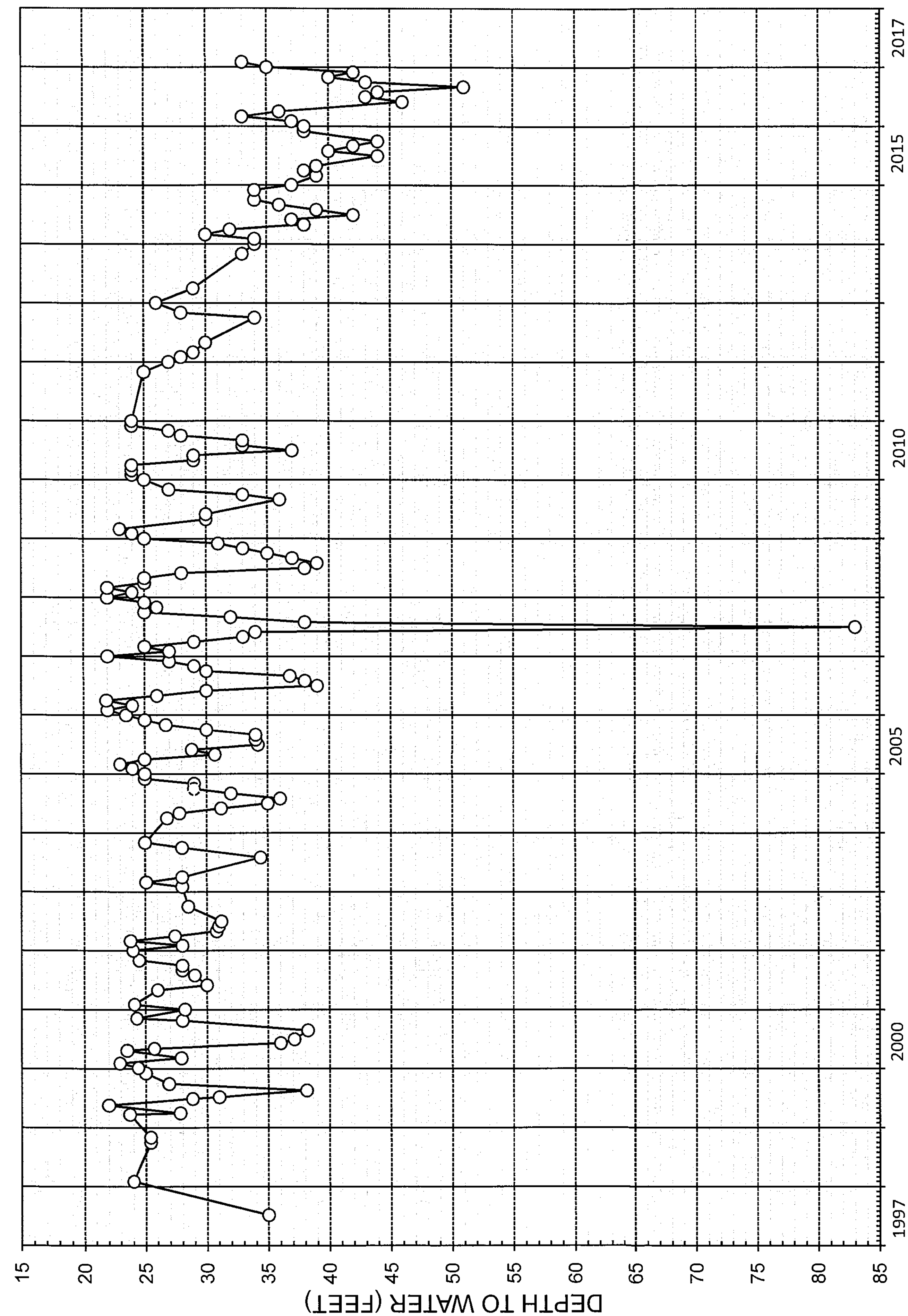


WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 2

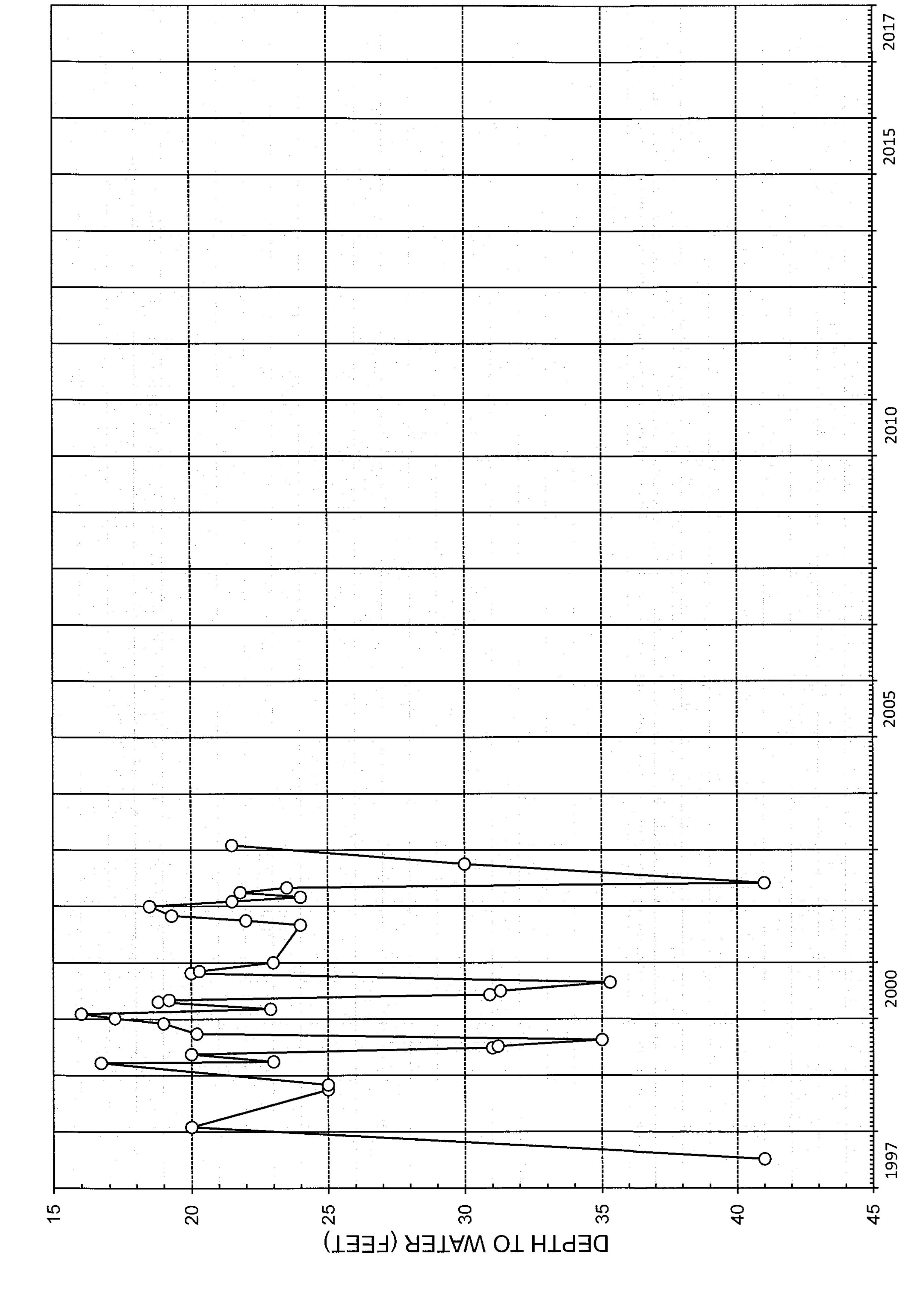

WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 3
DEPTH TO WATER (FEET)
10
15
20
25
30
35
40
45
50
1997
2000
2005
2010
2015
2017



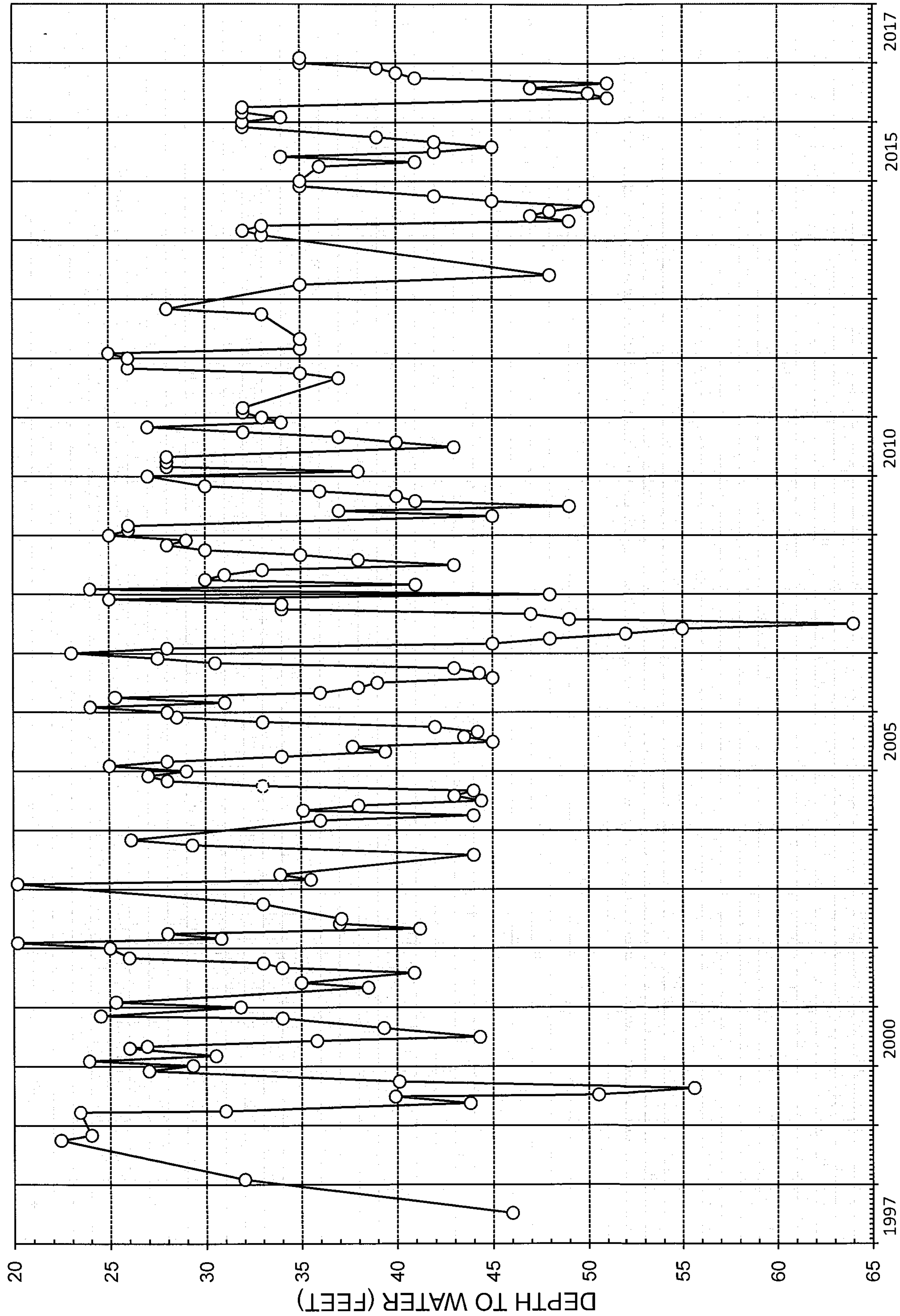
WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 6



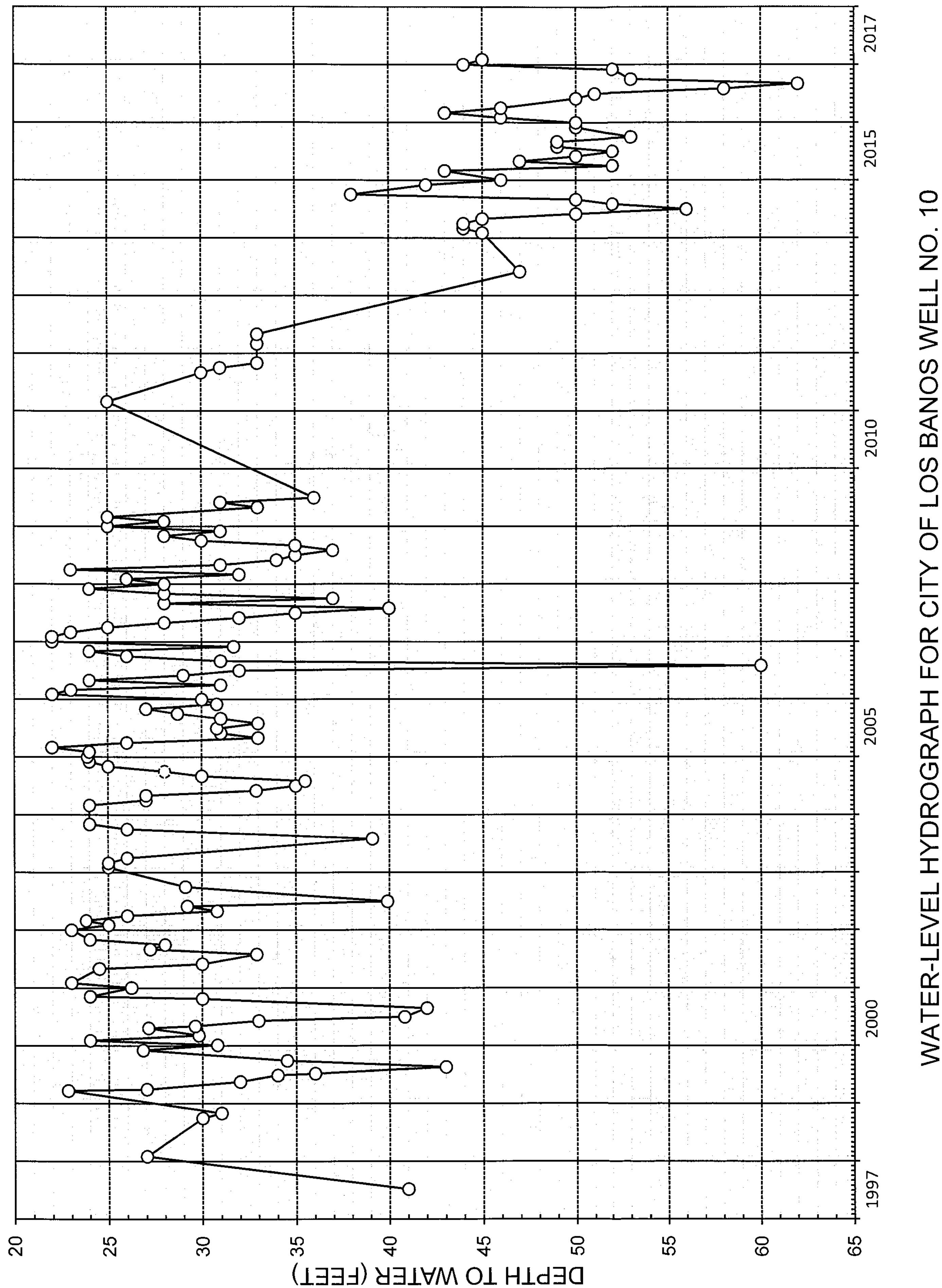
WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 7

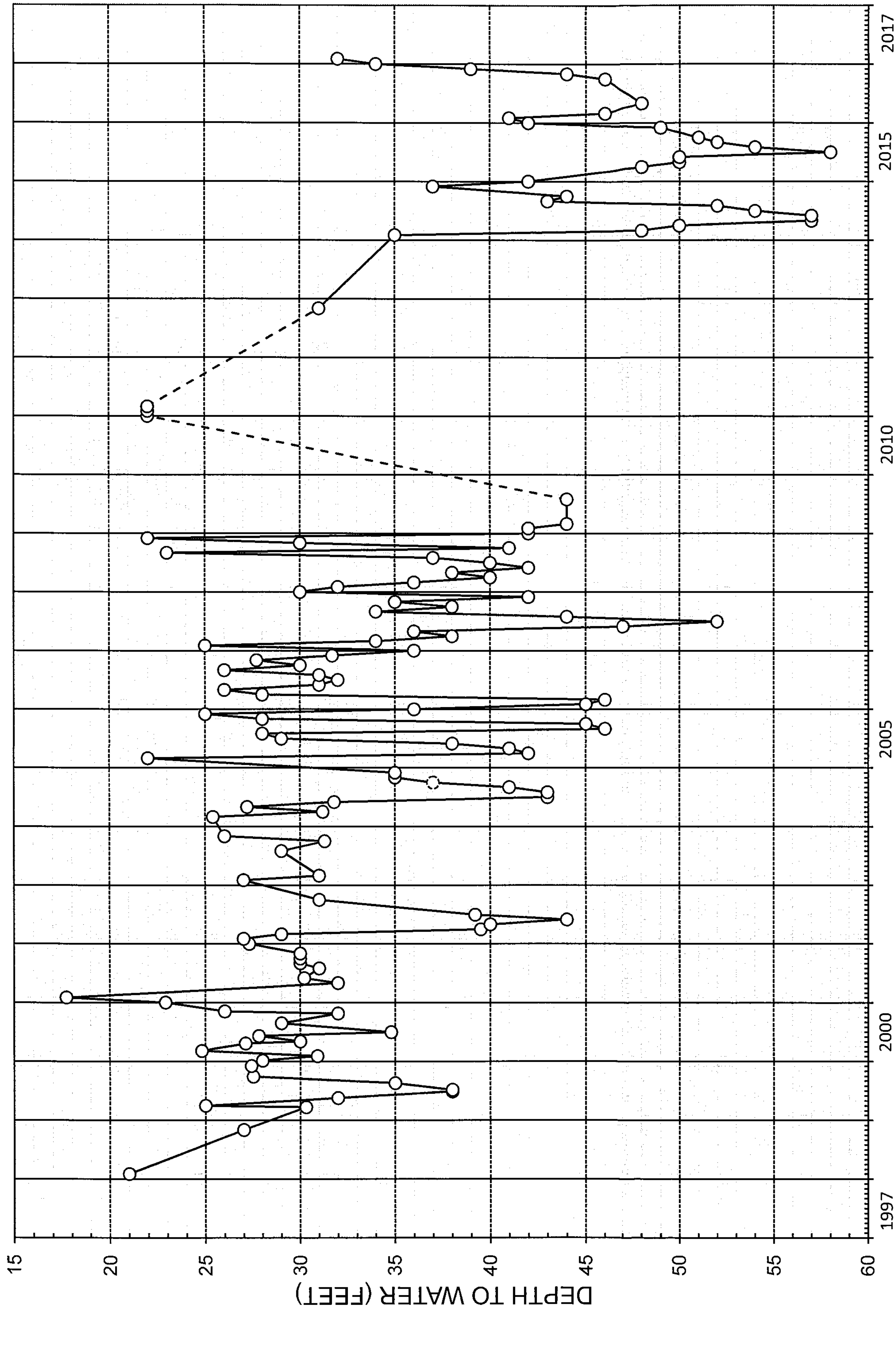


WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 8

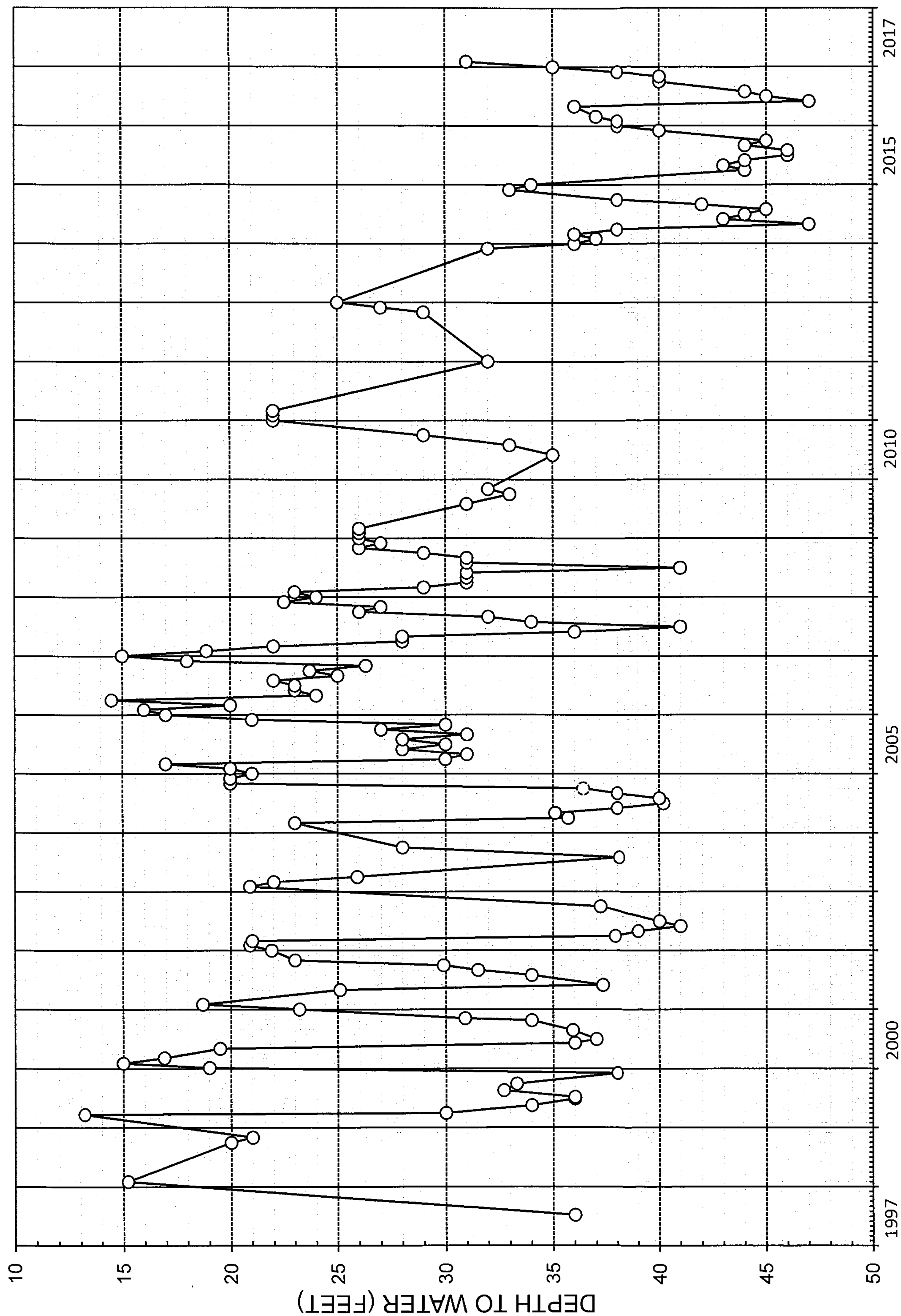


WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 9

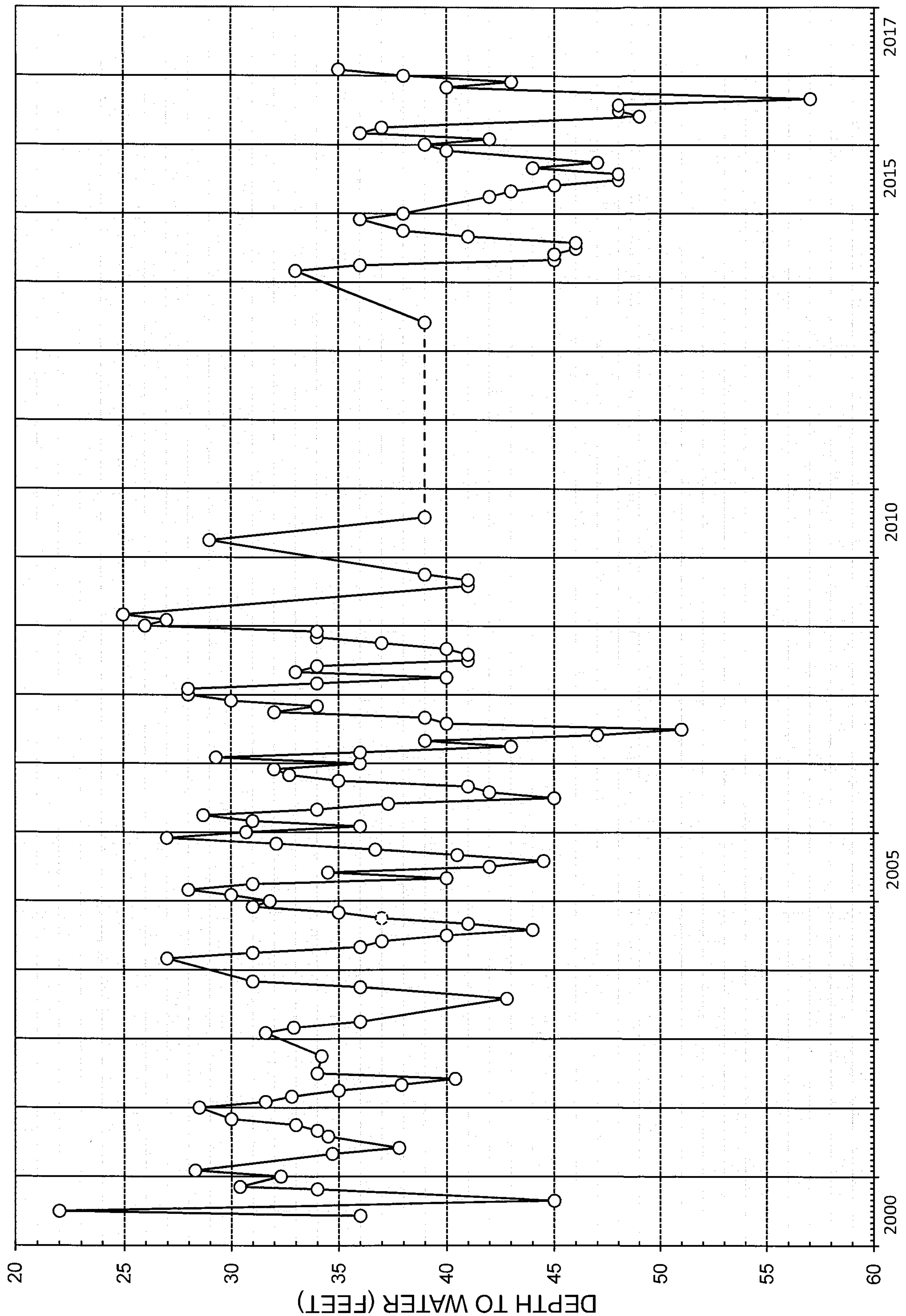

WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 10
DEPTH TO WATER (FEET)
20
25
30
35
40
45
50
55
60
65
1997
2000
2005
2010
2015
2017



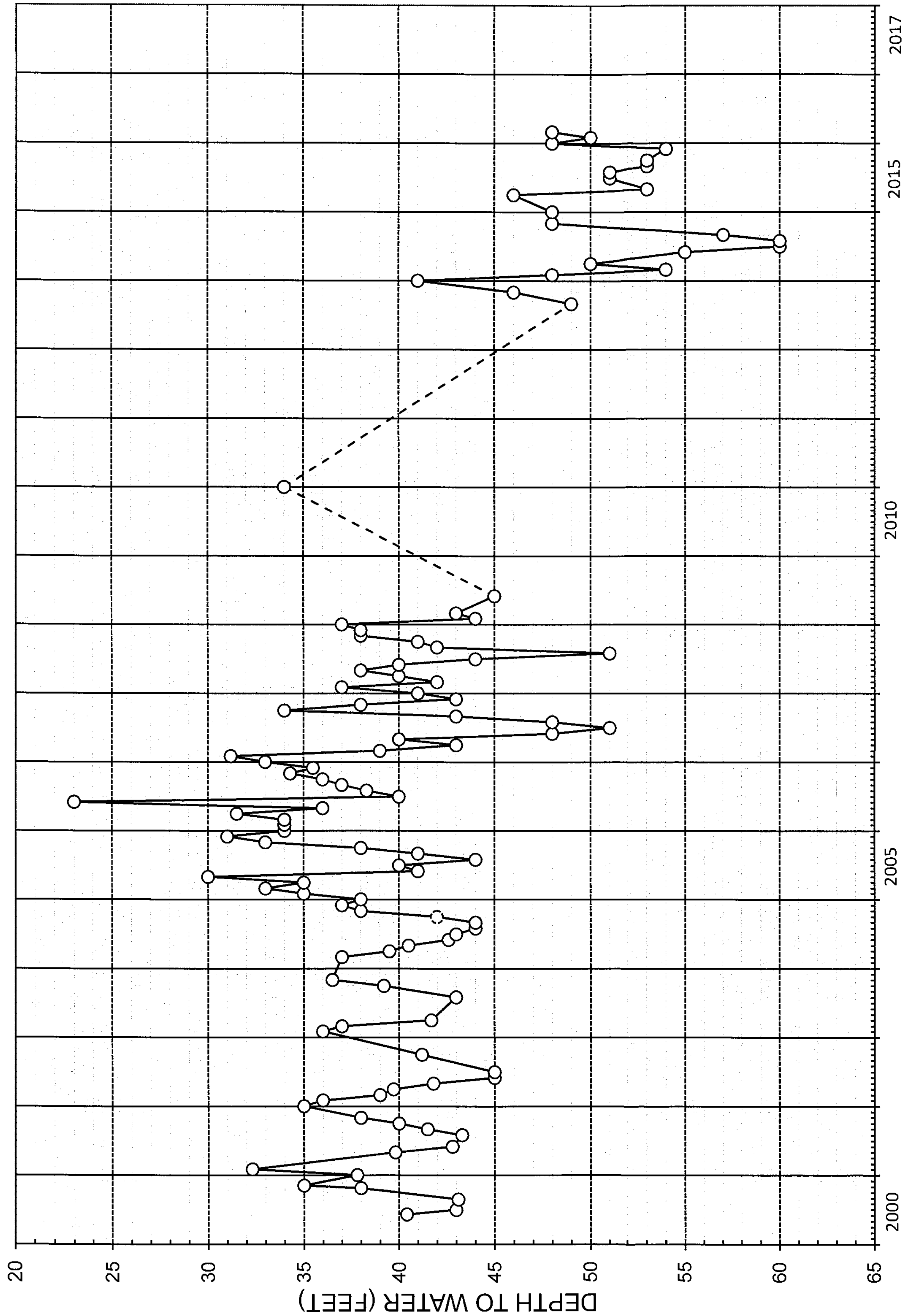
WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 11



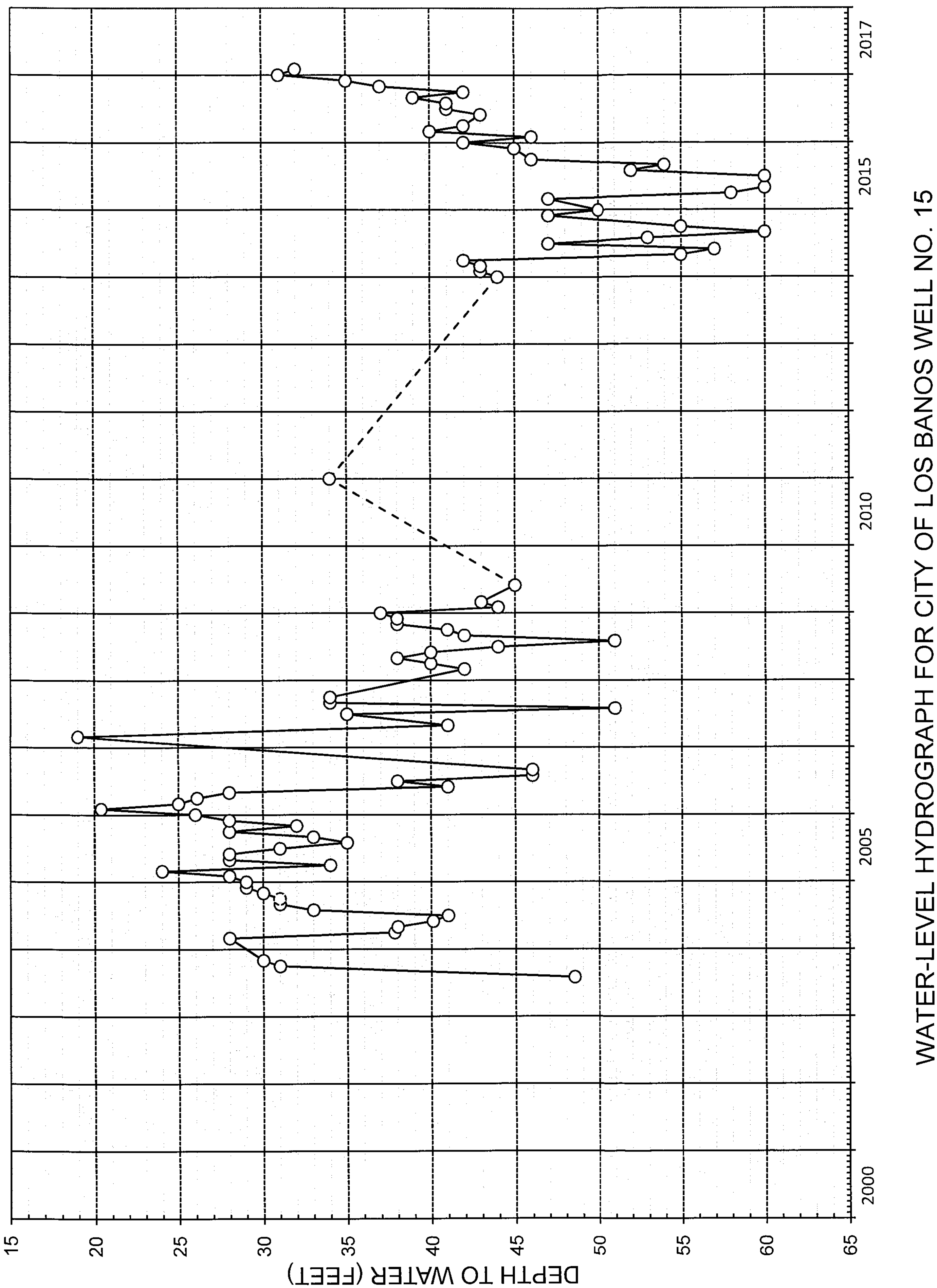
WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 12

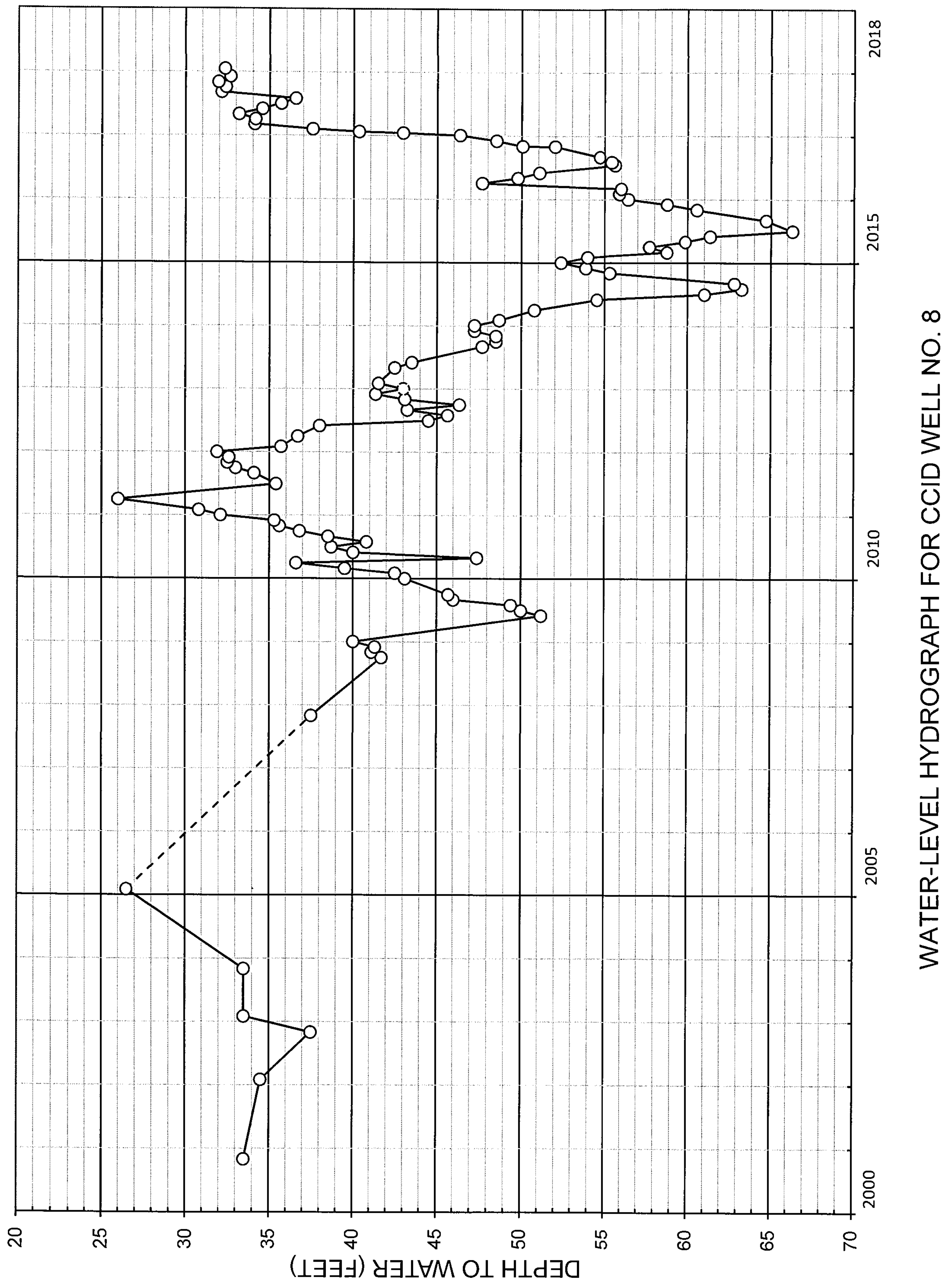


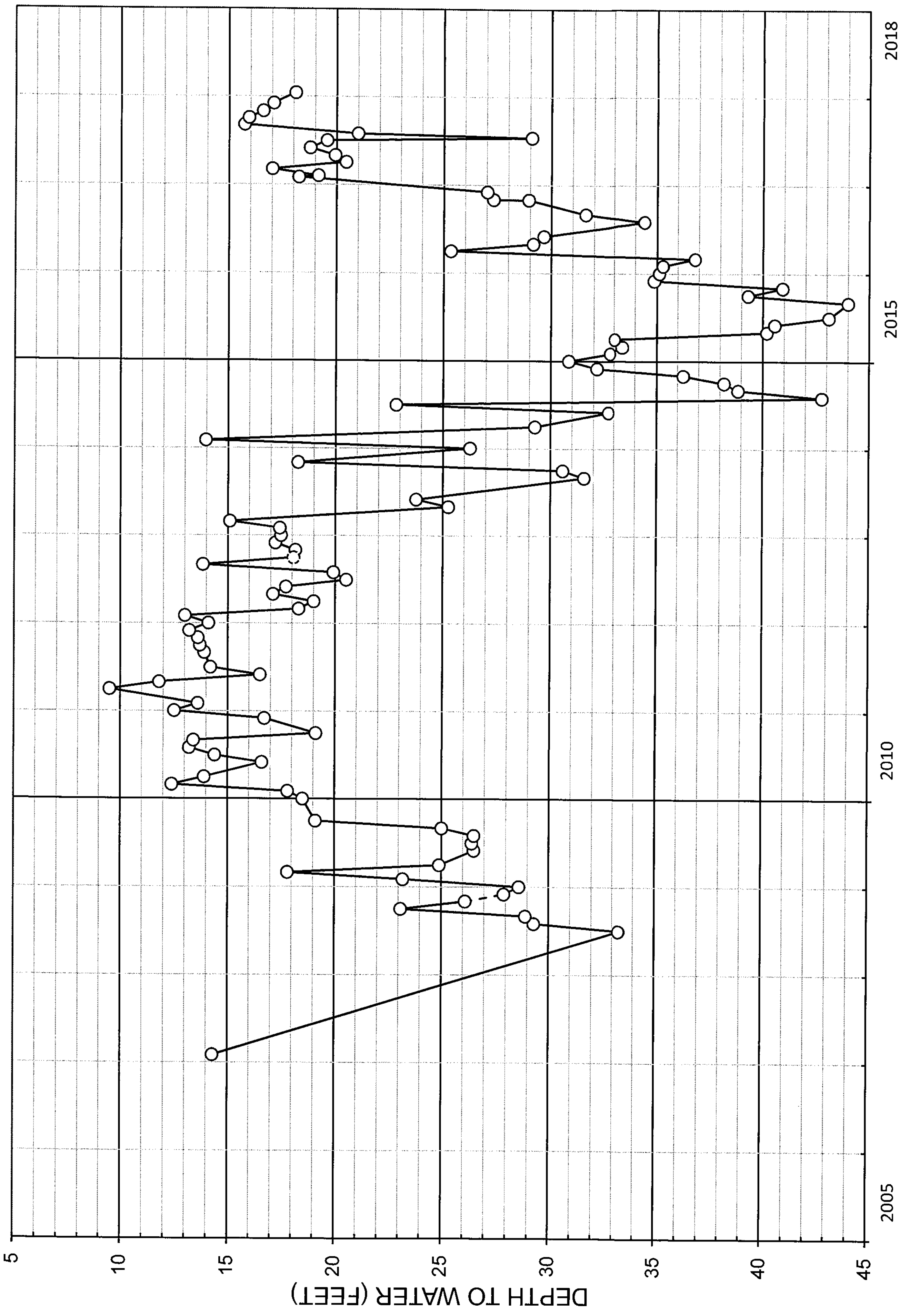
WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 13



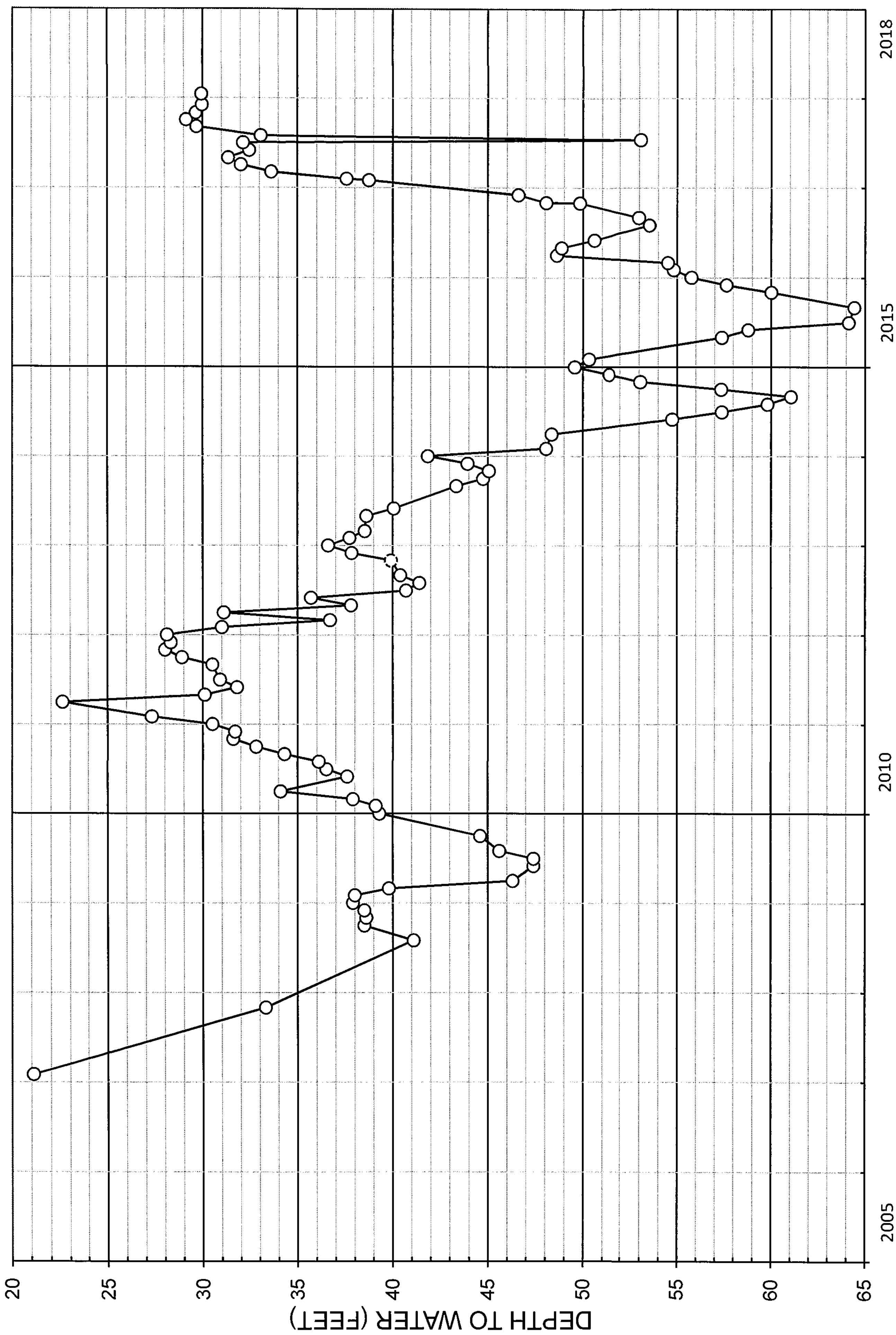
WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 14


WATER-LEVEL HYDROGRAPH FOR CITY OF LOS BANOS WELL NO. 15
DEPTH TO WATER (FEET)
15
20
25
30
35
40
45
50
55
60
65
2000
2005
2010
2015
2017

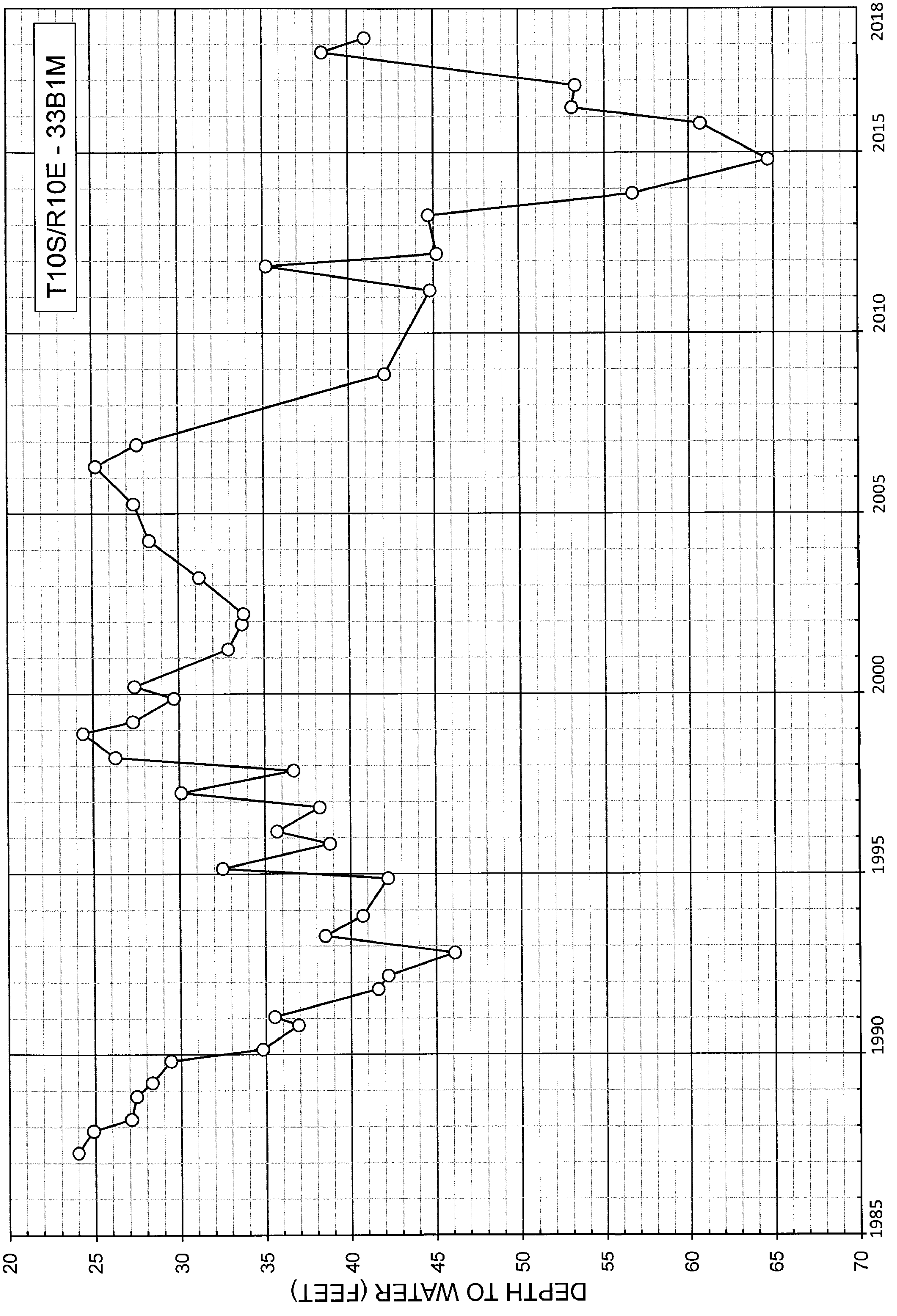

WATER-LEVEL HYDROGRAPH FOR CCID WELL NO. 8
DEPTH TO WATER (FEET)
20
25
30
35
40
45
50
55
60
65
70
2000
2005
2010
2015
2018



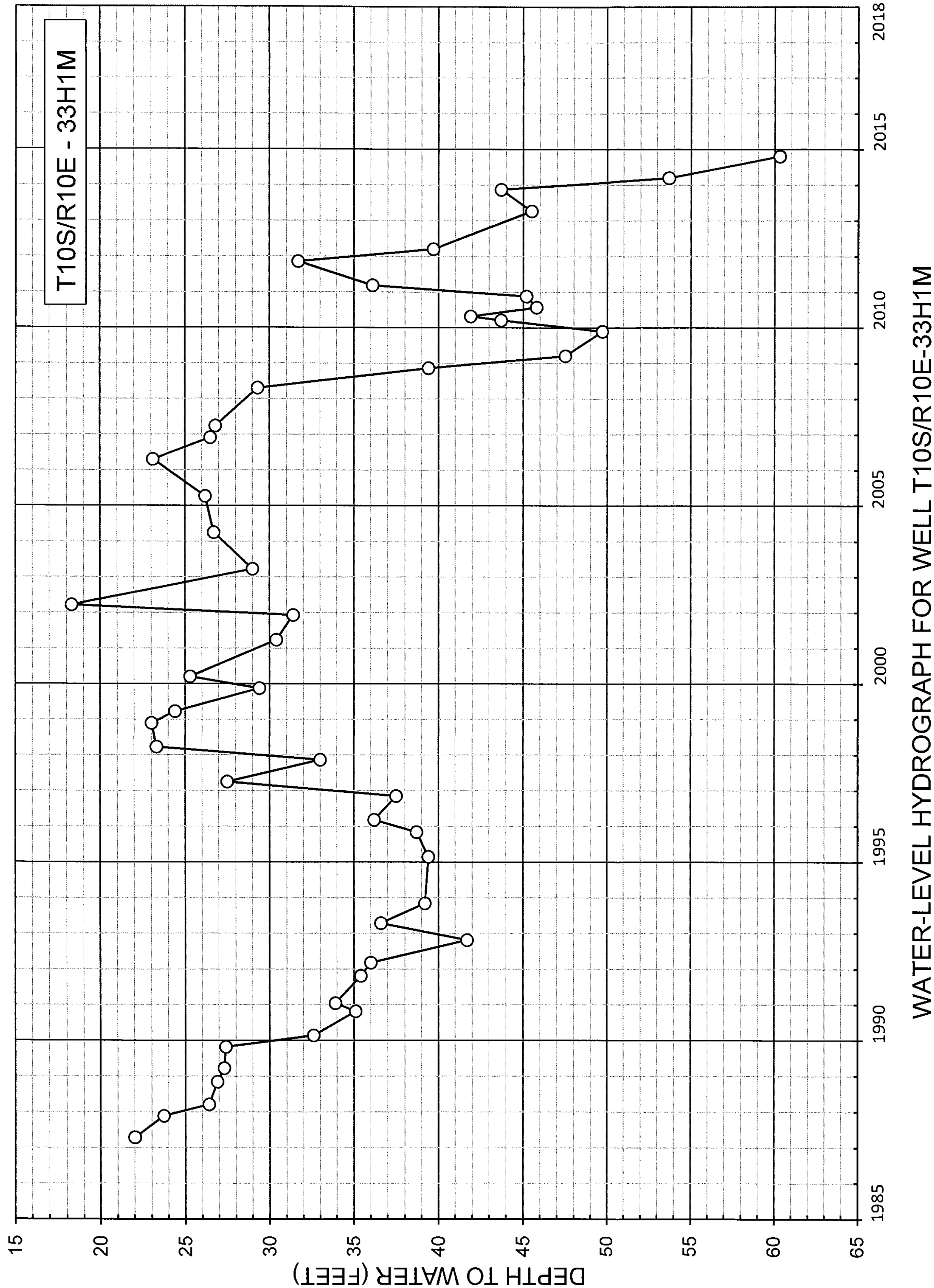
WATER-LEVEL HYDROGRAPH FOR CCID WELL NO. 48

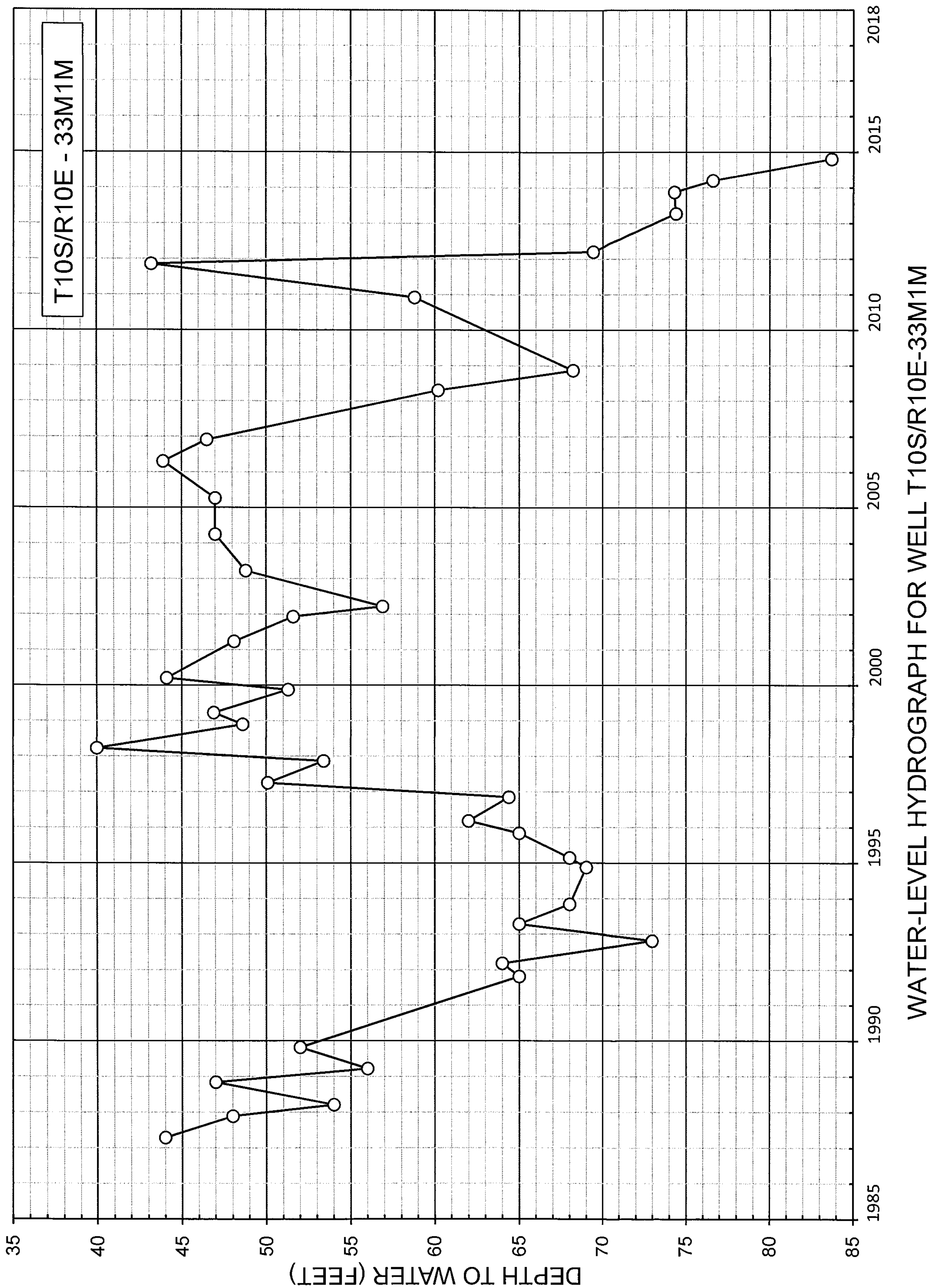


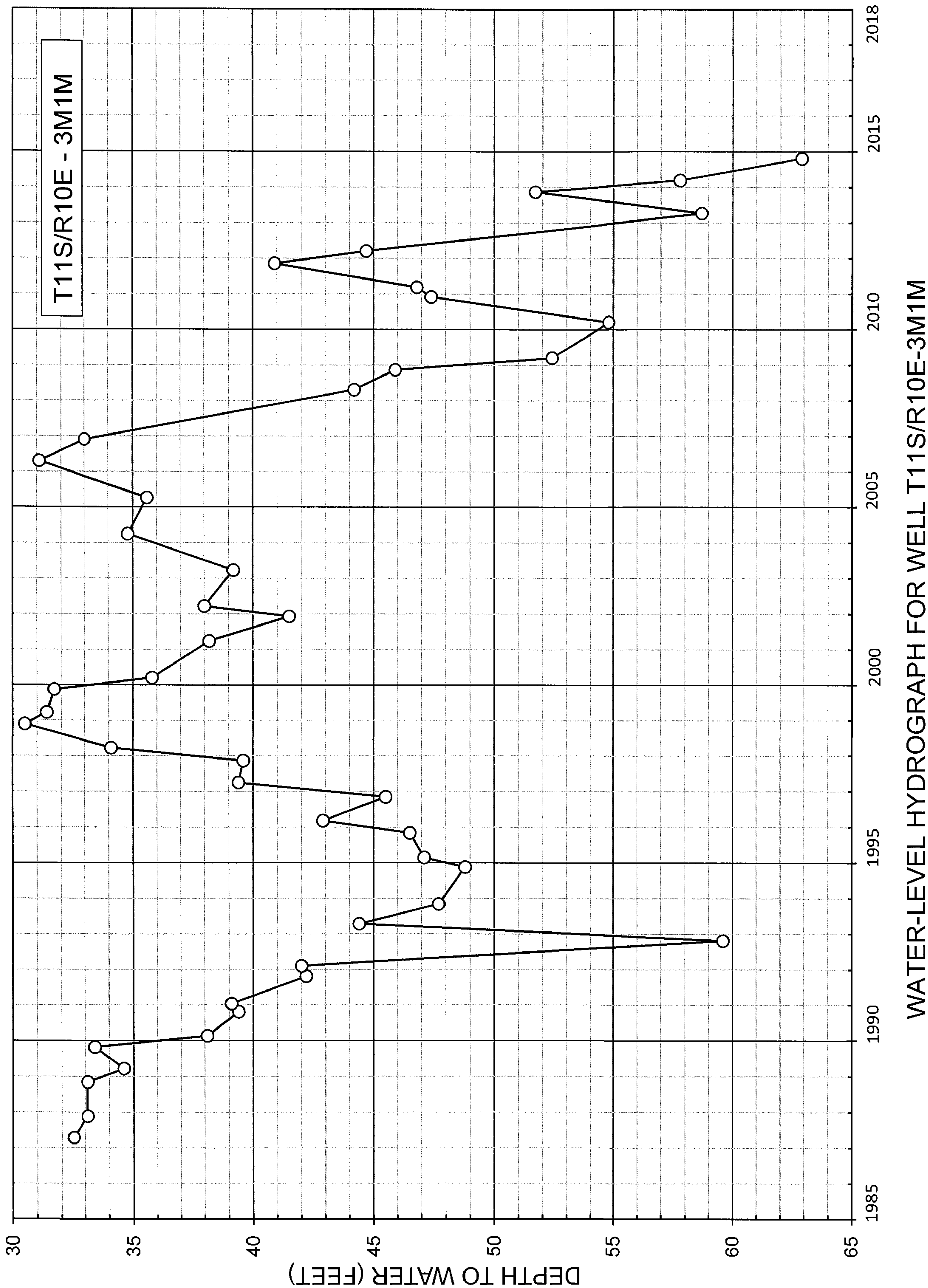
WATER-LEVEL HYDROGRAPH FOR CCID WELL NO. 62

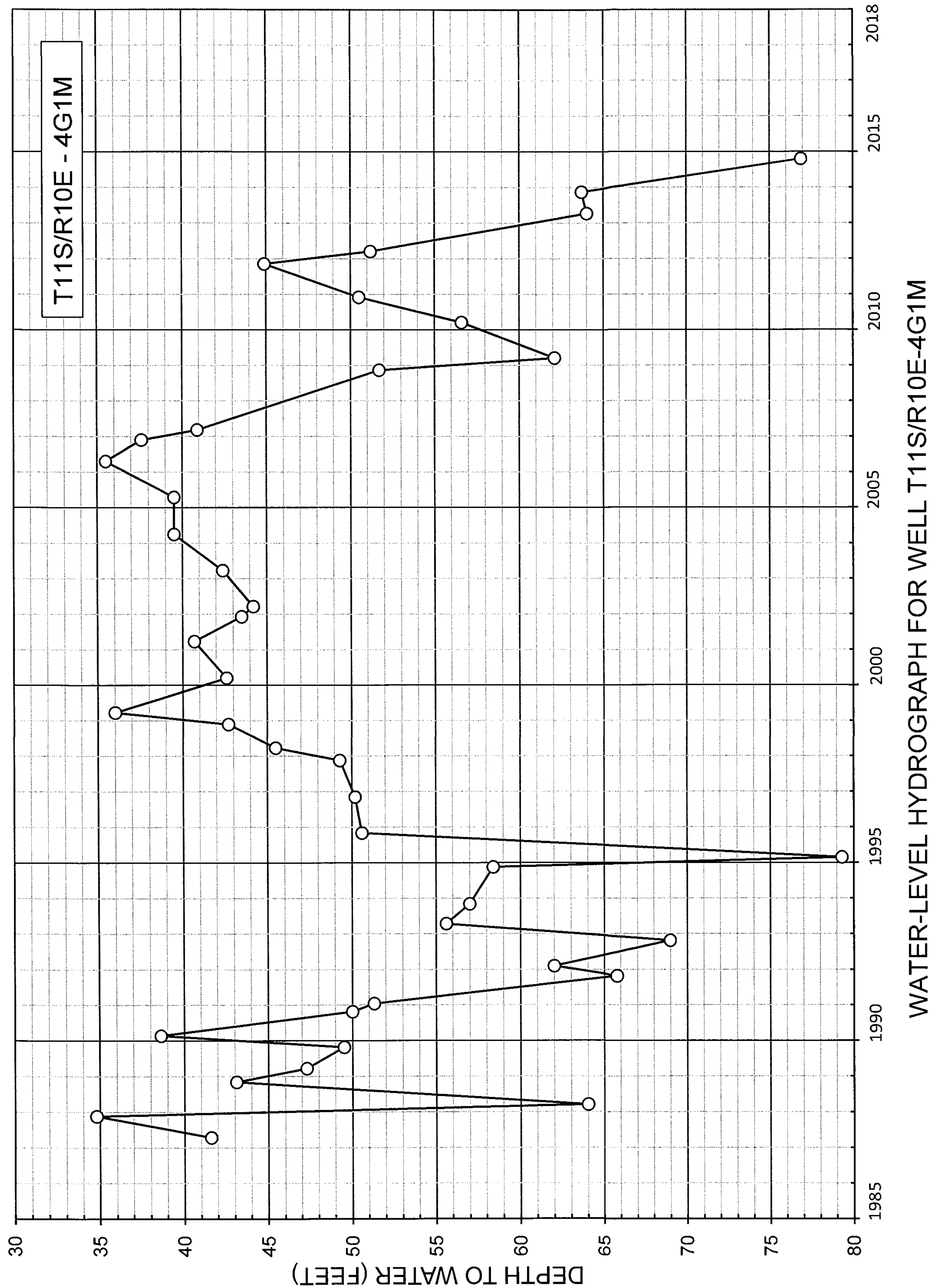


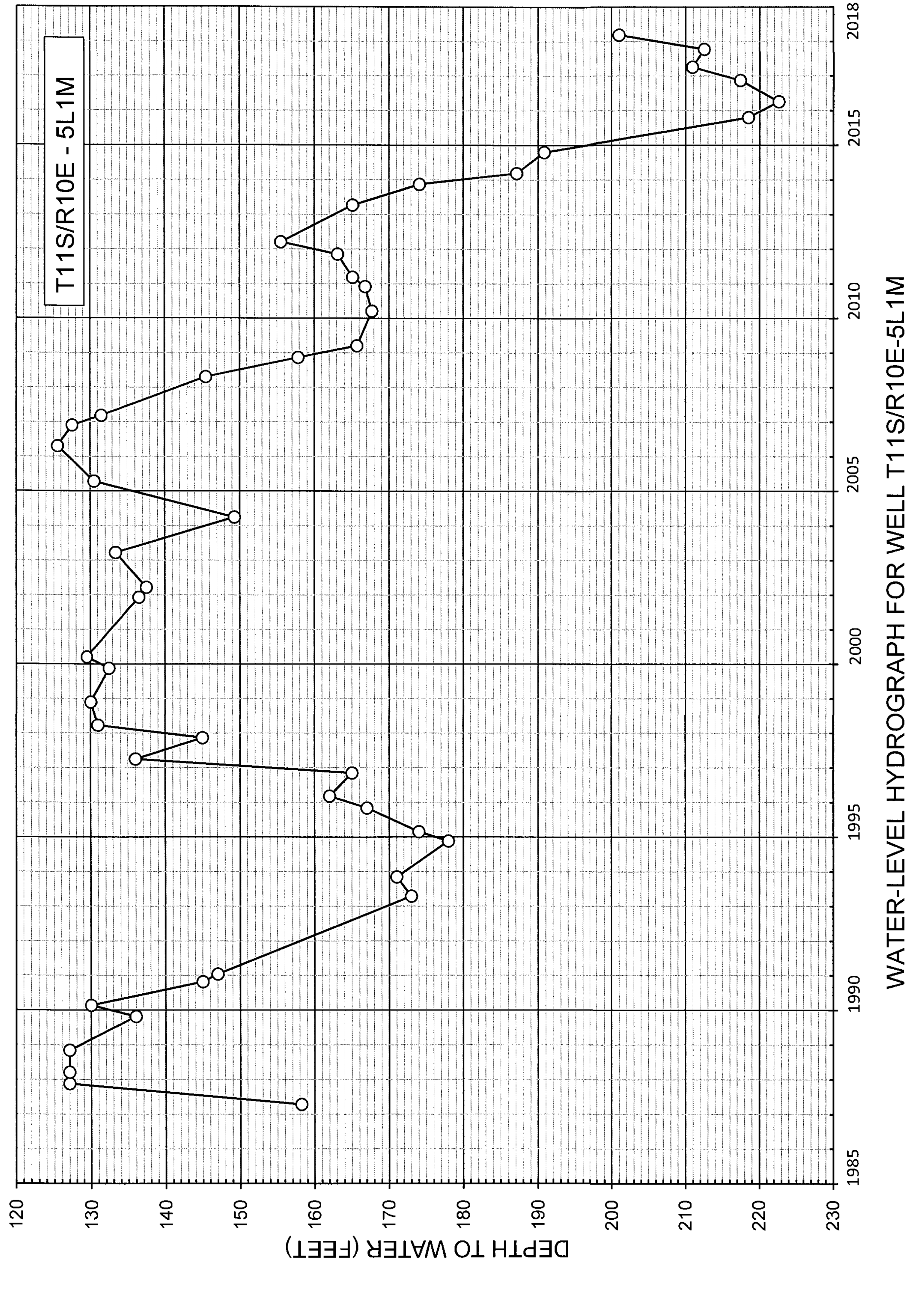
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-33B1M

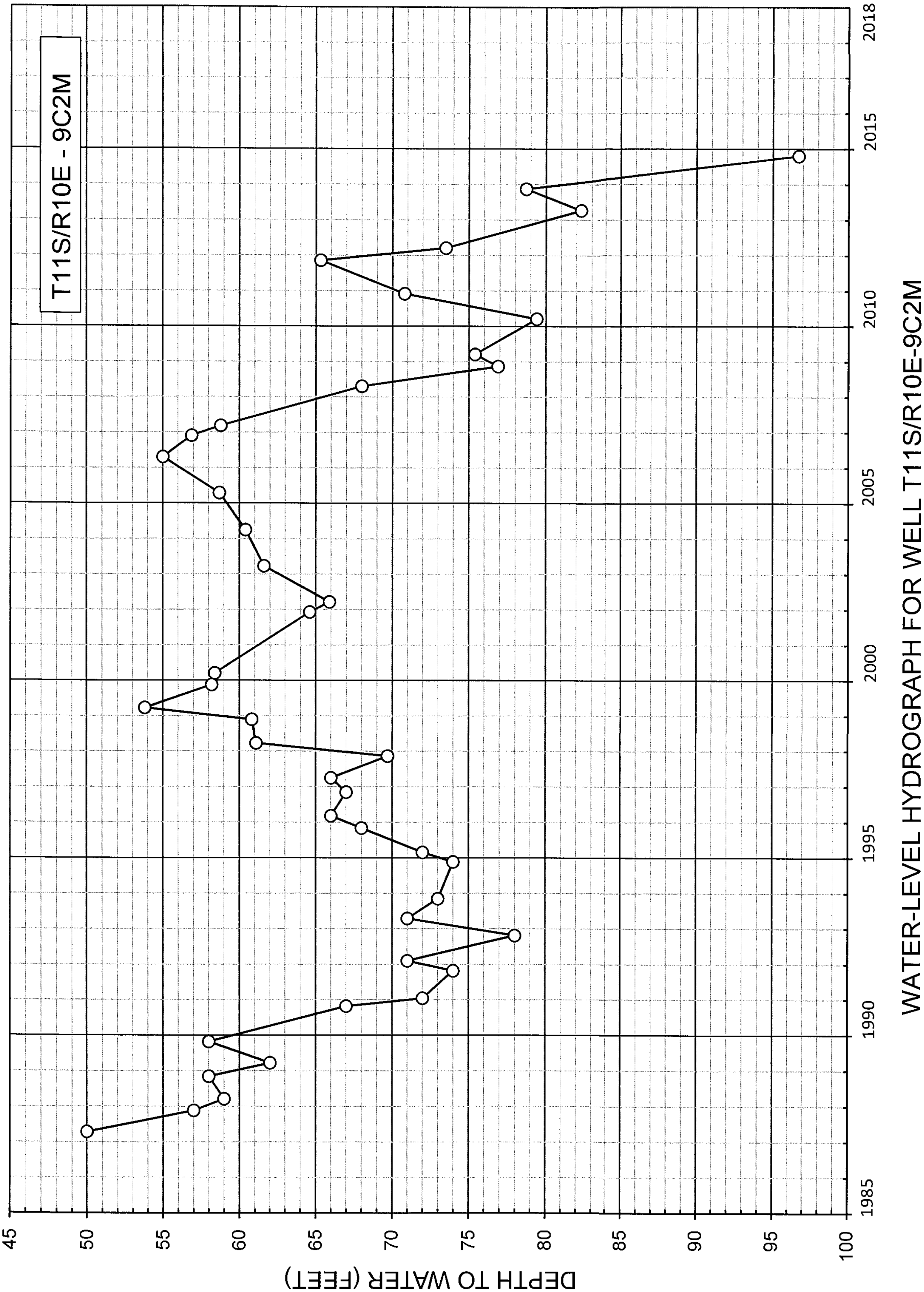

T10S/R10E - 33H1M
DEPTH TO WATER (FEET)
15
20
25
30
35
40
45
50
55
60
65
1985
1990
1995
2000
2005
2010
2015
2018
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-33H1M

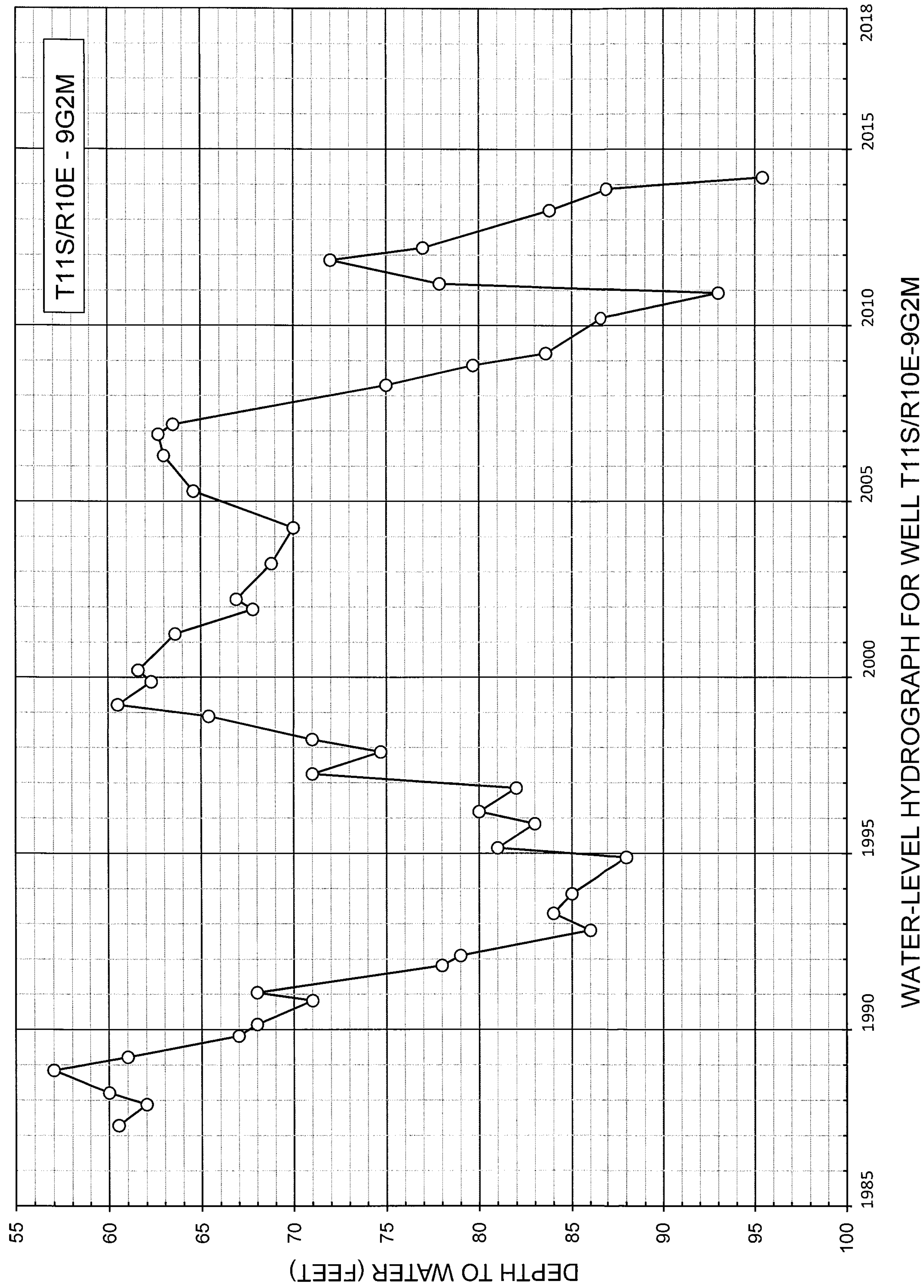

T10S/R10E - 33M1M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-33M1M
DEPTH TO WATER (FEET)
35
40
45
50
55
60
65
70
75
80
85
1985
1990
1995
2000
2005
2010
2015
2018

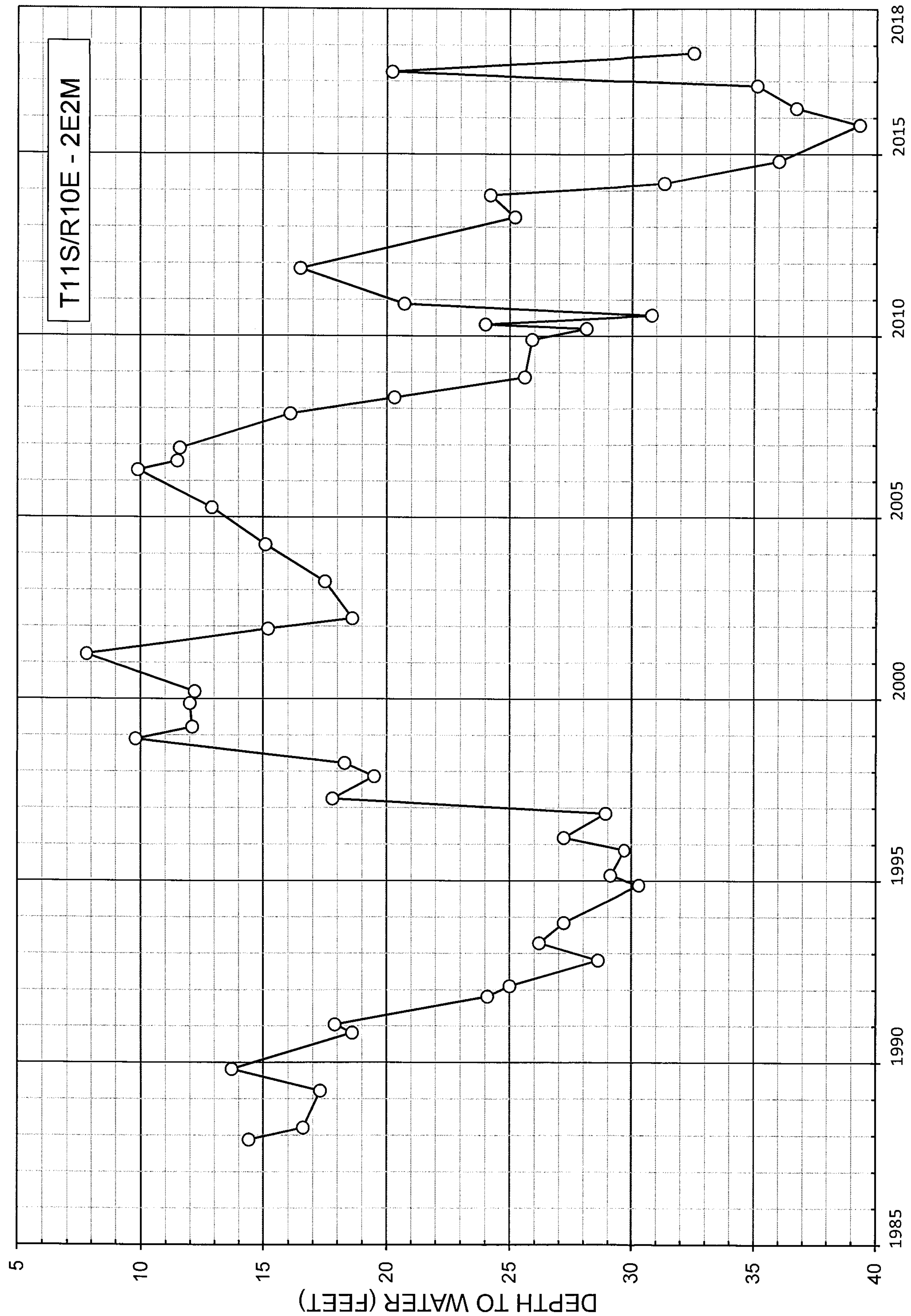

T11S/R10E - 3M1M
DEPTH TO WATER (FEET)
30
35
40
45
50
55
60
65
1985
1990
1995
2000
2005
2010
2015
2018
WATER-LEVEL HYDROGRAPH FOR WELL T11S/R10E-3M1M


T11S/R10E - 4G1M
WATER-LEVEL HYDROGRAPH FOR WELL T11S/R10E-4G1M
DEPTH TO WATER (FEET)
30
35
40
45
50
55
60
65
70
75
80
1985
1990
1995
2000
2005
2010
2015
2018

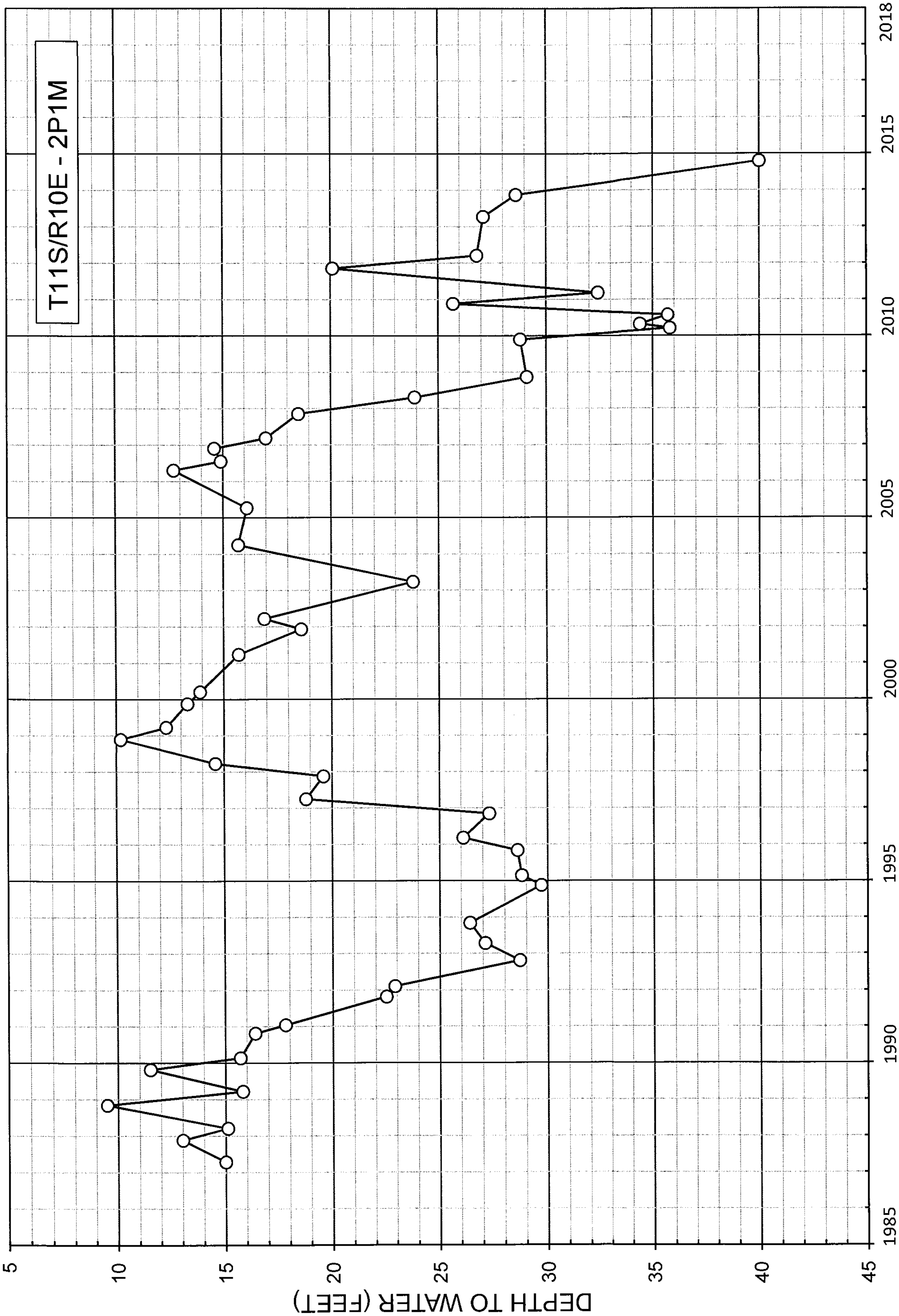

T11S/R10E - 5L1M
WATER-LEVEL HYDROGRAPH FOR WELL T11S/R10E-5L1M
DEPTH TO WATER (FEET)
120
130
140
150
160
170
180
190
200
210
220
230
1985
1990
1995
2000
2005
2010
2015
2018


T11S/R10E - 9C2M
WATER-LEVEL HYDROGRAPH FOR WELL T11S/R10E-9C2M
DEPTH TO WATER (FEET)
45
50
55
60
65
70
75
80
85
90
95
100
1985
1990
1995
2000
2005
2010
2015
2018

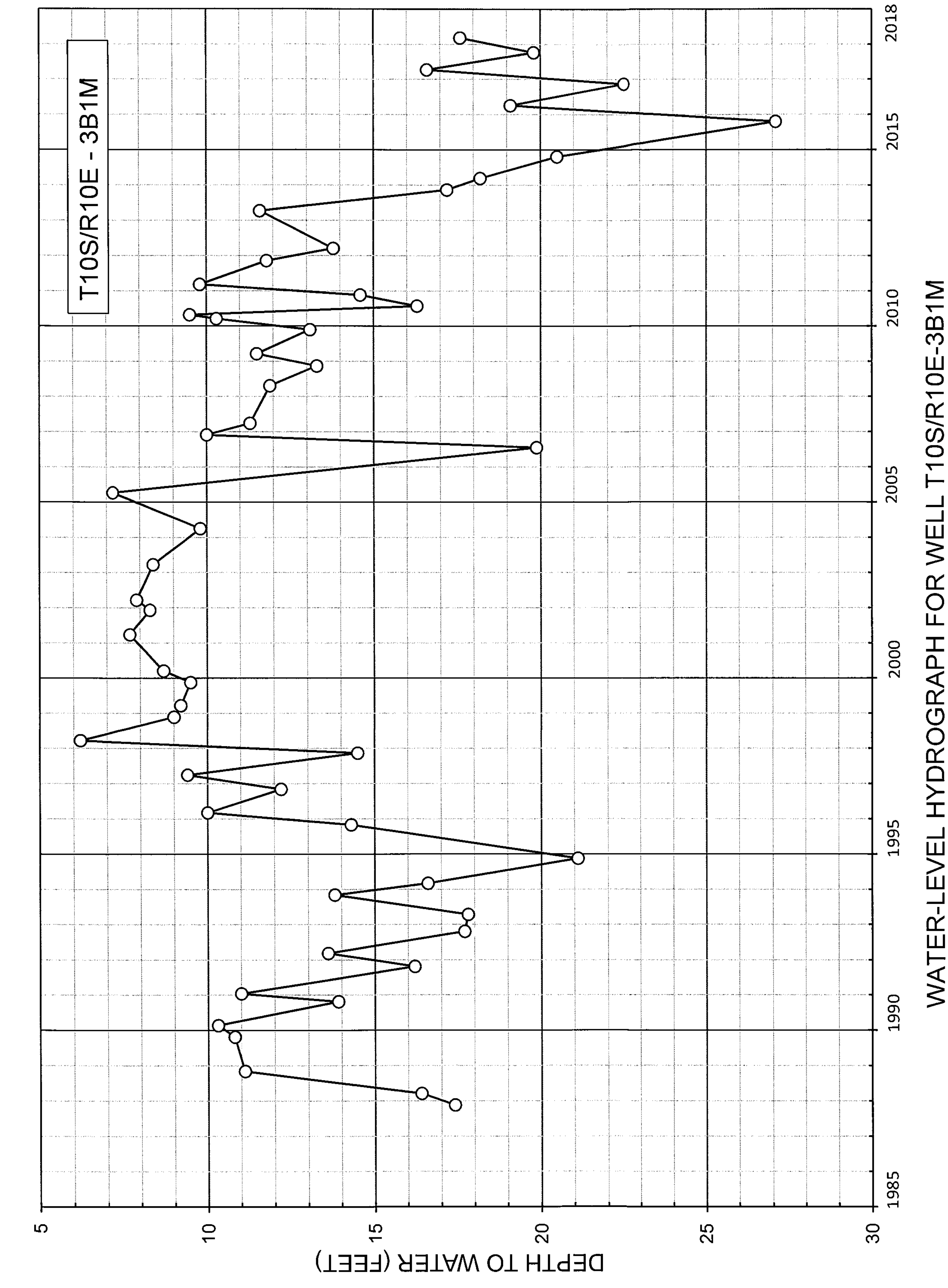

T11S/R10E - 9G2M
DEPTH TO WATER (FEET)
55
60
65
70
75
80
85
90
95
100
1985
1990
1995
2000
2005
2010
2015
2018
WATER-LEVEL HYDROGRAPH FOR WELL T11S/R10E-9G2M

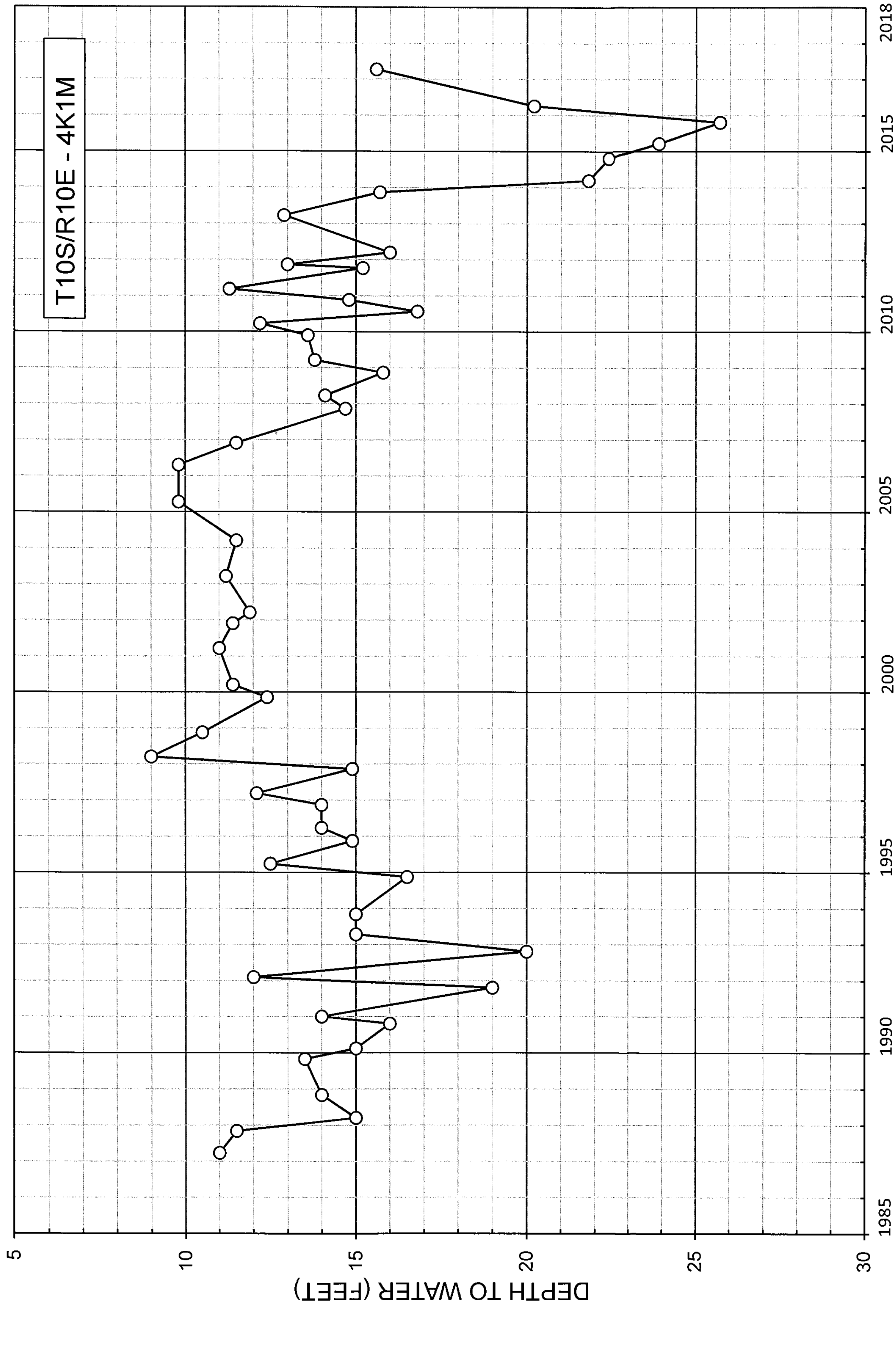


WATER-LEVEL HYDROGRAPH FOR WELL T11S/R10E-2E2M

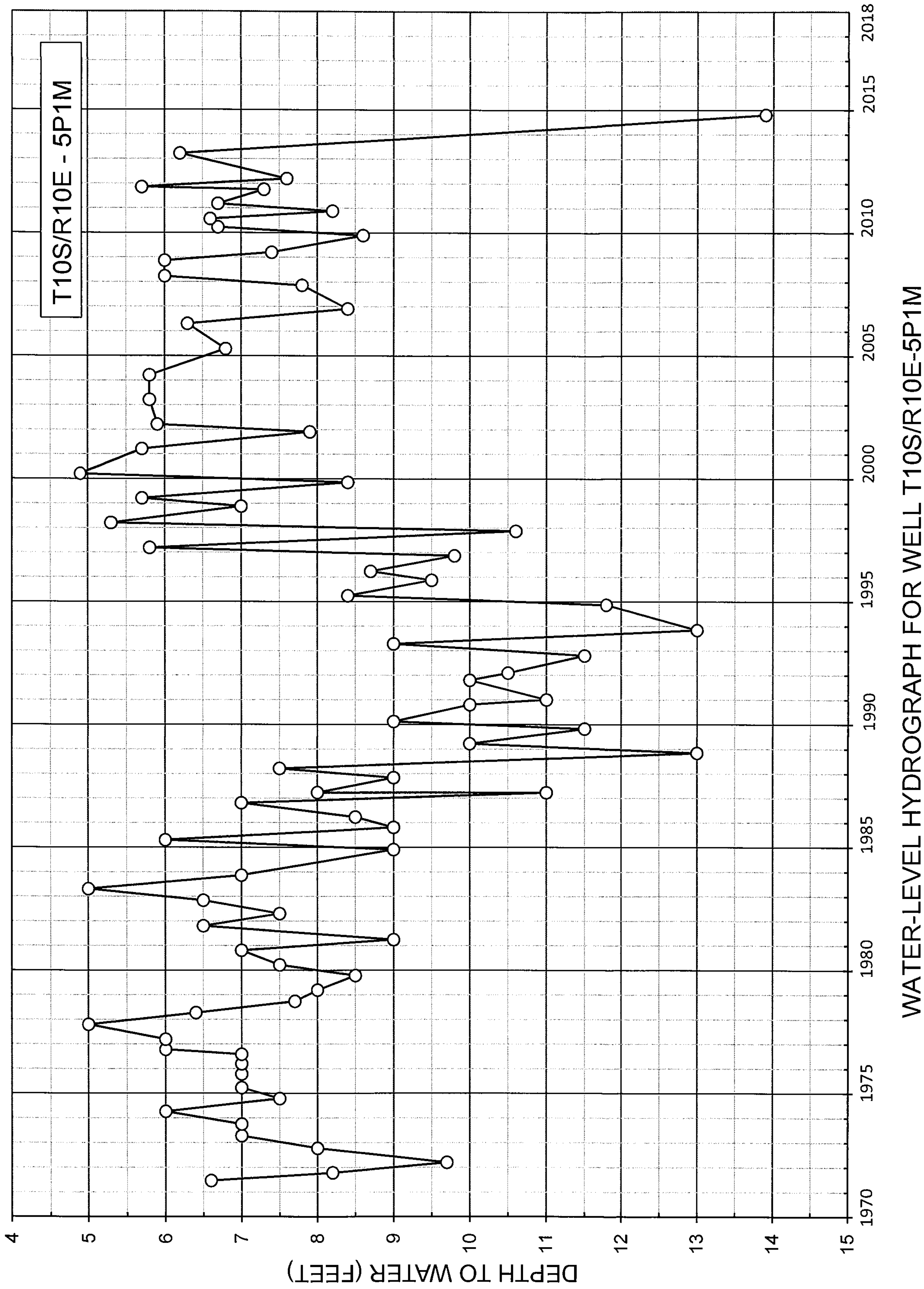


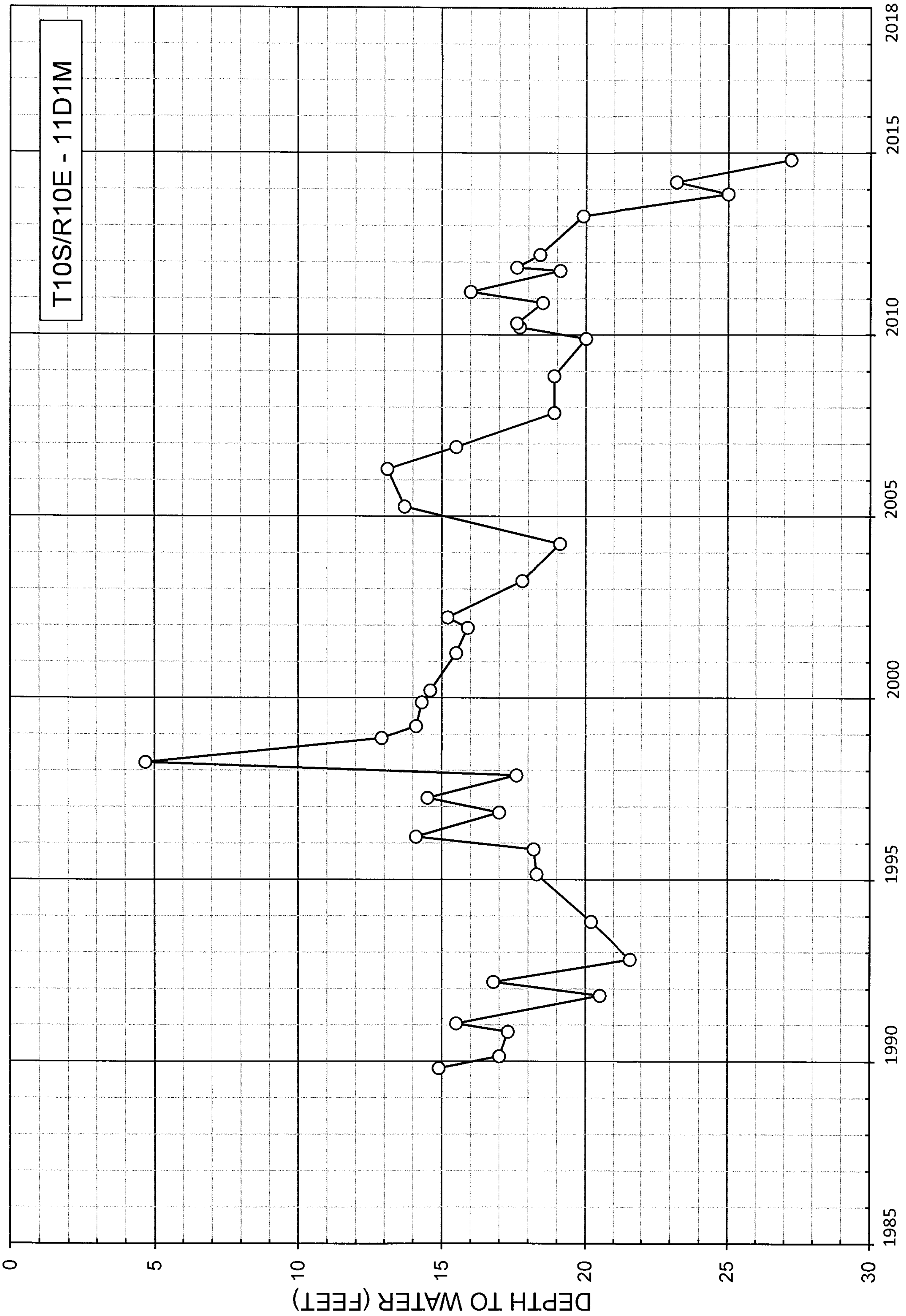
WATER-LEVEL HYDROGRAPH FOR WELL T11S/R10E-2P1M


T10S/R10E - 3B1M
DEPTH TO WATER (FEET)
5
10
15
20
25
30
1985
1990
1995
2000
2005
2010
2015
2018
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-3B1M

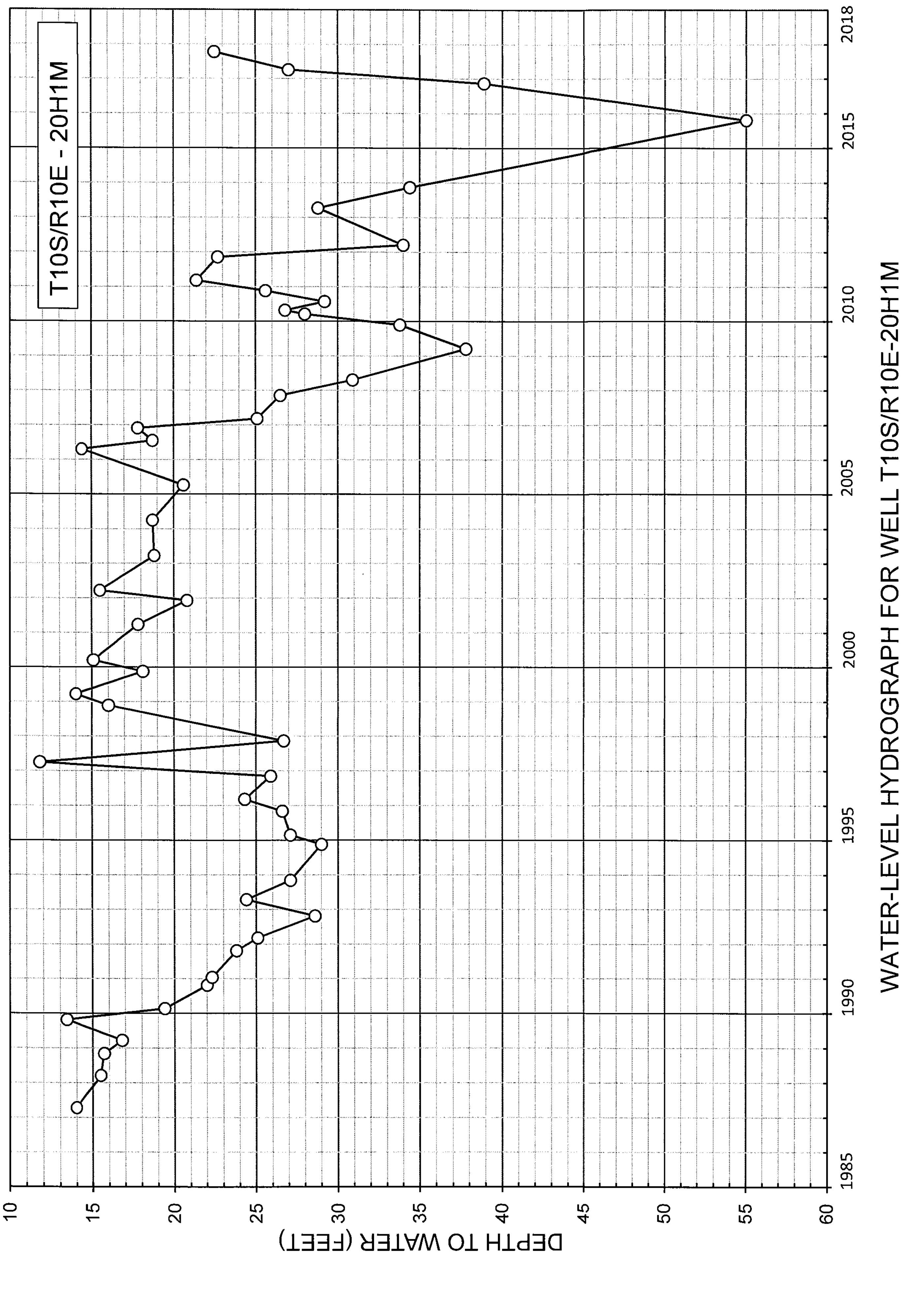


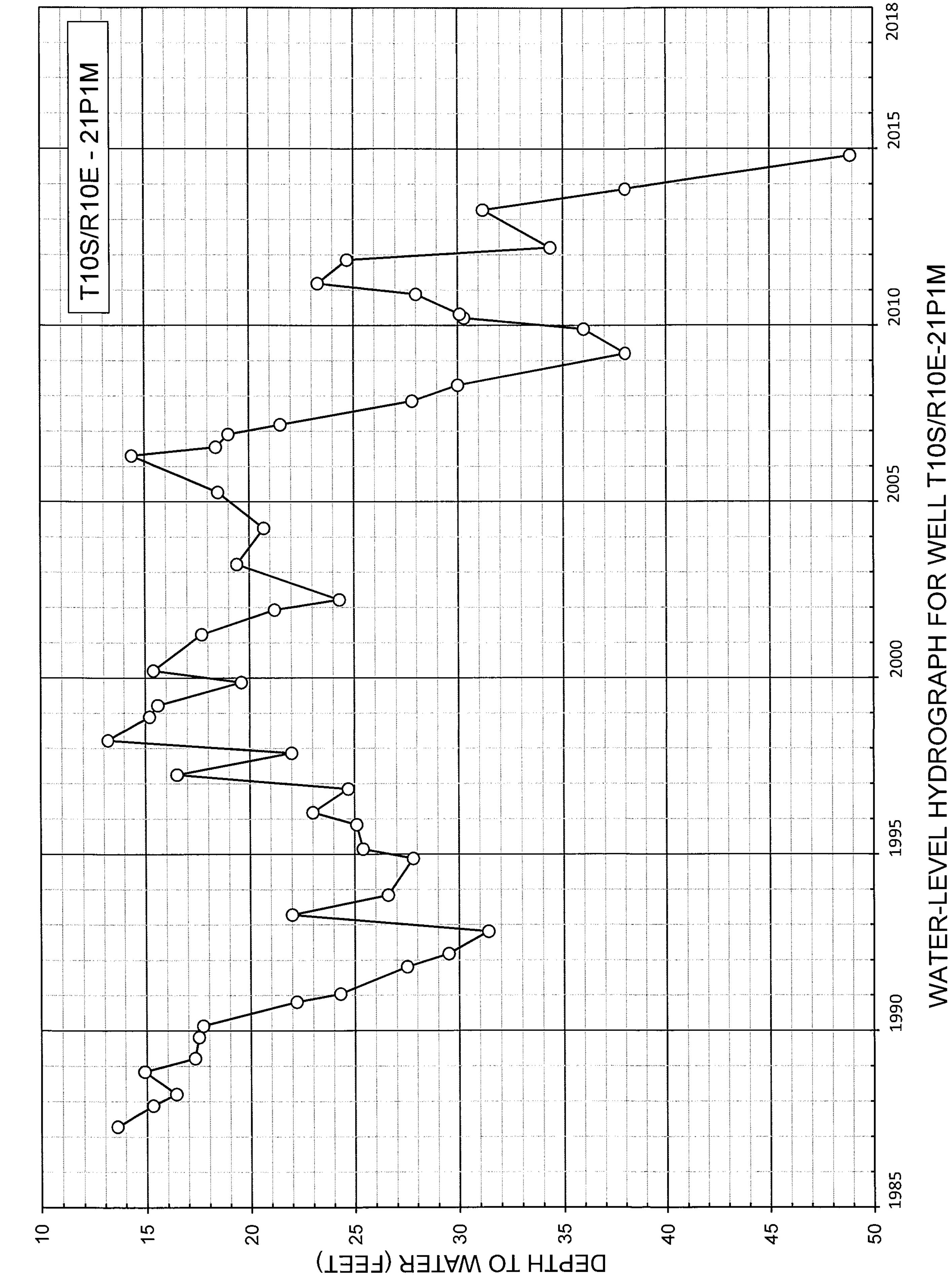
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-4K1M

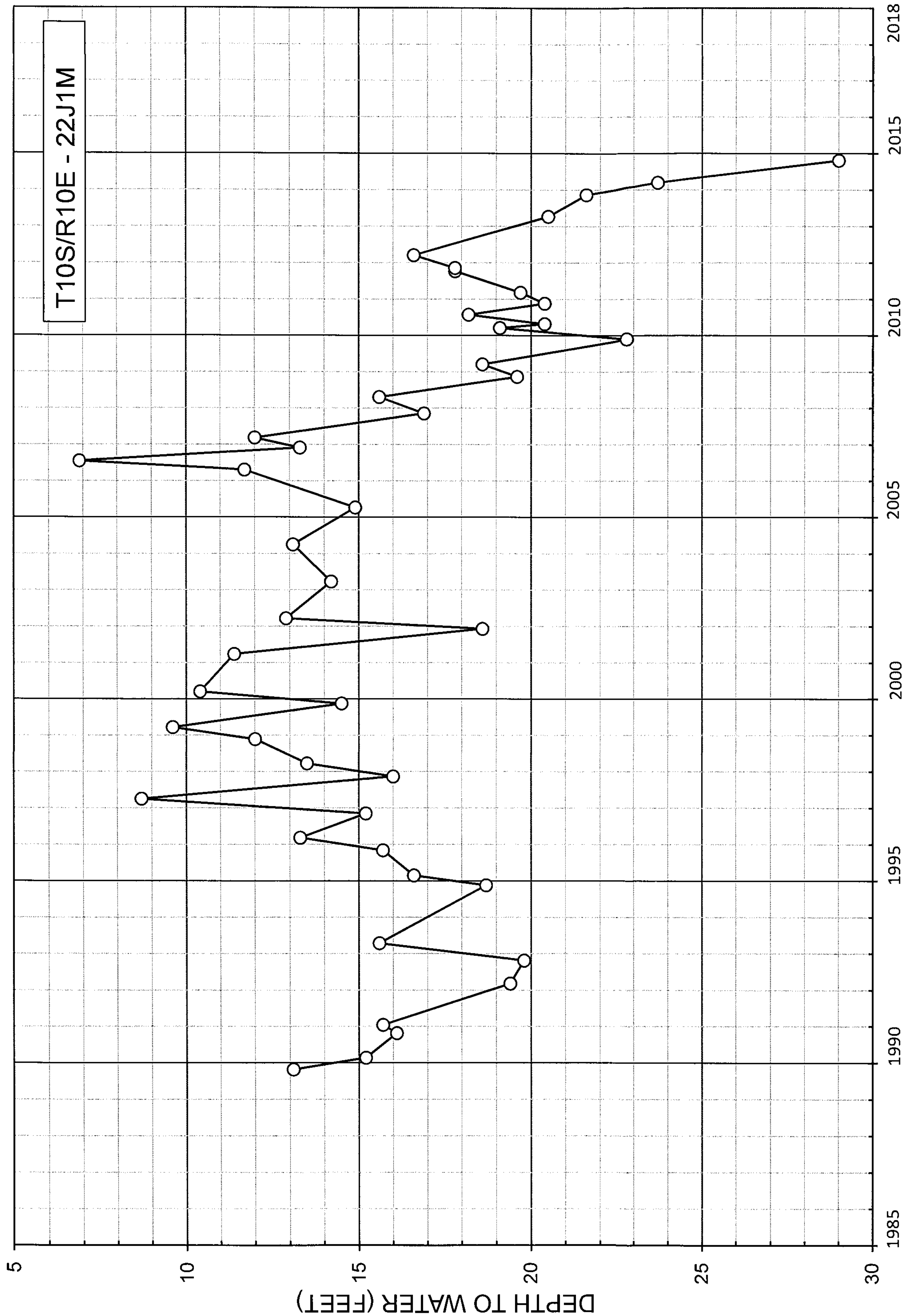

T10S/R10E - 5P1M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-5P1M
DEPTH TO WATER (FEET)
4
5
6
7
8
9
10
11
12
13
14
15
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2018



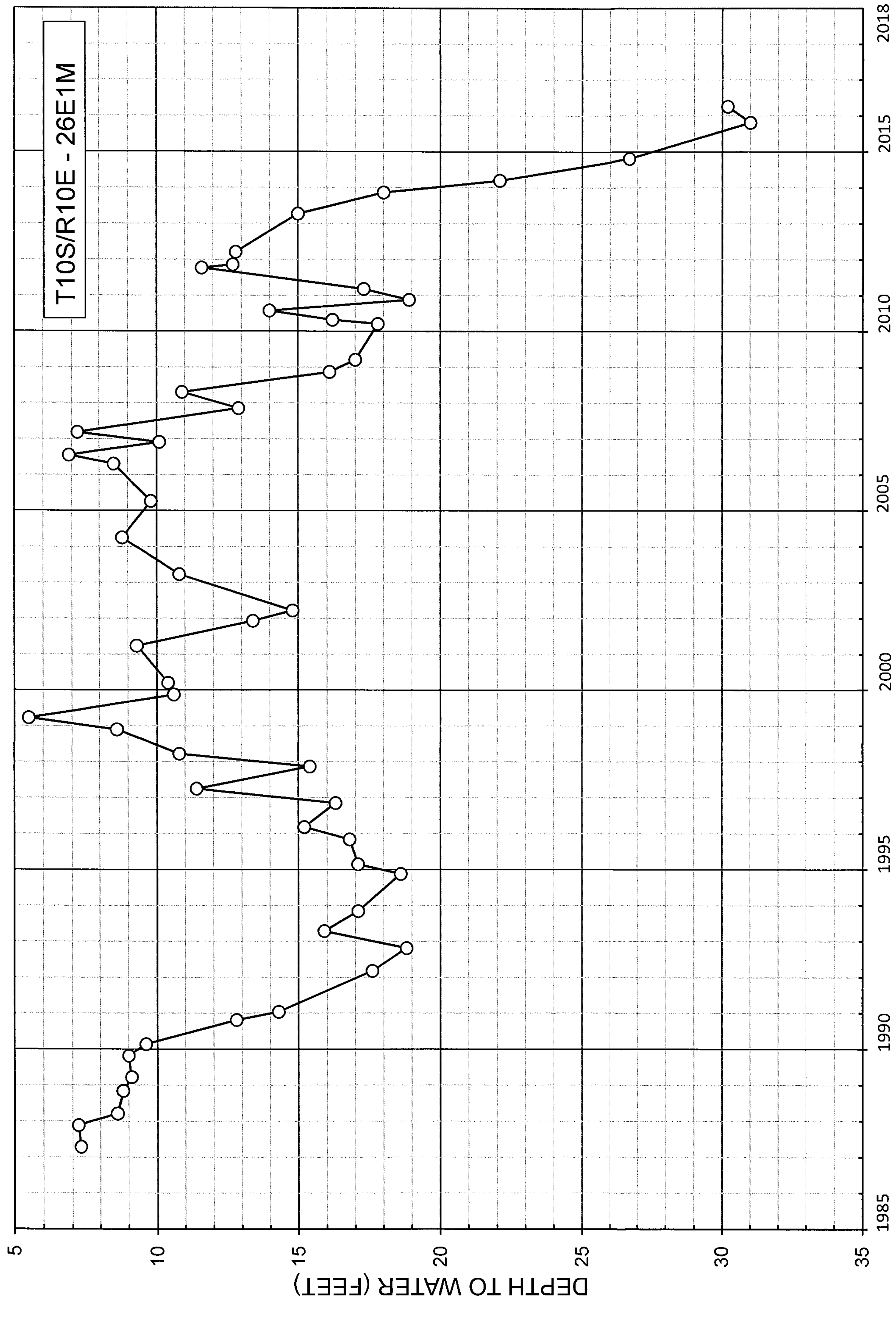
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-11D1M


T10S/R10E - 20H1M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-20H1M
DEPTH TO WATER (FEET)
10
15
20
25
30
35
40
45
50
55
60
1985
1990
1995
2000
2005
2010
2015
2018

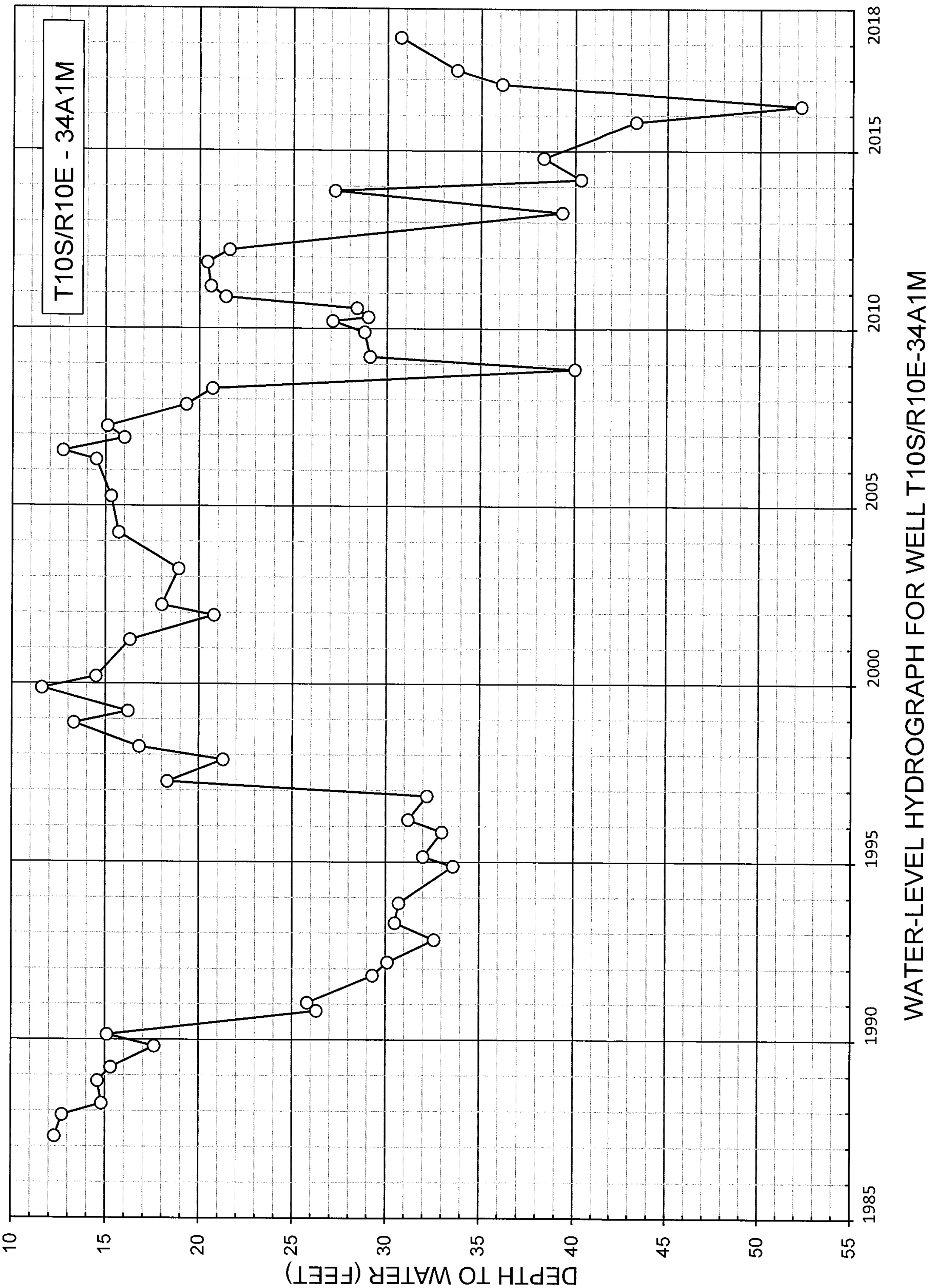

T10S/R10E - 21P1M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-21P1M
DEPTH TO WATER (FEET)
10
15
20
25
30
35
40
45
50
1985
1990
1995
2000
2005
2010
2015
2018

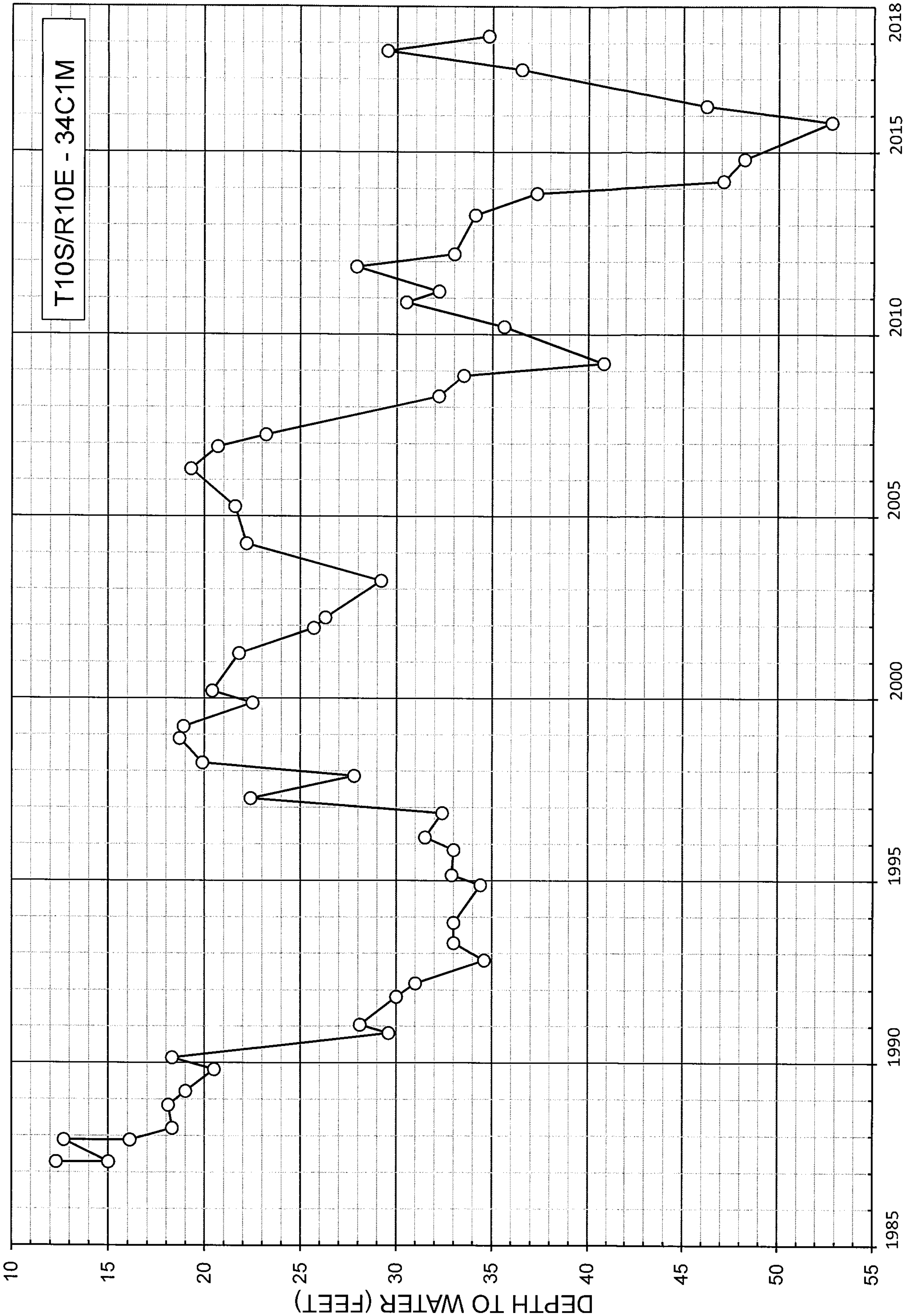


WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-22J1M

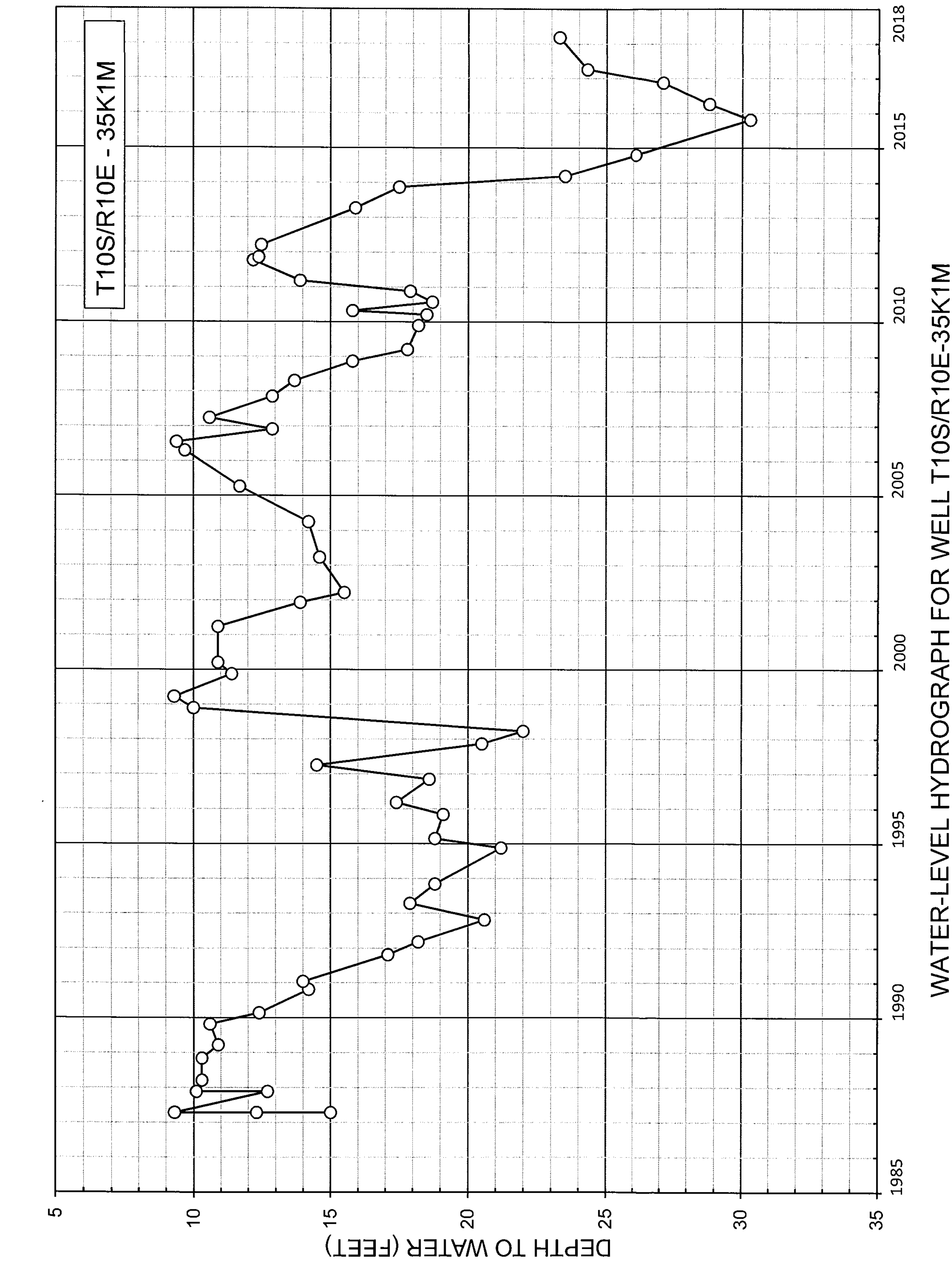


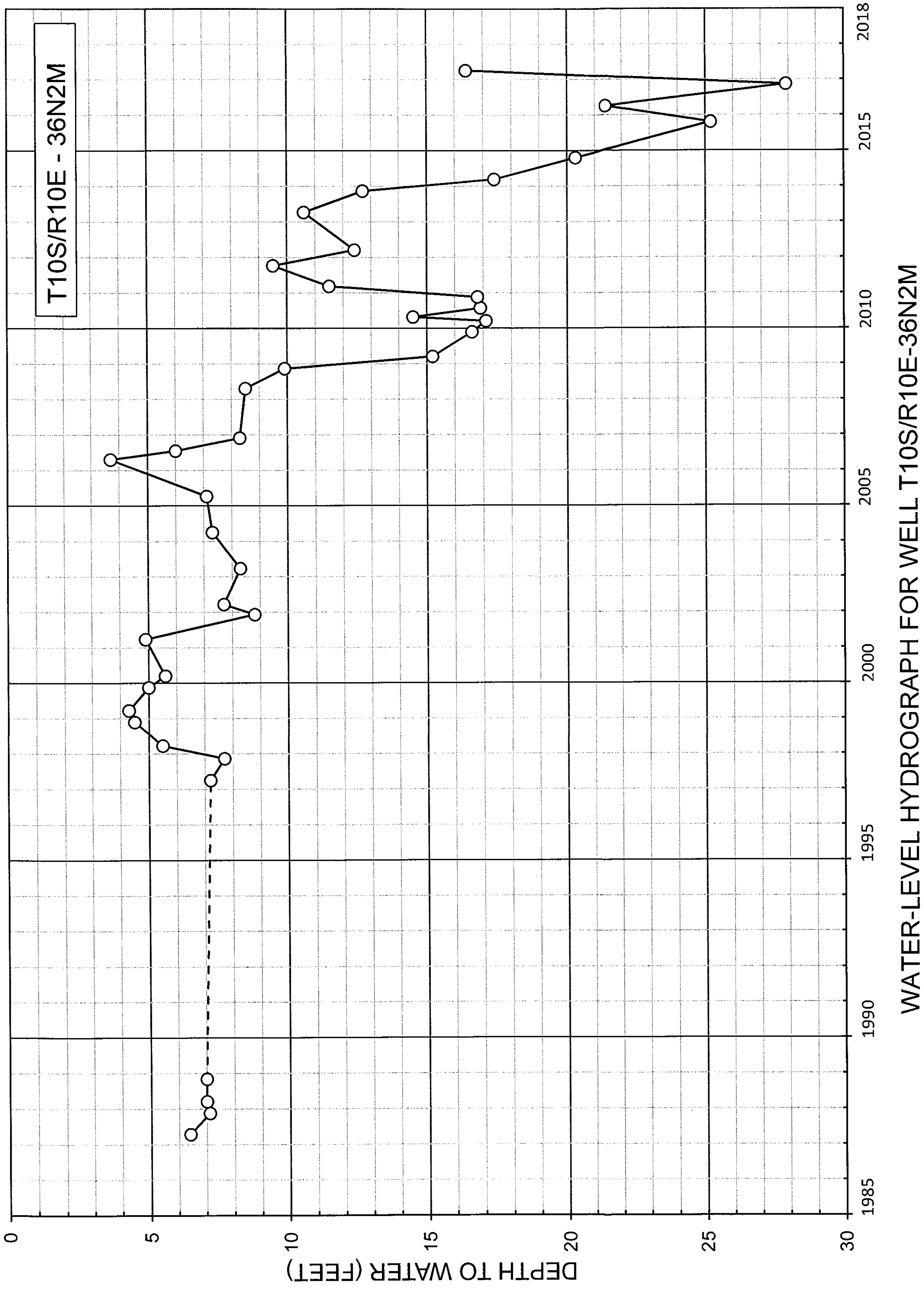
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-26E1M

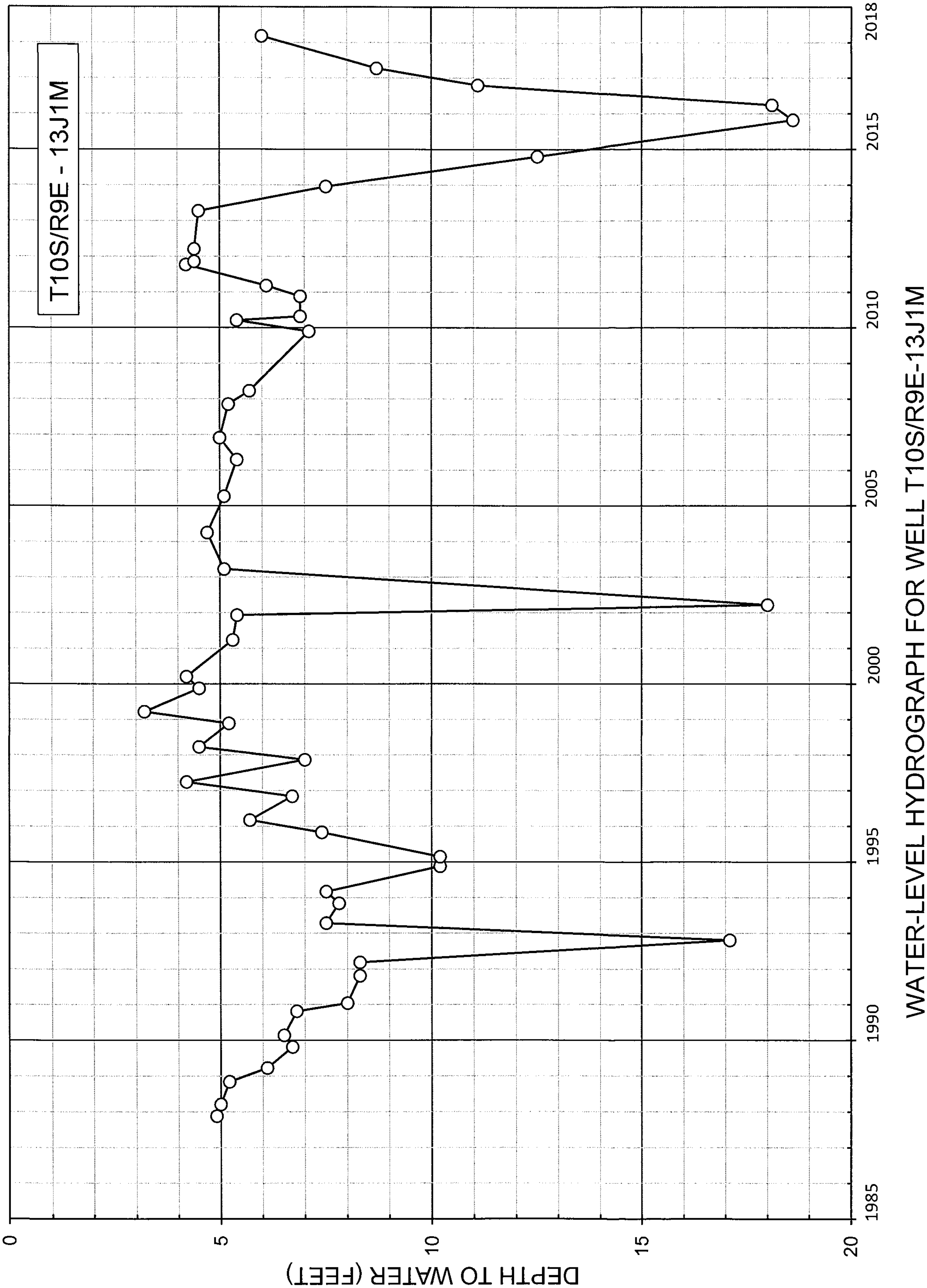

T10S/R10E - 34A1M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-34A1M
DEPTH TO WATER (FEET)
10
15
20
25
30
35
40
45
50
55
1985
1990
1995
2000
2005
2010
2015
2018



WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-34C1M


T10S/R10E - 35K1M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-35K1M
DEPTH TO WATER (FEET)
5
10
15
20
25
30
35
1985
1990
1995
2000
2005
2010
2015
2018


T10S/R10E - 36N2M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R10E-36N2M
DEPTH TO WATER (FEET)
0
5
10
15
20
25
30
1985
1990
1995
2000
2005
2010
2015
2018


T10S/R9E - 13J1M
WATER-LEVEL HYDROGRAPH FOR WELL T10S/R9E-13J1M
DEPTH TO WATER (FEET)
0
5
10
15
20
1985
1990
1995
2000
2005
2010
2015
2018

APPENDIX B

LOS BANOS CREEK STREAMFLOW RECORDS

Los Banos Creek Outflow

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1965													-
1966													-
1967					26		6			3			35
1968			10	6	2	7	2	2	2				31
1969	6,708	11,851	5,952				3			8	12		24,534
1970	4,865	595		12			4					3,273	8,749
1971	1,460				2		12	4	4		3		1,485
1972			3	2		3	3		2		1		14
1973	1,793	8,840	3,810		5	6	3	2	3	4	3	54	14,523
1974	3,979		1,373	3,995	1			4	6	6	6	5	9,375
1975		1,186	4,651	359				7		10	7		6,220
1976	3								1				4
1977									2				2
1978	4,550	15,075	4,455	432						1			24,513
1979		4,614	684	553					1				5,852
1980	4,677	8,277	1,948		3			1				3	14,909
1981	7		153	645				4		1			810
1982	6,367	4,447	1,263	7,252	1,004	1					569	7,942	28,845
1983	9,263	13,178	18,556	3,021	2,529				298		1,872	5,574	54,291
1984	2,297	2,144	454										4,895
1985			766	294					12	3			1,075
1986		5,695	10,608		21	50		48	234				16,656
1987		960		1	3			2	1	1			968
1988	1			1			1		1	4			8
1989				1			1			1			3
1990	1			1				1		2			5
1991	1												1
1992				1						1			2
1993	6,760	6,601	2,292	1,014		1				1			16,669
1994		1,514											1,514
1995	5,794	462	12,888	2,182			1			1			21,328
1996	1,705	11,674	3,208	875	148			7		1	1,015	9,649	28,282
1997	17,825	4,547	976						1				23,349
1998	10,643	37,048	8,422	2,892	1,885	1,190				248	128	282	62,738
1999	1,190	4,630	214	1			1				1		6,037
2000		5,821	1,028										6,849
2001		2	934				1				2		939
2002		192								1		3,588	3,781
2003	2,106		132		1	1							2,240
2004		1,455	735										2,190
2005	5,025	5,140	3,318		809								14,292
2006	3,554		2,310	1,553									7,417
2007									1				1
2008		958							5				963
2009													-

2010		728	2,396									784	3,908
2011	2,864	3,782	5,906	700									13,252
2012													-
2013													-
2014													-
2015													-
2016			5,430	390									5,820
Totals:	103,438	161,416	104,875	26,183	6,439	1,259	38	82	574	297	3,619	31,154	439,374

Sacramento District
Water Control Data System

US Army Corps of Engineers

WCDS HOME GLOSSARY CONTACT DISTRICT HOME

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	01OCT2016	0.0	0.0	20562.	19375.
2400	02OCT2016	0.0	0.0	20562.	19361.
2400	03OCT2016	0.0	0.0	20562.	19356.
2400	04OCT2016	0.0	0.0	20562.	19347.
2400	05OCT2016	0.0	0.0	20562.	19338.
2400	06OCT2016	0.0	0.0	20562.	19334.
2400	07OCT2016	0.0	0.0	20562.	19329.
2400	08OCT2016	0.0	0.0	20562.	19325.
2400	09OCT2016	0.0	0.0	20562.	19306.
2400	10OCT2016	0.0	0.0	20562.	19306.
2400	11OCT2016	0.0	0.0	20562.	19306.
2400	12OCT2016	0.0	0.0	20562.	19297.
2400	13OCT2016	0.0	0.0	20562.	19297.
2400	14OCT2016	0.0	0.0	20562.	19288.
2400	15OCT2016	0.0	0.0	20562.	19288.
2400	16OCT2016	0.0	0.0	20562.	19288.
2400	17OCT2016	0.0	0.0	20562.	19284.
2400	18OCT2016	0.0	0.0	20562.	19279.
2400	19OCT2016	0.0	0.0	20562.	19275.
2400	20OCT2016	0.0	0.0	20562.	19270.
2400	21OCT2016	0.0	0.0	20562.	19261.
2400	22OCT2016	0.0	0.0	20562.	19257.
2400	23OCT2016	0.0	0.0	20562.	19257.
2400	24OCT2016	0.0	0.0	20562.	19243.
2400	25OCT2016	0.0	0.0	20562.	19243.
2400	26OCT2016	0.0	0.0	20562.	19243.
2400	27OCT2016	0.0	0.0	20562.	19243.
2400	28OCT2016	0.0	0.0	20562.	19302.
2400	29OCT2016	0.0	0.0	20562.	19297.
2400	30OCT2016	0.0	0.0	20562.	19297.
2400	31OCT2016	0.0	0.0	20562.	19297.
2400	01NOV2016	0.0	0.0	20562.	19297.
2400	02NOV2016	0.0	0.0	20562.	19284.
2400	03NOV2016	5.0	0.0	20562.	19293.
2400	04NOV2016	0.0	0.0	20562.	19284.
2400	05NOV2016	0.0	0.0	20562.	19284.
2400	06NOV2016	0.0	0.0	20562.	19284.
2400	07NOV2016	0.0	0.0	20562.	19279.
2400	08NOV2016	0.0	0.0	20562.	19279.
2400	09NOV2016	0.0	0.0	20562.	19275.
2400	10NOV2016	0.0	0.0	20562.	19275.
2400	11NOV2016	0.0	0.0	20562.	19270.
2400	12NOV2016	0.0	0.0	20562.	19270.
2400	13NOV2016	3.0	0.0	20562.	19275.
2400	14NOV2016	3.0	0.0	20562.	19266.
2400	15NOV2016	3.0	0.0	20562.	19257.

1

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LOS BANOS LOS BANOS LOS BANOS LOS BANOS

FLOW-RES IN FLOW-RES OUT TOP CON STOR STOR-RES EOP
cfs cfs ac-ft ac-ft

TIME	DATE	PER-AVER	PER-AVER	INST-VAL	INST-VAL
2400	16NOV2016	0.0	0.0	20562.	19257.
2400	17NOV2016	0.0	0.0	20562.	19257.
2400	18NOV2016	0.0	0.0	20562.	19247.
2400	19NOV2016	0.0	0.0	20562.	19234.
2400	20NOV2016	0.0	0.0	20562.	19252.
2400	21NOV2016	0.0	0.0	20562.	19247.
2400	22NOV2016	0.0	0.0	20562.	19247.
2400	23NOV2016	0.0	0.0	20562.	19247.
2400	24NOV2016	0.0	0.0	20562.	19243.
2400	25NOV2016	0.0	0.0	20562.	19234.
2400	26NOV2016	2.0	0.0	20562.	19238.
2400	27NOV2016	2.0	0.0	20562.	19243.
2400	28NOV2016	0.0	0.0	20562.	19234.
2400	29NOV2016	0.0	0.0	20562.	19234.
2400	30NOV2016	0.0	0.0	20562.	19229.
2400	01DEC2016	0.0	0.0	20562.	19229.
2400	02DEC2016	0.0	0.0	20562.	19220.
2400	03DEC2016	0.0	0.0	20562.	19220.
2400	04DEC2016	0.0	0.0	20562.	19220.
2400	05DEC2016	0.0	0.0	20562.	19211.
2400	06DEC2016	0.0	0.0	20562.	19211.
2400	07DEC2016	0.0	0.0	20562.	19211.
2400	08DEC2016	0.0	0.0	20562.	19211.
2400	09DEC2016	0.0	0.0	20562.	19216.
2400	10DEC2016	0.0	0.0	20562.	19211.
2400	11DEC2016	3.0	0.0	20562.	19216.
2400	12DEC2016	0.0	0.0	20562.	19216.
2400	13DEC2016	0.0	0.0	20562.	19216.
2400	14DEC2016	0.0	0.0	20562.	19211.
2400	15DEC2016	4.0	0.0	20562.	19220.
2400	16DEC2016	0.0	0.0	20562.	19216.
2400	17DEC2016	0.0	0.0	20562.	19216.
2400	18DEC2016	0.0	0.0	20562.	19198.
2400	19DEC2016	0.0	0.0	20562.	19198.
2400	20DEC2016	2.0	0.0	20562.	19202.
2400	21DEC2016	0.0	0.0	20562.	19193.
2400	22DEC2016	3.0	0.0	20562.	19198.
2400	23DEC2016	11.0	0.0	20562.	19220.
2400	24DEC2016	0.0	0.0	20562.	19216.
2400	25DEC2016	0.0	0.0	20562.	19207.
2400	26DEC2016	0.0	0.0	20562.	19207.
2400	27DEC2016	0.0	0.0	20562.	19207.
2400	28DEC2016	0.0	0.0	20562.	19207.
2400	29DEC2016	0.0	0.0	20562.	19198.
2400	30DEC2016	0.0	0.0	20562.	19198.
2400	31DEC2016	0.0	0.0	20562.	19198.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	01JAN2017	0.0	0.0	20562.	19184.
2400	02JAN2017	5.0	0.0	20562.	19193.
2400	03JAN2017	0.0	0.0	20562.	19193.
2400	04JAN2017	287.0	0.0	20562.	19763.
2400	05JAN2017	134.0	0.0	20562.	20030.
2400	06JAN2017	54.0	35.0	20562.	20067.
2400	07JAN2017	101.0	50.0	20562.	20169.
2400	08JAN2017	564.0	73.0	20562.	21143.
2400	09JAN2017	651.0	175.0	20562.	22088.
2400	10JAN2017	242.0	200.0	20562.	22171.
2400	11JAN2017	1369.0	688.0	20562.	23522.
2400	12JAN2017	273.0	427.0	20562.	23216.
2400	13JAN2017	140.0	343.0	20562.	22812.
2400	14JAN2017	98.0	258.0	20562.	22495.
2400	15JAN2017	69.0	200.0	20562.	22235.
2400	16JAN2017	63.0	200.0	20562.	21962.
2400	17JAN2017	0.0	200.0	20562.	21565.

2400	18JAN2017	0.0	0.0	20562.	21478.
2400	19JAN2017	394.0	0.0	20562.	21864.
2400	20JAN2017	0.0	217.0	20562.	21435.
2400	21JAN2017	659.0	416.0	20562.	22966.
2400	22JAN2017	886.0	450.0	20562.	23831.
2400	23JAN2017	1565.0	900.0	20562.	25151.
2400	24JAN2017	776.0	907.0	20562.	24890.
2400	25JAN2017	613.0	1800.0	20562.	24306.
2400	26JAN2017	97.0	454.0	20562.	23598.
2400	27JAN2017	62.0	450.0	20562.	22827.
2400	28JAN2017	48.0	450.0	20562.	22030.
2400	29JAN2017	39.0	450.0	20562.	21215.
2400	30JAN2017	28.0	450.0	20562.	20379.
2400	31JAN2017	24.0	150.0	20562.	20128.
2400	01FEB2017	42.0	0.0	20562.	20211.
2400	02FEB2017	0.0	0.0	20562.	20211.
2400	03FEB2017	66.0	0.0	20562.	20458.
2400	04FEB2017	62.0	0.0	20562.	20580.
2400	05FEB2017	47.0	52.0	20562.	20571.
2400	06FEB2017	51.0	129.0	20562.	20416.
2400	07FEB2017	707.0	200.0	20562.	21421.
2400	08FEB2017	399.0	200.0	20562.	21816.
2400	09FEB2017	202.0	200.0	20562.	21821.
2400	10FEB2017	732.0	200.0	20562.	22876.
2400	11FEB2017	310.0	300.0	20562.	22896.
2400	12FEB2017	146.0	399.0	20562.	22392.
2400	13FEB2017	100.0	400.0	20562.	21797.
2400	14FEB2017	68.0	400.0	20562.	21138.
2400	15FEB2017	57.0	400.0	20562.	20458.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	16FEB2017	58.0	300.0	20562.	19979.
2400	17FEB2017	66.0	200.0	20562.	19813.
2400	18FEB2017	106.0	150.0	20562.	19726.
2400	19FEB2017	65.0	99.0	20562.	19657.
2400	20FEB2017	1124.0	116.0	20562.	21656.
2400	21FEB2017	1124.0	300.0	20562.	23291.
2400	22FEB2017	369.0	425.0	20562.	23181.
2400	23FEB2017	187.0	450.0	20562.	22658.
2400	24FEB2017	119.0	450.0	20562.	22001.
2400	25FEB2017	0.0	450.0	20562.	21282.
2400	26FEB2017	72.6	450.2	20562.	20533.
2400	27FEB2017	65.0	325.0	20562.	20016.
2400	28FEB2017	68.0	142.0	20562.	19740.
2400	01MAR2017	100.0	400.0	20562.	21797.
2400	02MAR2017	0.0	0.0	20562.	19882.
2400	03MAR2017	0.0	0.0	20562.	20007.
2400	04MAR2017	47.0	0.0	20562.	20188.
2400	05MAR2017	66.0	0.0	20562.	20318.
2400	06MAR2017	64.0	0.0	20562.	20444.
2400	07MAR2017	43.0	0.0	20562.	20529.
2400	08MAR2017	38.0	0.0	20562.	20604.
2400	09MAR2017	33.0	0.0	20562.	20670.
2400	10MAR2017	33.0	0.0	20562.	20736.
2400	11MAR2017	28.0	0.0	20562.	20792.
2400	12MAR2017	27.0	0.0	20562.	20844.
2400	13MAR2017	26.0	0.0	20562.	20896.
2400	14MAR2017	19.0	0.0	20562.	20934.
2400	15MAR2017	22.0	0.0	20562.	20977.
2400	16MAR2017	14.0	0.0	20723.	21005.
2400	17MAR2017	17.0	0.0	20884.	21039.
2400	18MAR2017	14.0	0.0	21045.	21067.
2400	19MAR2017	19.0	0.0	21206.	21105.
2400	20MAR2017	19.0	0.0	21367.	21143.
2400	21MAR2017	19.0	0.0	21528.	21181.
2400	22MAR2017	31.0	0.0	21688.	21243.
2400	23MAR2017	20.0	0.0	21849.	21282.

2400	24MAR2017	17.0	0.0	22010.	21315.
2400	25MAR2017	19.0	0.0	22171.	21353.
2400	26MAR2017	0.0	0.0	22332.	21353.
2400	27MAR2017	19.0	0.0	22493.	21430.
2400	28MAR2017	8.0	0.0	22654.	21445.
2400	29MAR2017	17.0	0.0	22815.	21478.
2400	30MAR2017	8.0	0.0	22976.	21493.
2400	31MAR2017	7.0	0.0	23137.	21507.
2400	01APR2017	7.0	0.0	23298.	21521.
2400	02APR2017	0.0	0.0	23459.	21445.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	03APR2017	97.0	0.0	23619.	21637.
2400	04APR2017	8.0	0.0	23780.	21652.
2400	05APR2017	4.5	0.0	23941.	21661.
2400	06APR2017	12.0	0.0	24102.	21685.
2400	07APR2017	0.0	0.0	24263.	21709.
2400	08APR2017	17.0	0.0	24424.	21743.
2400	09APR2017	8.0	0.0	24585.	21758.
2400	10APR2017	7.0	0.0	24746.	21772.
2400	11APR2017	13.0	0.0	24907.	21797.
2400	12APR2017	0.0	0.0	25068.	21801.
2400	13APR2017	13.0	0.0	25229.	21826.
2400	14APR2017	2.0	0.0	25390.	21830.
2400	15APR2017	8.0	0.0	25551.	21845.
2400	16APR2017	10.0	0.0	25711.	21864.
2400	17APR2017	5.0	0.0	25872.	21874.
2400	18APR2017	12.0	0.0	26033.	21898.
2400	19APR2017	0.0	0.0	26194.	21898.
2400	20APR2017	0.0	0.0	26355.	21935.
2400	21APR2017	0.0	0.0	26516.	21937.
2400	22APR2017	0.0	0.0	26677.	21937.
2400	23APR2017	10.0	0.0	26838.	21957.
2400	24APR2017	0.0	0.0	26999.	21952.
2400	25APR2017	3.0	0.0	27160.	21957.
2400	26APR2017	0.0	0.0	27321.	21957.
2400	27APR2017	3.0	0.0	27482.	21962.
2400	28APR2017	0.0	0.0	27642.	21962.
2400	29APR2017	0.0	0.0	27803.	21962.
2400	30APR2017	12.0	0.0	27964.	21986.
2400	01MAY2017	0.0	0.0	28125.	21962.
2400	02MAY2017	0.0	0.0	28286.	21962.
2400	03MAY2017	4.5	0.0	28447.	21971.
2400	04MAY2017	0.0	0.0	28608.	21952.
2400	05MAY2017	0.0	0.0	28769.	21957.
2400	06MAY2017	0.0	0.0	28930.	21947.
2400	07MAY2017	0.0	0.0	29091.	21937.
2400	08MAY2017	0.0	0.0	29252.	21937.
2400	09MAY2017	0.0	0.0	29413.	21932.
2400	10MAY2017	0.0	0.0	29573.	21923.
2400	11MAY2017	0.0	0.0	29734.	21918.
2400	12MAY2017	0.0	0.0	29895.	21918.
2400	13MAY2017	0.0	0.0	30056.	21903.
2400	14MAY2017	0.0	0.0	30217.	21894.
2400	15MAY2017	0.0	0.0	30378.	21884.
2400	16MAY2017	0.0	0.0	30539.	21836.
2400	17MAY2017	0.0	0.0	30700.	21869.
2400	18MAY2017	0.0	0.0	30861.	21867.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL

2400	19MAY2018	0.0	0.0	31183.	19919.
2400	20MAY2018	0.0	0.0	31344.	19915.
2400	21MAY2018	0.0	0.0	31505.	19901.
2400	22MAY2018	0.0	0.0	31665.	19896.
2400	23MAY2018	0.0	0.0	31826.	19887.
2400	24MAY2018	0.0	0.0	31987.	19873.
2400	25MAY2018	0.0	0.0	32148.	19869.
2400	26MAY2018	0.0	0.0	32309.	19864.
2400	27MAY2018	0.0	0.0	32470.	19901.
2400	28MAY2018	0.0	0.0	32631.	19855.
2400	29MAY2018	0.0	0.0	32792.	19850.
2400	30MAY2018	0.0	0.0	32953.	19823.
2400	31MAY2018	0.0	0.0	33114.	19813.
2400	01JUN2018	0.0	0.0	33275.	19804.
2400	02JUN2018	0.0	0.0	33436.	19800.
2400	03JUN2018	0.0	0.0	33596.	19800.
2400	04JUN2018	0.0	0.0	33757.	19786.
2400	05JUN2018	0.0	0.0	33918.	19763.
2400	06JUN2018	0.0	0.0	34079.	19740.
2400	07JUN2018	0.0	0.0	34240.	19726.
2400	08JUN2018	0.0	0.0	34401.	19722.
2400	09JUN2018	0.0	0.0	34562.	19703.
2400	10JUN2018	26.0	0.0	34562.	19754.
2400	11JUN2018	0.0	0.0	34562.	19754.
2400	12JUN2018	0.0	0.0	34562.	19676.
2400	13JUN2018	0.0	0.0	34562.	19667.
2400	14JUN2018	0.0	0.0	34562.	19653.
2400	15JUN2018	0.0	0.0	34562.	19644.
2400	16JUN2018	0.0	0.0	34562.	19644.
2400	17JUN2018	0.0	0.0	34562.	19616.
2400	18JUN2018	0.0	0.0	34562.	19607.
2400	19JUN2018	0.0	0.0	34562.	19593.
2400	20JUN2018	25.0	0.0	34562.	19644.
2400	21JUN2018	0.0	0.0	34562.	19575.
2400	22JUN2018	0.0	0.0	34562.	19566.
2400	23JUN2018	34.0	0.0	34562.	19634.
2400	24JUN2018	0.0	0.0	34562.	19534.
2400	25JUN2018	0.0	0.0	34562.	19529.
2400	26JUN2018	0.0	0.0	34562.	19516.
2400	27JUN2018	0.0	0.0	34562.	19497.
2400	28JUN2018	0.0	0.0	34562.	19479.
2400	29JUN2018	0.0	0.0	34562.	19470.
2400	30JUN2018	0.0	0.0	34562.	19466.
2400	01JUL2018	0.0	0.0	34562.	19447.
2400	02JUL2018	0.0	0.0	34562.	19438.
2400	03JUL2018	0.0	0.0	34562.	19461.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	04JUL2018	0.0	0.0	34562.	19415.
2400	05JUL2018	0.0	0.0	34562.	19402.
2400	06JUL2018	0.0	0.0	34562.	19393.
2400	07JUL2018	37.0	0.0	34562.	19466.
2400	08JUL2018	0.0	0.0	34562.	19361.
2400	09JUL2018	46.0	0.0	34562.	19452.
2400	10JUL2018	0.0	0.0	34562.	19347.
2400	11JUL2018	0.0	0.0	34562.	19320.
2400	12JUL2018	0.0	0.0	34562.	19306.
2400	13JUL2018	0.0	0.0	34562.	19306.
2400	14JUL2018	0.0	0.0	34562.	19306.
2400	15JUL2018	0.0	0.0	34562.	19275.
2400	16JUL2018	0.0	0.0	34562.	19261.
2400	17JUL2018	0.0	0.0	34562.	19252.
2400	18JUL2018	0.0	0.0	34562.	19243.
2400	19JUL2018	0.0	0.0	34562.	19225.
2400	20JUL2018	0.0	0.0	34562.	19207.
2400	21JUL2018	0.0	0.0	34562.	19198.
2400	22JUL2018	0.0	0.0	34562.	19180.

2400	23JUL2017	0.0	0.0	34562.	21153.
2400	24JUL2017	0.0	0.0	34562.	21143.
2400	25JUL2017	0.0	0.0	34562.	21129.
2400	26JUL2017	0.0	0.0	34562.	21119.
2400	27JUL2017	0.0	0.0	34562.	21110.
2400	28JUL2017	0.0	0.0	34562.	21091.
2400	29JUL2017	0.0	0.0	34562.	21077.
2400	30JUL2017	0.0	0.0	34562.	21077.
2400	31JUL2017	0.0	0.0	34562.	21072.
2400	01AUG2017	0.0	0.0	34562.	21048.
2400	02AUG2017	0.0	0.0	34562.	21039.
2400	03AUG2017	0.0	0.0	34562.	21024.
2400	04AUG2017	0.0	0.0	34562.	21015.
2400	05AUG2017	0.0	0.0	34562.	21005.
2400	06AUG2017	0.0	0.0	34562.	20986.
2400	07AUG2017	0.0	0.0	34562.	20982.
2400	08AUG2017	0.0	0.0	34562.	20967.
2400	09AUG2017	0.0	0.0	34562.	20948.
2400	10AUG2017	0.0	0.0	34562.	20939.
2400	11AUG2017	0.0	0.0	34221.	20929.
2400	12AUG2017	0.0	0.0	33879.	20920.
2400	13AUG2017	0.0	0.0	33538.	20906.
2400	14AUG2017	0.0	0.0	33196.	20891.
2400	15AUG2017	0.0	0.0	32855.	20877.
2400	16AUG2017	0.0	0.0	32513.	20863.
2400	17AUG2017	0.0	0.0	32172.	20863.
2400	18AUG2017	0.0	0.0	31830.	20844.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	19AUG2017	0.0	0.0	31489.	20835.
2400	20AUG2017	0.0	0.0	31147.	20825.
2400	21AUG2017	0.0	0.0	30806.	20816.
2400	22AUG2017	0.0	0.0	30464.	20806.
2400	23AUG2017	0.0	0.0	30123.	20797.
2400	24AUG2017	0.0	0.0	29782.	20787.
2400	25AUG2017	0.0	0.0	29440.	20778.
2400	26AUG2017	0.0	0.0	29099.	20764.
2400	27AUG2017	0.0	0.0	28757.	20759.
2400	28AUG2017	0.0	0.0	28416.	20745.
2400	29AUG2017	0.0	0.0	28074.	20745.
2400	30AUG2017	0.0	0.0	27733.	20721.
2400	31AUG2017	0.0	0.0	27391.	20721.
2400	01SEP2017	0.0	0.0	27050.	20698.
2400	02SEP2017	0.0	0.0	26708.	20698.
2400	03SEP2017	0.0	0.0	26367.	20684.
2400	04SEP2017	0.0	0.0	26025.	20674.
2400	05SEP2017	0.0	0.0	25684.	20660.
2400	06SEP2017	0.0	0.0	25342.	20651.
2400	07SEP2017	0.0	0.0	25001.	20641.
2400	08SEP2017	0.0	0.0	24660.	20632.
2400	09SEP2017	0.0	0.0	24318.	20627.
2400	10SEP2017	0.0	0.0	23977.	20613.
2400	11SEP2017	0.0	0.0	23635.	20613.
2400	12SEP2017	0.0	0.0	23294.	20604.
2400	13SEP2017	0.0	0.0	22952.	20585.
2400	14SEP2017	0.0	0.0	22611.	20557.
2400	15SEP2017	0.0	0.0	22269.	20557.
2400	16SEP2017	2.5	0.0	21928.	20562.
2400	17SEP2017	0.0	0.0	21586.	20552.
2400	18SEP2017	0.0	0.0	21245.	20524.
2400	19SEP2017	0.0	0.0	20903.	20515.
2400	20SEP2017	0.0	0.0	20562.	20496.
2400	21SEP2017	0.0	0.0	20562.	20490.
2400	22SEP2017	0.0	0.0	20562.	20482.
2400	23SEP2017	0.0	0.0	20562.	20468.
2400	24SEP2017	0.0	0.0	20562.	20454.
2400	25SEP2017	0.0	0.0	20562.	20454.

2400 26SEP2017	0.0	0.0	20562.	20449.
2400 27SEP2017	0.0	0.0	20562.	20435.
2400 28SEP2017	2.5	0.0	20562.	20440.
2400 29SEP2017	0.0	0.0	20562.	20435.
2400 30SEP2017	0.0	0.0	20562.	20416.

***** Advisory: Inflows are a computed value. The inflows are computed from changes in storages which can produce erratic hourly results. Inflows can be averaged over several hours to produce a more realistic value.**

Sacramento District
Water Control Data System

US Army Corps of Engineers

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	01OCT2017	0.0	0.0	20562.	20407.
2400	02OCT2017	0.0	0.0	20562.	20398.
2400	03OCT2017	0.0	0.0	20562.	20388.
2400	04OCT2017	0.0	0.0	20562.	20384.
2400	05OCT2017	0.0	0.0	20562.	20374.
2400	06OCT2017	0.0	0.0	20562.	20370.
2400	07OCT2017	0.0	0.0	20562.	20356.
2400	08OCT2017	0.0	0.0	20562.	20351.
2400	09OCT2017	0.0	0.0	20562.	20346.
2400	10OCT2017	0.0	0.0	20562.	20337.
2400	11OCT2017	0.0	0.0	20562.	20328.
2400	12OCT2017	0.0	0.0	20562.	20328.
2400	13OCT2017	0.0	0.0	20562.	20314.
2400	14OCT2017	0.0	0.0	20562.	20309.
2400	15OCT2017	0.0	0.0	20562.	20304.
2400	16OCT2017	0.0	0.0	20562.	20295.
2400	17OCT2017	2.0	44.0	20562.	20211.
2400	18OCT2017	0.0	75.0	20562.	20063.
2400	19OCT2017	0.0	75.0	20562.	19910.
2400	20OCT2017	0.0	46.0	20562.	19809.
2400	21OCT2017	0.0	0.0	20562.	19809.
2400	22OCT2017	0.0	0.0	20562.	19809.
2400	23OCT2017	0.0	0.0	20562.	19800.
2400	24OCT2017	0.0	0.0	20562.	19800.
2400	25OCT2017	0.0	0.0	20562.	19800.
2400	26OCT2017	0.0	0.0	20562.	19800.
2400	27OCT2017	0.0	0.0	20562.	19790.
2400	28OCT2017	0.0	0.0	20562.	19790.
2400	29OCT2017	0.0	0.0	20562.	19790.
2400	30OCT2017	0.0	0.0	20562.	19786.
2400	31OCT2017	0.0	0.0	20562.	19786.
2400	01NOV2017	0.0	0.0	20562.	19777.
2400	02NOV2017	0.0	0.0	20562.	19777.
2400	03NOV2017	0.0	0.0	20562.	19772.
2400	04NOV2017	0.0	0.0	20562.	19772.
2400	05NOV2017	0.0	0.0	20562.	19772.
2400	06NOV2017	0.0	0.0	20562.	19767.
2400	07NOV2017	0.0	0.0	20562.	19763.
2400	08NOV2017	0.0	0.0	20562.	19758.
2400	09NOV2017	0.0	0.0	20562.	19758.
2400	10NOV2017	0.0	0.0	20562.	19758.
2400	11NOV2017	3.0	0.0	20562.	19763.
2400	12NOV2017	0.0	0.0	20562.	19763.
2400	13NOV2017	0.0	0.0	20562.	19754.
2400	14NOV2017	0.0	0.0	20562.	19744.
2400	15NOV2017	0.0	0.0	20562.	19744.

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LOS BANOS	LOS BANOS	LOS BANOS	LOS BANOS
FLOW-RES IN cfs	FLOW-RES OUT cfs	TOP CON STOR ac-ft	STOR-RES EOP ac-ft

TIME	DATE	PER-AVER	PER-AVER	INST-VAL	INST-VAL
2400	16NOV2017	7.0	0.0	20562.	19758.
2400	17NOV2017	0.0	0.0	20562.	19758.
2400	18NOV2017	0.0	0.0	20562.	19758.
2400	19NOV2017	0.0	0.0	20562.	19758.
2400	20NOV2017	0.0	0.0	20562.	19754.
2400	21NOV2017	2.5	0.0	20562.	19749.
2400	22NOV2017	0.0	0.0	20562.	19749.
2400	23NOV2017	0.0	0.0	20562.	19744.
2400	24NOV2017	2.5	0.0	20562.	19749.
2400	25NOV2017	2.5	0.0	20562.	19744.
2400	26NOV2017	0.0	2.5	20562.	19749.
2400	27NOV2017	0.0	0.0	20562.	19749.
2400	28NOV2017	0.0	0.0	20562.	19744.
2400	29NOV2017	0.0	0.0	20562.	19744.
2400	30NOV2017	0.0	0.0	20562.	19744.
2400	01DEC2017	0.0	0.0	20562.	19735.
2400	02DEC2017	0.0	0.0	20562.	19731.
2400	03DEC2017	0.0	0.0	20562.	19731.
2400	04DEC2017	0.0	0.0	20562.	19726.
2400	05DEC2017	0.0	0.0	20562.	19722.
2400	06DEC2017	0.0	0.0	20562.	19722.
2400	07DEC2017	0.0	0.0	20562.	19717.
2400	08DEC2017	0.0	0.0	20562.	19717.
2400	09DEC2017	0.0	0.0	20562.	19717.
2400	10DEC2017	0.0	0.0	20562.	19708.
2400	11DEC2017	0.0	0.0	20562.	19703.
2400	12DEC2017	0.0	0.0	20562.	19699.
2400	13DEC2017	0.0	0.0	20562.	19699.
2400	14DEC2017	0.0	0.0	20562.	19699.
2400	15DEC2017	2.0	0.0	20562.	19703.
2400	16DEC2017	0.0	0.0	20562.	19699.
2400	17DEC2017	0.0	0.0	20562.	19685.
2400	18DEC2017	0.0	0.0	20562.	19685.
2400	19DEC2017	0.0	0.0	20562.	19685.
2400	20DEC2017	0.0	0.0	20562.	19680.
2400	21DEC2017	0.0	0.0	20562.	19680.
2400	22DEC2017	0.0	0.0	20562.	19671.
2400	23DEC2017	0.0	0.0	20562.	19676.
2400	24DEC2017	0.0	0.0	20562.	19671.
2400	25DEC2017	0.0	0.0	20562.	19671.
2400	26DEC2017	0.0	0.0	20562.	19671.
2400	27DEC2017	0.0	0.0	20562.	19671.
2400	28DEC2017	0.0	0.0	20562.	19662.
2400	29DEC2017	3.0	0.0	20562.	19667.
2400	30DEC2017	0.0	0.0	20562.	19662.
2400	31DEC2017	0.0	0.0	20562.	19662.

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		LOS BANOS	LOS BANOS	LOS BANOS	LOS BANOS
		FLOW-RES IN	FLOW-RES OUT	TOP CON STOR	STOR-RES EOP
		cfs	cfs	ac-ft	ac-ft
TIME	DATE	PER-AVER	PER-AVER	INST-VAL	INST-VAL
2400	01JAN2018	0.0	0.0	20562.	19662.
2400	02JAN2018	0.0	0.0	20562.	19662.
2400	03JAN2018	2.5	0.0	20562.	19667.
2400	04JAN2018	0.0	0.0	20562.	19667.
2400	05JAN2018	0.0	0.0	20562.	19667.
2400	06JAN2018	0.0	0.0	20562.	19676.
2400	07JAN2018	0.0	0.0	20562.	19671.
2400	08JAN2018	19.0	0.0	20562.	19708.
2400	09JAN2018	21.0	0.0	20562.	19749.
2400	10JAN2018	0.0	0.0	20562.	19747.
2400	11JAN2018	0.0	0.0	20562.	19744.
2400	12JAN2018	0.0	0.0	20562.	19749.
2400	13JAN2018	0.0	0.0	20562.	19744.
2400	14JAN2018	3.0	0.0	20562.	19749.
2400	15JAN2018	0.0	0.0	20562.	19744.
2400	16JAN2018	3.0	0.0	20562.	19749.
2400	17JAN2018	0.0	0.0	20562.	19754.

2400	18JAN2018	3.0	0.0	20562.	19754.
2400	19JAN2018	0.0	0.0	20562.	19754.
2400	20JAN2018	0.0	0.0	20562.	19754.
2400	21JAN2018	0.0	0.0	20562.	19740.
2400	22JAN2018	0.0	0.0	20562.	19735.
2400	23JAN2018	0.0	0.0	20562.	19740.
2400	24JAN2018	0.0	0.0	20562.	19740.
2400	25JAN2018	0.0	0.0	20562.	19740.
2400	26JAN2018	0.0	0.0	20562.	19735.
2400	27JAN2018	0.0	0.0	20562.	19731.
2400	28JAN2018	0.0	0.0	20562.	19731.
2400	29JAN2018	0.0	0.0	20562.	19731.
2400	30JAN2018	2.0	0.0	20562.	19735.
2400	31JAN2018	0.0	0.0	20562.	19731.
2400	01FEB2018	0.0	0.0	20562.	19726.
2400	02FEB2018	0.0	0.0	20562.	19726.
2400	03FEB2018	0.0	0.0	20562.	19731.
2400	04FEB2018	2.0	0.0	20562.	19726.
2400	05FEB2018	0.0	0.0	20562.	19722.
2400	06FEB2018	0.0	0.0	20562.	19722.
2400	07FEB2018	0.0	0.0	20562.	19717.
2400	08FEB2018	0.0	0.0	20562.	19717.
2400	09FEB2018	0.0	0.0	20562.	19712.
2400	10FEB2018	0.0	0.0	20562.	19712.
2400	11FEB2018	0.0	0.0	20562.	19708.
2400	12FEB2018	0.0	0.0	20562.	19708.
2400	13FEB2018	0.0	0.0	20562.	19708.
2400	14FEB2018	0.0	0.0	20562.	19585.
2400	15FEB2018	0.0	0.0	20562.	19694.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	16FEB2018	0.0	0.0	20562.	19685.
2400	17FEB2018	0.0	0.0	20562.	19680.
2400	18FEB2018	0.0	0.0	20562.	19680.
2400	19FEB2018	0.0	0.0	20562.	19671.
2400	20FEB2018	0.0	0.0	20562.	19657.
2400	21FEB2018	0.0	0.0	20562.	19657.
2400	22FEB2018	0.0	0.0	20562.	19648.
2400	23FEB2018	0.0	0.0	20562.	19648.
2400	24FEB2018	0.0	0.0	20562.	19644.
2400	25FEB2018	0.0	0.0	20562.	19639.
2400	26FEB2018	2.5	0.0	20562.	19644.
2400	27FEB2018	2.0	0.0	20562.	19648.
2400	28FEB2018	0.0	0.0	20562.	19648.
2400	01MAR2018	11.0	0.0	20562.	19657.
2400	02MAR2018	5.0	0.0	20562.	19667.
2400	03MAR2018	0.0	3.5	20562.	19662.
2400	04MAR2018	0.0	0.0	20562.	19657.
2400	05MAR2018	0.0	0.0	20562.	19657.
2400	06MAR2018	0.0	0.0	20562.	19653.
2400	07MAR2018	0.0	0.0	20562.	19653.
2400	08MAR2018	0.0	0.0	20562.	19653.
2400	09MAR2018	0.0	0.0	20562.	19653.
2400	10MAR2018	2.0	0.0	20562.	19657.
2400	11MAR2018	0.0	0.0	20562.	19635.
2400	12MAR2018	0.0	0.0	20562.	19653.
2400	13MAR2018	0.0	0.0	20562.	19653.
2400	14MAR2018	0.0	0.0	20562.	19653.
2400	15MAR2018	0.0	0.0	20723.	19648.
2400	16MAR2018	0.0	0.0	20884.	19644.
2400	17MAR2018	2.0	0.0	21045.	19648.
2400	18MAR2018	0.0	0.0	21206.	19648.
2400	19MAR2018	0.0	0.0	21367.	19648.
2400	20MAR2018	5.0	0.0	21528.	19657.
2400	21MAR2018	7.0	0.0	21688.	19671.
2400	22MAR2018	79.0	0.0	21849.	19827.
2400	23MAR2018	86.0	0.0	22010.	19998.

2400	24MAR2018	26.0	0.0	22171.	20049.
2400	25MAR2018	14.0	0.0	22332.	20077.
2400	26MAR2018	11.0	0.0	22493.	20100.
2400	27MAR2018	7.0	0.0	22654.	20114.
2400	28MAR2018	7.0	0.0	22815.	20128.
2400	29MAR2018	7.0	0.0	22976.	20141.
2400	30MAR2018	0.0	0.0	23137.	20141.
2400	31MAR2018	0.0	0.0	23298.	20115.
2400	01APR2018	0.0	0.0	23459.	20115.
2400	02APR2018	0.0	0.0	23619.	20151.

		LOS BANOS	LOS BANOS	LOS BANOS	LOS BANOS
		FLOW-RES IN	FLOW-RES OUT	TOP CON STOR	STOR-RES EOP
		cfs	cfs	ac-ft	ac-ft
TIME	DATE	PER-AVER	PER-AVER	INST-VAL	INST-VAL
2400	03APR2018	0.0	0.0	23780.	20151.
2400	04APR2018	0.0	0.0	23941.	20141.
2400	05APR2018	3.0	0.0	24102.	20146.
2400	06APR2018	3.0	0.0	24263.	20151.
2400	07APR2018	5.0	0.0	24424.	20160.
2400	08APR2018	3.0	0.0	24585.	20165.
2400	09APR2018	5.0	0.0	24746.	20174.
2400	10APR2018	0.0	0.0	24907.	20174.
2400	11APR2018	0.0	0.0	25068.	20169.
2400	12APR2018	5.0	0.0	25229.	20179.
2400	13APR2018	0.0	0.0	25390.	20155.
2400	14APR2018	0.0	0.0	25551.	20155.
2400	15APR2018	0.0	0.0	25711.	20146.
2400	16APR2018	0.0	0.0	25872.	20146.
2400	17APR2018	0.0	0.0	26033.	20146.
2400	18APR2018	0.0	0.0	26194.	20141.
2400	19APR2018	0.0	0.0	26355.	20132.
2400	20APR2018	0.0	0.0	26516.	20132.
2400	21APR2018	0.0	0.0	26677.	20132.
2400	22APR2018	0.0	0.0	26838.	20128.
2400	23APR2018	0.0	0.0	26999.	20128.
2400	24APR2018	0.0	0.0	27160.	20118.
2400	25APR2018	0.0	0.0	27321.	20114.
2400	26APR2018	0.0	0.0	27482.	20100.
2400	27APR2018	0.0	0.0	27642.	20100.
2400	28APR2018	0.0	0.0	27803.	20090.
2400	29APR2018	0.0	0.0	27964.	20077.
2400	30APR2018	0.0	0.0	28125.	20077.
2400	01MAY2018	0.0	0.0	28286.	20067.
2400	02MAY2018	0.0	0.0	28447.	20053.
2400	03MAY2018	0.0	0.0	28608.	20072.
2400	04MAY2018	0.0	0.0	28769.	20049.
2400	05MAY2018	0.0	0.0	28930.	20044.
2400	06MAY2018	0.0	0.0	29091.	20040.
2400	07MAY2018	0.0	0.0	29252.	20035.
2400	08MAY2018	0.0	0.0	29413.	20040.
2400	09MAY2018	0.0	0.0	29573.	20021.
2400	10MAY2018	0.0	0.0	29734.	20026.
2400	11MAY2018	0.0	0.0	29895.	20012.
2400	12MAY2018	0.0	0.0	30056.	19984.
2400	13MAY2018	7.0	0.0	30217.	19998.
2400	14MAY2018	0.0	0.0	30378.	19970.
2400	15MAY2018	0.0	0.0	30539.	19956.
2400	16MAY2018	0.0	0.0	30700.	19947.
2400	17MAY2018	0.0	0.0	30861.	19942.
2400	18MAY2018	0.0	0.0	31022.	19933.

		LOS BANOS	LOS BANOS	LOS BANOS	LOS BANOS
		FLOW-RES IN	FLOW-RES OUT	TOP CON STOR	STOR-RES EOP
		cfs	cfs	ac-ft	ac-ft
TIME	DATE	PER-AVER	PER-AVER	INST-VAL	INST-VAL

2400 19MAY2018	0.0	0.0	31183.	19919.
2400 20MAY2018	0.0	0.0	31344.	19915.
2400 21MAY2018	0.0	0.0	31505.	19901.
2400 22MAY2018	0.0	0.0	31665.	19896.
2400 23MAY2018	0.0	0.0	31826.	19887.
2400 24MAY2018	0.0	0.0	31987.	19873.
2400 25MAY2018	0.0	0.0	32148.	19869.
2400 26MAY2018	0.0	0.0	32309.	19864.
2400 27MAY2018	0.0	0.0	32470.	19901.
2400 28MAY2018	0.0	0.0	32631.	19855.
2400 29MAY2018	0.0	0.0	32792.	19850.
2400 30MAY2018	0.0	0.0	32953.	19823.
2400 31MAY2018	0.0	0.0	33114.	19813.
2400 01JUN2018	0.0	0.0	33275.	19804.
2400 02JUN2018	0.0	0.0	33436.	19800.
2400 03JUN2018	0.0	0.0	33596.	19800.
2400 04JUN2018	0.0	0.0	33757.	19786.
2400 05JUN2018	0.0	0.0	33918.	19763.
2400 06JUN2018	0.0	0.0	34079.	19740.
2400 07JUN2018	0.0	0.0	34240.	19726.
2400 08JUN2018	0.0	0.0	34401.	19722.
2400 09JUN2018	0.0	0.0	34562.	19703.
2400 10JUN2018	26.0	0.0	34562.	19754.
2400 11JUN2018	0.0	0.0	34562.	19754.
2400 12JUN2018	0.0	0.0	34562.	19676.
2400 13JUN2018	0.0	0.0	34562.	19667.
2400 14JUN2018	0.0	0.0	34562.	19653.
2400 15JUN2018	0.0	0.0	34562.	19644.
2400 16JUN2018	0.0	0.0	34562.	19644.
2400 17JUN2018	0.0	0.0	34562.	19616.
2400 18JUN2018	0.0	0.0	34562.	19607.
2400 19JUN2018	0.0	0.0	34562.	19593.
2400 20JUN2018	25.0	0.0	34562.	19644.
2400 21JUN2018	0.0	0.0	34562.	19575.
2400 22JUN2018	0.0	0.0	34562.	19566.
2400 23JUN2018	34.0	0.0	34562.	19634.
2400 24JUN2018	0.0	0.0	34562.	19534.
2400 25JUN2018	0.0	0.0	34562.	19529.
2400 26JUN2018	0.0	0.0	34562.	19516.
2400 27JUN2018	0.0	0.0	34562.	19497.
2400 28JUN2018	0.0	0.0	34562.	19479.
2400 29JUN2018	0.0	0.0	34562.	19470.
2400 30JUN2018	0.0	0.0	34562.	19466.
2400 01JUL2018	0.0	0.0	34562.	19447.
2400 02JUL2018	0.0	0.0	34562.	19438.
2400 03JUL2018	0.0	0.0	34562.	19461.

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TIME DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400 04JUL2018	0.0	0.0	34562.	19415.
2400 05JUL2018	0.0	0.0	34562.	19402.
2400 06JUL2018	0.0	0.0	34562.	19393.
2400 07JUL2018	37.0	0.0	34562.	19466.
2400 08JUL2018	0.0	0.0	34562.	19361.
2400 09JUL2018	46.0	0.0	34562.	19452.
2400 10JUL2018	0.0	0.0	34562.	19347.
2400 11JUL2018	0.0	0.0	34562.	19320.
2400 12JUL2018	0.0	0.0	34562.	19306.
2400 13JUL2018	0.0	0.0	34562.	19306.
2400 14JUL2018	0.0	0.0	34562.	19306.
2400 15JUL2018	0.0	0.0	34562.	19275.
2400 16JUL2018	0.0	0.0	34562.	19261.
2400 17JUL2018	0.0	0.0	34562.	19252.
2400 18JUL2018	0.0	0.0	34562.	19243.
2400 19JUL2018	0.0	0.0	34562.	19225.
2400 20JUL2018	0.0	0.0	34562.	19207.
2400 21JUL2018	0.0	0.0	34562.	19198.
2400 22JUL2018	0.0	0.0	34562.	19180.

2400	23JUL2018	0.0	0.0	34562.	19175.
2400	24JUL2018	0.0	0.0	34562.	19162.
2400	25JUL2018	0.0	0.0	34562.	19144.
2400	26JUL2018	0.0	0.0	34562.	19130.
2400	27JUL2018	0.0	0.0	34562.	19116.
2400	28JUL2018	0.0	0.0	34562.	19112.
2400	29JUL2018	0.0	0.0	34562.	19089.
2400	30JUL2018	0.0	0.0	34562.	19080.
2400	31JUL2018	0.0	0.0	34562.	19067.
2400	01AUG2018	0.0	0.0	34562.	19053.
2400	02AUG2018	0.0	0.0	34562.	19040.
2400	03AUG2018	0.0	0.0	34562.	19026.
2400	04AUG2018	0.0	0.0	34562.	19008.
2400	05AUG2018	0.0	0.0	34562.	18995.
2400	06AUG2018	0.0	0.0	34562.	18986.
2400	07AUG2018	0.0	0.0	34562.	18981.
2400	08AUG2018	0.0	0.0	34562.	18963.
2400	09AUG2018	0.0	0.0	34562.	18954.
2400	10AUG2018	0.0	0.0	34221.	18941.
2400	11AUG2018	0.0	0.0	33879.	18936.
2400	12AUG2018	0.0	0.0	33538.	18914.
2400	13AUG2018	0.0	0.0	33196.	18901.
2400	14AUG2018	0.0	0.0	32855.	18887.
2400	15AUG2018	0.0	0.0	32513.	18878.
2400	16AUG2018	0.0	0.0	32172.	18878.
2400	17AUG2018	0.0	0.0	31830.	18860.
2400	18AUG2018	0.0	0.0	31489.	18847.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	19AUG2018	0.0	0.0	31147.	18838.
2400	20AUG2018	0.0	0.0	30806.	18820.
2400	21AUG2018	0.0	0.0	30464.	18820.
2400	22AUG2018	0.0	0.0	30123.	18807.
2400	23AUG2018	0.0	0.0	29782.	18791.
2400	24AUG2018	0.0	0.0	29440.	18775.
2400	25AUG2018	0.0	0.0	29099.	18762.
2400	26AUG2018	0.0	0.0	28757.	18757.
2400	27AUG2018	0.0	0.0	28416.	18744.
2400	28AUG2018	0.0	0.0	28074.	18726.
2400	29AUG2018	0.0	0.0	27733.	18722.
2400	30AUG2018	0.0	0.0	27391.	18708.
2400	31AUG2018	0.0	0.0	27050.	18704.
2400	01SEP2018	0.0	0.0	26708.	18699.
2400	02SEP2018	0.0	0.0	26367.	18686.
2400	03SEP2018	0.0	0.0	26025.	18682.
2400	04SEP2018	0.0	0.0	25684.	18673.
2400	05SEP2018	0.0	0.0	25342.	18664.
2400	06SEP2018	0.0	0.0	25001.	18664.
2400	07SEP2018	0.0	0.0	24660.	18650.
2400	08SEP2018	0.0	0.0	24318.	18637.
2400	09SEP2018	0.0	0.0	23977.	18628.
2400	10SEP2018	0.0	0.0	23635.	18615.
2400	11SEP2018	0.0	0.0	23294.	18601.
2400	12SEP2018	0.0	0.0	22952.	18588.
2400	13SEP2018	0.0	0.0	22611.	18570.
2400	14SEP2018	0.0	0.0	22269.	18570.
2400	15SEP2018	0.0	0.0	21928.	18548.
2400	16SEP2018	0.0	0.0	21586.	18544.
2400	17SEP2018	0.0	0.0	21245.	18535.
2400	18SEP2018	0.0	0.0	20903.	18530.
2400	19SEP2018	0.0	0.0	20562.	18517.
2400	20SEP2018	0.0	0.0	20562.	18508.
2400	21SEP2018	0.0	0.0	20562.	18499.
2400	22SEP2018	0.0	0.0	20562.	18495.
2400	23SEP2018	0.0	0.0	20562.	18495.
2400	24SEP2018	0.0	0.0	20562.	18482.
2400	25SEP2018	2.0	0.0	20562.	18486.

2400	26SEP2018	0.0	0.0	20562.	18463.
2400	27SEP2018	0.0	0.0	20562.	18464.
2400	28SEP2018	0.0	0.0	20562.	18464.
2400	29SEP2018	0.0	0.0	20562.	18446.
2400	30SEP2018	0.0	0.0	20562.	18442.

***** Advisory: Inflows are a computed value. The inflows are computed from changes in storages which can produce erratic hourly results. Inflows can be averaged over several hours to produce a more realistic value.**

Sacramento District
Water Control Data System

US Army Corps of Engineers

WCDS HOME GLOSSARY CONTACT DISTRICT HOME

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TIME DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400 01OCT2018	0.0	0.0	20562.	18429.
2400 02OCT2018	0.0	0.0	20562.	18424.
2400 03OCT2018	0.0	0.0	20562.	18415.
2400 04OCT2018	0.0	0.0	20562.	18411.
2400 05OCT2018	0.0	0.0	20562.	18402.
2400 06OCT2018	0.0	0.0	20562.	18398.
2400 07OCT2018	0.0	0.0	20562.	18384.
2400 08OCT2018	0.0	0.0	20562.	18380.
2400 09OCT2018	5.0	0.0	20562.	18389.
2400 10OCT2018	0.0	0.0	20562.	18367.
2400 11OCT2018	0.0	0.0	20562.	18358.
2400 12OCT2018	0.0	0.0	20562.	18354.
2400 13OCT2018	0.0	0.0	20562.	18345.
2400 14OCT2018	0.0	0.0	20562.	18336.
2400 15OCT2018	0.0	0.0	20562.	18331.
2400 16OCT2018	0.0	0.0	20562.	18327.
2400 17OCT2018	0.0	0.0	20562.	18318.
2400 18OCT2018	0.0	0.0	20562.	18314.
2400 19OCT2018	0.0	0.0	20562.	18305.
2400 20OCT2018	0.0	0.0	20562.	18301.
2400 21OCT2018	0.0	0.0	20562.	18301.
2400 22OCT2018	0.0	0.0	20562.	18287.
2400 23OCT2018	0.0	0.0	20562.	18287.
2400 24OCT2018	0.0	0.0	20562.	18287.
2400 25OCT2018	0.0	0.0	20562.	18279.
2400 26OCT2018	0.0	0.0	20562.	18274.
2400 27OCT2018	0.0	0.0	20562.	18274.
2400 28OCT2018	0.0	0.0	20562.	18265.
2400 29OCT2018	0.0	0.0	20562.	18261.
2400 30OCT2018	0.0	0.0	20562.	18252.
2400 31OCT2018	0.0	0.0	20562.	18248.
2400 01NOV2018	0.0	0.0	20562.	18239.
2400 02NOV2018	0.0	0.0	20562.	18239.
2400 03NOV2018	0.0	0.0	20562.	18230.
2400 04NOV2018	0.0	0.0	20562.	18230.
2400 05NOV2018	0.0	0.0	20562.	18221.
2400 06NOV2018	0.0	0.0	20562.	18221.
2400 07NOV2018	0.0	0.0	20562.	18217.
2400 08NOV2018	0.0	0.0	20562.	18204.
2400 09NOV2018	0.0	0.0	20562.	18204.
2400 10NOV2018	0.0	0.0	20562.	18204.
2400 11NOV2018	0.0	0.0	20562.	18204.
2400 12NOV2018	0.0	0.0	20562.	18204.
2400 13NOV2018	0.0	0.0	20562.	18204.
2400 14NOV2018	0.0	0.0	20562.	18204.
2400 15NOV2018	0.0	0.0	20562.	18204.

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LOS BANOS FLOW-RES IN cfs	LOS BANOS FLOW-RES OUT cfs	LOS BANOS TOP CON STOR ac-ft	LOS BANOS STOR-RES EOP ac-ft

TIME	DATE	PER-AVER	PER-AVER	INST-VAL	INST-VAL
2400	16NOV2018	0.0	0.0	20562.	18204.
2400	17NOV2018	0.0	0.0	20562.	18204.
2400	18NOV2018	0.0	0.0	20562.	18204.
2400	19NOV2018	0.0	0.0	20562.	18204.
2400	20NOV2018	0.0	0.0	20562.	18204.
2400	21NOV2018	0.0	0.0	20562.	18164.
2400	22NOV2018	0.0	0.0	20562.	18169.
2400	23NOV2018	0.0	0.0	20562.	18169.
2400	24NOV2018	7.0	0.0	20562.	18182.
2400	25NOV2018	0.0	0.0	20562.	18160.
2400	26NOV2018	0.0	0.0	20562.	18160.
2400	27NOV2018	0.0	0.0	20562.	18160.
2400	28NOV2018	13.0	0.0	20562.	18186.
2400	29NOV2018	11.0	0.0	20562.	18208.
2400	30NOV2018	0.0	0.0	20562.	18208.
2400	01DEC2018	0.0	0.0	20562.	18208.
2400	02DEC2018	0.0	0.0	20562.	18199.
2400	03DEC2018	0.0	0.0	20562.	18195.
2400	04DEC2018	2.0	0.0	20562.	18199.
2400	05DEC2018	0.0	0.0	20562.	18199.
2400	06DEC2018	0.0	0.0	20562.	18199.
2400	07DEC2018	0.0	0.0	20562.	18199.
2400	08DEC2018	0.0	0.0	20562.	18195.
2400	09DEC2018	0.0	0.0	20562.	18195.
2400	10DEC2018	9.0	0.0	20562.	18213.
2400	11DEC2018	0.0	0.0	20562.	18195.
2400	12DEC2018	0.0	0.0	20562.	18191.
2400	13DEC2018	0.0	0.0	20562.	18191.
2400	14DEC2018	0.0	0.0	20562.	18191.
2400	15DEC2018	0.0	0.0	20562.	18186.
2400	16DEC2018	36.0	0.0	20562.	18257.
2400	17DEC2018	0.0	0.0	20562.	18213.
2400	18DEC2018	64.0	0.0	20562.	18340.
2400	19DEC2018	0.0	0.0	20562.	18208.
2400	20DEC2018	0.0	0.0	20562.	18208.
2400	21DEC2018	0.0	0.0	20562.	18199.
2400	22DEC2018	0.0	0.0	20562.	18199.
2400	23DEC2018	3.0	0.0	20562.	18204.
2400	24DEC2018	39.0	0.0	20562.	18283.
2400	25DEC2018	0.0	0.0	20562.	18265.
2400	26DEC2018	0.0	0.0	20562.	18199.
2400	27DEC2018	0.0	0.0	20562.	18195.
2400	28DEC2018	0.0	0.0	20562.	18208.
2400	29DEC2018	0.0	0.0	20562.	18186.
2400	30DEC2018	0.0	0.0	20562.	18186.
2400	31DEC2018	0.0	0.0	20562.	18186.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	01JAN2019	0.0	0.0	20562.	18178.
2400	02JAN2019	4.0	0.0	20562.	18186.
2400	03JAN2019	0.0	0.0	20562.	18169.
2400	04JAN2019	0.0	0.0	20562.	18169.
2400	05JAN2019	0.0	0.0	20562.	18169.
2400	06JAN2019	0.0	0.0	20562.	18169.
2400	07JAN2019	15.0	0.0	20562.	18199.
2400	08JAN2019	0.0	0.0	20562.	18182.
2400	09JAN2019	31.0	0.0	20562.	18243.
2400	10JAN2019	0.0	0.0	20562.	18182.
2400	11JAN2019	0.0	0.0	20562.	18182.
2400	12JAN2019	0.0	0.0	20562.	18182.
2400	13JAN2019	73.0	0.0	20562.	18327.
2400	14JAN2019	0.0	0.0	20562.	18178.
2400	15JAN2019	0.0	0.0	20562.	18178.
2400	16JAN2019	4.0	0.0	20562.	18186.
2400	17JAN2019	40.0	0.0	20562.	18265.

2400	18JAN2019	40.0	31.0	20562.	18327.
2400	19JAN2019	27.0	31.0	20562.	18380.
2400	20JAN2019	0.0	0.0	20562.	18380.
2400	21JAN2019	0.0	0.0	20562.	18424.
2400	22JAN2019	6.0	0.0	20562.	18437.
2400	23JAN2019	9.0	0.0	20562.	18455.
2400	24JAN2019	11.0	0.0	20562.	18477.
2400	25JAN2019	9.0	0.0	20562.	18495.
2400	26JAN2019	5.0	0.0	20562.	18504.
2400	27JAN2019	7.0	0.0	20562.	18517.
2400	28JAN2019	7.0	0.0	20562.	18517.
2400	29JAN2019	0.0	0.0	20562.	18535.
2400	30JAN2019	0.0	0.0	20562.	18548.
2400	31JAN2019	0.0	0.0	20562.	18548.
2400	01FEB2019	0.0	0.0	20562.	18566.
2400	02FEB2019	0.0	0.0	20562.	18659.
2400	03FEB2019	99.0	0.0	20562.	18856.
2400	04FEB2019	620.0	0.0	20562.	20086.
2400	05FEB2019	1282.0	0.0	20562.	21153.
2400	06FEB2019	164.0	200.0	20562.	21081.
2400	07FEB2019	97.0	200.0	20562.	20877.
2400	08FEB2019	46.0	200.0	20562.	20571.
2400	09FEB2019	141.0	200.0	20562.	20454.
2400	10FEB2019	452.0	200.0	20562.	20953.
2400	11FEB2019	188.0	200.0	20562.	20929.
2400	12FEB2019	0.0	0.0	20562.	20929.
2400	13FEB2019	27.0	200.0	20562.	20477.
2400	14FEB2019	584.0	200.0	20562.	21239.
2400	15FEB2019	513.0	200.0	20562.	21860.

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TIME	DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400	16FEB2019	374.0	200.0	20562.	22205.
2400	17FEB2019	242.0	200.0	20562.	22289.
2400	18FEB2019	143.0	200.0	20562.	22176.
2400	19FEB2019	89.0	200.0	20562.	21957.
2400	20FEB2019	68.0	200.0	20562.	21695.
2400	21FEB2019	76.0	200.0	20562.	21449.
2400	22FEB2019	39.0	200.0	20562.	21129.
2400	23FEB2019	33.0	200.0	20562.	20797.
2400	24FEB2019	32.0	200.0	20562.	20463.
2400	25FEB2019	25.0	150.0	20562.	20216.
2400	26FEB2019	25.0	100.0	20562.	20067.
2400	27FEB2019	21.0	100.0	20562.	19910.
2400	28FEB2019	0.0	0.0	20562.	19910.
2400	01MAR2019	21.0	0.0	20562.	19882.
2400	02MAR2019	35.0	0.0	20562.	19952.
2400	03MAR2019	37.0	0.0	20562.	20026.
2400	04MAR2019	28.0	0.0	20562.	20081.
2400	05MAR2019	30.0	0.0	20562.	20141.
2400	06MAR2019	54.0	0.0	20562.	20248.
2400	07MAR2019	123.0	0.0	20562.	20491.
2400	08MAR2019	97.0	0.0	20562.	20684.
2400	09MAR2019	64.0	0.0	20562.	20811.
2400	10MAR2019	62.0	0.0	20562.	20934.
2400	11MAR2019	65.0	0.0	20562.	21062.
2400	12MAR2019	50.0	0.0	20562.	21162.
2400	13MAR2019	34.0	0.0	20562.	21229.
2400	14MAR2019	31.0	0.0	20562.	21291.
2400	15MAR2019	27.0	0.0	20723.	21344.
2400	16MAR2019	24.0	0.0	20884.	21392.
2400	17MAR2019	24.0	0.0	21045.	21440.
2400	18MAR2019	17.0	0.0	21206.	21473.
2400	19MAR2019	20.0	0.0	21367.	21512.
2400	20MAR2019	43.0	0.0	21528.	21555.
2400	21MAR2019	29.0	0.0	21688.	21584.
2400	22MAR2019	24.0	0.0	21849.	21608.
2400	23MAR2019	87.0	0.0	22010.	21695.

2400 24MAR2019	0.0	0.0	22171.	21690.
2400 25MAR2019	10.0	0.0	22332.	21709.
2400 26MAR2019	15.0	0.0	22493.	21738.
2400 27MAR2019	10.0	0.0	22654.	21758.
2400 28MAR2019	15.0	0.0	22815.	21787.
2400 29MAR2019	10.0	0.0	22976.	21806.
2400 30MAR2019	5.0	0.0	23137.	21816.
2400 31MAR2019	15.0	0.0	23298.	21845.
2400 01APR2019	8.0	0.0	23459.	21860.
2400 02APR2019	2.0	0.0	23619.	21864.

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TIME DATE	LOS BANOS FLOW-RES IN cfs PER-AVER	LOS BANOS FLOW-RES OUT cfs PER-AVER	LOS BANOS TOP CON STOR ac-ft INST-VAL	LOS BANOS STOR-RES EOP ac-ft INST-VAL
2400 03APR2019	42.0	0.0	23780.	21947.
2400 04APR2019	0.0	0.0	23941.	21889.
2400 05APR2019	10.0	0.0	24102.	21908.
2400 06APR2019	3.0	0.0	24263.	21913.
2400 07APR2019	8.0	0.0	24424.	21928.
2400 08APR2019	2.0	0.0	24585.	21932.
2400 09APR2019	5.0	0.0	24746.	21942.
2400 10APR2019	0.0	0.0	24907.	21937.
2400 11APR2019	0.0	0.0	25068.	21932.
2400 12APR2019	5.0	0.0	25229.	21942.
2400 13APR2019	0.0	0.0	25390.	21942.
2400 14APR2019	0.0	0.0	25551.	21937.
2400 15APR2019	3.0	0.0	25711.	21942.
2400 16APR2019	0.0	0.0	25872.	21937.
2400 17APR2019	3.0	0.0	26033.	21942.
2400 18APR2019	0.0	0.0	26194.	21942.
2400 19APR2019	3.0	0.0	26355.	21947.
2400 20APR2019	0.0	0.0	26516.	21942.
2400 21APR2019	0.0	0.0	26677.	21937.
2400 22APR2019	0.0	0.0	26838.	21937.
2400 23APR2019	0.0	0.0	26999.	21932.
2400 24APR2019	0.0	0.0	27160.	21932.
2400 25APR2019	3.0	0.0	-	21937.

***** Advisory: Inflows are a computed value. The inflows are computed from changes in storages which can produce erratic hourly results. Inflows can be averaged over several hours to produce a more realistic value.**

APPENDIX C

PUMPAGE FROM WELLS

SJREC GSA

updated 04/29/2019

ANNUAL PUMPAGE IN ACRE FEET FOR DEEP WELLS LOCATED IN THE CITY OF LOS BANOS URBAN GROWTH BOUNDARY AREA AND IN THE AREA SOUTH TO THE STATE AQUEDUCT with and without the LOS BANOS CREEK SUB-AREA

DEEP WELL STUDY AREA	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
SUMMARY TABLE A												
Deep wells in City of Los Banos Urban Growth Boundary												
Sum A+B+C	14,797	14,754	8,628	8,314	14,153	15,861	11,633	7,064	13,779	9,540	8,286	8,668
Deep Wells O/S City of Los Banos Urban Growth Boundary												
Sum D+E	5,767	6,982	6,118	5,019	5,439	4,172	7,470	5,494	4,978	844	1,735	3,407
Deep Wells - LB Creek Sub-Area												
Sum F	4,580	4,642	5,392	6,330	5,247	4,256	2,812	6,846	6,139	1,970	1,173	1,393
Sum G	4,012	2,790	1,403	176	1,252	3,644	3,503	2,528	2,177	174	18	205
Deep Wells DMC/Aqueduct - LB Creek Sub-Area												
Sum H+I+J	1,319	4,397	5,239	1,024	226	4,303	3,100	4,340	1,776	2,859	0	211
Deep Wells others-SLWD LB Creek Sub-Area												
Sum L	6,006	9,058	9,495	7,910	8,770	8,466	6,439	7,726	7,446	4,380	1,309	4,190
Sum A+B+C+D+E	20,564	21,736	14,745	13,333	19,591	20,033	19,102	12,558	18,757	10,384	10,021	12,076
Sum F+G+H+I+J+L	15,917	20,886	21,530	15,440	15,495	20,670	15,855	21,440	17,538	9,383	2,500	5,999
Total (AF)	36,482	42,622	36,275	28,773	35,086	40,702	34,957	33,998	36,295	19,767	12,521	18,074
Sum A+B+C+D+E (%)	56%	51%	41%	46%	56%	49%	55%	37%	52%	53%	80%	67%
Sum F+G+H+I+J+L (%)	44%	49%	59%	54%	44%	51%	45%	63%	48%	47%	20%	33%

SUMMARY TABLE B	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total - CITY (A)	9113	8876	877	809	7718	8313	7955	0	6057	6622	7412	7659
Total - PRIVATE (IN URBAN) (B)	4,221	4,957	6,460	6,916	6,000	6,058	2,161	5,971	6,852	2,789	867	973
Total - PRIVATE (O/S URBAN) (E+F+H)	9,643	13,161	13,190	11,275	10,372	9,062	9,256	12,103	10,748	2,814	2,902	4,793
Total - CCID (IN URBAN) (C)	1,463	922	1,291	589	435	1,490	1,517	1,093	870	130	7	36
Total - CCID (IN URBAN) (D)	1,314	930	991	510	314	1,206	1,026	717	966	0	6	14
Total - CCID (O/S URBAN) (G)	4,012	2,790	1,403	176	1,252	3,644	3,503	2,528	2,177	174	18	205
Total - PRIVATE OTHERS (O/S URBAN) (I+J+L)	6,716	10,986	12,062	8,499	8,996	10,929	9,539	11,586	8,625	7,239	1,309	4,394
Total (AF)	36,482	42,622	36,275	28,773	35,086	40,702	34,957	33,998	36,295	19,767	12,521	18,074

NOTES:

A. City of Los Banos Wells

B. Private Deep Wells within the City of Los Banos Urban Growth Boundary

C. CCID Deep Wells within the City of Los Banos Urban Growth Boundary

D. CCID Deep Wells O/S the City of Los Banos Urban Growth Boundary

E. Private Deep Wells O/S the City of Los Banos Urban Growth Boundary

F. Private Deep Wells O/S the City of Los Banos Urban Growth Boundary
Los Banos Creek Sub-Area

G. CCID Deep Wells O/S the City of Los Banos Urban Growth Boundary
Los Banos Creek Sub-Area

H. Deep Wells - DMC Pumpers O/S the City of Los Banos Urban Growth Boundary
Los Banos Creek Sub-Area

I. Deep Wells - DMC Pumpers - SLWD O/S the City of Los Banos Urban Growth Boundary
Los Banos Creek Sub-Area

J. Deep Wells Aqueduct Pumpers - SLWD O/S the City of Los Banos Urban Growth Boundary
Los Banos Creek Sub-Area

L. Deep Wells - others-SLWD - O/S the City of Los Banos Urban Growth Boundary

APPENDIX D

RESULTS OF CHEMICAL ANALYSES OF WATER FROM CITY WELLS

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-01
Sampled By: Ryan Harris
Sample Description: Well 1

Sample Date - Time: 07/12/17 - 08:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.07 Temp=25.9 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**190**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**190**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Chloride	EPA 300.0	**97**	1.0	mg/L	1	A708812	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:51	07/12/17	
Conductivity @ 25C	SM 2510B	**820**	1.0	umhos/cm	1	A708761	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.12**	0.10	mg/L	1	A708812	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**35**	0.25	ug/L	5	A708827	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.35**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**4.0**	0.23	mg/L	1	A708812	07/13/17 10:53	07/13/17	
Nitrate as N	EPA 300.0	**4.0**	0.23	mg/L	1	A708812.	07/13/17 10:53	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708812	07/13/17 10:53	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**7.9**		pH Units	1	A708761	07/12/17	07/12/17	
pH Temperature in °C		**23.4**							
Sulfate as SO4	EPA 300.0	**73**	1.0	mg/L	1	A708812	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**480**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	ND	0.10	NTU	1	A708680	07/12/17 19:16	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**6.1**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.073**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**54**	0.10	mg/L	1	A708842	07/13/17	07/21/17	MS1.4
Chromium	EPA 200.8	**35**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**27**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.5**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	**4.1**	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-01
Sampled By: Ryan Harris
Sample Description: Well 1

Sample Date - Time: 07/12/17 - 08:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.07 Temp=25.9 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**68**	1.0	mg/L	1	A708842	07/13/17	07/21/17	MS1.4
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**240**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**1.51**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.220**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	98 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	98 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-01
Sampled By: Ryan Harris
Sample Description: Well 1

Sample Date - Time: 07/12/17 - 08:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.07 Temp=25.9 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-01
Sampled By: Ryan Harris
Sample Description: Well 1

Sample Date - Time: 07/12/17 - 08:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.07 Temp=25.9 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	92 %	*Acceptable range:*	*70-130 %*					
Surrogate: Bromofluorobenzene	EPA 524.2	103 %	*Acceptable range:*	*70-130 %*					
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-02
Sampled By: Ryan Harris
Sample Description: Well 2

Sample Date - Time: 07/12/17 - 09:08
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=6.99 Temp=24.8 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**180**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**180**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Chloride	EPA 300.0	**86**	1.0	mg/L	1	A708812	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:53	07/12/17	
Conductivity @ 25C	SM 2510B	**770**	1.0	umhos/cm	1	A708761	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.12**	0.10	mg/L	1	A708812	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**34**	0.25	ug/L	5	A708827	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.40**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**4.2**	0.23	mg/L	1	A708812	07/13/17 11:05	07/13/17	
Nitrate as N	EPA 300.0	**4.2**	0.23	mg/L	1	A708812	07/13/17 11:05	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708812	07/13/17 11:05	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**8.0**		pH Units	1	A708761	07/12/17	07/12/17	
pH Temperature in °C		**23.4**							
Sulfate as SO4	EPA 300.0	**64**	1.0	mg/L	1	A708812	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**440**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.42**	0.10	NTU	1	A708680	07/12/17 19:18	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**5.3**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.067**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**50**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**34**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**26**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.5**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-02
Sampled By: Ryan Harris
Sample Description: Well 2

Sample Date - Time: 07/12/17 - 09:08
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=6.99 Temp=24.8 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**66**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**230**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**2.01**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.246**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	104 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	104 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

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Certificate of Analysis

Sample ID: A7G1000-02
Sampled By: Ryan Harris
Sample Description: Well 2

Sample Date - Time: 07/12/17 - 09:08
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=6.99 Temp=24.8 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

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Certificate of Analysis

Sample ID: A7G1000-02
Sampled By: Ryan Harris
Sample Description: Well 2

Sample Date - Time: 07/12/17 - 09:08
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=6.99 Temp=24.8 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	104 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	100 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

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Certificate of Analysis

Sample ID: A7G1000-03
Sampled By: Ryan Harris
Sample Description: Well 3

Sample Date - Time: 07/12/17 - 09:23
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=27.1 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**210**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**210**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Chloride	EPA 300.0	**120**	1.0	mg/L	1	A708812	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:54	07/12/17	
Conductivity @ 25C	SM 2510B	**970**	1.0	umhos/cm	1	A708761	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.11**	0.10	mg/L	1	A708812	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**33**	0.25	ug/L	5	A708827	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.47**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**6.3**	0.23	mg/L	1	A708812	07/13/17 11:40	07/13/17	
Nitrate as N	EPA 300.0	**6.3**	0.23	mg/L	1	A708812	07/13/17 11:40	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708812	07/13/17 11:40	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**7.9**		pH Units	1	A708761	07/12/17	07/12/17	
pH Temperature in °C		**23.3**							
Sulfate as SO4	EPA 300.0	**91**	1.0	mg/L	1	A708812	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**580**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.11**	0.10	NTU	1	A708680	07/12/17 19:19	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**4.7**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.080**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**66**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**32**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**34**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.6**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-03
Sampled By: Ryan Harris
Sample Description: Well 3

Sample Date - Time: 07/12/17 - 09:23
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=27.1 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**83**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**300**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**3.02**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.291**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	106 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	106 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-03
Sampled By: Ryan Harris
Sample Description: Well 3

Sample Date - Time: 07/12/17 - 09:23
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=27.1 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-03
Sampled By: Ryan Harris
Sample Description: Well 3

Sample Date - Time: 07/12/17 - 09:23
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=27.1 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	94 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	102 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-04
Sampled By: Ryan Harris
Sample Description: Well 5

Sample Date - Time: 07/12/17 - 12:25
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.06 Temp=28.5 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**13**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**330**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**330**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Chloride	EPA 300.0	**230**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:55	07/12/17	
Conductivity @ 25C	SM 2510B	**1800**	1.0	umhos/cm	1	A708761	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.10**	0.10	mg/L	1	A708813	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**43**	0.25	ug/L	5	A708827	07/13/17	07/13/17	
Langelier Index	SM 2330B	**1.0**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**8.0**	0.23	mg/L	1	A708813	07/13/17 14:26	07/13/17	
Nitrate as N	EPA 300.0	**8.0**	0.23	mg/L	1	A708813	07/13/17 14:26	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708813	07/13/17 14:26	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	4.0	ug/L	2	A709365	07/25/17	07/25/17	DL1.0
pH (1)	SM 4500-H+ B	**8.0**		pH Units	1	A708761	07/12/17	07/12/17	
pH Temperature in °C		**23.3**							
Sulfate as SO4	EPA 300.0	**240**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**1100**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.14**	0.10	NTU	1	A708680	07/12/17 19:20	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**5.9**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.10**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**120**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**43**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	**5.2**	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**67**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**3.0**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	**3.3**	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-04
Sampled By: Ryan Harris
Sample Description: Well 5

Sample Date - Time: 07/12/17 - 12:25
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.06 Temp=28.5 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**160**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**590**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**9.06**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.479**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	107 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	107 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-04
Sampled By: Ryan Harris
Sample Description: Well 5

Sample Date - Time: 07/12/17 - 12:25
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.06 Temp=28.5 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	**0.53**	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-04
Sampled By: Ryan Harris
Sample Description: Well 5

Sample Date - Time: 07/12/17 - 12:25
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.06 Temp=28.5 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	90 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	102 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		**0.53**	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-05
Sampled By: Ryan Harris
Sample Description: Well 6

Sample Date - Time: 07/12/17 - 11:06
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=6.99 Temp=27.0 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**120**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**120**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Chloride	EPA 300.0	**100**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:56	07/12/17	
Conductivity @ 25C	SM 2510B	**680**	1.0	umhos/cm	1	A708761	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.12**	0.10	mg/L	1	A708813	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**28**	0.25	ug/L	5	A708827	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.30**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**3.5**	0.23	mg/L	1	A708813	07/13/17 14:49	07/13/17	
Nitrate as N	EPA 300.0	**3.5**	0.23	mg/L	1	A708813	07/13/17 14:49	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708813	07/13/17 14:49	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**8.1**		pH Units	1	A708761	07/12/17	07/12/17	
pH Temperature in °C		**23.2**							
Sulfate as SO4	EPA 300.0	**50**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**380**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	ND	0.10	NTU	1	A708680	07/12/17 19:21	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**5.7**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.10**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**47**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**27**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**23**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.4**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-05
Sampled By: Ryan Harris
Sample Description: Well 6

Sample Date - Time: 07/12/17 - 11:06
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=6.99 Temp=27.0 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**47**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**210**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	ND	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.156**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	105 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	105 %	*Acceptable range: 70-130 %*						

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-06
Sampled By: Ryan Harris
Sample Description: Well 7

Sample Date - Time: 07/12/17 - 12:45
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.11 Temp=27.3 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**13**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**340**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**340**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Chloride	EPA 300.0	**220**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:57	07/12/17	
Conductivity @ 25C	SM 2510B	**1700**	1.0	umhos/cm	1	A708761	07/12/17	07/12/17	
Fluoride	EPA 300.0	ND	0.10	mg/L	1	A708813	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**42**	0.25	ug/L	5	A708827	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.98**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**7.6**	0.23	mg/L	1	A708813	07/13/17 15:01	07/13/17	
Nitrate as N	EPA 300.0	**7.6**	0.23	mg/L	1	A708813	07/13/17 15:01	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708813	07/13/17 15:01	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	4.0	ug/L	2	A709365	07/25/17	07/25/17	DL1.0
pH (1)	SM 4500-H+ B	**8.0**		pH Units	1	A708761	07/12/17	07/12/17	
pH Temperature in °C		**23.2**							
Sulfate as SO4	EPA 300.0	**240**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**1100**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	ND	0.10	NTU	1	A708680	07/12/17 19:22	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**5.3**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.060**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**110**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**42**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**63**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.9**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	**4.1**	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-06
Sampled By: Ryan Harris
Sample Description: Well 7

Sample Date - Time: 07/12/17 - 12:45
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.11 Temp=27.3 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**160**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**530**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**12.6**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.561**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	105 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	105 %	*Acceptable range: 70-130 %*						

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-07
Sampled By: Ryan Harris
Sample Description: Well 9

Sample Date - Time: 07/12/17 - 12:03
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=28.4 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**170**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**170**	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708761	07/12/17	07/12/17	
Chloride	EPA 300.0	**84**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:58	07/12/17	
Conductivity @ 25C	SM 2510B	**760**	1.0	umhos/cm	1	A708761	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.11**	0.10	mg/L	1	A708813	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**36**	0.25	ug/L	5	A708829	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.36**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**2.3**	0.23	mg/L	1	A708813	07/13/17 15:25	07/13/17	
Nitrate as N	EPA 300.0	**2.3**	0.23	mg/L	1	A708813	07/13/17 15:25	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708813	07/13/17 15:25	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**8.0**		pH Units	1	A708761	07/12/17	07/12/17	
pH Temperature in °C		**23.3**							
Sulfate as SO4	EPA 300.0	**78**	1.0	mg/L	1	A708813	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**440**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.18**	0.10	NTU	1	A708680	07/12/17 19:23	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**7.2**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.083**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**48**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**35**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**27**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.5**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-07
Sampled By: Ryan Harris
Sample Description: Well 9

Sample Date - Time: 07/12/17 - 12:03
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=28.4 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**63**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**230**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**3.52**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.311**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	106 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	106 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-07
Sampled By: Ryan Harris
Sample Description: Well 9

Sample Date - Time: 07/12/17 - 12:03
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=28.4 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-07
Sampled By: Ryan Harris
Sample Description: Well 9

Sample Date - Time: 07/12/17 - 12:03
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.05 Temp=28.4 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	87 %	*Acceptable range:*	*70-130 %*					
Surrogate: Bromofluorobenzene	EPA 524.2	99 %	*Acceptable range:*	*70-130 %*					
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-08
Sampled By: Ryan Harris
Sample Description: Well 10

Sample Date - Time: 07/12/17 - 13:05
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.12 Temp=23.2 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**13**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**270**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**270**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Chloride	EPA 300.0	**170**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 18:59	07/12/17	
Conductivity @ 25C	SM 2510B	**1400**	1.0	umhos/cm	1	A708803	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.11**	0.10	mg/L	1	A708888	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**35**	0.25	ug/L	5	A708829	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.83**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**7.0**	0.23	mg/L	1	A708888	07/13/17 19:18	07/13/17	
Nitrate as N	EPA 300.0	**7.0**	0.23	mg/L	1	A708888	07/13/17 19:18	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708888	07/13/17 19:18	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	4.0	ug/L	2	A709365	07/25/17	07/25/17	DL1.0
pH (1)	SM 4500-H+ B	**8.0**		pH Units	1	A708803	07/12/17	07/12/17	
pH Temperature in °C		**22.9**							
Sulfate as SO4	EPA 300.0	**190**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**860**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.39**	0.10	NTU	1	A708680	07/12/17 19:24	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**5.0**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.065**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**95**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**34**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**53**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.8**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	**2.3**	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-08
Sampled By: Ryan Harris
Sample Description: Well 10

Sample Date - Time: 07/12/17 - 13:05
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.12 Temp=23.2 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**120**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**450**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**10.6**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.516**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	104 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	104 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-08
Sampled By: Ryan Harris
Sample Description: Well 10

Sample Date - Time: 07/12/17 - 13:05
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.12 Temp=23.2 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-08
Sampled By: Ryan Harris
Sample Description: Well 10

Sample Date - Time: 07/12/17 - 13:05
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.12 Temp=23.2 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	88 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	99 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-09
Sampled By: Ryan Harris
Sample Description: Well 11

Sample Date - Time: 07/12/17 - 10:27
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.15 Temp=26.7 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**160**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**160**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Chloride	EPA 300.0	**84**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 19:00	07/12/17	
Conductivity @ 25C	SM 2510B	**690**	1.0	umhos/cm	1	A708803	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.13**	0.10	mg/L	1	A708888	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**23**	0.25	ug/L	5	A708829	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.44**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**4.1**	0.23	mg/L	1	A708888	07/13/17 19:29	07/13/17	
Nitrate as N	EPA 300.0	**4.1**	0.23	mg/L	1	A708888	07/13/17 19:29	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708888	07/13/17 19:29	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	**4.0**	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**8.1**		pH Units	1	A708803	07/12/17	07/12/17	
pH Temperature in °C		**22.8**							
Sulfate as SO4	EPA 300.0	**47**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**400**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.31**	0.10	NTU	1	A708680	07/12/17 19:25	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**3.8**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.094**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**49**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**23**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**23**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.1**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

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Certificate of Analysis

Sample ID: A7G1000-09
Sampled By: Ryan Harris
Sample Description: Well 11

Sample Date - Time: 07/12/17 - 10:27
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.15 Temp=26.7 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**45**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**220**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**3.02**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.291**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	108 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	108 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-09
Sampled By: Ryan Harris
Sample Description: Well 11

Sample Date - Time: 07/12/17 - 10:27
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.15 Temp=26.7 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-09
Sampled By: Ryan Harris
Sample Description: Well 11

Sample Date - Time: 07/12/17 - 10:27
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.15 Temp=26.7 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	92 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	104 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-10
Sampled By: Ryan Harris
Sample Description: Well 12

Sample Date - Time: 07/12/17 - 09:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.00 Temp=28.1 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**150**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**150**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Chloride	EPA 300.0	**75**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 19:01	07/12/17	
Conductivity @ 25C	SM 2510B	**660**	1.0	umhos/cm	1	A708803	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.13**	0.10	mg/L	1	A708888	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**24**	0.25	ug/L	5	A708829	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.43**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**3.7**	0.23	mg/L	1	A708888	07/13/17 19:39	07/13/17	
Nitrate as N	EPA 300.0	**3.7**	0.23	mg/L	1	A708888	07/13/17 19:39	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708888	07/13/17 19:39	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**8.1**		pH Units	1	A708803	07/12/17	07/12/17	
pH Temperature in °C		**22.7**							
Sulfate as SO4	EPA 300.0	**51**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**380**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.11**	0.10	NTU	1	A708680	07/12/17 19:26	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**4.3**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.10**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**50**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**24**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**22**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.1**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-10
Sampled By: Ryan Harris
Sample Description: Well 12

Sample Date - Time: 07/12/17 - 09:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.00 Temp=28.1 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	47	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	220	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	ND	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		0.191	±				
MDA95		1.06	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	102 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	102 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-10
Sampled By: Ryan Harris
Sample Description: Well 12

Sample Date - Time: 07/12/17 - 09:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.00 Temp=28.1 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-10
Sampled By: Ryan Harris
Sample Description: Well 12

Sample Date - Time: 07/12/17 - 09:53
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.00 Temp=28.1 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	94 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	102 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-11
Sampled By: Ryan Harris
Sample Description: Well 13

Sample Date - Time: 07/12/17 - 08:11
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.11 Temp=22.2 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**13**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**280**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**280**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Chloride	EPA 300.0	**170**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 19:02	07/12/17	
Conductivity @ 25C	SM 2510B	**1300**	1.0	umhos/cm	1	A708803	07/12/17	07/12/17	
Fluoride	EPA 300.0	ND	0.10	mg/L	1	A708888	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**42**	0.25	ug/L	5	A708829	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.83**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**5.8**	0.23	mg/L	1	A708888	07/13/17 19:50	07/13/17	
Nitrate as N	EPA 300.0	**5.8**	0.23	mg/L	1	A708888	07/13/17 19:50	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708888	07/13/17 19:50	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	4.0	ug/L	2	A709365	07/25/17	07/25/17	DL1.0
pH (1)	SM 4500-H+ B	**8.0**		pH Units	1	A708803	07/12/17	07/12/17	
pH Temperature in °C		**22.6**							
Sulfate as SO4	EPA 300.0	**140**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**780**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.14**	0.10	NTU	1	A708680	07/12/17 19:27	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**4.9**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.12**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**92**	0.10	mg/L	1	A708842	07/13/17	07/21/17	MS1.4
Chromium	EPA 200.8	**41**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**49**	0.10	mg/L	1	A708842	07/13/17	07/21/17	MS1.4
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.6**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-11
Sampled By: Ryan Harris
Sample Description: Well 13

Sample Date - Time: 07/12/17 - 08:11
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.11 Temp=22.2 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**98**	1.0	mg/L	1	A708842	07/13/17	07/21/17	MS1.4
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**430**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**4.03**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.330**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	108 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	108 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

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Certificate of Analysis

Sample ID: A7G1000-11
Sampled By: Ryan Harris
Sample Description: Well 13

Sample Date - Time: 07/12/17 - 08:11
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.11 Temp=22.2 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	**10**	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

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Certificate of Analysis

Sample ID: A7G1000-11
Sampled By: Ryan Harris
Sample Description: Well 13

Sample Date - Time: 07/12/17 - 08:11
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.11 Temp=22.2 °C

Organics

Analyte	Method	Result	Q	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS										
Tetrachloroethene (PCE)	EPA 524.2	**1.0**		0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND		0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND		0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND		0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND		0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND		5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND		0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	99 %		*Acceptable range:*	*70-130 %*					
Surrogate: Bromofluorobenzene	EPA 524.2	102 %		*Acceptable range:*	*70-130 %*					
Total 1,3-Dichloropropene		ND		0.50	ug/L					
Total Trihalomethanes		ND		0.50	ug/L					
Total Xylenes, EPA 524.2		ND		0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-12
Sampled By: Ryan Harris
Sample Description: Well 14

Sample Date - Time: 07/12/17 - 11:39
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.02 Temp=26.5 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**13**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**300**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**300**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Chloride	EPA 300.0	**190**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 19:03	07/12/17	
Conductivity @ 25C	SM 2510B	**1700**	1.0	umhos/cm	1	A708803	07/12/17	07/12/17	
Fluoride	EPA 300.0	ND	0.10	mg/L	1	A708888	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**38**	0.25	ug/L	5	A708829	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.86**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**5.5**	0.23	mg/L	1	A708888	07/13/17 20:01	07/13/17	
Nitrate as N	EPA 300.0	**5.5**	0.23	mg/L	1	A708888	07/13/17 20:01	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708888	07/13/17 20:01	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	4.0	ug/L	2	A709365	07/25/17	07/25/17	DL1.0
pH (1)	SM 4500-H+ B	**8.0**		pH Units	1	A708803	07/12/17	07/12/17	
pH Temperature in °C		**22.6**							
Sulfate as SO4	EPA 300.0	**310**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**1100**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.10**	0.10	NTU	1	A708680	07/12/17 19:28	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**6.0**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**96**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**38**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**54**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.8**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	**3.8**	2.0	ug/L	1	A708842	07/13/17	07/20/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-12
Sampled By: Ryan Harris
Sample Description: Well 14

Sample Date - Time: 07/12/17 - 11:39
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.02 Temp=26.5 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**190**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**460**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	**8.56**	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.467**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	103 %	*Acceptable range:*	*70-130 %*					
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	103 %	*Acceptable range:*	*70-130 %*					
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-12
Sampled By: Ryan Harris
Sample Description: Well 14

Sample Date - Time: 07/12/17 - 11:39
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.02 Temp=26.5 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-12
Sampled By: Ryan Harris
Sample Description: Well 14

Sample Date - Time: 07/12/17 - 11:39
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.02 Temp=26.5 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	88 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	90 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-13
Sampled By: Ryan Harris
Sample Description: Well 15

Sample Date - Time: 07/12/17 - 10:49
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.03 Temp=27.1 °C

BSK Associates Laboratory Fresno

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aggressive Index		**12**				A709340	07/24/17	07/24/17	
Alkalinity as CaCO3	SM 2320B	**150**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Bicarbonate as CaCO3	SM 2320B	**150**	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Carbonate as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Hydroxide as CaCO3	SM 2320B	ND	3.0	mg/L	1	A708803	07/12/17	07/12/17	
Chloride	EPA 300.0	**96**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Color, Apparent	SM 2120B	ND	5.0	CU	1	A708680	07/12/17 19:04	07/12/17	
Conductivity @ 25C	SM 2510B	**770**	1.0	umhos/cm	1	A708803	07/12/17	07/12/17	
Fluoride	EPA 300.0	**0.12**	0.10	mg/L	1	A708888	07/13/17	07/13/17	
Hexavalent Chromium	EPA 218.7	**19**	0.25	ug/L	5	A708829	07/13/17	07/13/17	
Langelier Index	SM 2330B	**0.44**				A709340	07/24/17	07/24/17	
MBAS, Calculated as LAS, mol wt 340	SM 5540C	ND	0.050	mg/L	1	A708807	07/12/17 20:00	07/12/17	
Nitrate + Nitrite as N	EPA 300.0	**4.7**	0.23	mg/L	1	A708888	07/13/17 20:23	07/13/17	
Nitrate as N	EPA 300.0	**4.7**	0.23	mg/L	1	A708888	07/13/17 20:23	07/13/17	
Nitrite as N	EPA 300.0	ND	0.050	mg/L	1	A708888	07/13/17 20:23	07/13/17	
Threshold Odor	SM 2150B	ND	1.0	T.O.N.	1	A708607	07/12/17 18:25	07/12/17	
Perchlorate	EPA 314.0	ND	2.0	ug/L	1	A709365	07/25/17	07/25/17	
pH (1)	SM 4500-H+ B	**8.1**		pH Units	1	A708803	07/12/17	07/12/17	
pH Temperature in °C		**22.5**							
Sulfate as SO4	EPA 300.0	**72**	1.0	mg/L	1	A708888	07/13/17	07/13/17	
Total Dissolved Solids	SM 2540C	**480**	5.0	mg/L	1	A708826	07/13/17	07/17/17	
Turbidity	SM 2130B	**0.10**	0.10	NTU	1	A708680	07/12/17 19:29	07/12/17	

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Aluminum	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Antimony	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Arsenic	EPA 200.8	**7.8**	2.0	ug/L	1	A708842	07/13/17	07/20/17	
Barium	EPA 200.7	**0.11**	0.050	mg/L	1	A708842	07/13/17	07/21/17	
Beryllium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	CV0.0
Cadmium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Calcium	EPA 200.7	**53**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Chromium	EPA 200.8	**18**	10	ug/L	1	A708842	07/13/17	07/20/17	
Copper	EPA 200.8	ND	5.0	ug/L	1	A708842	07/13/17	07/20/17	
Iron	EPA 200.7	ND	0.030	mg/L	1	A708842	07/13/17	07/21/17	
Lead	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Magnesium	EPA 200.7	**30**	0.10	mg/L	1	A708842	07/13/17	07/21/17	
Manganese	EPA 200.7	ND	0.010	mg/L	1	A708842	07/13/17	07/21/17	
Mercury	EPA 200.8	ND	0.20	ug/L	1	A708842	07/13/17	07/20/17	
Nickel	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Potassium	EPA 200.7	**2.2**	2.0	mg/L	1	A708842	07/13/17	07/21/17	
Selenium	EPA 200.8	ND	2.0	ug/L	1	A708842	07/13/17	07/20/17	

ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-13
Sampled By: Ryan Harris
Sample Description: Well 15

Sample Date - Time: 07/12/17 - 10:49
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.03 Temp=27.1 °C

Metals

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Silver	EPA 200.8	ND	10	ug/L	1	A708842	07/13/17	07/20/17	
Sodium	EPA 200.7	**47**	1.0	mg/L	1	A708842	07/13/17	07/21/17	
Thallium	EPA 200.8	ND	1.0	ug/L	1	A708842	07/13/17	07/20/17	
Hardness as CaCO3	SM 2340B	**260**	0.41	mg/L					
Zinc	EPA 200.7	ND	0.050	mg/L	1	A708842	07/13/17	07/21/17	

Radiological

Analyte	Method	Result	Units	Batch	Prepared	Analyzed	Qual
Gross Alpha	SM 7110C	ND	pCi/L	A709096	07/19/17	07/20/17	
1.65 Sigma Uncertainty		**0.110**	±				
MDA95		**1.06**	pCi/L				

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
EDB and DBCP by GC-ECD									
Dibromochloropropane (DBCP)	EPA 504.1	ND	0.010	ug/L	1	A708902	07/14/17	07/14/17	
Ethylene Dibromide (EDB)	EPA 504.1	ND	0.020	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 504.1	109 %	*Acceptable range: 70-130 %*						
EPA 505 - Simazine, Atrazine, and Alachlor Only									
Alachlor	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Atrazine	EPA 505	ND	0.50	ug/L	1	A708902	07/14/17	07/14/17	
Simazine	EPA 505	ND	1.0	ug/L	1	A708902	07/14/17	07/14/17	
Surrogate: 1-Br-2-Nitrobenzene	EPA 505	109 %	*Acceptable range: 70-130 %*						
Volatile Organics by GC-MS									
1,1,1,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,1-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2,2-Tetrachloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
1,1,2-Trichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,1-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,3-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2,4-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3,5-Trimethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,3-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-13
Sampled By: Ryan Harris
Sample Description: Well 15

Sample Date - Time: 07/12/17 - 10:49
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.03 Temp=27.1 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
1,3-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
1,4-Dichlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2,2-Dichloropropane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Butanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
2-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
2-Hexanone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
4-Chlorotoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
4-Methyl-2-pentanone	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Acetone	EPA 524.2	ND	10	ug/L	1	A708850	07/13/17	07/13/17	
Benzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromoform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Bromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Carbon Tetrachloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chlorobenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Chloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
cis-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromochloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dibromomethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichlorodifluoromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Dichloromethane	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Di-isopropyl ether (DIPE)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
Ethyl tert-Butyl Ether (ETBE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Ethylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Hexachlorobutadiene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Isopropylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
m,p-Xylenes	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Methyl-t-butyl ether	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Naphthalene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
n-Propylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
o-Xylene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
p-Isopropyltoluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
sec-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Styrene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
tert-Amyl Methyl Ether (TAME)	EPA 524.2	ND	3.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butyl alcohol (TBA)	EPA 524.2	ND	2.0	ug/L	1	A708850	07/13/17	07/13/17	
tert-Butylbenzene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	

BSK ASSOCIATES

Certificate of Analysis

Sample ID: A7G1000-13
Sampled By: Ryan Harris
Sample Description: Well 15

Sample Date - Time: 07/12/17 - 10:49
Matrix: Drinking Water
Sample Type: Grab

Field Data: pH=7.03 Temp=27.1 °C

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Volatile Organics by GC-MS									
Tetrachloroethene (PCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Toluene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,2-Dichloroethene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
trans-1,3-Dichloropropene	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichloroethene (TCE)	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Trichlorofluoromethane	EPA 524.2	ND	5.0	ug/L	1	A708850	07/13/17	07/13/17	
Vinyl Chloride	EPA 524.2	ND	0.50	ug/L	1	A708850	07/13/17	07/13/17	
Surrogate: 1,2-Dichlorobenzene-d4	EPA 524.2	105 %	*Acceptable range: 70-130 %*						
Surrogate: Bromofluorobenzene	EPA 524.2	103 %	*Acceptable range: 70-130 %*						
Total 1,3-Dichloropropene		ND	0.50	ug/L					
Total Trihalomethanes		ND	0.50	ug/L					
Total Xylenes, EPA 524.2		ND	0.50	ug/L					

Appendix T. Groundwater Conditions in the Dos Palos Sub-Area of the SJREC GSP

GROUNDWATER CONDITIONS IN THE DOS PALOS SUB-AREA OF THE SJREC GSP

prepared for
San Joaquin River Exchange
Contractors GSA
Los Banos, California

and
City of Dos Palos GSA
Dos Palos, California

by
Kenneth D. Schmidt & Associates
Groundwater Quality Consultants
Fresno, California

May 2019

KENNETH D. SCHMIDT AND ASSOCIATES
GROUNDWATER QUALITY CONSULTANTS
600 WEST SHAW AVE., SUITE 250
FRESNO, CALIFORNIA 93704
TELEPHONE (559) 224-4412

May 31, 2019

Mr. Chris White, Executive Director
San Joaquin River Exchange
Contractors GSA
P. O. Box 2115
Los Banos, CA 93635

Re: Dos Palos Sub-Area of the
SJREC GSP

Dear Chris:

Submitted herewith is our report on groundwater conditions in the Dos Palos Sub-area of the SJREC GSP. We appreciate the co-operation of the CCID and City of Dos Palos in providing information for this report.

Sincerely Yours,

[signature]

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist 176

REGISTERED GEOLOGIST • KENNETH D. SCHMIDT NO. 1578 • STATE OF CALIFORNIA

REGISTERED GEOLOGIST • KENNETH D. SCHMIDT NO. 176 CERTIFIED HYDROGEOLOGIST • STATE OF CALIFORNIA

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GROUNDWATER CONDITIONS IN THE DOS PALOS SUB-AREA OF THE SJREC GSP

INTRODUCTION

As part of the Groundwater Sustainability Plan (GSP) for the San Joaquin River Exchange Contractors (SJREC) GSA service area, GSPs for a number of cities, including Dos Palos, are being incorporated into the SJREC GSP. The City has been using water from the California Aqueduct for several decades, because of poor groundwater quality beneath the City. Kenneth D. Schmidt and Associates (KDSA, 2017) prepared a report on groundwater conditions in the vicinity of the City of Dos Palos, as part of an evaluation of potential sites for a backup well for the City. The area evaluated included the City and lands to the south and west along the pipeline extending between the Aqueduct and the City.

This report is intended to provide information on groundwater conditions within and near the Dos Palos Study Area (Figure 1). This area encompasses lands that are planned for future urban development. This study area is generally bounded by Carmellia Avenue to the north, W. Miller Avenue to the south, the Laguna Canal to the west, and N. Custer Avenue on the east. Lands surrounding most of the City are in the SJREC GSA. Some lands west of Folsom Avenue are in the Merced County Delta-Mendota GSA.

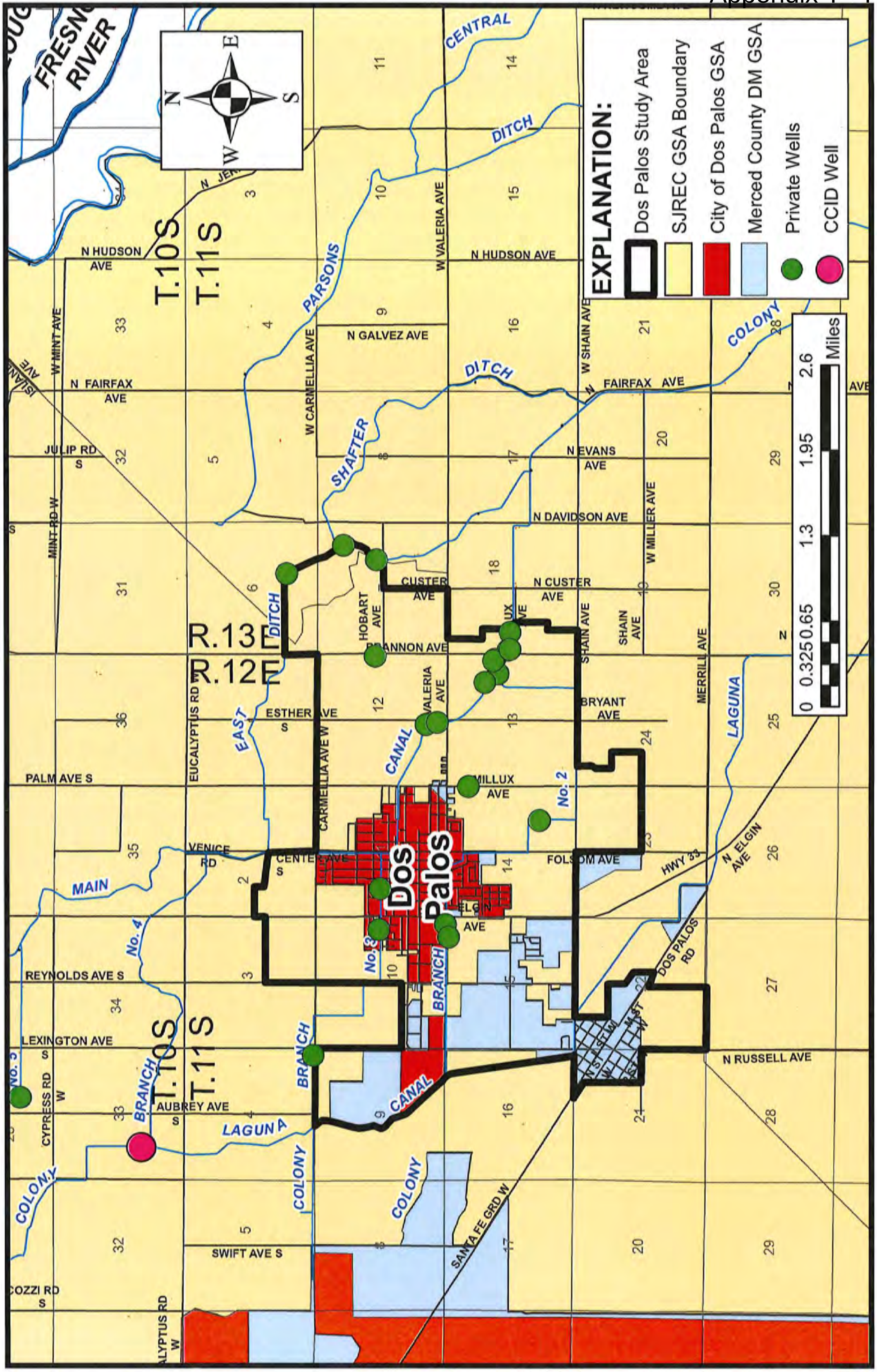

FIGURE 1-LOCATION OF DOS PALOS STUDY AREA AND SELECTED WELLS

SUBSURFACE GEOLOGIC CONDITIONS

Alluvial deposits comprise the aquifers in the Dos Palos vicinity. A regional confining bed, the Corcoran Clay, separates the upper and lower aquifers. The top of the Corcoran Clay is about 250 feet deep and the clay is about 120 feet thick beneath the City. There are numerous sand layers above and below the clay from which groundwater can be pumped.

WELL DATA

Two test holes were drilled in the City in Fall 1956. The first was a 627-foot deep hole near the City water works (west of the Joint Union High School). The second hole was drilled to a depth of 700 feet at a site about 2,000 feet east of the High School. Water samples were apparently collected from both holes, the chemical quality was determined to be unusable for public supply, and the holes were destroyed. Prior to the City obtaining water from the aqueduct, Luhdorff & Scalmanini conducted an evaluation for the City of the closest area where groundwater of suitable quality for public supply was present. They conducted a test well program near the Dos Palos Y (Highways 152 and 33). Although good quality groundwater was found, there was substantial local opposition to exporting groundwater from the Y area, and the proposed project was abandoned. In

1984, Kenneth D. Schmidt & Associates conducted an evaluation for the City and concluded that suitable quality groundwater for public supply wasn't present beneath the City. The City then went ahead with the project to obtain water from the Aqueduct. Water from the San Luis Canal (Aqueduct) was purchased from the CCID. A pipeline was subsequently built from near Eagle Field Road and the Aqueduct to the east to Russel Avenue, thence to the north and east and into the City.

Irrigation wells in the Dos Palos vicinity tap the upper aquifer, as higher salinity groundwater is normally present below the Corcoran Clay. CCID Well No. 6 is located northwest of the study area. The casing in this well is perforated between 50 and 180 feet in depth.

WATER LEVELS

Water levels in the Dos Palos vicinity are relatively shallow, generally less than 20 feet deep. Figure 2 is a water-level elevation map for the upper aquifer for Spring 2015. The City is near a groundwater divide. Groundwater northeast of the City flows to the northeast towards the San Joaquin River, groundwater to the south flows to the south and into the Panoche W.D., and groundwater northwest of the City flows to the northwest and into the Grassland W.D.

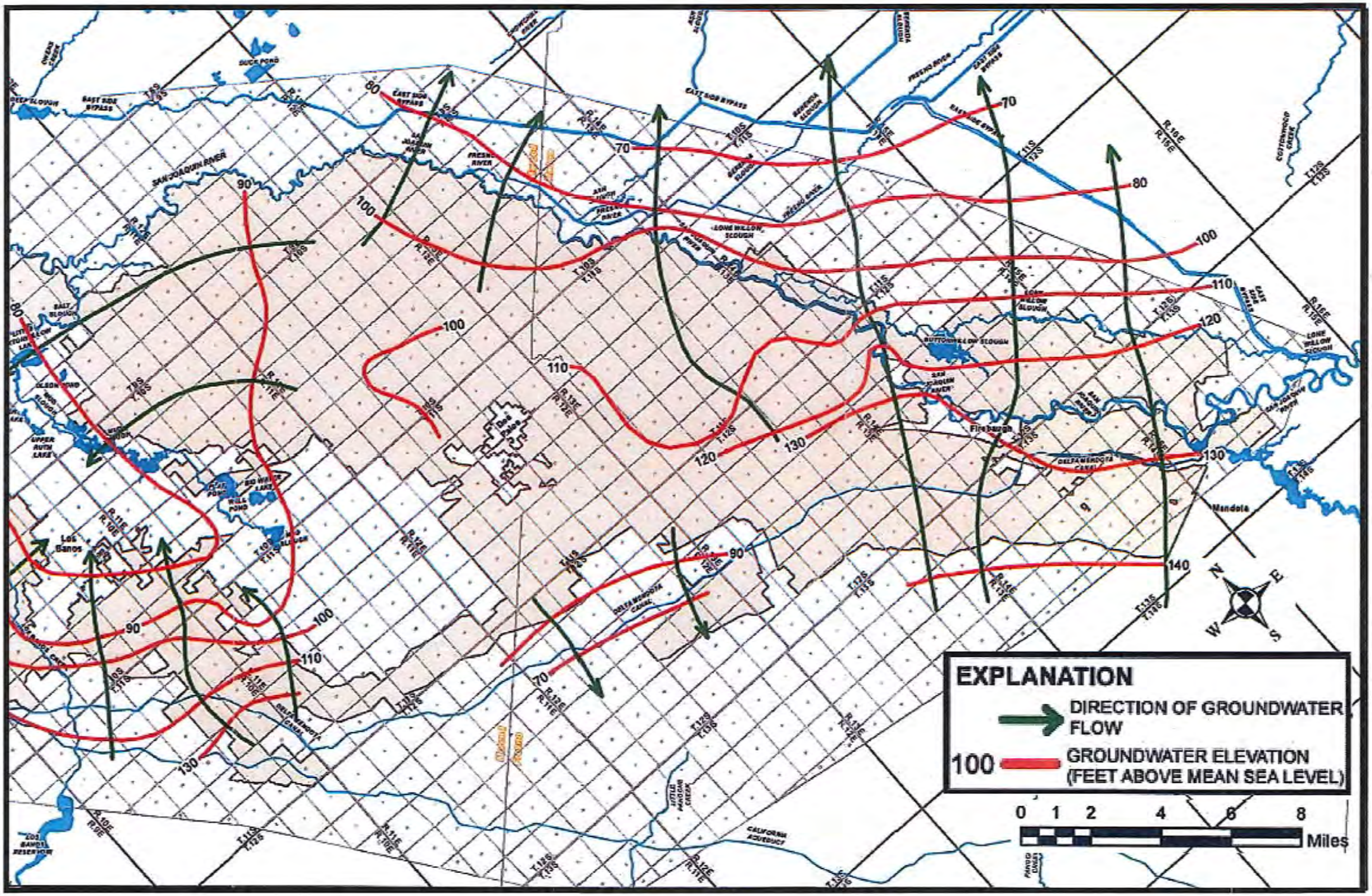

FIGURE 2 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR THE UPPER AQUIFER (SPRING 2015)

Figure 3 is a representative water-level hydrograph for the upper aquifer in the Dos Palos area. Well T11S/R13E-17E1 is located about a mile and a quarter east of the study area. Depth to water ranged from about two to 25 feet during 1965-2017. The deepest water levels of record were in 2015-16. Except for the recent drought, water-levels were stable, usually ranging from about three to 12 feet deep.

PUMP TEST DATA

Table 1 shows pump test data for CCID Well No. 6. Pump tests are available for 11 years between 2002 and 2016. The pumping rates ranged from 825 to 1,733 gpm. Specific capacities usually ranged from about 20 to 80 gpm per foot. The highest pumping rates and specific capacities were after the well perforations had been cleaned.

PUMPAGE

Table 2 shows annual pumpage from CCID Well No. 6 and 18 private irrigation wells in the study area (estimated by the CCID). Annual pumpage from CCID Well No. 6 ranged from about 50 to 1,030 acre-feet and averaged about 490 acre-feet per year from 2003 to 2017. The highest pumpage was in 2007 and the lowest

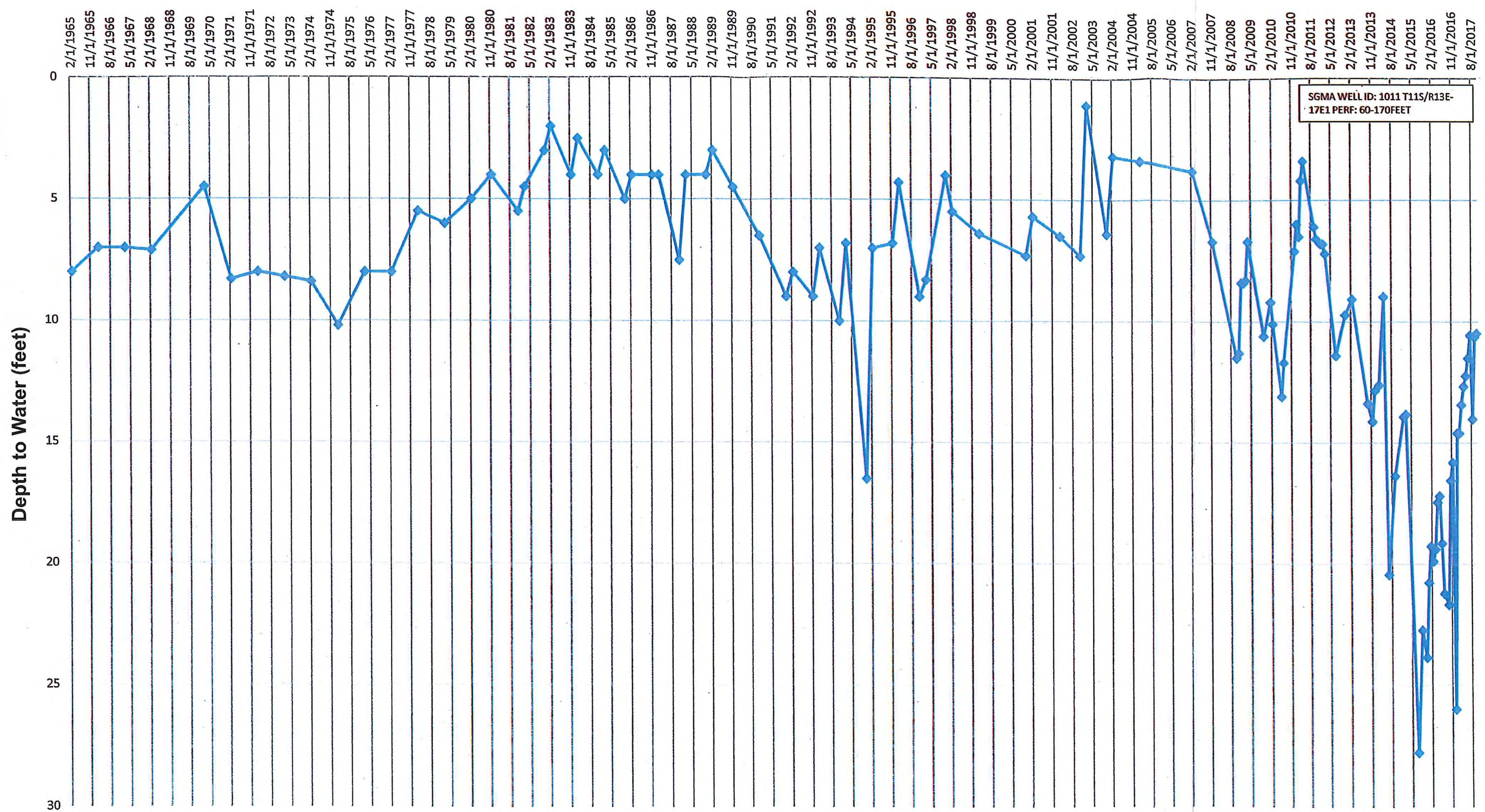

FIGURE 3-REPRESENTATIVE WATER-LEVEL HYDROGRAPH FOR UPPER AQUIFER IN THE DOS PALOS AREA

TABLE 1-PUMP TEST DATA FOR CCID WELL NO. 6

Date Tested	Pumping Rate (gpm)	Static Level (feet)	Pumping Level (feet)	Drawdown (feet)	Approximate Specific Capacity (gpm/ft)
6/3/02	1,526	29.82	64.00	34.18	44.60
7/25/03	1,532	—	78.30	78.30	—
7/28/04	1,105	20.70	76.50	55.80	19.10
6/28/05	1,002	18.70	70.00	51.30	18.80
8/31/07	825	17.30	75.00	57.70	14.30
4/1/09	1,557	25.15	49.14	23.99	64.90
10/25/10	1,328	11.20	38.20	27.00	49.20
8/1/11	1,642	24.60	48.20	23.60	69.60
9/25/12	1,634	25.00	45.50	20.50	79.70
6/24/14	825	18.00	28.00	10.00	82.50
10/15/16	1,733	12.70	42.49	29.79	58.20

TABLE 6-ANNUAL PUMPAGE FOR CCID WELL NO. 6 AND PRIVATE IRRIGATION WELLS

	Pumpage (AF)	
Year	CCID Wells	Private Wells
2003	265	5,013
2004	606	3,356
2005	382	3,639
2006	49	3,928
2007	1,028	3,121
2008	199	4,061
2009	454	4,540
2010	503	1,677
2011	413	2,353
2012	684	896
2013	813	1,718
2014	478	2,676
2015	508	7,870
2016	425	1,891
2017	178	375

pumpage was in 2006. Annual pumpage from the private irrigation wells ranged from about 380 acre-feet to 7,870 acre-feet from 2003 to 2017. The highest pumpage was in 2015 and the lowest pumpage was in 2017. The average pumpage from the private wells in the study area was about 3,360 acre-feet per year during 2003-17.

CITY AQUEDUCT WATER

Table 3 shows the water deliveries to the City from the aqueduct for 2003-16. The annual deliveries ranged from 970 to 1,778 acre-feet and averaged 1,400 acre-feet per year from 2003 to 2016.

CITY EFFLUENT

Table 4 shows annual volume of sewage effluent for the City for 2003 to 2016. The annual amount of effluent ranged from 476 to 744 acre-feet, and the average amount was about 640 acre-feet per year during this period. Net evaporation from the 54 acres of effluent ponds is estimated to average about 4.0 acre-feet per acre per year, or about 220 acre-feet per year. Most of the remainder of the effluent was used for crop irrigation.

TABLE 3-WATER DELIVERIES TO THE CITY FROM THE AQUEDUCT

Water Year	Volume (ac-ft)
2003	1,417
2004	1,495
2005	1,415
2006	1,455
2007	1,630
2008	1,664
2009	1,269
2010	1,280
2011	1,224
2012	1,346
2013	1,778
2014	1,417
2015	970
2016	1,231

TABLE 4-AMOUNTS OF CITY SEWAGE EFFLUENT AND POND EVAPORATION

Water Year	Total Effluent Volume (AF)	After Pond Evaporation Effluent Volume (AF)
2003	611	287
2004	657	333
2005	702	378
2006	688	364
2007	646	322
2008	678	354
2009	743	419
2010	694	370
2011	744	420
2012	677	353
2013	663	339
2014	536	212
2015	490	166
2016	476	152

CONSUMPTIVE USE

Urban

The urban consumptive use is from outside water use in the City, evaporation from the effluent ponds, and evapotranspiration of crops grown with effluent. The outside water use was estimated by subtracting the average amount of sewage effluent (640 acre feet per year) from the average amount of aqueduct water delivered (1,400 acre-feet per year) during 2003 to 2016. The average outside water use was thus 760 acre-feet per year for this period. The consumptive use due to outside water use in the City was estimated to be 70 percent of this, or 530 acre-feet per year. An average of about 420 acre-feet of effluent was used for crop irrigation. The estimated consumptive use was about 70 percent of this, or 300 acre-feet per year. Combined with the pond evaporation of 220 acre-feet per year, the average total urban consumptive use was thus about 1,050 acre-feet per year.

Rural

Table 5 shows CCID canal water deliveries and crop evapotranspiration from 2003-16. CCID water deliveries average 7,700 acre-feet per year. The crop evapotranspiration of applied water averaged about 5,900 acre-feet per year.

TABLE 5-CCID CANAL WATER DELIVERIES AND CROP EVAPOTRANSPIRATION

Water Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Acreage	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100
Water Delivered (AF)	7,800	9,500	7,300	6,400	7,400	8,200	7,900	7,300	7,500	9,100	10,200	6,600	6,700	6,100
ETc (AF)	7,500	8,300	7,500	7,900	6,800	6,900	8,900	7,000	7,500	7,500	7,400	6,500	7,000	6,800
ETiw (AF)	6,600	7,200	6,200	6,400	6,200	6,200	-	-	-	6,500	-	-	-	-

Total

The total consumptive use in the study area averaged about 6,950 acre-feet per year during 2003-16.

CHANGES IN GROUNDWATER STORAGE

Long-term water-level measurements for wells in the area indicated no overall change in storage. In the Dos Palos study area this is supported by the water budget calculations, which do not indicate a water deficit.

WATER BUDGET

The total amount of surface water (urban and rural) averaged 9,100 acre-feet per year, and this exceeded the consumptive use by an average of 2,150 acre-feet per year. The groundwater flows into and out of the study area help maintain a water balance. More groundwater flows out of the study area than into the area.

LAND SUBSIDENCE

Figure 4 shows land subsidence in the area for December 2013-December 2017. Land subsidence is due primarily to pumpage from the lower aquifer. The subsidence near Dos Palos was 0.5 foot during this period. The closest wells to Dos Palos where pumpage from the lower aquifer was occurring was in the Red Top-El

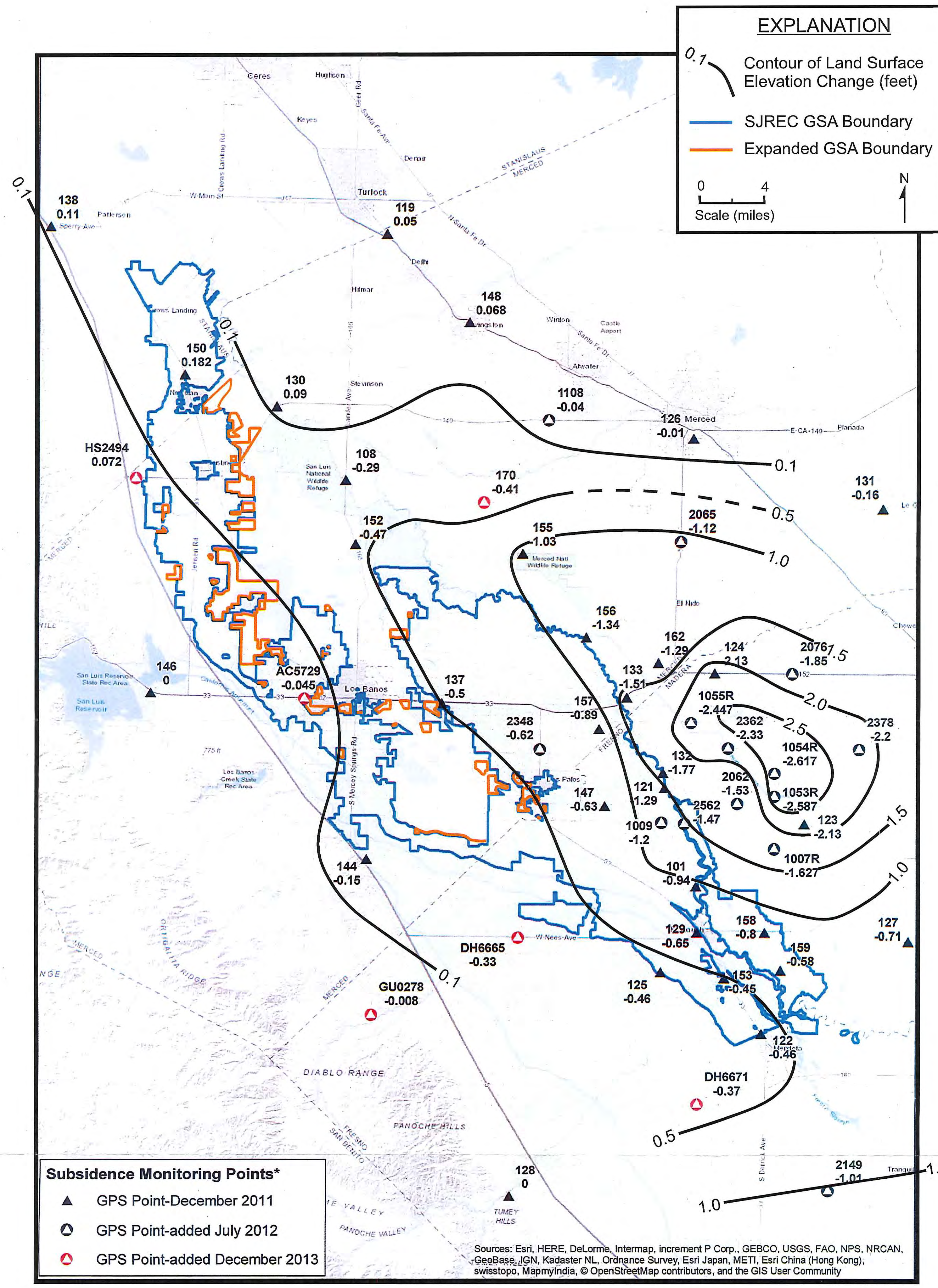

FIGURE 4-LAND SUBSIDENCE (DECEMBER 2013-DECEMBER 2017)

Nido area to the northeast and east, in the Panoche Water District to the southwest, and in the Broadview W.D. to the south. Figure 4 indicates that more than two feet of land subsidence occurred in the Red Top area during this period.

GROUNDWATER QUALITY

Water samples were collected from CCID Well No. 6 during ten years between 2003 and 2017. Table 6 shows the results of three analyses of water from this well. The water was of the sodium chloride type. Sodium concentrations ranged from 230 to 300 mg/l and chloride concentrations ranged from 450 to 550 mg/l. Nitrate concentrations were less than 1 mg/l, and boron concentrations ranged from 0.6 to 0.8 mg/l. Water from this well is of suitable quality for irrigation of crops when mixed with canal water. If used directly for irrigation, the water or soil would need to be treated because of the high sodium adsorption ratio. The boron concentrations exceeded desirable levels for direct irrigation of boron-sensitive crops, and chloride concentrations were too high for direct irrigation of some crops, such as almonds. The non-detectable nitrate concentrations indicate that the groundwater is anaerobic. Such groundwater can have high concentrations of iron, manganese, and arsenic, and have a rotten-egg odor due to hydrogen sulfide.

TABLE 6-CHEMICAL QUALITY OF WATER FROM CCID WELL NO. 6

Constituent (mg/l)	8/22/03	9/23/10	7/19/17
Calcium	91	110	120
Magnesium	52	57	59
Sodium	230	240	300
Potassium	3	4	5
Bicarbonate	170	210	180
Sulfate	130	210	200
Chloride	500	450	550
Nitrate	<1	<1	<1
pH	7.4	7.9	7.7
Electrical Conductivity (micromhos/cm @ 25°C)	2,000	2,100	2,500
Total Dissolved Solids (@ 180°C)	1,300	1,300	1,400
Boron	0.7	0.6	0.8

REFERENCES

Kenneth D. Schmidt & Associates, 2017, Letter report to QK, Inc. on Potential Well Sites between Dos Palos and California Aqueduct, 5p.

Appendix U. Updated Groundwater Conditions in the Vicinity of the City of Firebaugh

UPDATED GROUNDWATER CONDITIONS IN THE VICINITY OF THE CITY OF FIREBAUGH

prepared for
San Joaquin River Exchange Contractors GSA
Los Banos, California
and
City of Firebaugh GSA
Firebaugh, California

by
Kenneth D. Schmidt and Associates
Groundwater Quality Consultants
Fresno, California

May 2019

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GROUNDWATER QUALITY CONSULTANTS
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May 31, 2019

Mr. Chris White, Executive Director
San Joaquin River Exchange
Contractors GSA
P. O. Box 2115
Los Banos, CA 93635

Re: Firebaugh Sub-Area of the
SJREC GSP

Dear Chris:

Submitted herewith is our report on groundwater conditions in the Firebaugh Sub-area of the SJREC GSP. We appreciate the co-operation of the CCID and City of Firebaugh in providing information for this report.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist 176

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UPDATED GROUNDWATER CONDITIONS IN THE VICINITY OF THE CITY OF FIREBAUGH

INTRODUCTION

As part of the Groundwater Sustainability Plan (GSP) for the San Joaquin River Exchange Contractors (SJREC) GSA service area, GSPs for a number of cities, including Firebaugh, are being incorporated into the SJREC GSP. Kenneth D. Schmidt and Associates (KDSA) prepared a report on groundwater conditions in the vicinity of the City of Firebaugh in 2008 for the City 2030 general plans. That report provides substantial information that was used in preparing this report.

This report is intended to provide an update on groundwater conditions within the Firebaugh Study Area boundary (Figure 1). This boundary encompasses lands that are planned for future urban development. This study area is generally bounded by west Behymer Avenue on the north, the Outside Canal on the southwest, West Bullard Avenue on the south, and Road 6 on the east. The Central California Irrigation District (CCID) virtually adjoins the City on the west and south sides, and part of the City sphere of influence is in the District.

Figure 1 shows the study area boundary, City lands, and GSAs in the vicinity. There are two small areas that are in Madera Area-3 GSA, and the rest of the area is in the SJRECWA GSA.

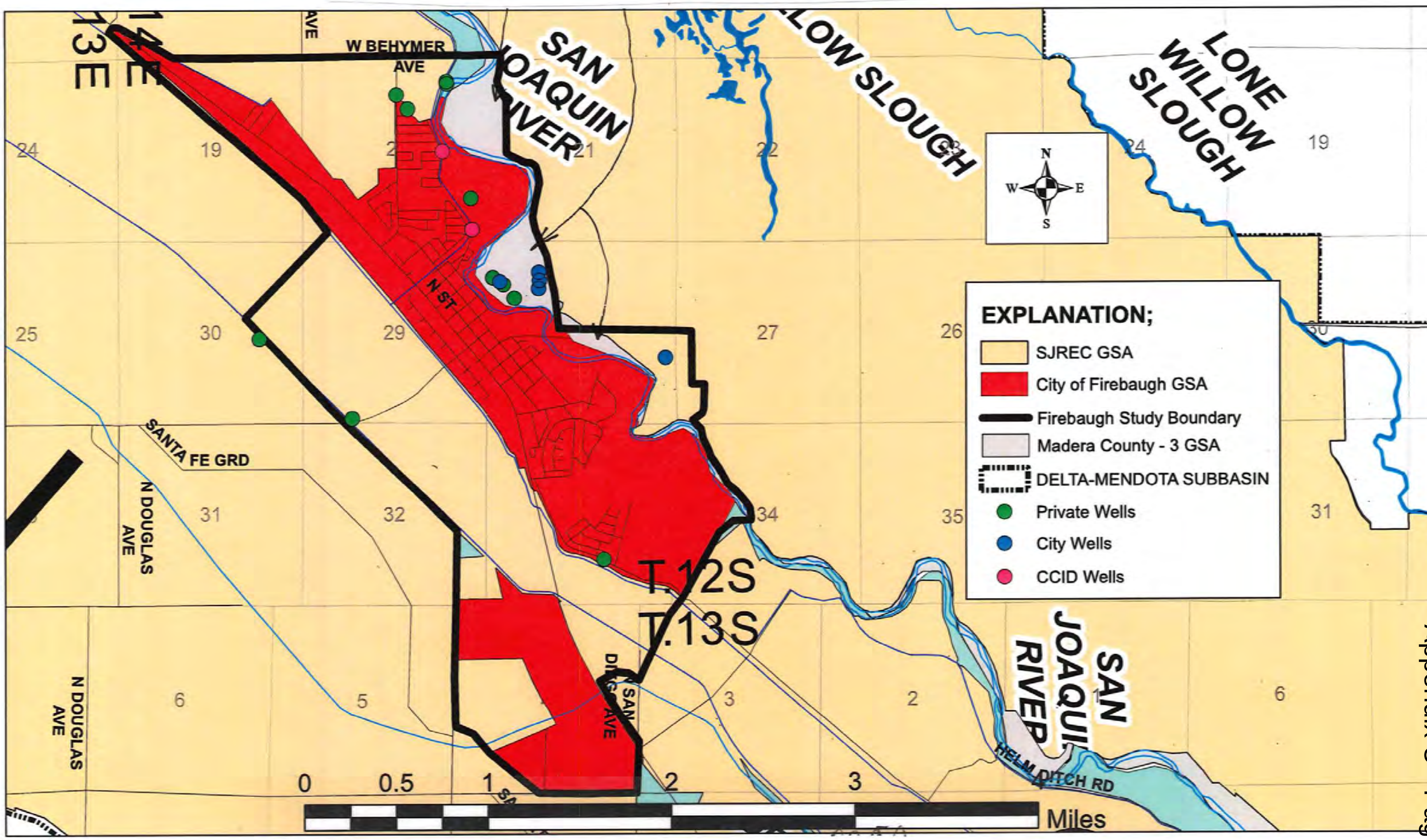

FIGURE 1-STUDY AREA BOUNDARY, CITY WELLS, AND SGMA GSAS

SUBSURFACE GEOLOGIC CONDITIONS

Alluvial deposits comprise the water producing deposits in the Firebaugh area. The Corcoran Clay is a regional, laterally extensive, confining bed beneath much of the west side of the San Joaquin Valley. Regionally, this blue clay has been used to separate an upper aquifer from an underlying lower aquifer. The focus of this evaluation focuses on groundwater in the upper aquifer, because groundwater in this aquifer is pumped by City wells. Deeper groundwater in the Firebaugh vicinity is indicated to be of unsuitable quality for public supply. The top of the Corcoran Clay is about 300 feet deep and the clay ranges from about 60 to 110 feet thick near Firebaugh. Belitz and Heimes (1990) showed that the Sierran Sands are present below a depth of about 100 feet and above the Corcoran Clay near the San Joaquin River near Mendota. These deposits are highly permeable and comprise the major aquifer that is used in the Firebaugh and Mendota areas. The top of these sands is shallower beneath Firebaugh, and these sands become thinner to the west of Firebaugh with increasing distance from the San Joaquin River. The Sierran Sands are overlain by Coast Range alluvial deposits, which are primarily fine-grained in the area west of Firebaugh.

As part of the previous evaluation, three subsurface geologic cross sections were developed (Figure 2). These cross sections were developed to focus primarily on conditions above the Corcoran

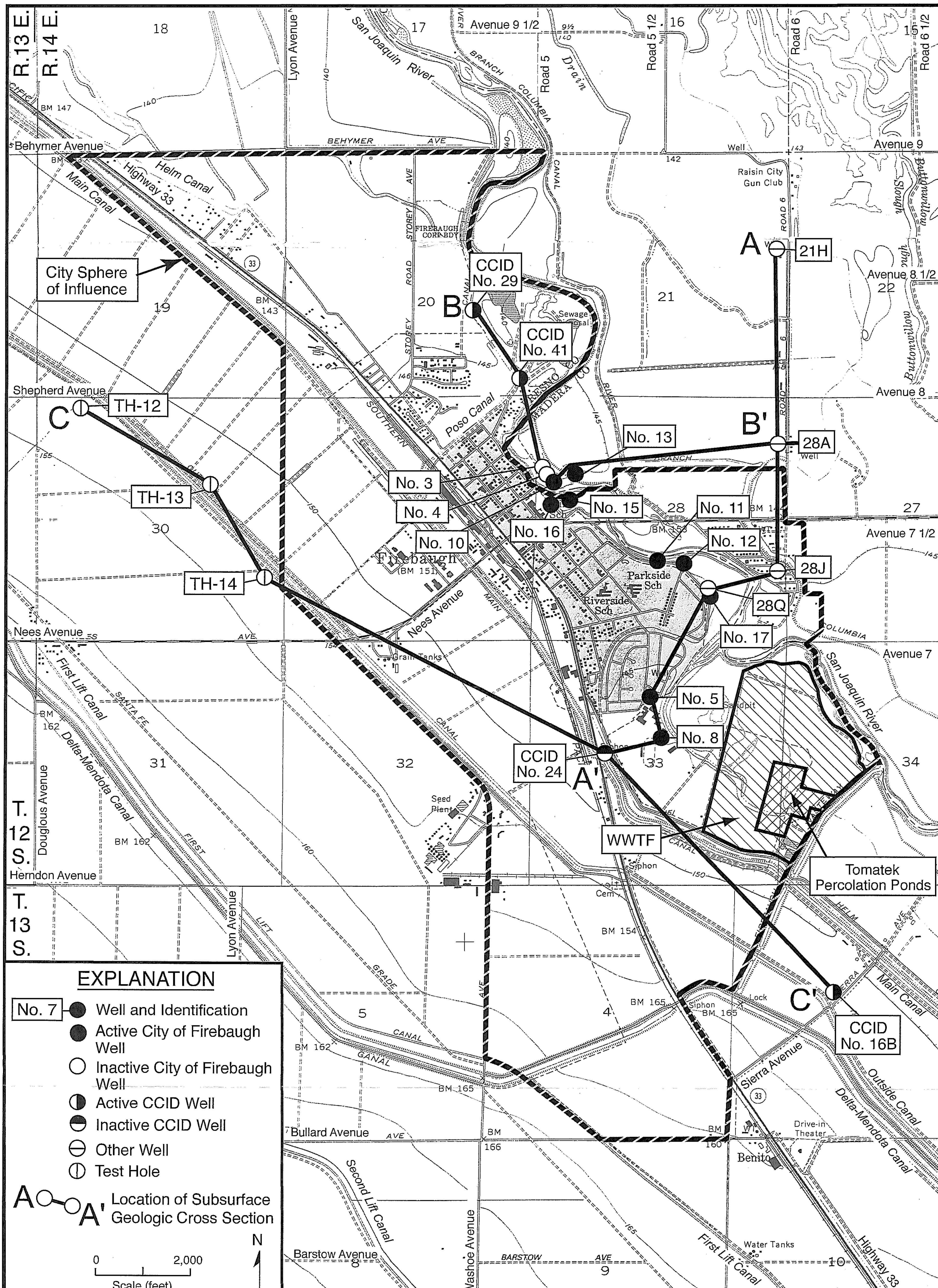

FIGURE 2 - LOCATIONS OF SELECTED WELLS, TEST HOLES AND SUBSURFACE GEOLOGIC CROSS SECTIONS

Clay at and near Firebaugh. Cross Section A-A′ extends from near Avenue 8-1/2 and Road 6, northeast of the City, to the south near the east edge of the City, and thence to the southeast through several City wells. Cross Section B-B′ extends from near the north part of the City to the southeast, through several City wells, and thence to the east to near Road 6. Cross Section C-C′ extends along the Outside Canal, west of the City to the southeast, through the southern part of the City to near Sierra Avenue.

Subsurface Cross Section A-A′ (Figure 3) shows the Corcoran Clay, which deepens to the southwest in the vicinity. The clay ranges from about 70 to 110 feet thick along this section. A more localized and thinner clay layer is present along the part of the cross section near the San Joaquin River. This has been termed the A-clay in the Mendota area and farther south. This shallow blue clay is overlain and underlain by the Sierran Sands at Firebaugh. Near Firebaugh and Mendota, the A-clay is a partial confining bed, partially separating the overlying groundwater from the underlying groundwater. The A-clay was identified at three wells (28J and former City Wells No. 5 and 8) along this section. Fine-grained deposits are predominant above the Corcoran Clay along the northeast part of the section. Near the San Joaquin River and farther southwest, sand is predominant above the Corcoran Clay along this section. Another regional blue clay,

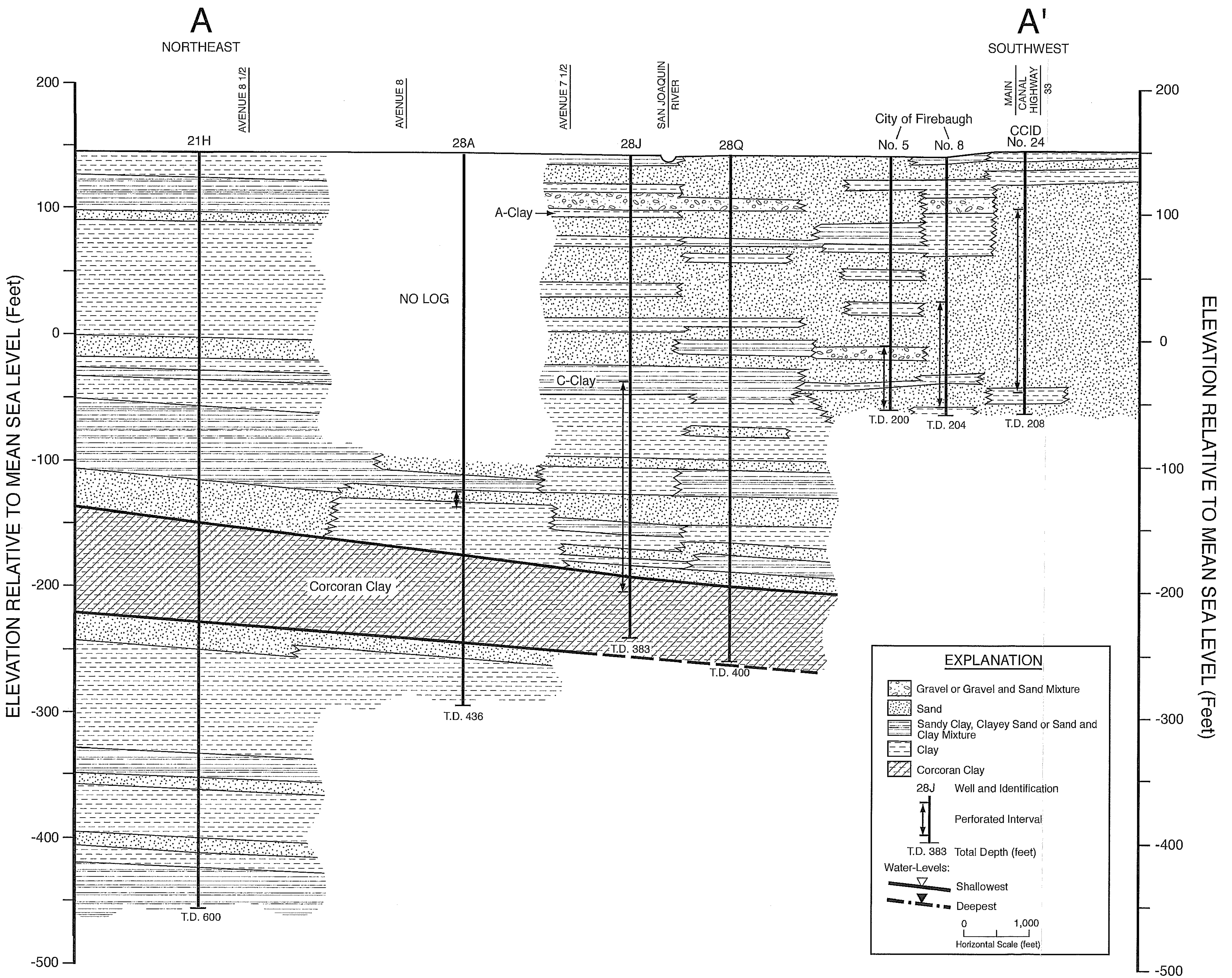

FIGURE 3 - SUBSURFACE GEOLOGIC CROSS SECTION A - A'

the C-clay, is also present near the San Joaquin River, and is about 150 to 200 feet deep beneath Firebaugh. Some stream channel deposits (coarser than sand) are present above the C-clay along this section.

Subsurface Cross Section B-B′ (Figure 4) also shows the Corcoran Clay, which is apparently about 100 feet thick along this section. The A-clay was penetrated by two wells along this section, at a depth of about 100 feet. Sand is predominant above the Corcoran Clay along the northwest part of this section. The C-clay was also penetrated by the same wells that penetrated the A-clay along this section, at a depth of about 150 to 170 feet. Stream channel deposits were encountered near the river both above and below the C-clay. The shallowest and deepest historical water levels for the two CCID wells are also shown on this section.

Cross Section C-C′ (Figure 5) extends from near Shephard Avenue and the Outside Canal to the southeast to near Sierra Avenue and the Main Canal. Three of the logs used along this cross section are for test holes done as part of a groundwater pumping/ water transfer project by the Firebaugh Canal Water District and the CCID. Electric logs and geologic logs are available for these holes. The remaining two logs are for two CCID wells. Two of the test holes (TH-12 and TH-13) reached the top of the Corcoran

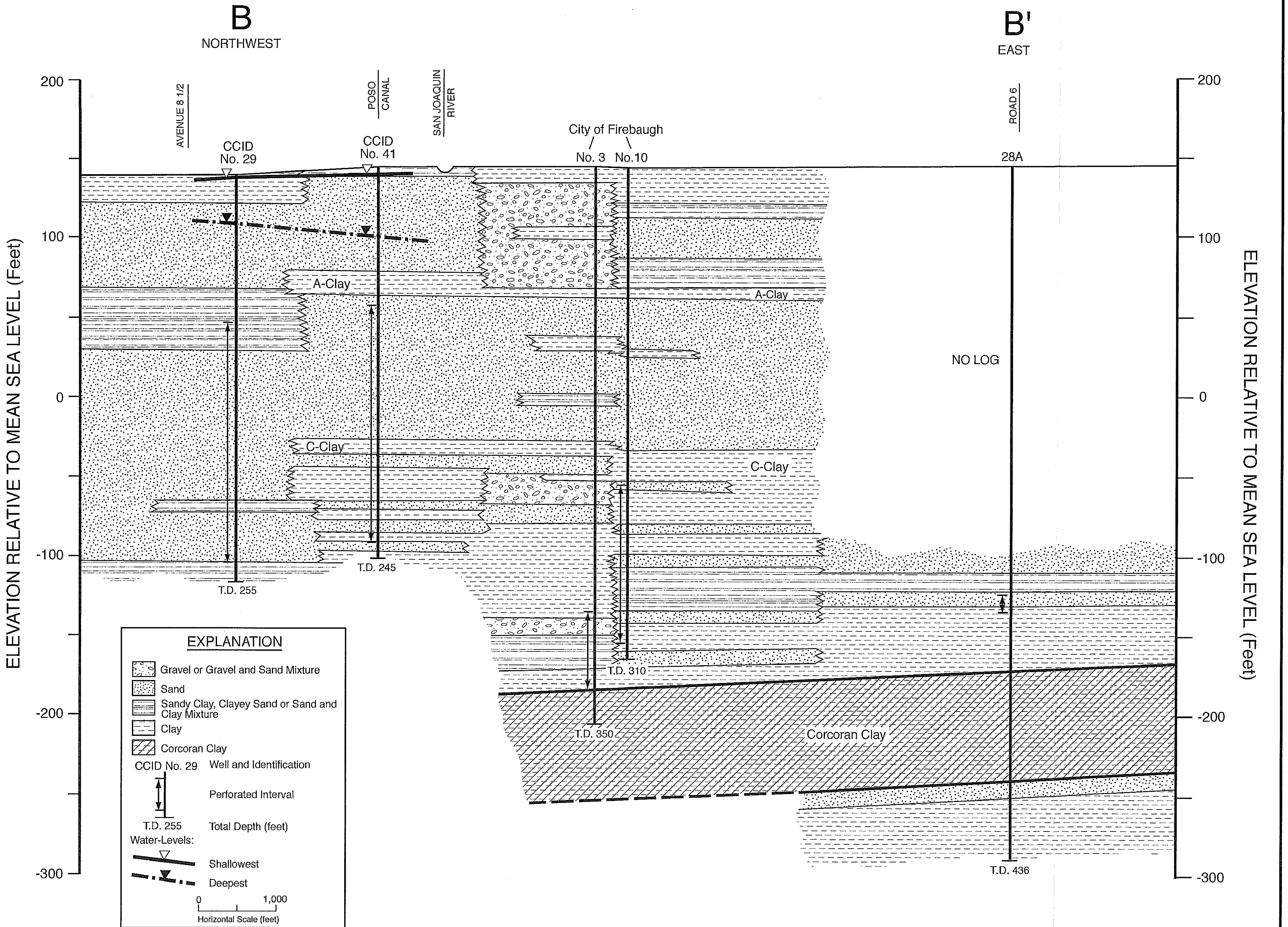

FIGURE 4 - SUBSURFACE GEOLOGIC CROSS SECTION B - B'

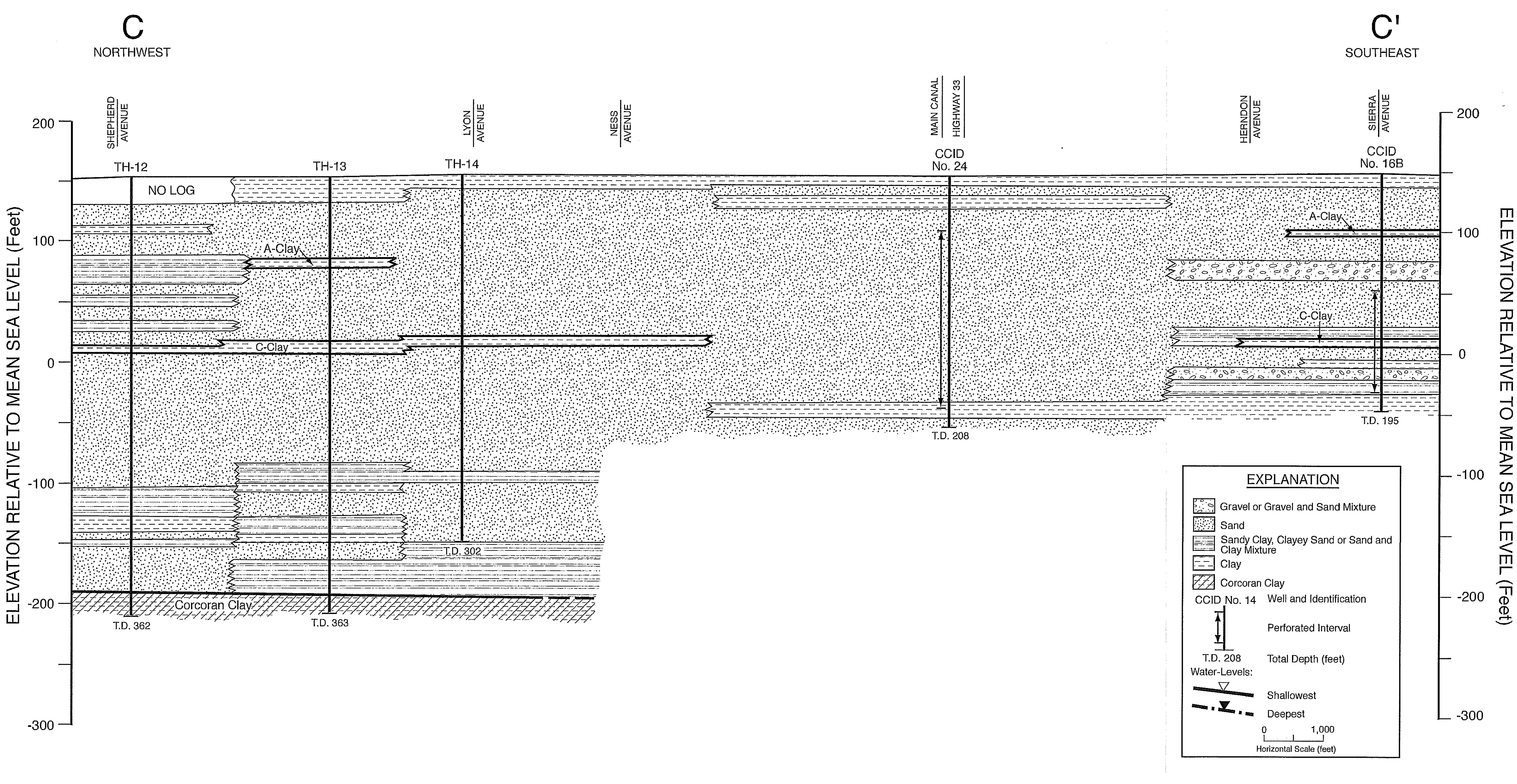

FIGURE 5 - SUBSURFACE GEOLOGIC CROSS SECTION C - C'

Clay, at a depth of 350 feet. Sand is predominant along the cross section, although there are more fine-grained deposits within the uppermost 150 feet to the northwest along this section. The A-clay was apparently at a depth of about 50 feet at CCID Well 16B and about 70 feet deep at TH-13. Some stream channel deposits were found at Well 16B. The C-clay was indicated to be present at the three test holes and at former CCID Well No. 16B.

CONSTRUCTION DATA FOR WELLS

Active City Wells

Table 1 shows construction data for the six active City wells. Cased depths range from 180 to 230 feet. The tops of the perforations range from 115 to 165 feet in depth. The more recent City wells generally have shallower depths to the top of the perforations compared to older wells. Annular seals range from 80 to 155 feet in depth.

CCID Wells

Table 2 shows construction data for two active CCID wells (No. 29 and 41) in the study area. Cased depths of these wells range from 236 to 248 feet, and the top of the perforations range from 86 to 93 feet deep.

TABLE 1-CONSTRUCTION DATA FOR ACTIVE CITY WELLS

No.	Date Drilled	Total Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
11	6/91	205	200	16	165-190	0-155
12	1/94	190	180	16	155-180	0-80
13	5/97	210	200	16	160-200	0-155
15	4/05	245	230	16	115-220	0-105
16	4/05	235	230	16	115-220	0-105
17	6/14	220	200	16	140-185	0-120

Records from well completion reports.

TABLE 2-CONSTRUCTION DATA FOR CCID WELLS

No.	Date Drilled	Total Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
29	01/64	-	248	18	93-105	-
41	3/67	245	236	16	86-236	-

Data from CCID.

WATER LEVELS

Depths and Elevations

Water levels in the upper aquifer in the Firebaugh area have been relatively shallow, primarily due to the small amount of groundwater that has been pumped for irrigation in the area west of the river (due to poor groundwater quality). The CCID Camp 13 Drainage District area is immediately west of Highway 33. Historically, groundwater wasn't pumped for irrigation in this area and water logging and subsurface drainage problems developed. Tile drainage systems were installed decades ago to allow irrigation to continue. Water levels are generally deeper in the area east of the river, because conjunctive use is practiced and a significant amount of groundwater is pumped for irrigation. Groundwater in that area is generally of suitable quality for irrigation. The shallowest and deepest water levels in CCID Wells No. 29 and 41 are shown on Cross Section B-B'. The shallowest levels generally coincide with the stage of the San Joaquin River. The CCID measures water levels in a number of shallow observation wells in the Camp 13 Drainage District. These measurements indicate that shallow groundwater flows into the San Joaquin River.

KDSA (2006) prepared water-level elevation maps for the upper aquifer in and near the Firebaugh area for Fall 1981 and Spring 1992. These maps were intended to portray normal conditions and drought conditions, respectively. Both of these maps indicated a northeast to north-northeast direction of groundwater flow. Groundwater was moving from beneath the CCID and Firebaugh Canal Water District (between the Main Canal and Third-Lift Canal) to the northeast, and into Madera County (Figure 6). The directions of groundwater flow shown on the map for Spring 1992 are indicated to be representative of current conditions.

Time Trends

Water-level and pumpage hydrographs were obtained from the CCID for the two District wells in the study area. Figure 7 is a long-term hydrograph for Well No. 29 and Figure 8 is one for Well No. 41. Depth to water in these wells has usually ranged from about 5 to 40 feet. The deepest water levels were during the early 1990's, in 1996, and in 2014 during heavy pumping episodes for irrigation wells in the vicinity. On the long-term, water levels in upper aquifer wells in the Firebaugh area have been relatively stable, and there is no evidence of groundwater overdraft.

AQUIFER CHARACTERISTICS

Well Capacities

Table 3 contains a summary of the results of pump tests conducted on five of the six active City wells during 2008. Pumping rates ranged from about 920 to 1,350 gpm. Specific capacities for these wells ranged from 11 to 53 gpm per foot. The highest

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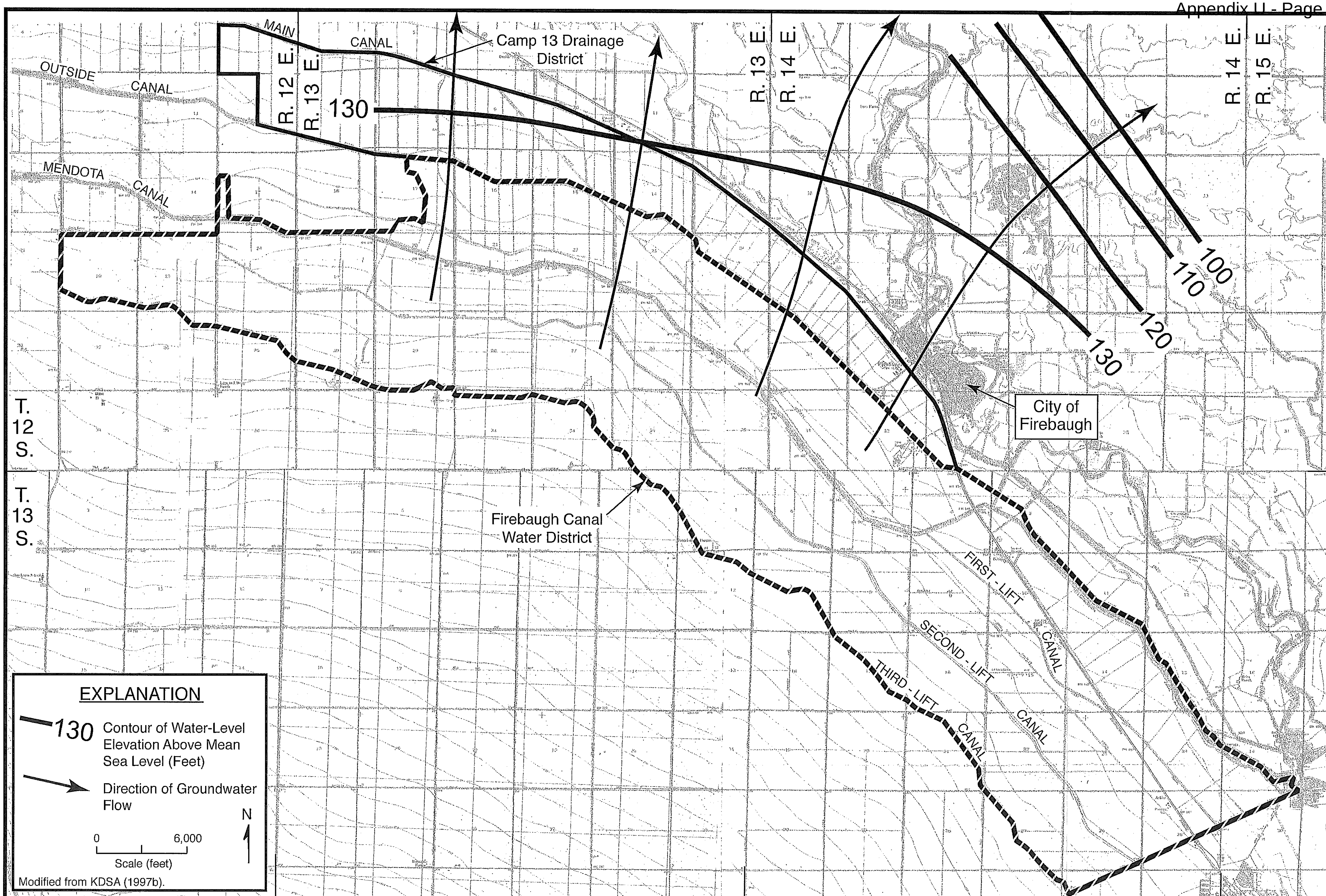

FIGURE 6 - WATER-LEVEL ELEVATION CONTOURS AND DIRECTION OF GROUNDWATER FLOW FOR UPPER AQUIFER (SPRING 1992)

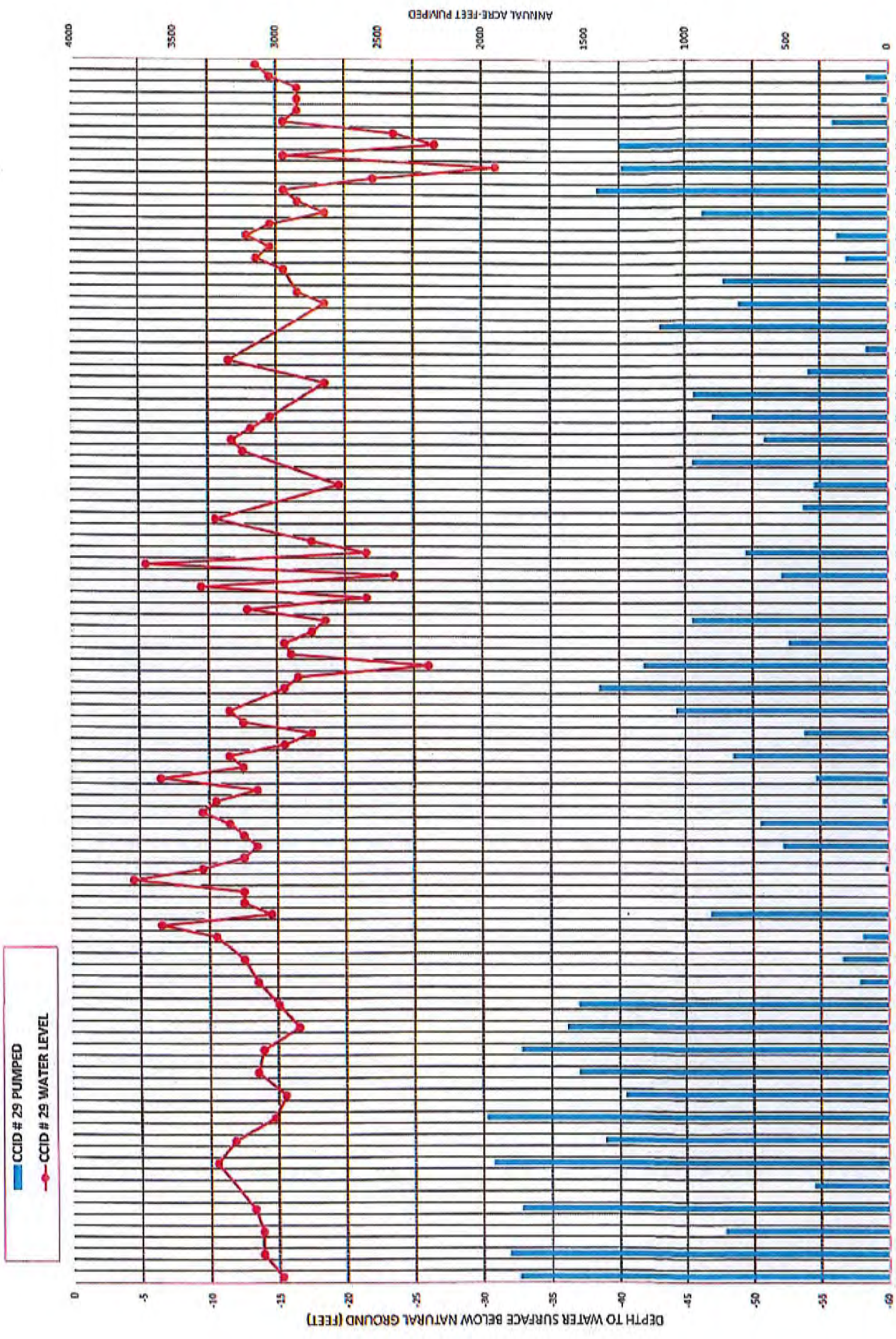

FIGURE 7 - LONG-TERM WATER-LEVEL AND PUMPAGE HYDROGRPAHS
FOR CCID WELL NO. 29

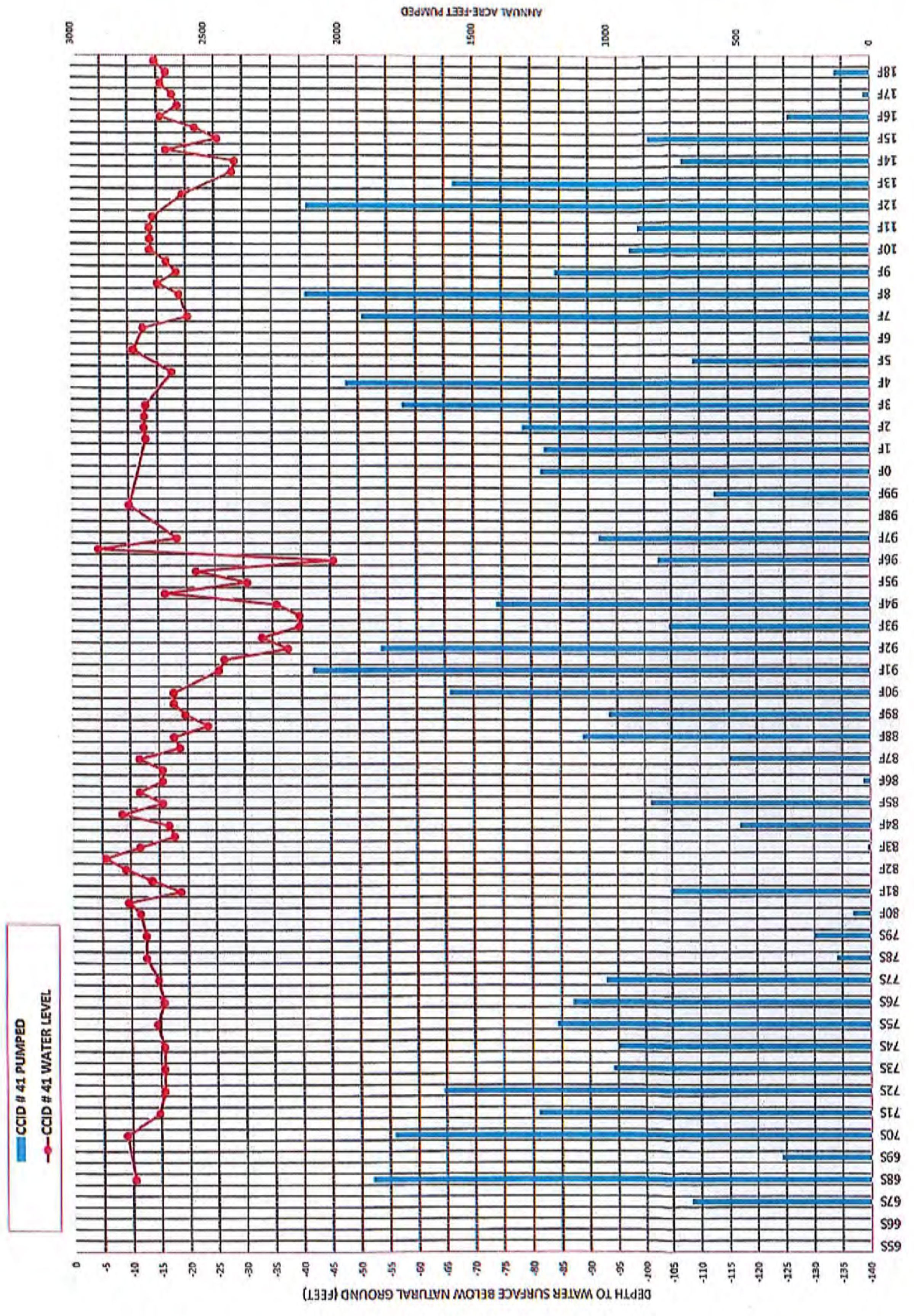

FIGURE 8 - LONG-TERM WATER-LEVEL AND PUMPAGE HYDROGRPAHS
FOR CCID WELL NO. 41

TABLE 3-PUMP TEST DATA FOR CITY WELLS

No.	Date	Pumping Rate (gpm)	Static Level (feet)	Pumping Level (feet)	Drawdown (feet)	Specific Capacity (gpm per foot)
11	4/25/08	919	29	111	82	11.2
12	4/25/08	952	46.5	122	76	12.6
13	9/19/08	1,011	68.5	106	38	27.0
15	9/19/08	1,230	34	66.5	33	37.8
16	9/17/08	1,352	27.5	53	26	53
17	7/15/14	1,500	31	97	66	23

Data from City of Firebaugh

specific capacities (exceeding 25 gpm per foot) were for Wells No. 13, 15, and 16. The casings in the last two of these wells are perforated significantly shallower (115 feet) than the other active City wells.

Table 4 contains a summary of the results of pump tests that were conducted on the two CCID wells during late September 2016. Pumping rates ranged from about 1,520 to 1,640 gpm, and specific capacities ranged from about 20 to 24 gpm per foot.

Aquifer Tests

On May 11, 2005, Gleim-Crown Pump Co. of Fresno conducted a 12-hour step drawdown test on new City Well No. 15. At a pumping rate of 1,000 gpm, the drawdown was 18.5 feet and the specific capacity was 54.0 gpm per foot. Uncorrected recovery measurements for these measurements indicated a transmissivity of 87,000 gpd per foot. Uncorrected values can be used when the drawdown stabilized or nearby stabilized by the end of the pumping period. This value pertains to deposits between a depth of 115 and 200 feet (above the C-clay). During October 28-29, 1996, a 24-hour constant discharge test was conducted on CCID Well No. 41 (KDSA, 1997b). The average pumping rate was 2,210 gpm, and the specific capacity was 30 gpm. Corrected recovery measurements for this test indicated a transmissivity of 78,000 gpd per foot. This value pertains to deposits between 115 and 220 feet in depth. The results of these tests are in good agreement in terms of transmissivity.

TABLE 4-PUMP TEST DATA FOR CCID WELLS

No.	Date	Pumping Rate (gpm)	Static Level (feet)	Pumping Level (feet)	Drawdown (feet)	Specific Capacity (gpm per foot)
29	10/15/16	1,638	20.0	89.0	69.0	23.7
41	10/15/16	1,520	19.0	95.0	76.0	19.9

Pump test results from Central California Irrigation District, Los Banos.

The A-clay partly separates shallow groundwater associated with San Joaquin River streamflow from water tapped by City wells. The vertical hydraulic conductivity of the A-clay at Firebaugh has not been determined. However, several leaky aquifer tests have been conducted near Mendota, which allowed values of this parameter to be determined in that area. An average vertical hydraulic conductivity of about 0.02 gpd per square foot was determined for the A-clay. Groundwater below the A-clay is normally confined or partially confined. The storage coefficient for strata below the A-clay and above the Corcoran Clay near Mendota averaged about 0.001. These values are considered applicable to the Firebaugh study area.

PUMPAGE

Table 5 provides the annual City pumpage during 2003-07 and 2012-17. The annual pumpage ranged from 2,170 acre-feet in 2012 to 2,575 acre-feet in 2014. During 2012-13 and 2015-17, the annual pumpage was less due to water conservation measures. The average annual pumpage was 2,390 acre-feet per year.

Table 6 provides annual pumpage for the two active CCID wells in the Firebaugh area for 2003-2016. Annual pumpage has varied significantly, depending on the availability of surface water supplies in the District. The pumpage from these two wells ranged from about 325 acre-feet during 2006 to about 3,040 feet during 2007. The average pumpage from the two CCID wells was

TABLE 5-ANNUAL PUMPAGE FROM
CITY OF FIREBAUGH WELLS

Year	Pumpage (acre-feet
2003	2,436
2004	2,538
2005	2,418
2006	2,434
2007	2,569
2012	2,170
2013	2,349
2014	2,575
2015	2,312
2016	2,248
2017	2,270
Average	2,390

Records from City of Firebaugh

TABLE 6-ANNUAL PUMPAGE FROM CCID WELLS

Year	Pumpage (acre-feet)
2003	2,623
2004	2,925
2005	1,059
2006	326
2007	3,039
2008	2,856
2009	2,001
2010	1,117
2011	1,131
2012	3,033
2013	3,011
2014	2,089
2015	2,116
2016	575
Average	1,990

Records from Central California Irrigation District, Los Banos.

about 1,990 acre-feet per year during 2003-16.

Annual pumpage from private wells in the study area was estimated by the CCID for six years between 2003 and 2016. This pumpage ranged from 67 acre-feet in 2016 to 1,737 acre-feet in 2015.

CANAL WATER DELIVERIES

CCID provided records of canal water deliveries to 1,300 acres of irrigated lands in the study area for 2003-16. Canal deliveries ranged from 3,000 to 4,300 acre-feet per year and averaged 3,700 acre-feet per year, or about 2.8 acre-feet per acre.

CONSUMPTIVE USE

Rural

The CCID provided estimates of evapotranspiration for irrigated crops in the study area. Evapotranspiration of applied water ranged from 2,000 to 3,400 acre-feet per year and averaged 2,800 acre-feet per year for 2003-16, or an average of 2.2 acre-feet per year. There was some private irrigation well pumpage to supplement the canal deliveries.

Urban

The urban consumptive use is estimated by first substracting the sewage effluent for the pumpage to determine the outside water use. For 2003-16, this would be 2,400 acre-feet per year minus (700 acre-feet per year + 525 acre-feet per year for Tomatek), or 1,175 acre-feet per year. The consumptive use for outside irrigation was estimated to be 70 percent of this value, or 820 acre-feet per year. An additional 340 acre-feet per year was consumed by crop irrigation of Tomatek effluent and 100 acre-feet were evaporated from the City effluent ponds. The total urban consumptive use was 1,260 acre-feet per year.

The total urban and rural consumptive use was thus about 4,000 acre-feet per year, or about 300 acre-feet per year greater than the canal water deliveries.

SOURCES OF RECHARGE

The primary sources of recharge to groundwater in the Firebaugh Area are canal seepage, deep percolation of applied irrigation water, San Joaquin River seepage, and groundwater inflow from the southwest. Normal streamflow in the river at Firebaugh, in the absence of upstream floodflows in the Fresno Slough and the San Joaquin River east of Mendota, is due to operational releases of water from the Mendota Pool. This water is delivered to the San Luis Canal Company at Sack Dam (east of Dos Palos). Operational releases down the river range from about 50 cfs during non-irrigation periods to about 500 cfs during summer irrigation periods. The best sources of recharge to groundwater in the Firebaugh area in terms of chemical quality are river seepage and canal seepage. The poorest source of recharge in terms of groundwater is groundwater inflow from the southwest. The more recent City wells have generally been drilled adjacent to the San Joaquin River and have had shallower perforations. This has minimized the influence of inflow of poor quality groundwater from the southwest and maximized the influence of river seepage on the chemical quality of water from City wells.

There are a number of canals southwest of Firebaugh. The CCID Main Canal passes through Firebaugh primarily west of Highway 33, and a lateral, the Poso Canal, passes through the north part of the City. The Main Canal is about four miles long within the City's sphere of influence. The Poso Canal is about a mile and a half long within the City's sphere of influence. The CCID Outside Canal passes through the area west of Firebaugh. This canal is an average of about a half mile southwest of the Main Canal. CCID has estimated the amounts of seepage from District canals. The average seepage is about 0.6 cfs per mile of canal for the Poso Canal and about 1.0 cfs per mile of canal for the Main Canal. For the Main and Poso Canals in the City sphere of influence, the estimated seepage is about 2,800 acre-feet per year. The Delta-Mendota Canal (DMC) and three Firebaugh Canal Water District lift canals are located farther southwest and upgradient of the City of Firebaugh.

GROUNDWATER QUALITY

Inorganic Chemical Constituents

The total dissolved solids (TDS) concentrations of groundwater in the upper aquifer increase significantly to the southwest in the Firebaugh-Mendota area (Figure 9). This illustration was modified from KDSA (2006), and represents conditions in the early to mid-2000's. Electrical conductivities in micromhos per centimeter at 25°C can be multiplied by two-thirds to estimate TDS concentrations. Electrical conductivities of the groundwater in the upper aquifer were about 2,000 micromhos per centimeter at 25°C near the Main Canal and about 4,000 to 6,000 micromhos near the Outside Canal.

Table 7 shows the results of analyses of water collected from City wells during 2016-17 for analyses of inorganic chemical constituents and alpha activity. TDS concentrations ranged from 460 to 660 mg/l. The lowest TDS concentrations were in wells located adjacent to the river that had relatively shallow perforations. The primary source of recharge of this low salinity groundwater is indicated to be from seepage from the San Joaquin River. Water were of the sodium-mixed anion type. Nitrate concentrations in water from City wells were not detectable, indicative of reduced conditions in the groundwater. Fluoride concentrations were all well below the maximum contaminant level (MCL) of 2.0 mg/l. Iron concentrations in water from four of the wells ranged

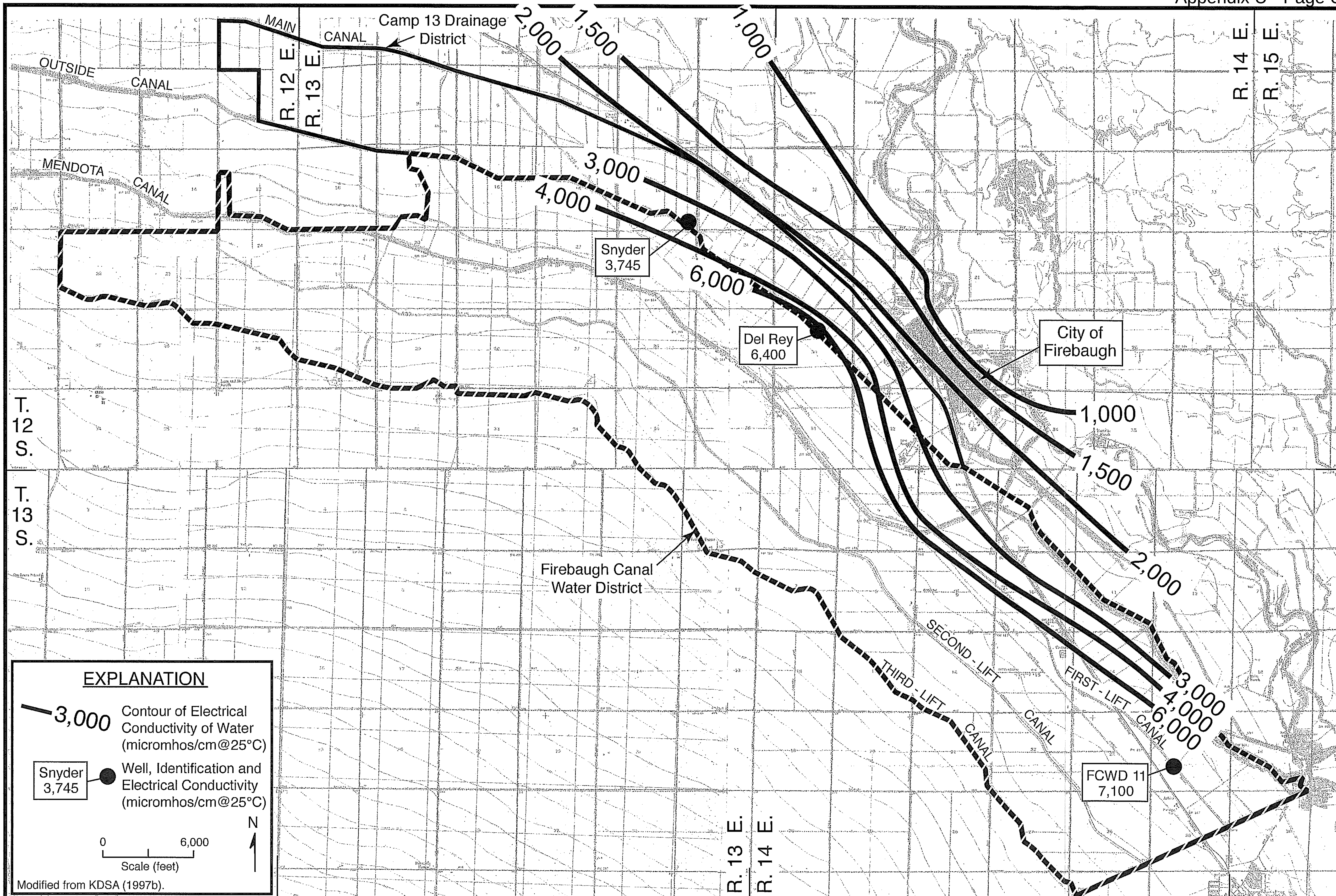

FIGURE 9 - ELECTRICAL CONDUCTIVITY OF WATER FROM WELLS TAPPING UPPER AQUIFER

TABLE 7-CHEMICAL QUALITY OF WATER FROM CITY OF FIREBAUGH WELLS

Constituent (mg/l)	No. 11	No. 12	No. 13	No. 15	No. 16	No. 17
Calcium	43	56	24	38	30	49
Magnesium	30	31	10	24	13	32
Sodium	100	140	130	150	140	130
Bicarbonate	220	317	159	159	146	342
Sulfate	110	78	94	87	83	49
Chloride	140	210	140	170	220	170
Nitrate	<2	<2	<2	<2	<2	<2
Fluoride	<0.1	<0.1	<0.1	0.2	0.1	<0.1
pH	7.4	7.3	7.8	7.8	7.8	7.9
Electrical Conductivity (micromhos/cm @ 25°C)	910	1,100	810	890	920	1,000
Total Dissolved Solids (@180°C)	550	660	460	540	530	580
Iron	0.55	0.51	<0.1	0.50	0.23	0.26
Manganese	0.73	0.85	0.27	0.53	0.40	0.58
Arsenic	7.6	7.2	6.5	13	6.3	6.4
Hexavalent Chromium (ppb)	<1	<1	<1	<1	<1	<1
Selenium	<5	<5	<5	<5	<5	<5
Alpha Activity (pc/l)	7.8	4.5	<3	<3	4.8	15.4
Date	1/10/17	1/10/17	1/10/17	1/10/17	4/9/16	1/10/17
Perforated Interval (ft)	165-190	155-180	160-170& 185-200	115-220	115-220	140-185

Samples for determination of hexavalent chromium were collected on 8/15/14.

from 0.3 to 0.6 mg/l, at or exceeding the MCL of 0.3 mg/l. Manganese concentrations ranged from 0.27 to 0.85 mg/l, exceeding the recommended MCL of 0.05 mg/l. The arsenic concentration in water from one of the wells (No. 15) was 13 ppb, exceeding the MCL of 10 ppb. Arsenic concentrations in water from Well No. 15 were below the MCL during two other sampling rounds in 2017. Arsenic concentrations in the other wells ranged from 6 to 8 ppb, below the MCL. Water from Wells No. 16 has had arsenic concentrations of 11 ppb for two other sampling rounds in 2017. Selenium concentrations in water from the City wells were less than 5 ppb, below the MCL. The primary constituents of concern in water from City wells are thus iron, manganese, and arsenic. Water from the City wells is treated for removal of these constituents.

Table 8 shows results of analyses of inorganic chemical constituents in water from two CCID wells, both of which are located along the Poso Canal. TDS concentrations ranged from 410 to 1,000 mg/l. Nitrate concentrations were less than 1 mg/l. Water from the wells was of the sodium chloride type.

Radiological Constituents

Alpha activities in water from the City wells were 8 picocuries per liter or less, well below the MCL of 15 picocuries per liter, except for Well No. 17, which had 15 picocuries per liter, (at the MCL).

TABLE 8- CHEMICAL QUALITY OF
WATER FROM CCID WELLS

Constituent (mg/l)	Well 29	Well 41
Calcium	93	75
Magnesium	19	14
Sodium	300	98
Potassium	4	3
Carbonate	<10	<10
Bicarbonate	150	96
Sulfate	250	88
Chloride	330	100
Nitrate	<1	<1
Boron	0.6	0.4
pH	8.0	0.3
Electrical Conductivity (micromhos/cm @ 25°C)	1,800	700
Total Dissolved Solids (@180°C)	1,000	410
Date	7/19/17	7/19/17
Perforated Interval	92-243	86-236

Analyses by BSK Laboratory of Fresno, from Central California Irrigation District.

Trace Organic Chemical Constituents

Comprehensive Title 22 drinking water analyses for trace organics are periodically done for City wells. Concentrations of these constituents have generally been well below MCLs or problem levels.

WATER BUDGET FOR EXISTING CONDITIONS

CCID delivered an average of 3,700 acre-feet per year to 1,300 acres of irrigated land in the study area during 2003-16. CCID determined the evapotranspiration of crops in the study area for 2003-16. For 2003-08, the evapotranspiration of applied water ET_{IW} was determined from the ITRC water use study report for 1994-2008 (crop coefficient method). For 2009-16, the total evapotranspiration (ETc) was determined from the ITRC metric report (landsat data). The average ETc for crops in the study area was 3,300 acre-feet per year. The average ET_{IW}/ETc was 86 percent. Thus the estimated evapotranspiration of applied water for 2003-16 in the study area was 2,800 acre-feet per year. There was an additional ET_{IW} for the Tomatek effluent. An average of 525 acre-feet per year of effluent was applied to 160 acres of crops during 2003-16. The average ET_{IW} was 380 acre-feet per year. Thus the average total evapotranspiration of applied water by crops in the study area for 2003-16 was 3,200 acre-feet per year. The urban consumptive use was estimated by deducting the amount of City and Tomatek wastewater (combined 1,230 acre-feet per year) from the average City pumpage (2,390 acre-feet per year). This yielded 1,160 acre-feet per year of outside water use. Using an average urban irrigation efficiency of 70 percent, the urban consumptive use averaged about 800 acre-feet per year. The total consumptive use in the study area was about 4,000 acre-feet per year.

Groundwater is pumped within the study area by the City, CCID, the Eastside Acres water system, the High School, private irrigators, and several industries. Groundwater recharge comes from canal seepage, river seepage, deep percolation from irrigated areas including Tomatek wastewater, percolation of City WWTF effluent, and groundwater inflow.

In 2003-17, the estimated pumpage average within the study area was:

Entity	Pumpage (AF/yr)
City	2,390
CCID	1,990
Eastside Acres	100
High School	70
Private Wells	690
Total	4,550

The CCID pumpage is an average value over the long-term. The estimated total pumpage in the study area was about 4,600 acre-feet per year. In addition, about 500 acre-feet per year of tile drainage in the Camp 13 Drainage District was exported from within the

City sphere of influence (personal communication from CCID).

The City sewer collection system serves the City and Eastside Acres. The City WWTF is located northwest of the Firebaugh Wasteway, between the Main Canal and the San Joaquin River (Figure 1). There are about 30 acres of percolation ponds near the WWTF for City effluent, and another 160 acres of irrigated land where Tomatek wastewater was used. All of the City effluent was percolated from the ponds.

The average amount of City effluent was about 700 acre-feet per year for 2003-16. The average amount of Tomatek wastewater was about 525 acre-feet per year during this period. Percolation from the City wastewater ponds is estimated to have been about 700 acre-feet per year.

Amounts of recharge to the groundwater in the study area are estimated as follows:

Item	Amount (AF/yr)
Effluent and Tomatek Wastewater Percolation	800
Canal Seepage	2,800
River Seepage	2,500
Deep Percolation from Crop Irrigation	900
Groundwater Inflow	2,000

The total estimated recharge to the groundwater in the City sphere of influence during 2003-16 was about 9,000 acre-feet per. The excess of recharge above the combination of pumpage and exported tile drainage (5,050 acre-feet per year) was equal to the groundwater outflow from the sphere of influence (about 3,950 acre-feet per year).

REFERENCES

Kenneth D. Schmidt & Associates, 2008, "Groundwater Conditions in the Vicinity of the City of Firebaugh" report prepared for City of Firebaugh, 39p

Appendix V. Update on Groundwater Conditions in the Mendota Sub-Area of the SJREC GSP

UPDATE ON GROUNDWATER CONDITIONS IN THE MENDOTA SUB-AREA OF THE SJREC GSP

prepared for
San Joaquin River Exchange
Contractors GSA
Los Banos, California

and
City of Mendota GSA
Mendota, California

by
Kenneth D. Schmidt & Associates
Groundwater Quality Consultants
Fresno, California

May 2019

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TELEPHONE (559) 224-4412

May 31, 2019

Mr. Chris White, Executive Director
San Joaquin River Exchange
Contractors GSA
P. O. Box 2115
Los Banos, CA 93635

Re: Gustine Sub-Area of the
SJREC GSP

Dear Chris:

Submitted herewith is our report on groundwater conditions in the Gustine Sub-area of the SJREC GSP. We appreciate the cooperation of the CCID and City of Gustine in providing information for this report.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist 176

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INTRODUCTION

As part of the Groundwater Sustainability Plan (GSP) for the San Joaquin River Exchange Contractors (SJREC) service area, GSPs for a number of cities, including Mendota, are being incorporated into the SJREC GSP. Kenneth D. Schmidt and Associates (KDSA, 1999 and 2008) prepared two reports on groundwater conditions in the vicinity of the City of Mendota for the Central California Irrigation District (CCID) and the City.

This report is intended to provide an update on groundwater conditions within the Mendota Study Area boundary (Figure 1). This boundary encompasses lands that are planned for future urban development. This study area is generally bounded by Bass Avenue on the north, N. Ohio Avenue on the west, West California Avenue on the south, and San Benito Avenue on the east. Lands northeast of Mendota are in the Aliso Water District GSA, lands north of Mendota are in the SJREC GSA, and lands east of the Mendota Sub-area are in the Farmers Water District (FWD) GSA. Several areas near the study area are in Fresno County Management Areas "A" and "B".

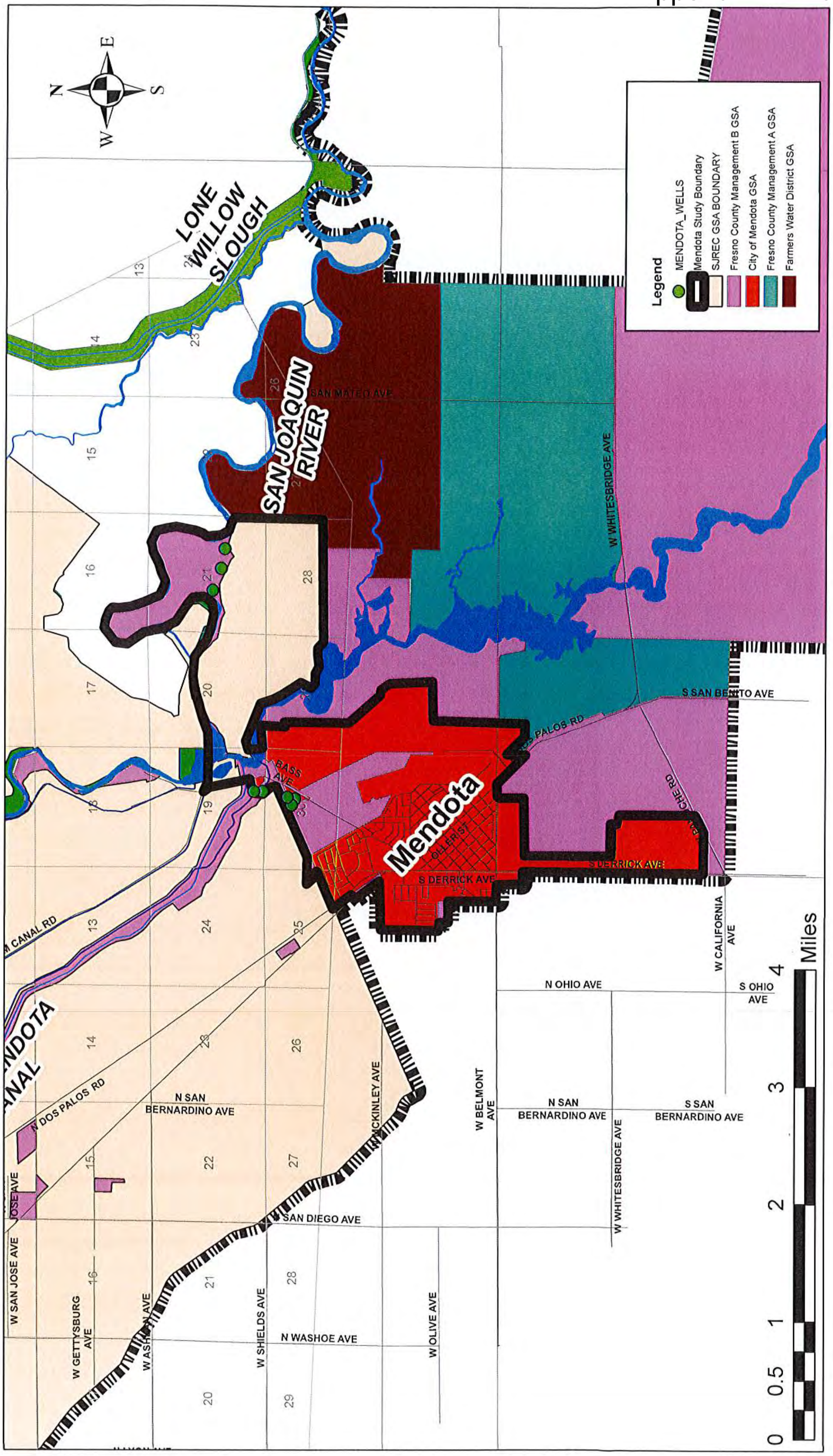


FIGURE 1-LOCATION OF MENDOTA SUB-AREA, STUDY AREA BOUNDARY, AND SELECTED WELLS

Of particular interest in this update are: 1) groundwater quality issues 2) the extent of groundwater overdraft, 3) land subsidence, and 4) the historical water budget and that for future urban development of the study area.

The Mendota Sub-area study area is within a larger area associated with a monitoring program for the Mendota Pool Group (MPG) pumping program. Some of the MPG wells are located west of the Fresno Slough branch of the Mendota Pool area near the study area. Substantial monitoring of pumpage, water levels, land subsidence, and groundwater quality has been done for the MPG program during the past 15 years. The last annual report on this monitoring was provided by Luhdorff & Scalmanini (L&S) and KDSA (2018) and provided useful information for this report.

SUBSURFACE GEOLOGIC CONDITIONS

Alluvial deposits comprise the aquifer in the Mendota area. Subsurface deposits near Mendota are termed the older alluvium and the Tulare Formation. KDSA (2019) indicated that the base of the usable aquifer in the Mendota area, or bottom of the basin in SGMA terminology, was about 500 to 800 feet deep. A major confining bed is present beneath much of the west side of the San Joaquin Valley, including the Mendota area. This clay is termed the Corcoran Clay, and divides the aquifer system into upper and lower aquifers. The Corcoran Clay is readily discernible from the drillers logs for most wells in the area, due to its blue color. The over-lying and under-lying deposits are usually tan or brown in color.

Two other confining beds that are more localized and shallower than the Corcoran Clay are important in the Mendota area. One of these is the A-Clay, which is present at an average depth of about 70 feet, and another is the C-Clay, which is present at an average depth of about 250 feet. Shallow groundwater above the A-Clay (locally termed the "shallow zone") is pumped from a number of shallow MPG wells west of the Fresno Slough between Mendota Dam and Whitesbridge Road. Groundwater between the A-Clay and Corcoran Clay is locally termed the "deep zone". Groundwater below the Corcoran Clay (the lower aquifer) is generally not tapped in the Mendota area due to higher salinity.

KDSA (1999) developed two subsurface geologic cross sections extending through the City (Figure 2). These were developed as part of a process to develop a new City well field, following degradation of groundwater quality in the City Bass Avenue well field. Drillers and electric logs for water wells and test holes were obtained from the City, the CCID, and the California Department of Water Resources in Fresno for use in developing these cross sections. Cross Section H-H' extends from north to south through the study area. Cross Section J-J' extends from

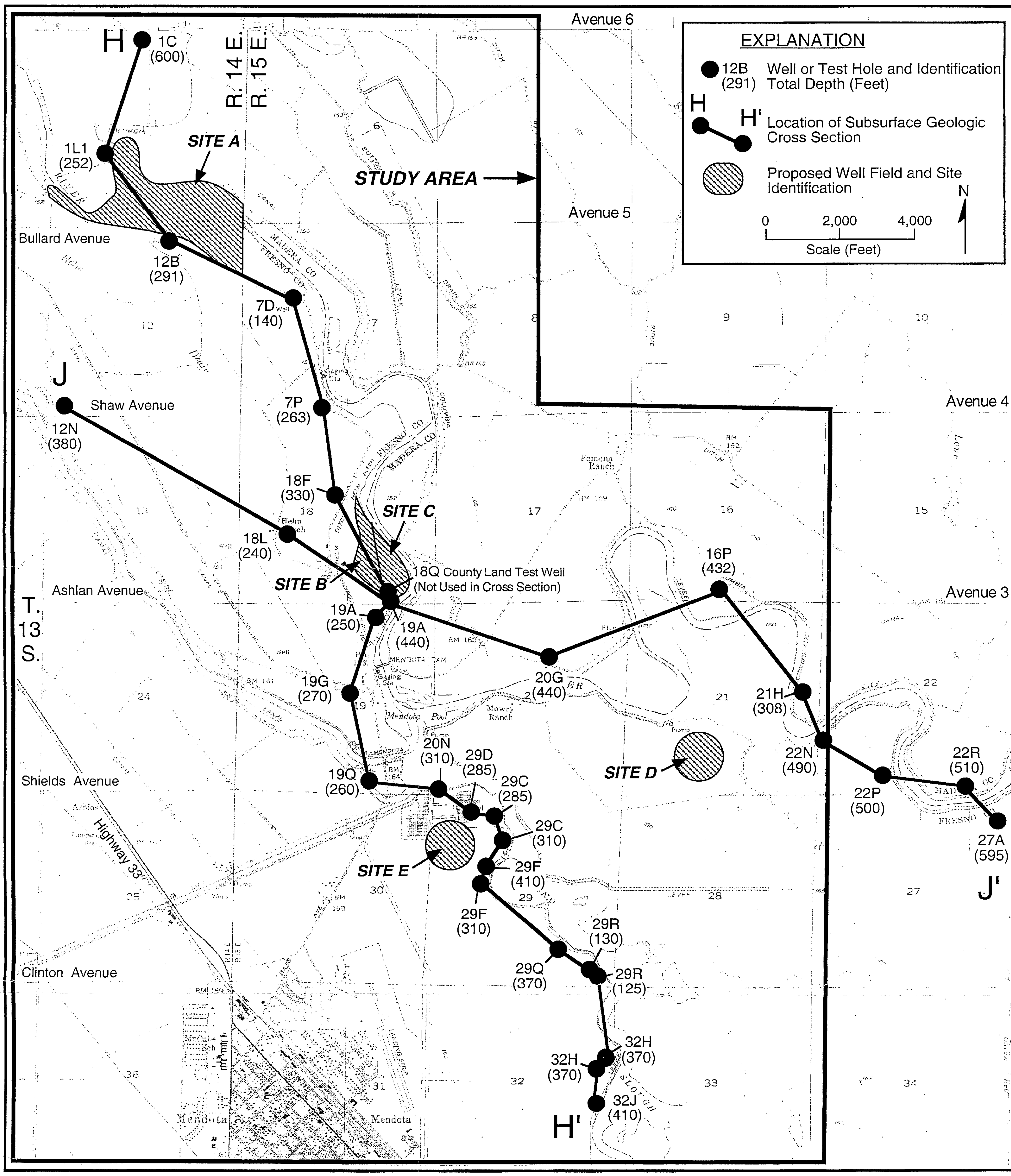


FIGURE 2-LOCATION OF SELECTED TEST HOLES AND WELLS AND SUBSURFACE GEOLOGIC CROSS SECTIONS

the northwest to the southeast, north of Mendota.

Subsurface Geologic Cross Section H-H′ (Figure 3) extends from near the extension of Avenue 6 on the north, to the southeast along the San Joaquin River, through the City wastewater treatment facility, to east of the former Mendota Biomass Plant. Only three wells or test holes along this section apparently are deep enough to have reached the Corcoran Clay. The top of the Corcoran Clay is about 400 feet deep along this section. Since the section is nearly perpendicular to the inferred dip of the Corcoran Clay, the top of the clay appears to be nearly flat along this cross section. The thickness of this clay increases to the north along the section, from about 30 feet to more than 70 feet.

The A-Clay appears to be more continuous beneath the part of the section south of Mendota Dam. In this area the top of this clay ranges from about 70 to 100 feet in depth below the land surface. The clay is normally about 10 to 20 feet thick, except near the south part of the cross section. The clay is usually only about 10 feet thick and is missing at some locations along the part of the section north of the Dam. This discontinuity may be associated with the influence of the ancestral San Joaquin River in this area. Although Section H-H' does not pass through the City wells which are along Bass Avenue south of the Main Lift Canal (No. 2, 3, and 4), geologic and electric logs for these

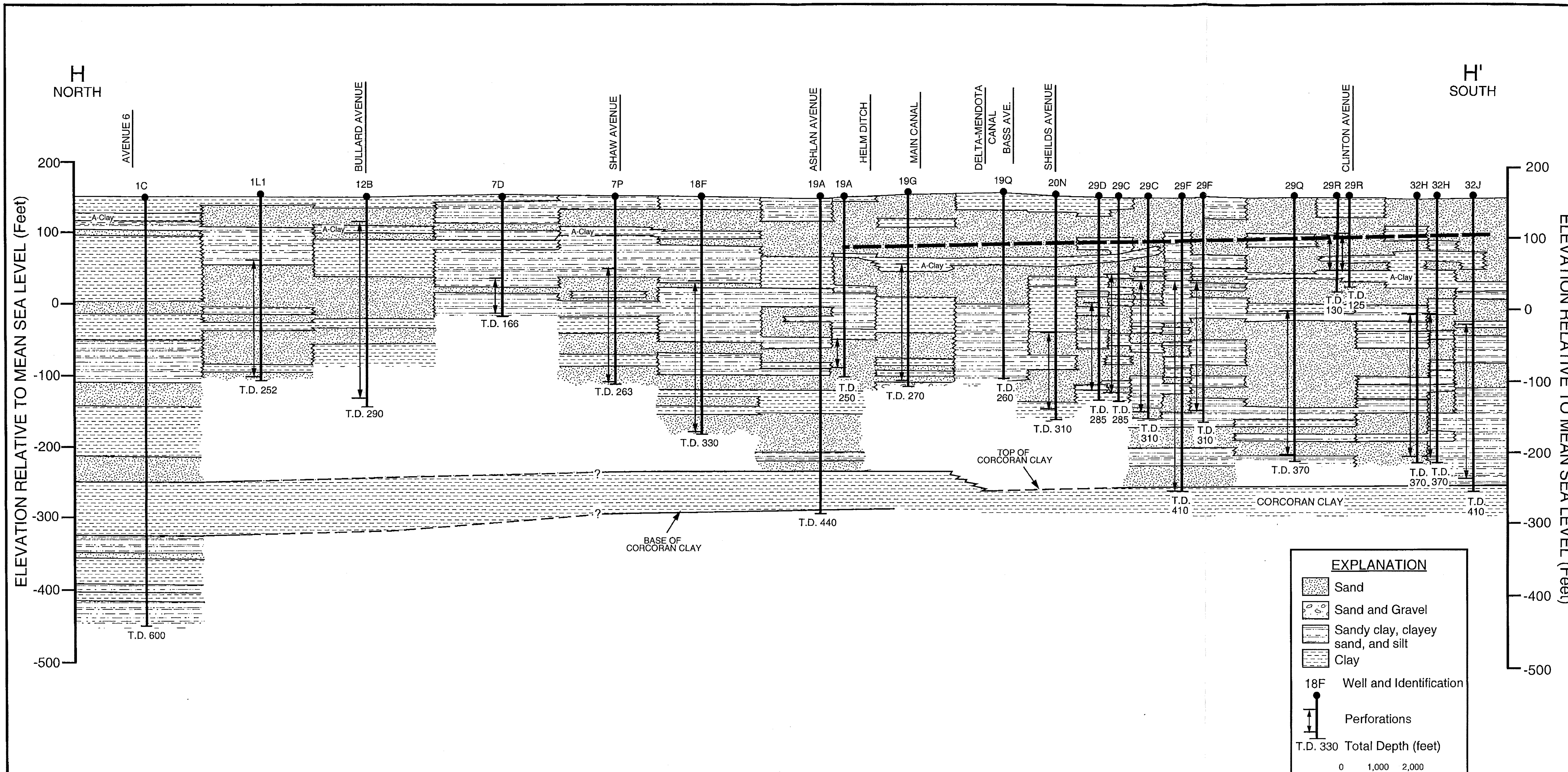


FIGURE 3-SUBSURFACE GEOLOGIC CROSS SECTION H-H'

wells indicate that the A-Clay is also missing in this area. No other laterally extensive, significant confining beds are indicated to be present along this section. Sand and gravel are common above the A-Clay along this section, and several major sand strata are present below the A-Clay and above the Corcoran Clay. These coarse-grained deposits are derived from the Sierra Nevada and are generally highly permeable.

Cross Section J-J' (Figure 4) extends from near Shaw Avenue to the southeast, along the San Joaquin River branch of the Mendota Pool to near San Mateo Avenue. Site D (Figure 2) was eventually selected for the new City well field. Eight wells or test holes along this section reached the Corcoran Clay, and many of these also penetrated the base of this clay. The top of the Corcoran Clay appears to be slightly deeper beneath the southeast part of the section. The Corcoran Clay ranges from about 40 to 60 feet in thickness along this section.

The A-Clay appears to be missing along most of this section west of the San Joaquin River. Where it is present, the clay appears to be somewhat discontinuous, and to be present at two different depths in the part of the section east of the San Joaquin River. Near and east of Site C, the top of the A-Clay is about 20 to 50 feet deep, and the clay is about 5 to 20 feet thick. Farther east, the clay is deeper, and the top ranges from about 70 to 90 feet in deep. The A-Clay appears to thicken

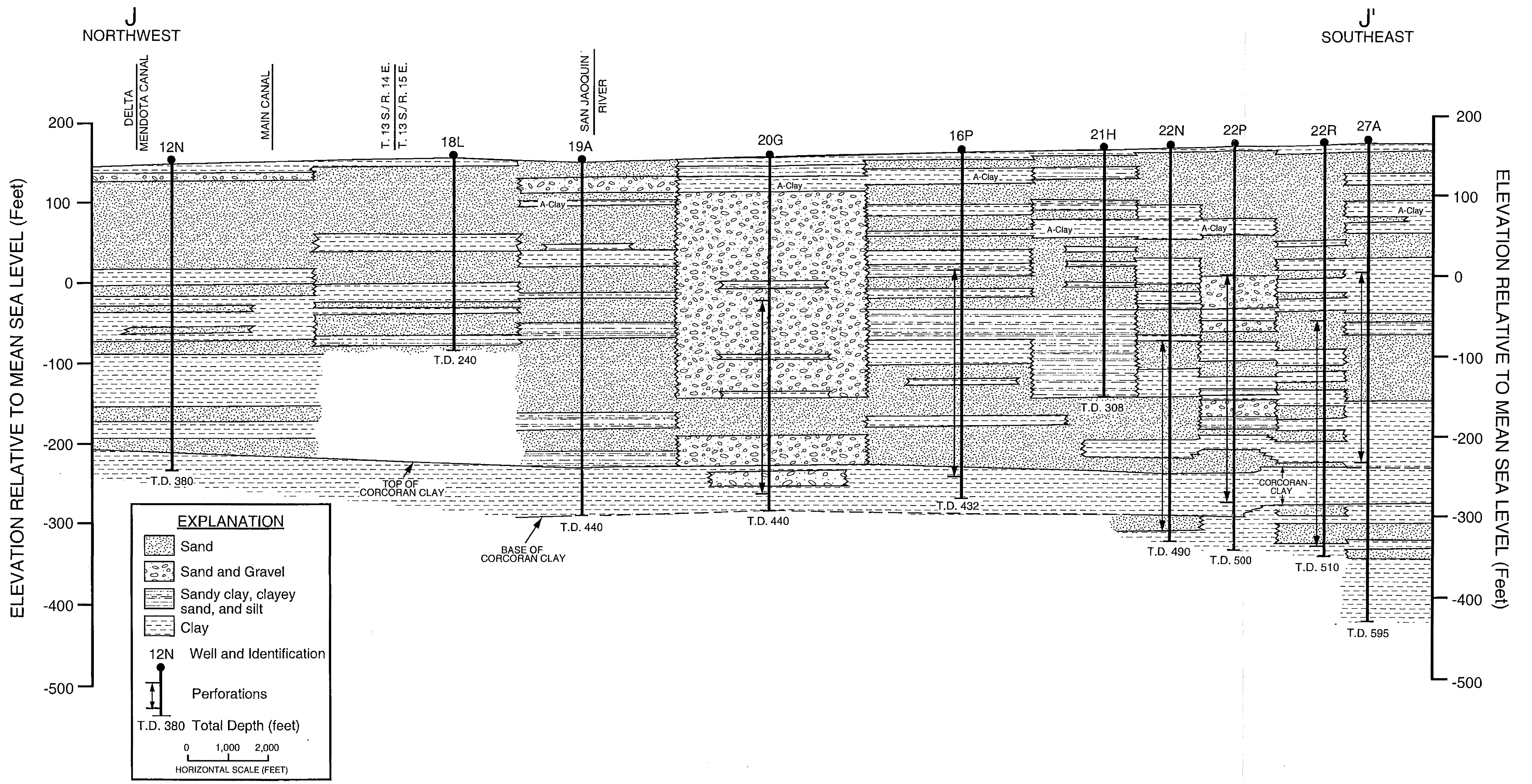


FIGURE 4-SUBSURFACE GEOLOGIC CROSS SECTION J-J'

to the east along this section, from about five feet at Well 16P almost 40 feet at Well 27A. The results of groundwater monitoring north of the San Joaquin River in the area along the east part of this section indicate that the A-Clay is a significant confining bed in this area. No other laterally extensive confining beds are indicated to be present along this section. Numerous sand and some gravel layers are present above the Corcoran Clay. These deposits are also derived from the Sierra Nevada and are generally indicated to be highly permeable.

WATER SUPPY WELLS

Figure 1 shows locations of City of Mendota and CCID wells in the study area. The active City public supply wells (No. 7, 8, and 9) are located at the B&B Ranch south of the San Joaquin River. Table 1 summarizes construction data for these wells. The wells were constructed in Summer 2001, all have cased depth of 405 feet, and they tap strata between the C-Clay and the Corcoran Clay. The City also has six wells near the north end of the Mendota Pool (the Fordel wells). Five of these wells are perforated from 50 to 100 feet in depth and primarily tap strata above the A-Clay. The sixth well (termed Fordel M-1) is perforated from 200 to 300 feet in depth, and taps strata between the A-Clay and Corcoran Clay. Water from the Fordel wells is pumped into the Mendota Pool, as part of an agreement with the B&B Ranch allowing the

TABLE 1-CONSTRUCTION DATA FOR CITY OF MENDOTA PUBLIC SUPPLY WELLS

No.	Date Drilled	Drilled Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
7	06/01	420	405	14	260-395	0-240
8	08/01	405	405	14	240-375	0-230
9	08/01	405	405	16	260-395	0-240

Records from well completion reports.

City to pump water from the City public supply wells on the B&B Ranch.

Table 2 shows construction data for four CCID wells in the Headgate area. Cased depths of these wells range from 210 to 360 feet, and the top of the perforations range from 80 to 200 feet deep. Two of these wells (5A and 32C) tap strata between the A-Clay and the C-Clay. The two other wells (28D and 35A) tap strata between the A-Clay and the Corcoran Clay.

WATER LEVELS

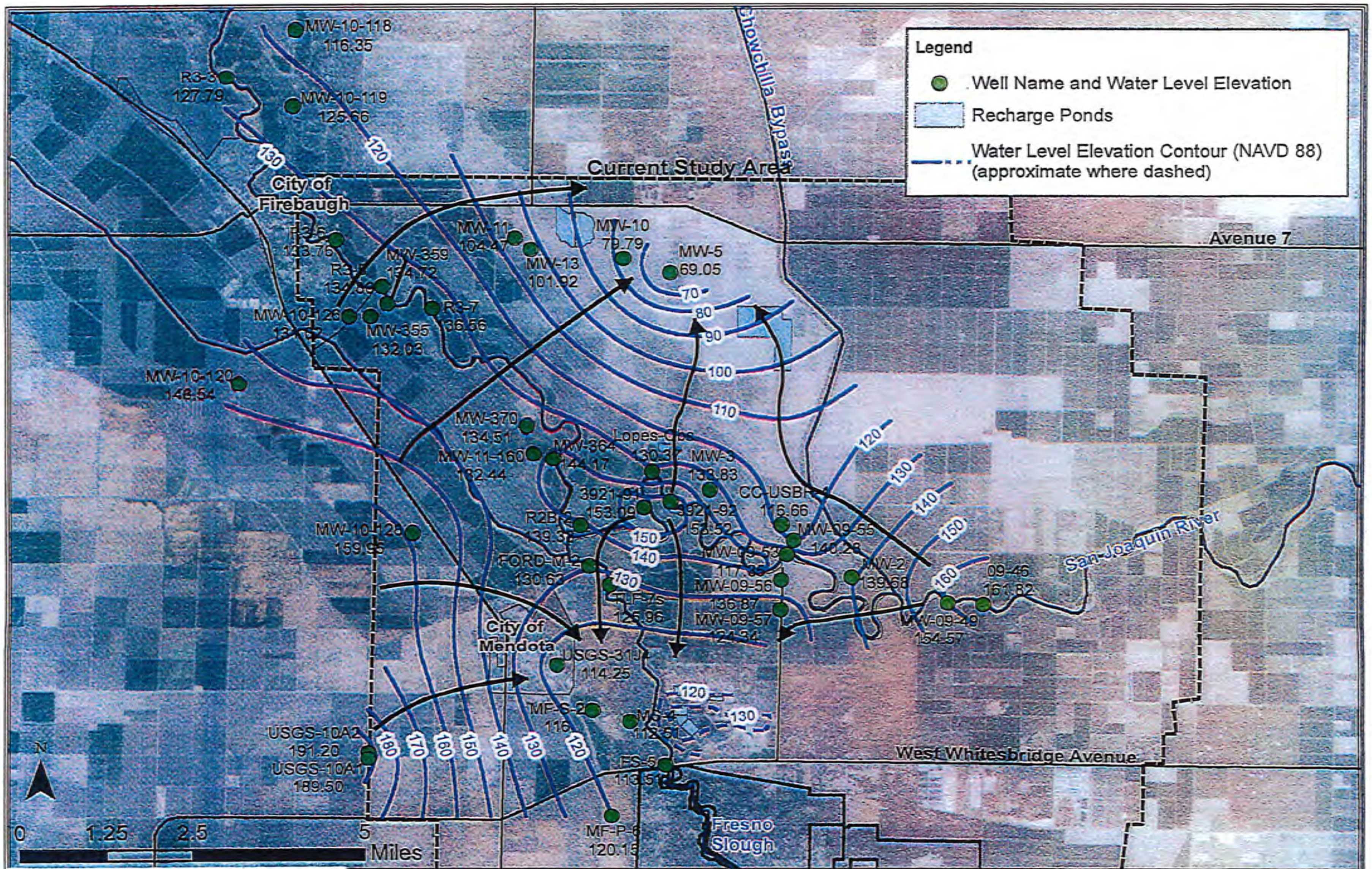
Water-Level Elevations

Water-level elevations contour and direction of groundwater flow maps are routinely prepared in the Mendota area by Luhdorff & Scalmanini for the MPG pumping program. One set of maps is for the "shallow zone", or above the A-Clay. Another is for the "deep zone", which is between the A-Clay and the Corcoran Clay. Figure 5 shows water-level elevations and the direction of groundwater flow for the shallow zone in Winter 2016-17. Water-level elevations ranged from 180 feet above mean sea level southwest of Mendota to less than 70 feet north-northeast of Mendota. Two pumping depressions were indicated. One was southeast of the City, around a number of MPG shallow wells west of the Fresno Slough branch of the pool. Another was east of the City of Firebaugh and west of the Chowchilla Bypass. A

TABLE 2-CONSTRUCTION DATA FOR CCID WELLS

No.	Date Drilled	Drilled Depth (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
5A	04/90	270	260	16	100-260	0-20
28D	04/03	378	360	17.4	200-360	0-50
32C	04/06	210	210	16	80-200	0-50
35A	02/66	311	154	16	90-154	0-30
			311	14	154-311	

Data from well completion reports.



Modified from Luhdorff & Scalmanini.

FIGURE 5-WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR THE SHALLOW ZONE (WINTER 2016-17)

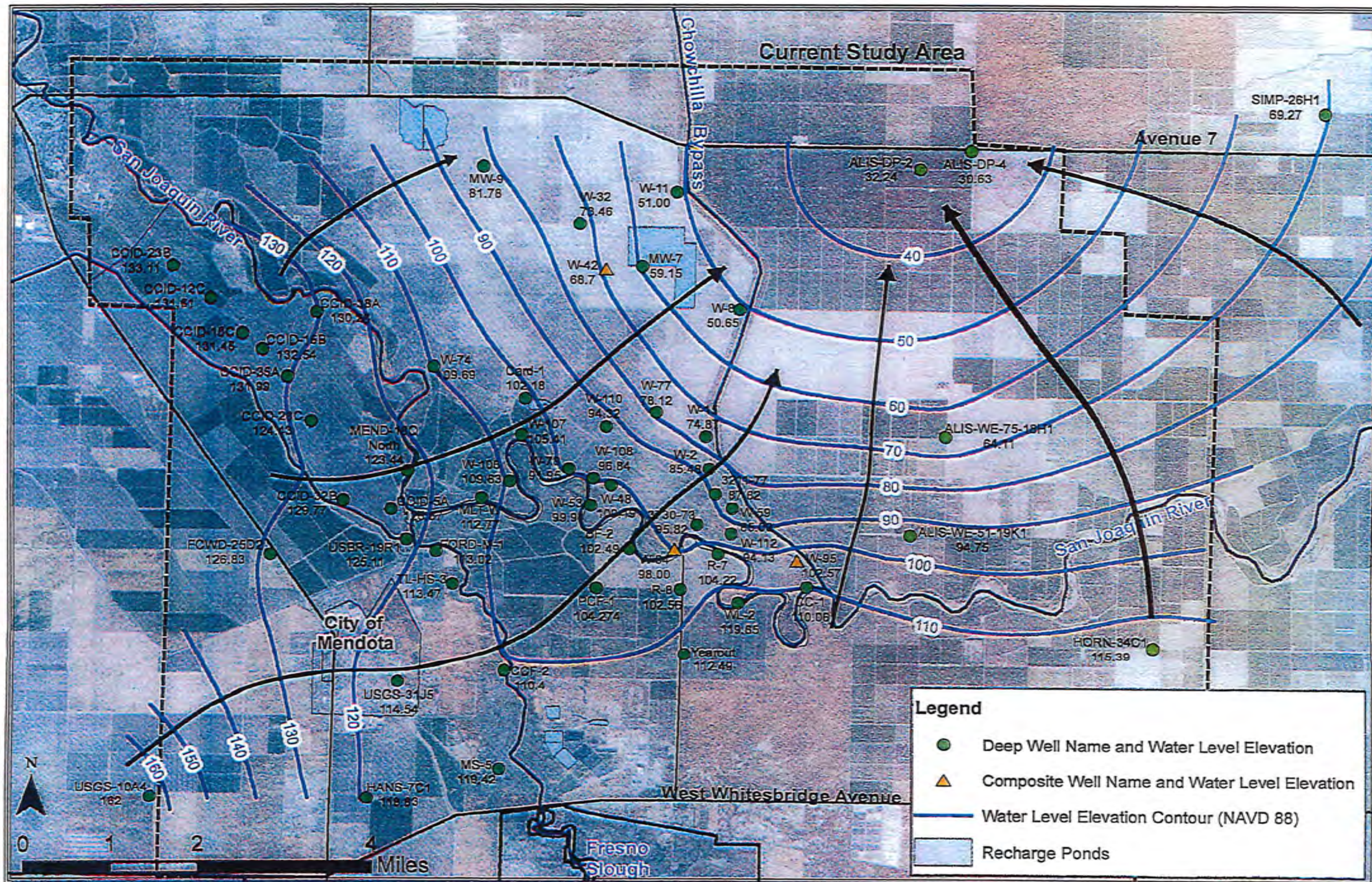
recharge ridge was indicated beneath the San Joaquin River branch of the pool. None of the MPG wells in the FWD (south of the east branch of the pool) are perforated above the A-Clay.

Figure 6 is a water-level elevation and direction of ground-water flow map for the deep zone in Winter 2016-17. Water-level elevations ranged from 160 feet above mean sea level southwest of Mendota less than 40 feet in the area west of the Chowchilla Bypass and north of Avenue 5. Groundwater was flowing from the southwest and south toward a pumping depression in the north part of the Aliso Water District. The direction of groundwater flow beneath the City was to the east. The water-level elevations for the deep zone do not indicate a recharge ridge beneath the San Joaquin River, and this is due to the A-Clay.

Time Trends

Figure 7 is a water-level hydrograph for City of Mendota Public Supply Well No. 7 for 2003-16. Depth to water has ranged from about 50 feet to about 160 feet. Overall, the shallowest levels in the winter have been relatively stable, but the deepest levels have shown a decline averaging about 4.8 feet per year.

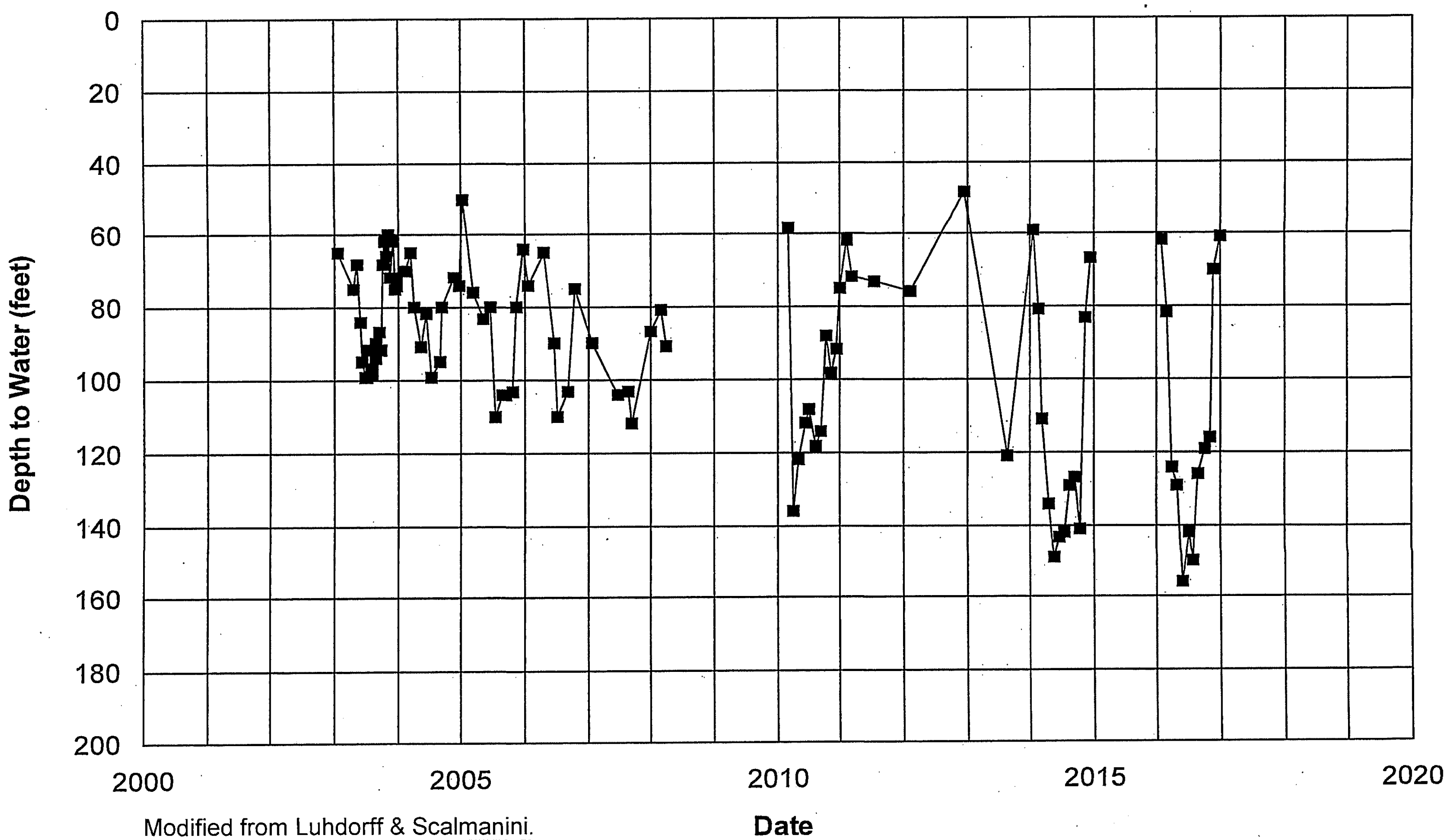
Figure 8 is a water-level hydrograph for City of Mendota Fordel Well No. M-1 for 1993-2016. This well taps strata between the A-Clay and Corcoran Clay. Depth to water ranged from about 30 to more than 120 feet. Overall, the shallowest seasonal water levels rose from 1993-1998, associated with a reduction



Modified from Luhdorff & Scalmanini.

FIGURE 6-WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR THE DEEP ZONE (WINTER 2016-17)

City of Mendota Well No. 7



Modified from Luhdorff & Scalmanini.

FIGURE 7-WATER-LEVEL HYDROGRAPH FOR CITY OF MENDOTA WELL NO. 7

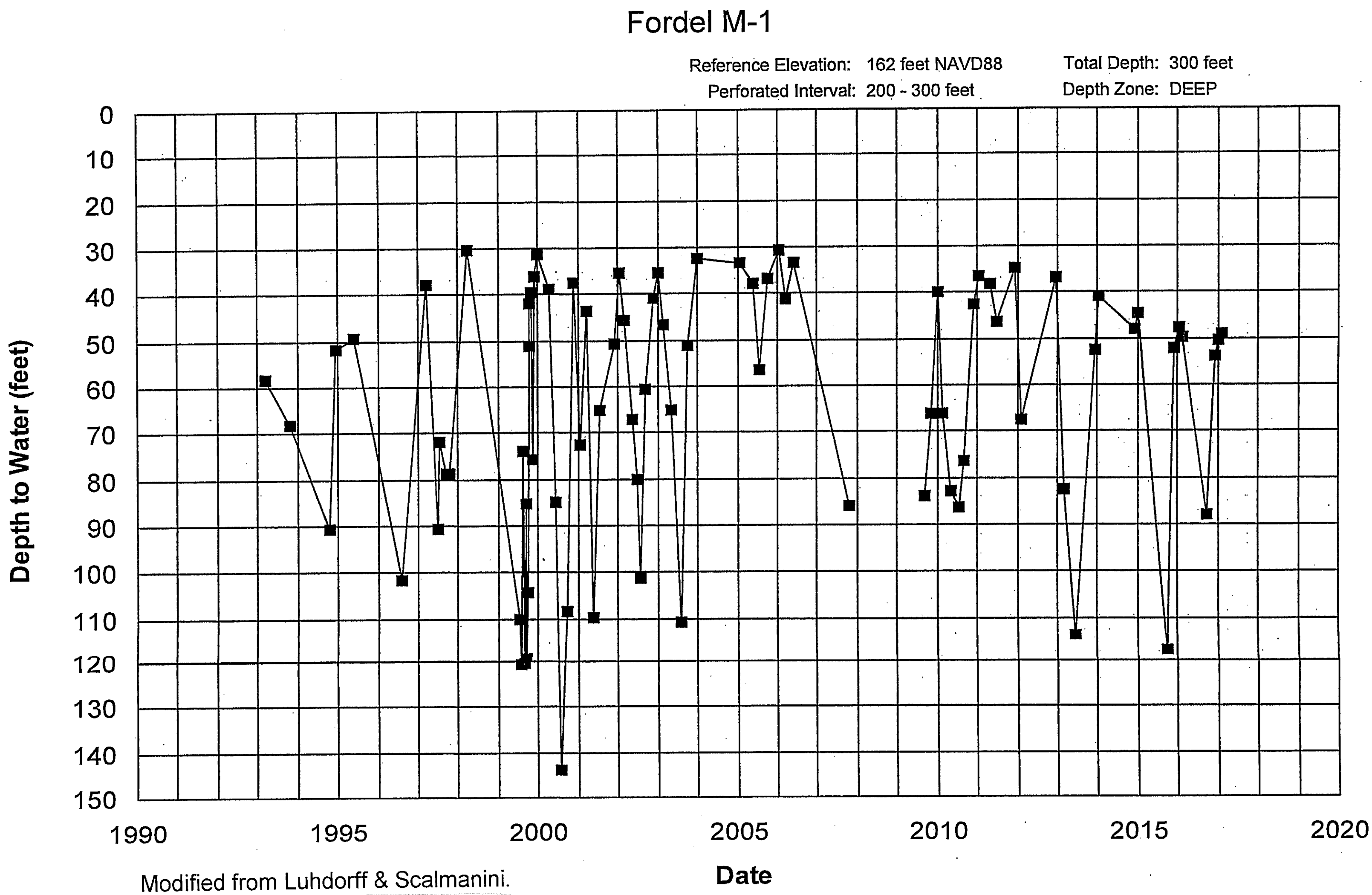


FIGURE 8-WATER-LEVEL HYDROGRAPH FOR CITY OF MENDOTA
FORDEL WELL M-1

in pumping from deep MPG wells along the Fresno Slough branch of the pool. The shallowest levels were then relatively stable through early 2013, then fell during 2013-16. The deepest seasonal levels have varied significantly.

Figure 8 is a water-level hydrograph for City of Mendota Fordel Well No. M-2 for 1993-2016. This well primarily taps strata above the A-Clay. Depth to water ranged from about 15 to almost 50 feet. The shallowest seasonal levels rose after 1993 through 1997, associated with a reduction in pumpage from shallow MPG wells west of the Fresno Slough branch of the pool. Overall, the shallowest levels were relatively stable from 1997 through 2011, then fell during 2012-16. Deepest seasonal levels have slightly risen during the period of record.

Figure 9 is a water-level hydrograph for CCID Well No. 5A, which is located close to Mendota Dam and taps strata between the C-Clay and Corcoran Clay. Depth to water ranged from about 10 to 55 feet. The shallowest seasonal water levels fell during 1993-94 due to heavy pumping from deep MPG wells west of the Fresno Slough branch of the Mendota Pool. Shallow water levels recovered after 1994, and were relatively stable until late 2011. Shallow water levels then fell during 2012-16. Deep water levels have fluctuated significantly, but show a relatively stable trend.

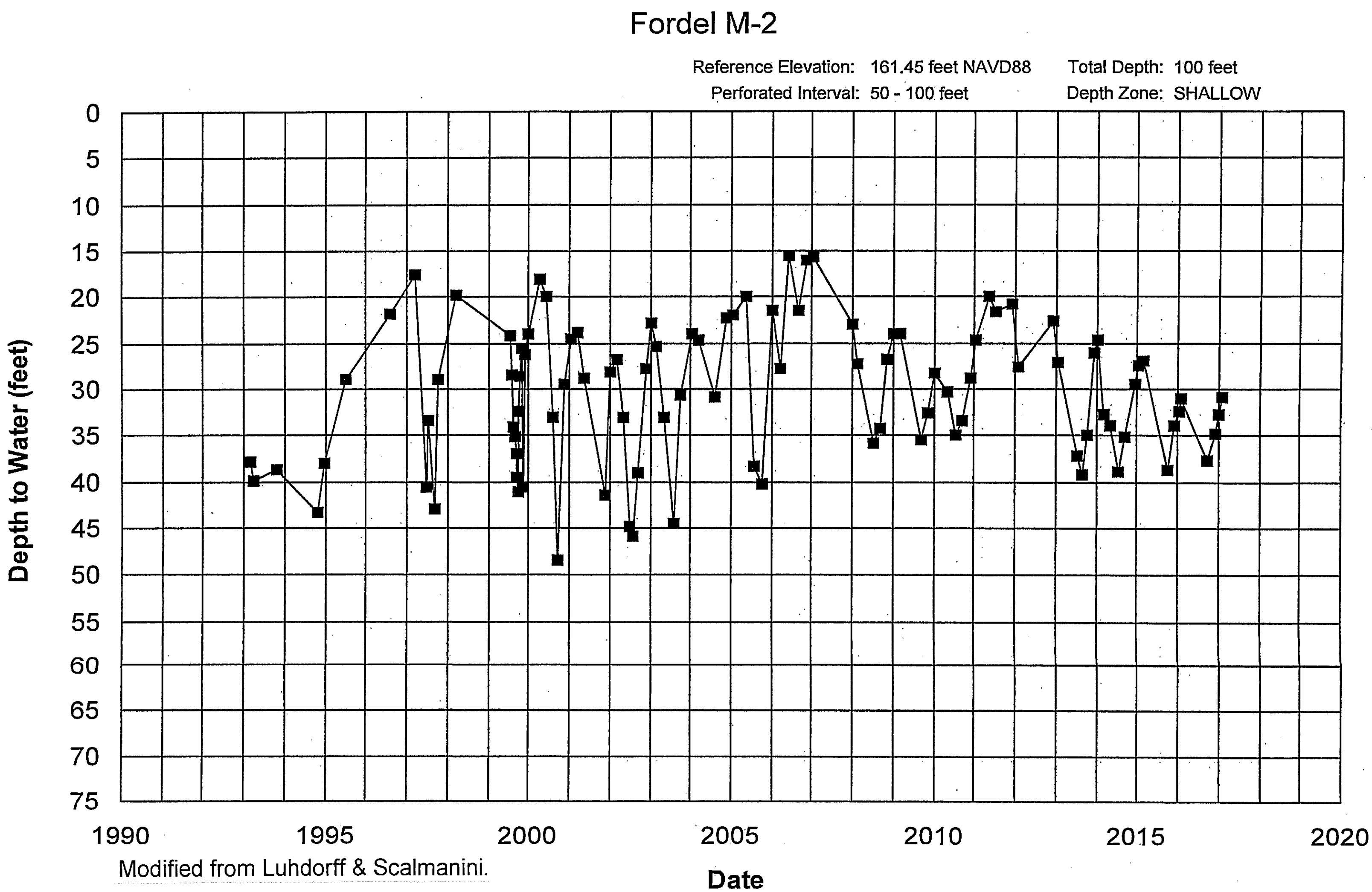
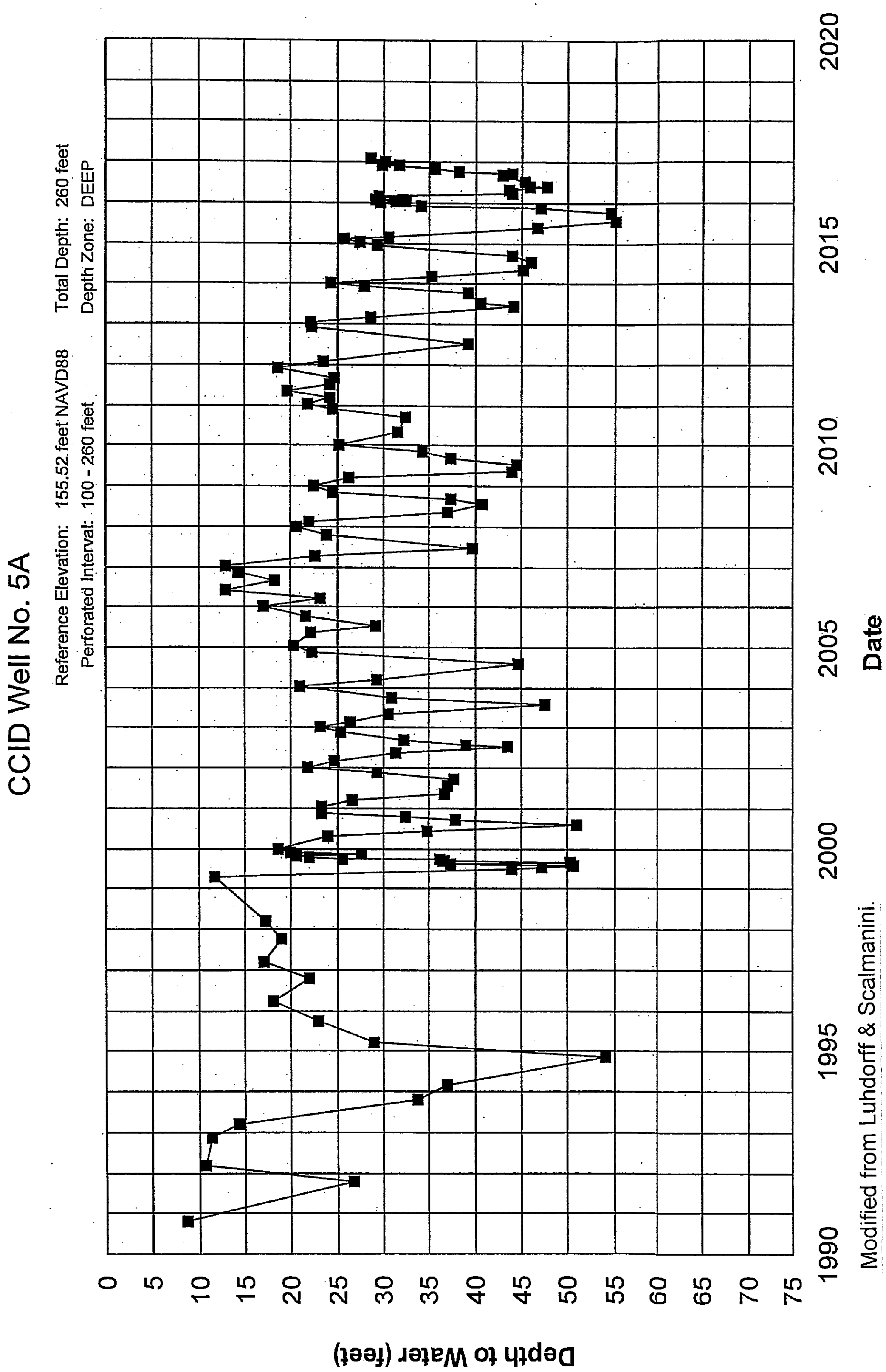


FIGURE 9-WATER-LEVEL HYDROGRAPH FOR CITY OF MENDOTA
FORDEL WELL M-2



Modified from Luhdorff & Scalmanini.

FIGURE 10-WATER-LEVEL HYDROGRAPH FOR CCID WELL 5A

Figure 11 is a water-level hydrograph for CCID Well 35A, which is located about a mile and a half north of Well No. 5A. Records extend from 1966 to 2016. This well taps strata between the A-Clay and the Corcoran Clay. Depth to water ranged from about 5 to 35 feet. Water levels were relatively stable over the long-term, with declines during dry periods and recoveries in the following years.

AQUIFER CHARACTERISTICS

Table 3 shows pump tests for City of Mendota public supply wells in November 2016. Pumping rates ranged from about 1,080 to 1,230 gpm, and specific capacities ranged from about 37 to 46 gpm per foot of drawdown. The specific capacity values are higher than they should be, because true static water levels weren't measured. Thus the drawdowns shown aren't as large as they actually were.

Table 4 shows pump tests for the four CCID wells in the study area from 2017. Pumping rates ranged from about 600 to 1,760 gpm, and specific capacities ranged from about 8 to 37.5 gpm per foot.

KDSA (1999) summarized information on aquifer characteristics in the Mendota area. Transmissivity values for most of the tested wells tapping strata below the A-clay and above the Corcoran Clay averaged 72,000 gpd per foot. A storage coefficient of 0.001 was determined from a two-week long aquifer test on Well T13S/R14E-24M1, north of Mendota, in 1988-89. A constant

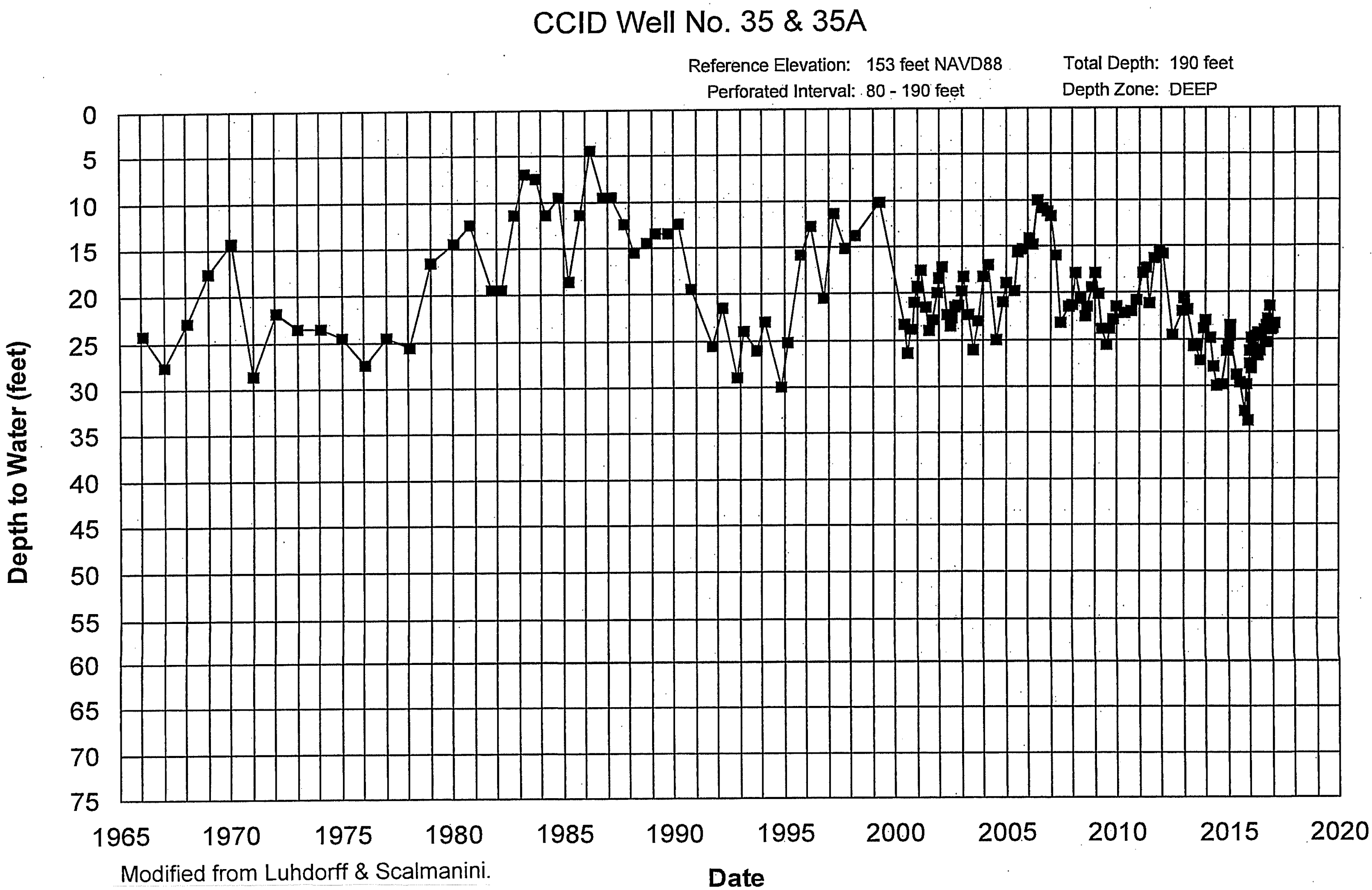


FIGURE 11-WATER-LEVEL HYDROGRAPH FOR CCID WELL 35A

TABLE 3-PUMP TEST DATA FOR CITY OF MENDOTA WELLS

No.	Date Tested	Pumping Rate (feet)	Static Level (feet)	Pumping Level (inches)	Drawdown (feet)	Specific Capacity (gpm/ft)
7	11/30/16	1,200	88.0	114.0	26.0	46.2
8	11/30/16	1,231	87.0	115.0	28.0	44.0
9	11/30/16	1,081	85.0	114.0	29.0	37.3

"Static levels" are 5-minute recovery levels, and are thus deeper than true static levels.

TABLE 4-PUMP TEST DATA FOR CCID WELLS

No.	Date Tested	Pumping Rate (feet)	Static Level (feet)	Pumping Level (feet))	Drawdown (feet)	Specific Capacity (gpm/ft)
5A	7/30/18	1,179	31.7	180.8	149.1	7.9
28D	7/31/18	1,650	41.0	95.0	44.0	37.5
32C	7/30/18	600	27.0	90.0	63.0	9.5
35A	7/31/15	1,756	19.5	94.2	74.7	23.5

Data from Central Irrigation District.

discharge test was conducted on City Well No. 9 in July 2001. The average pumping rate was 1,000 gpm, the specific capacity was 30.0 gpm per foot, and a transmissivity of 69,000 gpd per foot was obtained from recovery measurements. This was in good agreement with the average transmissivity for most of the previous tests in the Mendota area.

KDSA conducted a 72-hour constant discharge test on two Coburn Ranch wells in November 2014. These wells (No. 65 and 66) were located about a mile east of CCID Well No. 28C, just west of the Helm Ditch. These wells were about 260 feet deep and tapped strata primarily between the A-Clay and C-Clay. Five other deep zone wells were used as observation wells for the test. A specific capacity of 25 gpm per foot was obtained for Well 65 and 14 gpm per foot for Well 66. A distance-drawdown plot indicated a transmissivity of 116,000 gpd per foot and a storage coefficient of 0.0013. Corrected recovery measurements for five of the wells indicated an average transmissivity of 118,000 gpd per foot. Thus the best transmissivity value for the test was 117,000 gpd per foot.

PUMPAGE

City of Mendota

Table 5 shows annual pumpage from City of Mendota public supply wells for 2003-2017. The highest pumpage was in 2008-12

TABLE 5-ANNUAL PUMPAGE FROM
CITY OF MENDOTA WELLS

	Pumpage (acre-feet)	
Year	Public Supply	Fordel
2003	1,589	1,840
2004	1,665	1,825
2005	1,622	1,993
2006	1,632	1,219
2007	1,800	1,788
2008	1,803	2,473
2009	-	1,954
2010	1,800	988
2011	-	1,912
2012	1,800	1,813
2013	1,511	2,464
2014	1,388	1,966
2015	1,397	1,972
2016	1,727	2,038
2017	1,841	83

and in 2017 (1,800 to about 1,840 acre-feet per year). During the drought in 2014-15 the pumpage was about 1,400 acre-feet per year.

The San Luis Delta Mendota Water Authority provided annual pumpage values for the City Fordel wells from 2003-2017. These values represent pumpage from the wells minus a five percent loss that was applied to each month while pumping occurred. Annual pumpage ranged from 83 acre-feet in 2017 to about 2,470 acre-feet in 2008 and 2013. Low pumpage years were when San Joaquin and/or Kings River water was entering the Mendota Pool and transfer pumping was minimal.

CCID

Pumpage from nine CCID wells in the Headgate well field was about 690 acre-feet in 2016. Of that amount, about 300 acre-feet was from wells in the study area.

CITY EFFLUENT

City of Mendota effluent is discharged to 76 acres of percolation ponds at a site west of the Fresno Slough branch of the pool and south of the San Joaquin River branch. In 2017, about 1,180 acre-feet of effluent were discharged. It is estimated that about 300 acre-feet per year of the effluent were evaporated each year, and the reminder, or about 880 acre-feet per year percolated to the groundwater.

CANAL WATER DELIVERIES

The Columbia Canal Co. delivers canal water to 800 acres of land in the study area. From 2003-2016, an average of 1,630 acre-feet per year of water were delivered.

CONSUMPTIVE USE

Urban

The amount of outside water use is estimated by deducting the amount of sewage effluent from the pumpage. For 2017, the estimated City pumpage was about 1,840 acre-feet per year and the effluent flow was about 1,180 acre-feet per year. The outside water use for the City was thus 660 acre-feet per year. Assuming an irrigation efficiency of 70 percent, the consumptive use would be about 460 acre-feet per year. Combined with about 300 acre-feet per year of evaporation from the effluent ponds, the total urban consumptive use was about 760 acre-feet per year.

Rural

For 2003-08, values of evapotranspiration of applied water (ET_{IW}) were taken from ITRC 1997-2018 water use study report. For 2009-16, the total evapotranspiration of crops (ETc) was calculated based on the relationship between Eto and Kc values.

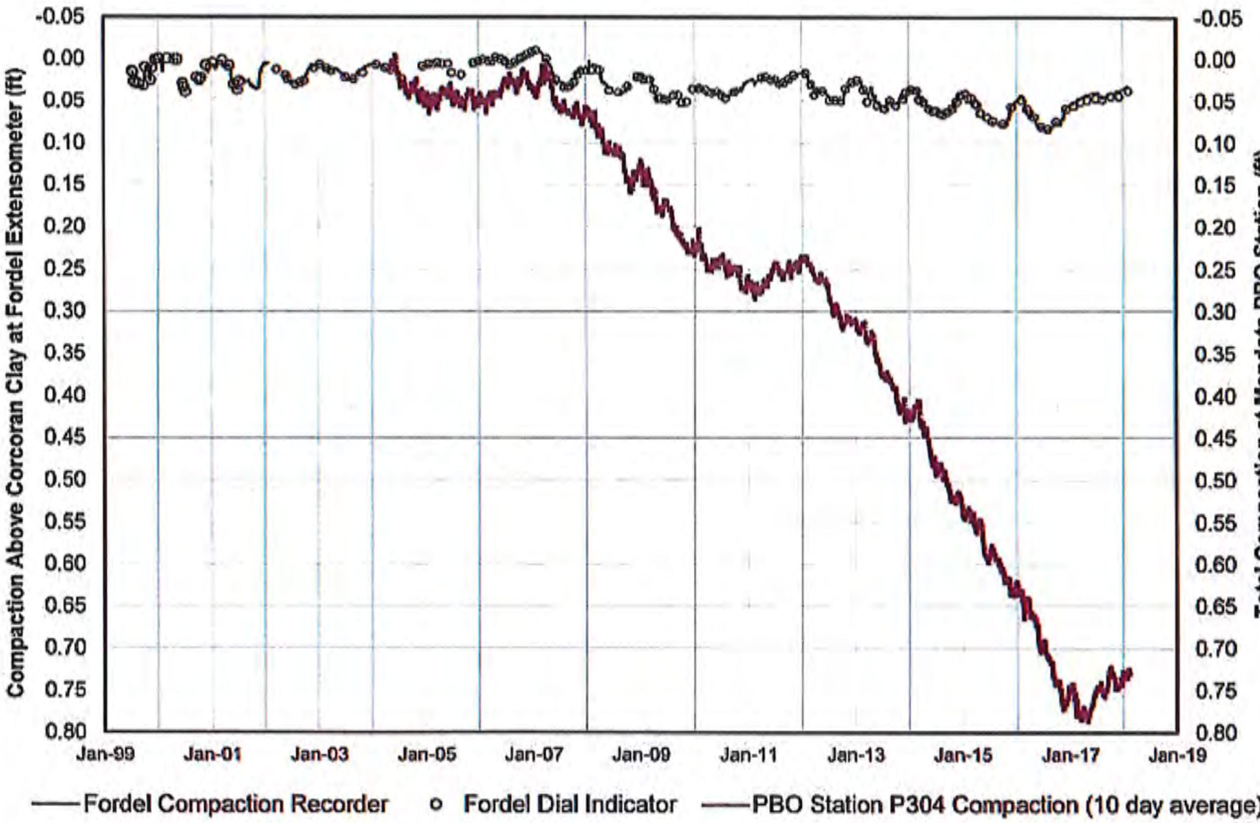
For the 800 acres of irrigated land in the Columbia Canal Co. service area south of the San Joaquin River, the estimated evapotranspiration of applied water averaged about 2,800 acre-feet per year.

Total

The estimated total consumptive use in the study area as of 2017 was 3,560 acre-feet per year. There was an estimated 3,740 acre-feet of canal water and Mendota Pool water used in the study area. Considering the error of estimate, the surface water used was slightly greater than the total consumptive use.

LAND SUBSIDENCE

As of 1972, there had been about four feet of land subsidence at Mendota. Because there has been little pumpage from below the Corcoran Clay at and near Mendota, this subsidence was attributed to pumping from below the Corcoran Clay in the area southwest of Mendota and also in Madera County, northeast of Mendota. The Fordel compaction recorder was installed near the Mendota Airport by the MPG in 1999. This recorder monitors subsidence due to compaction above the Corcoran Clay. Figure 12 shows compaction for the Fordel recorder for 1999-2018. Although there was a small amount of compaction (about 0.05 foot) above the Corcoran Clay, most of this compaction was reversible. That is, once water levels recovered after pumping episodes, the land surface rebounded.



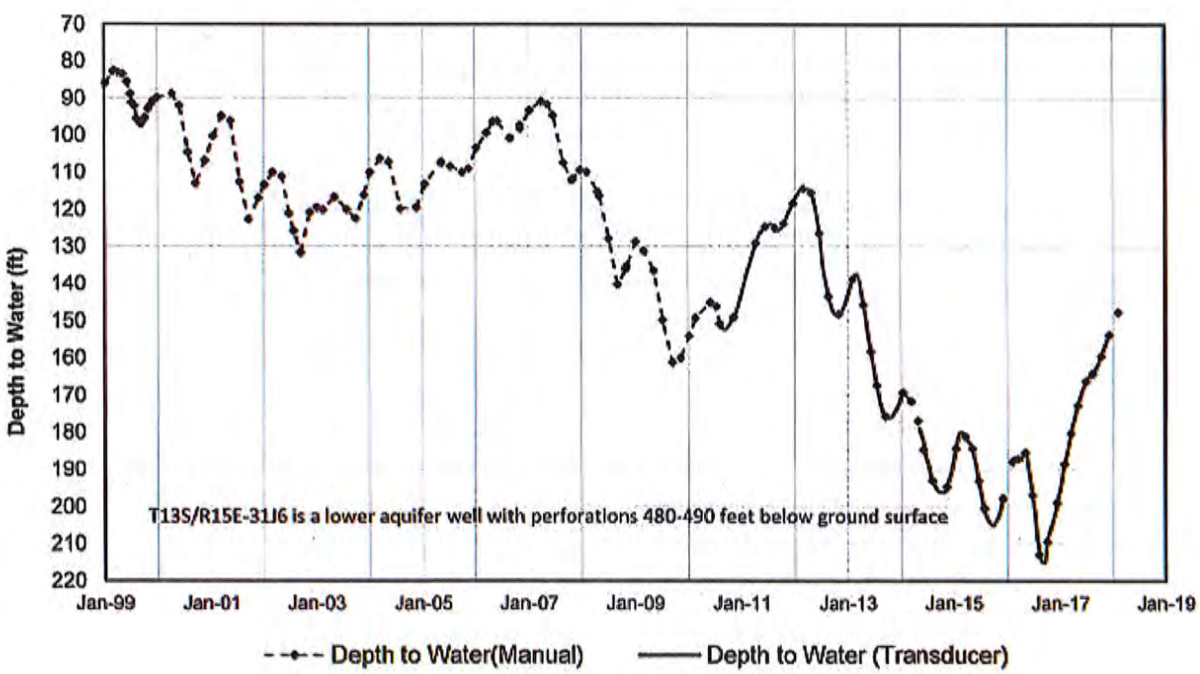


FIGURE 12 - COMPACTION AND WATER LEVELS
AT THE FORDEL RECORDER

There is a GPS monitoring station (P304) south of Mendota between Highway 33 and the Fresno Slough branch of the Mendota Pool. This station measures land subsidence due to compaction from the land surface to the depths of the deepest wells in the area (about 1,200 feet deep). There was little land subsidence at the station during 2004-2006. Total subsidence was about 0.8 feet between January 2007 and January 2018.

CHANGE IN GROUNDWATER STORAGE

Because there was no significant change in water levels for the unconfined aquifer (shallow zone) prior to the recent drought, there was no storage change over the hydrologic base period. The lower aquifer remained full of water, even though the water levels fell about 100 feet between January 2007 and January 2017. This was due to pumping in the Westlands W.D. and in Madera County, as there was insignificant pumpage from the lower aquifer in the Mendota area. There was a change in storage for the confining beds (Corcoran Clay and deeper ones). Multiplying the 0.8 foot decline in land surface elevation over a 2,400-acre area, this would be equivalent to a storage change of about 1,920 feet over ten years, or an average of about 190 acre-feet per year.

GROUNDWATER QUALITY

City Wells

Public Supply Wells

Table 7 provides chemical analyses of water from the City of Mendota Public Supply Wells. The samples were collected primarily in November 2015. The waters were of the sodium-mixed anion type. Total dissolved solids (TDS) concentrations ranged from 270 to 520 mg/l. Nitrate concentrations were less than 1 mg/l, likely indicative of anaerobic conditions, which are common in the Mendota area. Iron, manganese, arsenic, hexavalent chromium, and selenium concentrations and alpha activities were below the respective MCLs. The boron concentration was 1.1 mg/l, high enough to affect boron sensitive crops.

Fordel Wells

Table 8 provides chemical analyses of water from City of Mendota Fordel wells. Well M-1 is perforated below the A-Clay and above the Corcoran Clay. The total dissolved solids (TDS) concentration was 2,370 mg/l, much higher for this well compared to the nearby shallow Fordel wells. Water from this well was of the sodium sulfate-chloride type. The sulfate concentration was 550 mg/l, exceeding the MCL of 250 mg/l. The manganese concentration was 0.29 mg/l, exceeding the MCL of 0.05 mg/l.

Water from three other Fordel wells that were sampled, which primarily tap strata above the A-clay, had TDS concentrations ranging from about 570 to 900 mg/l. Water from these wells was

TABLE 7-CHEMICAL QUALITY OF WATER FROM
CITY OF MENDOTA PUBLIC SUPPLY WELLS

Constituent (mg/l)	No. 7	No. 8	No. 9	MCL
Calcium	3	<1	3	
Magnesium	<1	<1	<1	
Sodium	170	84	150	
Bicarbonate	195	122	180	
Sulfate	110	26	80	
Chloride	95	47	89	
Nitrate	<1	<1	<1	45
Fluoride	0.6	0.4	0.5	
pH	8.2	8.5	8.3	
Electrical Conductivity (micromhos/cm @ 25°C)	810	400	730	
Total Dissolved Solids (@ 180°C)	520	270	460	500
Iron	<0.1	0.17	<0.1	0.3
Manganese	0.03	<0.02	0.02	0.05
Arsenic (ppb)	6.7	<2	<2	10
Hexavalent Chromium (ppb)	<1	<1	<1	10
Selenium (ppb)	<5	<5	<5	10
Alpha Activity (picocuries per liter)	6.1	3.9	<3	15
Date	11/24/15	11/24/15	11/24/15	
Perforated Interval (feet)	260-395	210-375	260-395	

Samples for hexavalent chromium were collected on 12/23/14 and for alpha activity were collected on 2/12/13.

TABLE 8-CHEMICAL QUALITY OF WATER FROM
CITY OF MENDOTA FORDEL WELLS

Constituent (mg/l)	M-1	M-2	M-3	M-4
Calcium	42	28	33	29
Magnesium	5	11	15	14
Sodium	466	124	125	64
Potassium	6	3	4	3
Carbonate	<10	<10	<10	<10
Bicarbonate	200	120	140	130
Sulfate	550	86	114	38
Chloride	300	98	127	77
Nitrate	<0.5	<0.5	<0.5	<0.5
Fluoride	0.3	0.2	0.2	0.2
Boron	1.1	0.4	0.4	0.2
Iron	0.10	2.2	3.5	2.6
Manganese	0.29	0.48	0.55	0.70
pH	7.7	6.9	6.6	6.7
Electrical Conductivity (micromhos/cm @ 25°C)	2,370	760	900	571
Total Dissolved Solids	1,570	470	558	355
Sodium Adsorption Ratio	18.1	5.0	4.5	2.4
Date	8/26/15	8/26/15	8/26/15	8/26/15
Perforated Interval (feet)	200-300	50-100	50-100	50-100

Analyses by FGL Environmental of Santa Paula of the sodium bicarbonate-chloride type. Concentrations of iron and manganese exceeded the respective recommended MCLs of 0.3 and 0.05 mg/l. The chemical quality of shallow groundwater at these wells is primarily due to seepage for the Mendota Pool and the nearby City effluent ponds. Boron concentrations ranged from 0.2 to 0.4 mg/l, suitable for irrigation of crops.

CCID Wells

Table 9 provides chemical analyses of water from four CCID wells near Mendota from July 2016. TDS concentrations ranged from 680 to 1,100 mg/l. Sulfate concentrations ranged from 220 to 460 mg/l, compared to the recommended MCL of 250 mg/l. Nitrate concentrations were less than 0.2 mg/l, indicative of anaerobic conditions in the groundwater. Boron concentrations ranged from 0.4 to 1.6 mg/l. Historical analyses of water from a number of wells in the Headgate area indicate degradation in salinity, due to inflow of poor quality groundwater from the southwest, and possibly from downward flow from poor quality shallower groundwater.

WATER BUDGET

The Columbia Canal Co. delivered an average of 1,630 acre-feet per year of canal water to 800 acres of crops in the study area during 2003-16. The urban consumptive use was 760 acre-

TABLE 9-CHEMICAL QUALITY OF WATER FROM CCID WELLS

Constituent (mg/l)	Well 5-A	28D	32C	35A
Calcium	26	24	75	70
Magnesium	6	4	31	34
Sodium	200	340	230	180
Potassium	4	4	5	6
Bicarbonate	159	183	171	171
Sulfate	220	320	460	320
Chloride	120	230	140	170
Nitrate	<0.2	<0.2	<0.2	<0.2
Boron	0.48	0.96	1.6	0.4
pH	8.1	8.0	7.9	7.5
Electrical Conductivity (micromhos/cm @ 25°C)	1,100	1,700	1,600	1,400
Total Dissolved Solids	680	1,100	1,100	880
Date	7/28/16	7/28/16	7/28/16	7/28/16
Perforated Interval (feet)	100-260	200-360	80-200	90-311

Analyses by BSK Associates of Fresno.

feet per year during that period. For the rural area, the evapotranspiration of applied water averaged 2,800 acre-feet per year. The estimated total consumptive use in the study area was thus 3,560 acre-feet per year during 2003-16. There was an estimated 3,740 acre-feet per year of canal water and Mendota Pool water used in the study area. This value thus slightly exceeded the estimated total consumptive use in the study area.

The average annual pumpage for City of Mendota wells (including the Fordel wells) was about 3,500 acre-feet per year. There was another 300 acre-feet per year for CCID wells. The total pumpage was about 3,800 acre-feet per year. Sources of recharge include seepage of City effluent (880 acre-feet per year), deep percolation from urban irrigation (200 acre-feet per year), and deep percolation from irrigated lands in the CCC (about 500 acre-feet per year). There was an additional recharge due to seepage from the Mendota Pool and groundwater inflow in the upper aquifer. Water-level records indicate that there was essentially no change in storage in the unconfined aquifer during 2003-16. The groundwater inflows and outflows (above and below the A-clay) acted to maintain the water budget. This indicates that the groundwater inflow and pool seepage exceeded the outflow by about 2,400 acre-feet per year.

REFERENCES

Kenneth D. Schmidt & Associates, 1999, "Groundwater Conditions in the Vicinity of the City of Mendota" report prepared for CCID and City of Mendota, 55p.

Kenneth D. Schmidt & Associates, 2008, "Groundwater Conditions in the Vicinity of the B&B Ranch, Northeast of Mendota" report prepared for City of Mendota, 20p.

Kenneth D. Schmidt & Associates, 2019, "Hydrogeologic Conceptual Model and Groundwater Conditions for the San Joaquin River Exchange Contractors Service Area GSP" draft report prepared for SJREC GSA, Los Banos, California, 134p.

Luhdorff & Scalmanini and Kenneth D. Schmidt and Associates, 2018, "Mendota Pool Group Pumping and Monitoring Program: 2017 Annual Report", prepared for SJRECWA, Wonderful Orchards, and Mendota Pool Group.

Appendix W. Groundwater Conditions in the Turner Island Water District – 2 GSA

GROUNDWATER CONDITIONS IN THE TURNER ISLAND WATER DISTRICT-2 GSA

prepared for
San Joaquin River Exchange
Contractors GSA
Los Banos, California

by
Kenneth D. Schmidt & Associates
Groundwater Quality Consultants
Fresno, California

May 2019

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May 31, 2019

Mr. Chris White, Executive Director
San Joaquin River Exchange
  Contractors GSA
P. O. Box 2115
Los Banos, CA 93635

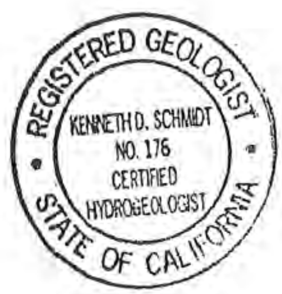
Re: Turner Island W.D. GSP of the
  SJREC GSP

Dear Chris:

Submitted herewith is our report on groundwater conditions in the Turner Island W.D. GSP. We appreciate the cooperation of the CCID and Turner Island W.D. in providing information for this report.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist 176



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INTRODUCTION

As part of the Groundwater Sustainability Plan (GSP) for the San Joaquin River Exchange Contractors (SJREC) GSP service area, GSPs for a number of cities and other areas in Merced County, including part of the Turner Island W.D., are being incorporated into the SJREC GSP. The District (Figure 1) is located south of the San Joaquin River and west of Poso Drive, northeast of the City of Los Banos. The study area is located just to the north of lands in the service area of the San Luis Canal Co., which are part of the SJREC GSA. The report is intended to provide information on groundwater conditions within and near the Turner Island W.D. study area.

SUBSURFACE GEOLOGIC CONDITIONS

The Corcoran Clay is a regional confining bed that extends throughout much of the west part of the San Joaquin Valley. This clay divides the groundwater into an overlying upper aquifer and underlying lower aquifer. The top of the Corcoran Clay is about 180 feet deep beneath the study area. There is a shallow clay layer that is less extensive in the valley, but is important beneath the District. This is termed the A-Clay. The top of the A-clay ranges from about 25 to 60 feet deep above the District.

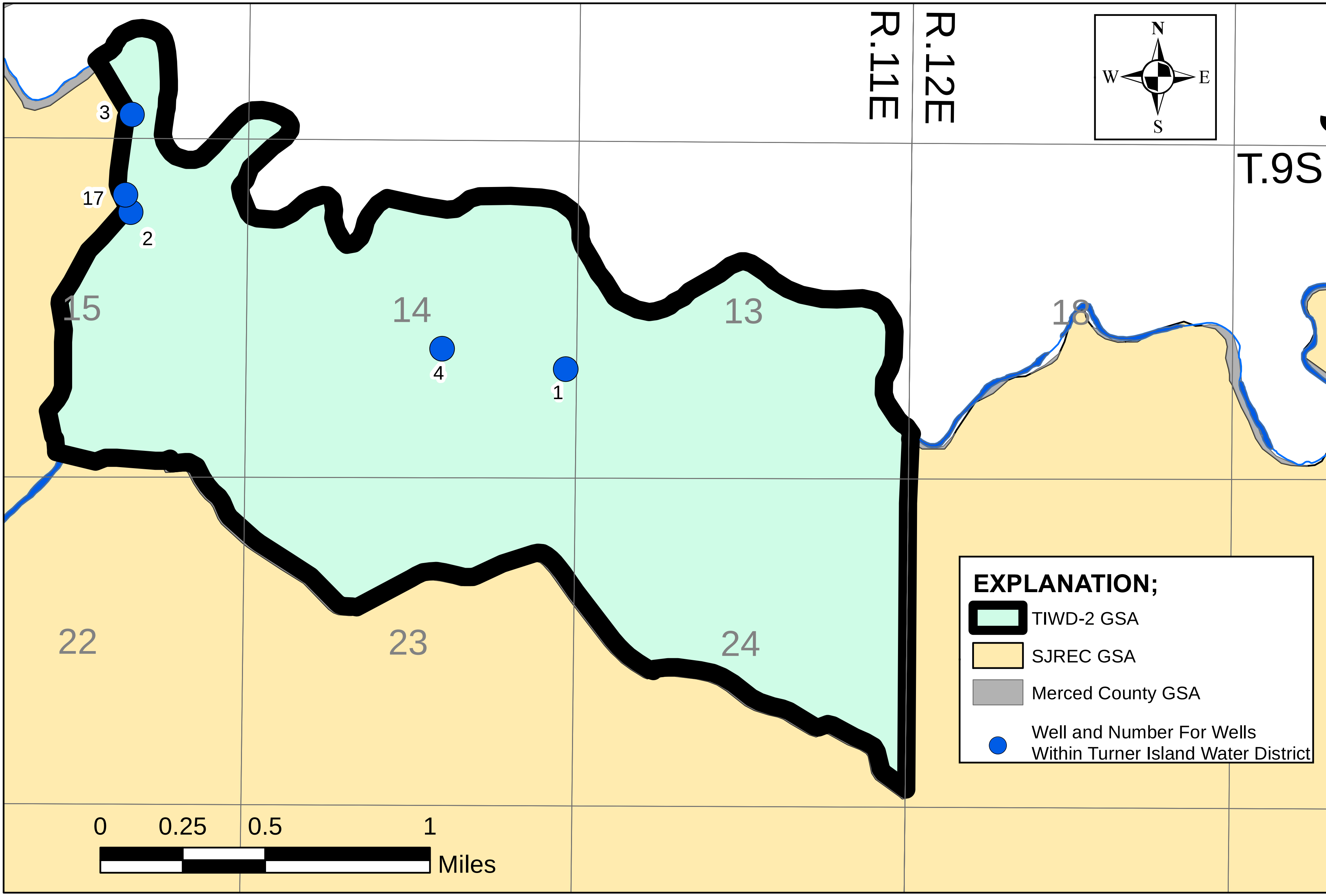

FIGURE 1 - LOCATION OF TURNER ISLAND WATER DISTRICT STUDY AREA

Shallow groundwater is often present beneath this clay layer. As part of this evaluation, a subsurface geologic cross section (A-A') was prepared (Figure 2) based on logs for District wells.

Cross Section A-A" (Figure 3) extends from District Well No. 3-TH to the northwest to the southeast through Well No.4-TH, then to the east-northeast to Well 16. The holes for Wells No. 3 and 4 extend below the Corcoran Clay. Fine-grained deposits were predominant above the Corcoran Clay at the test hole for Well No. 4, whereas coarse-grained deposits (sand) were more common above the Corcoran Clay at the test hole for Well No. 3 and at Well No. 16. The Corcoran Clay extended from about 180 to 230 feet in depth at the test hole Well No. 3 and from about 165 to 218 feet in depth at the test hole for Well No. 4. Coarse grained strata were common below the Corcoran Clay and above a depth of about 370 feet at the test hole for Wells No. 3 and 4.

WELL DATA

Table 1 provides construction data for the five wells within the District. These wells aren't owned by Districts. All of the wells tap the upper aquifer.

WATER LEVELS

Depth to water is shallow in the area, including for both upper aquifer and lower aquifer wells. A water-level elevation map is available for the upper aquifer in the San Luis Canal Co. service

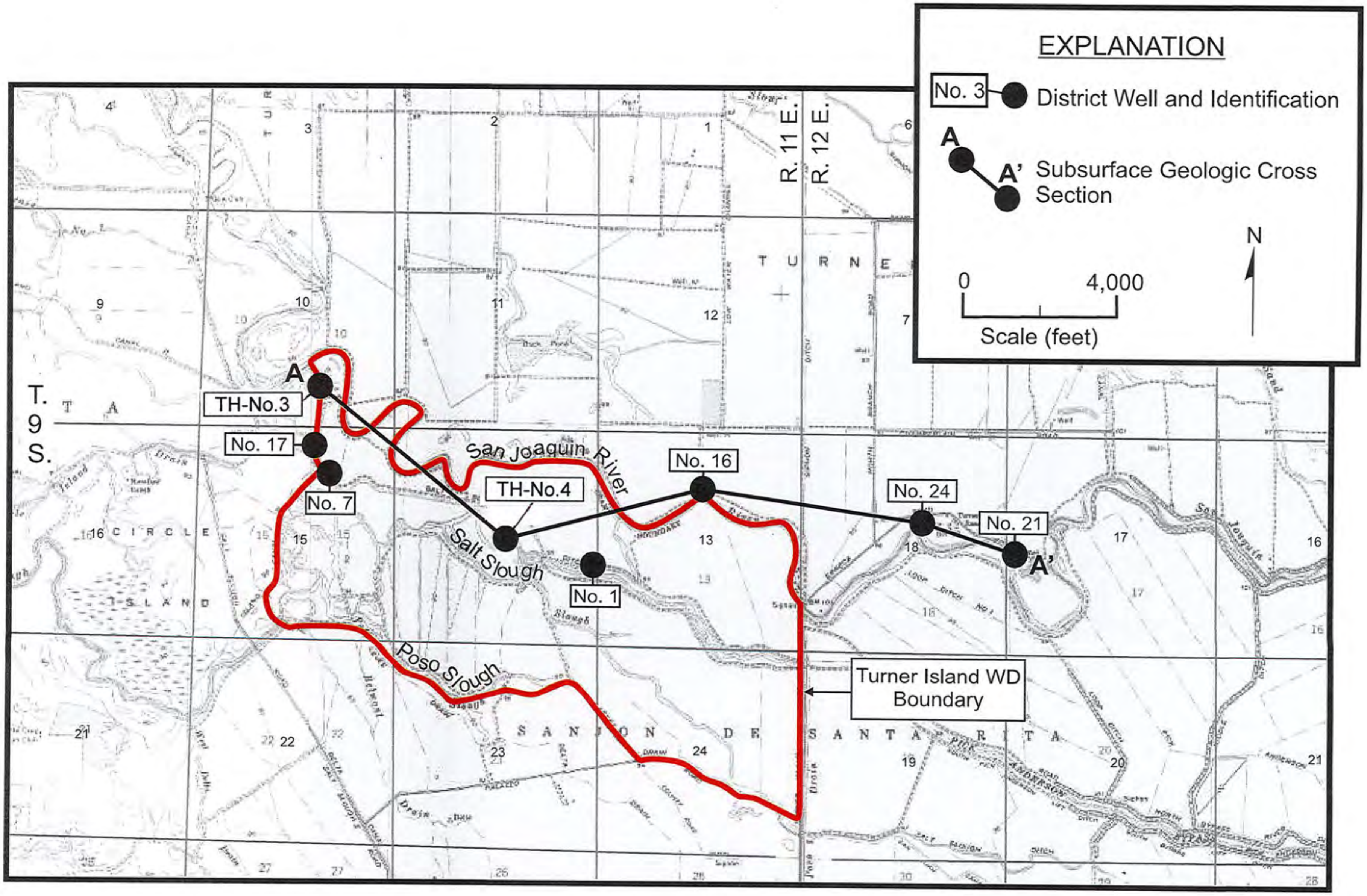

FIGURE 2 - LOCATIONS OF DISTRICT WELLS AND SUBSURFACE GEOLOGIC CROSS SECTION A-A'

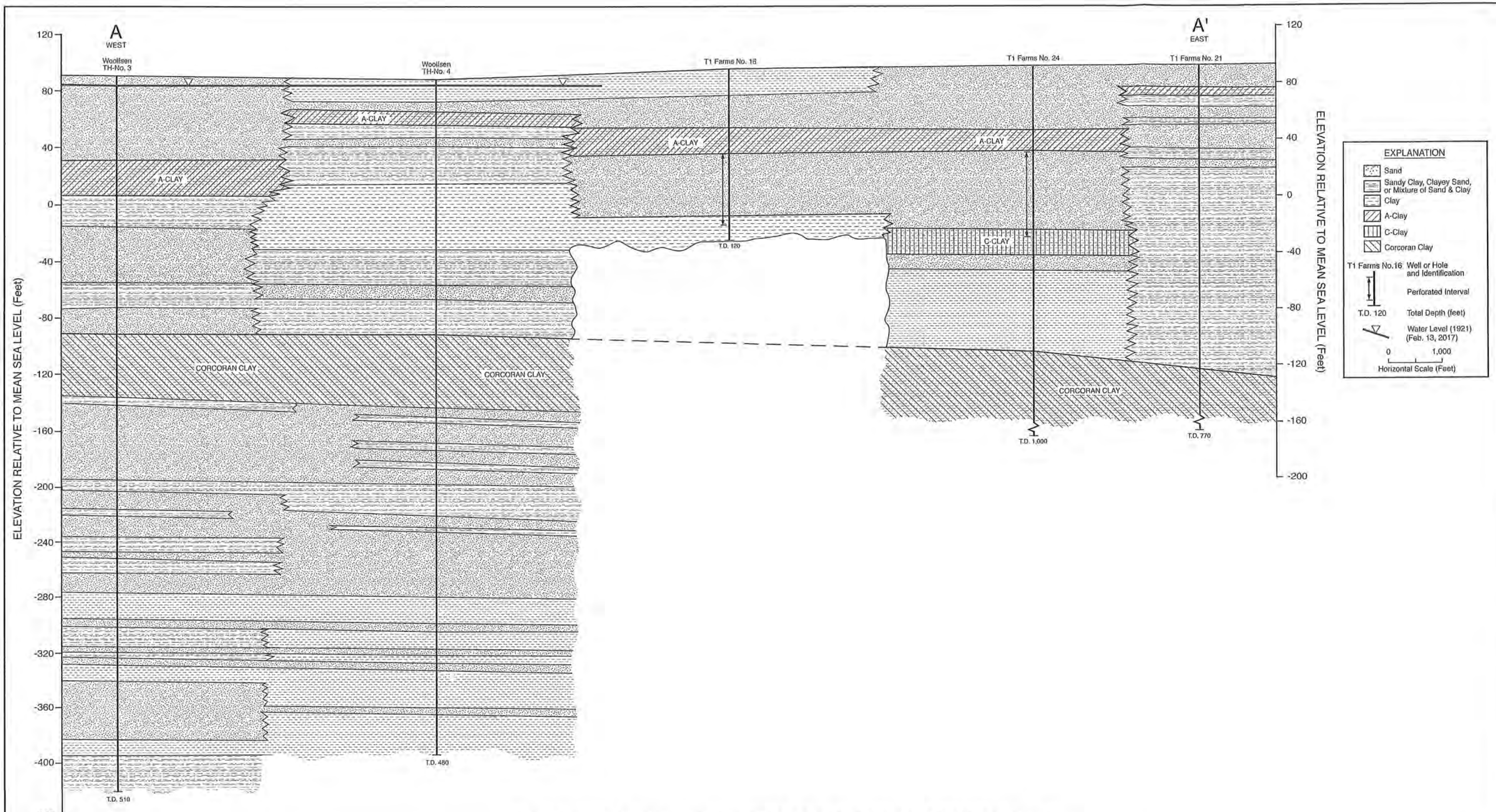

FIGURE 3 - SUBSURFACE GEOLOGIC CROSS SECTION A - A'

TABLE 1 - CONSTRUCTION DATA FOR TURNER ISLAND WD WELLS

No.	Date Constructed	Depth Drilled (feet)	Cased Depth (feet)	Casing Diameter (inches)	Perforated Interval (feet)	Annular Seal (feet)
1			150	17.4	50-180	-
2			180	17.4	60-180	-
3	9/12	-	205	16	80-200	0-50
4	9/12	-	140	16	60-140	0-50
17			140	16		

area for February 2017. This map indicates water level elevations ranged from about 83 to 88 feet above mean sea level beneath the study area. The regional direction of groundwater flow was to the northwest, generally parallel to the San Joaquin River. Monthly water-level elevations are available for the Turner Island WD wells in the study area. Water level elevations on February 13, 2017 (Figure 4) ranged from about 84 to 86 feet above mean sea level. Locally near the San Joaquin River, the direction of groundwater flow was to the southwest. On February 13, there was little difference in depth to water between the upper aquifer and lower aquifer wells.

The San Luis Canal Co. has prepared long-term water-level hydrographs for nine wells in their service area. These hydrographs extend back to the late 1990's, and show stable water levels and no indication of groundwater overdraft.

Water-level hydrographs for the five District wells in the study area for 2015-18 are provided in Appendix A. All of these hydrographs indicated rising water levels during this period. Figure 5 is considered a representative hydrograph for the upper aquifer (Well No. 1). Depth to water ranged from about five to thirteen feet. Figure 6 is considered a representative hydrograph for the lower aquifer (Well No. 3). Depth to water ranged from five to more than 36 feet.

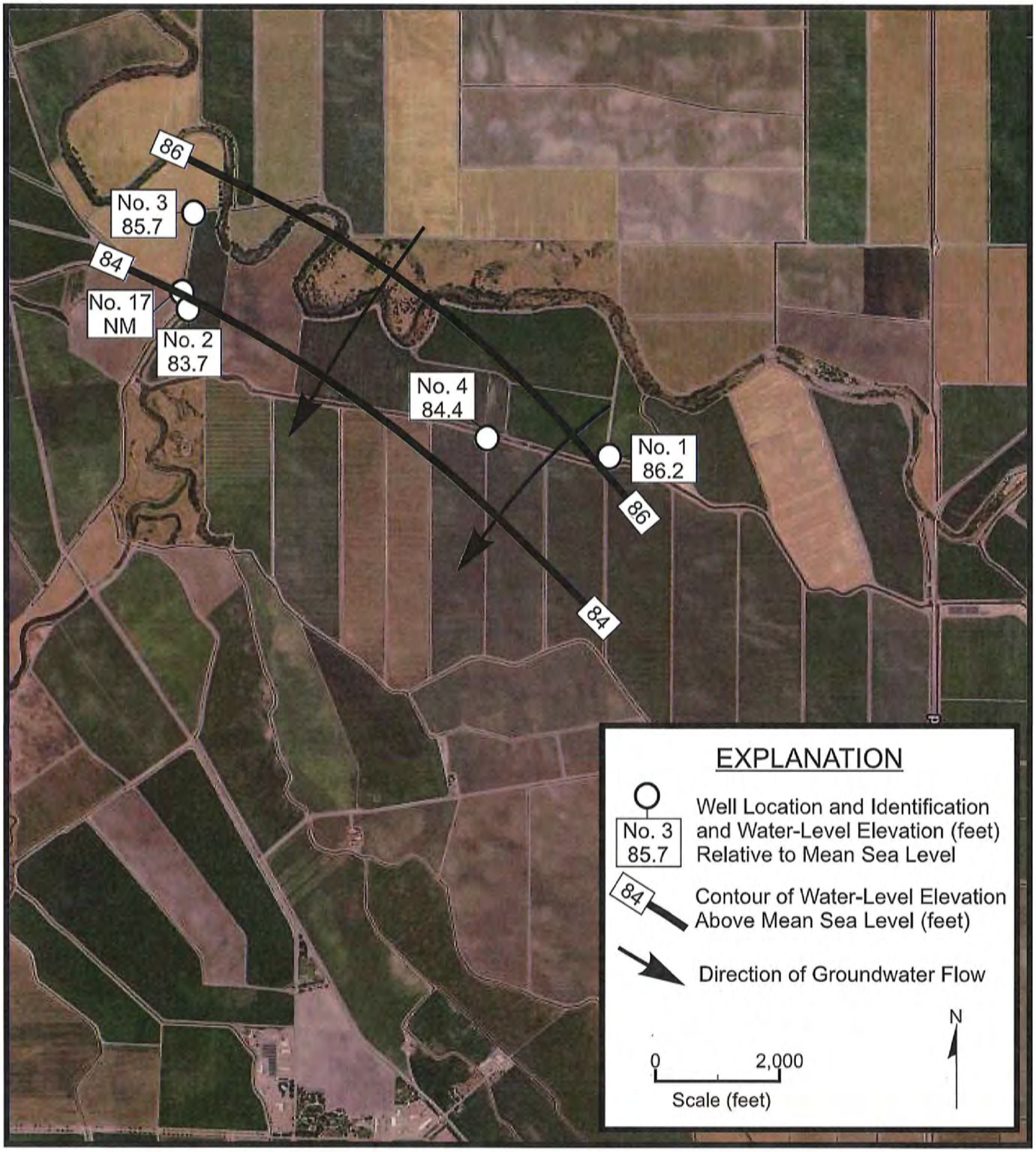

FIGURE 4 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW FOR FEBRUARY 13, 2017

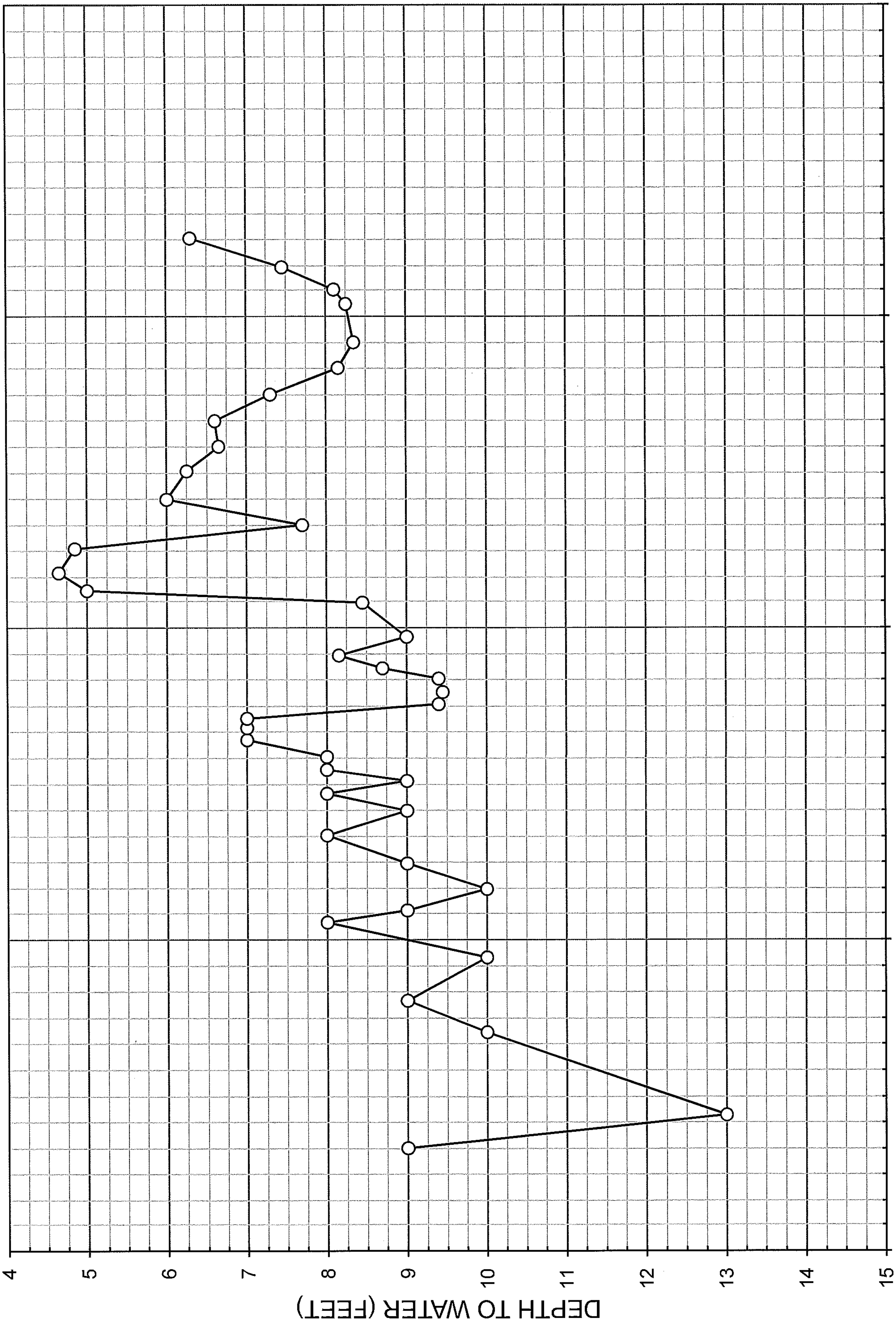

FIGURE 5-WATER-LEVEL HYDROGRAPH FOR TURNER ISLAND WD WELL NO. 1

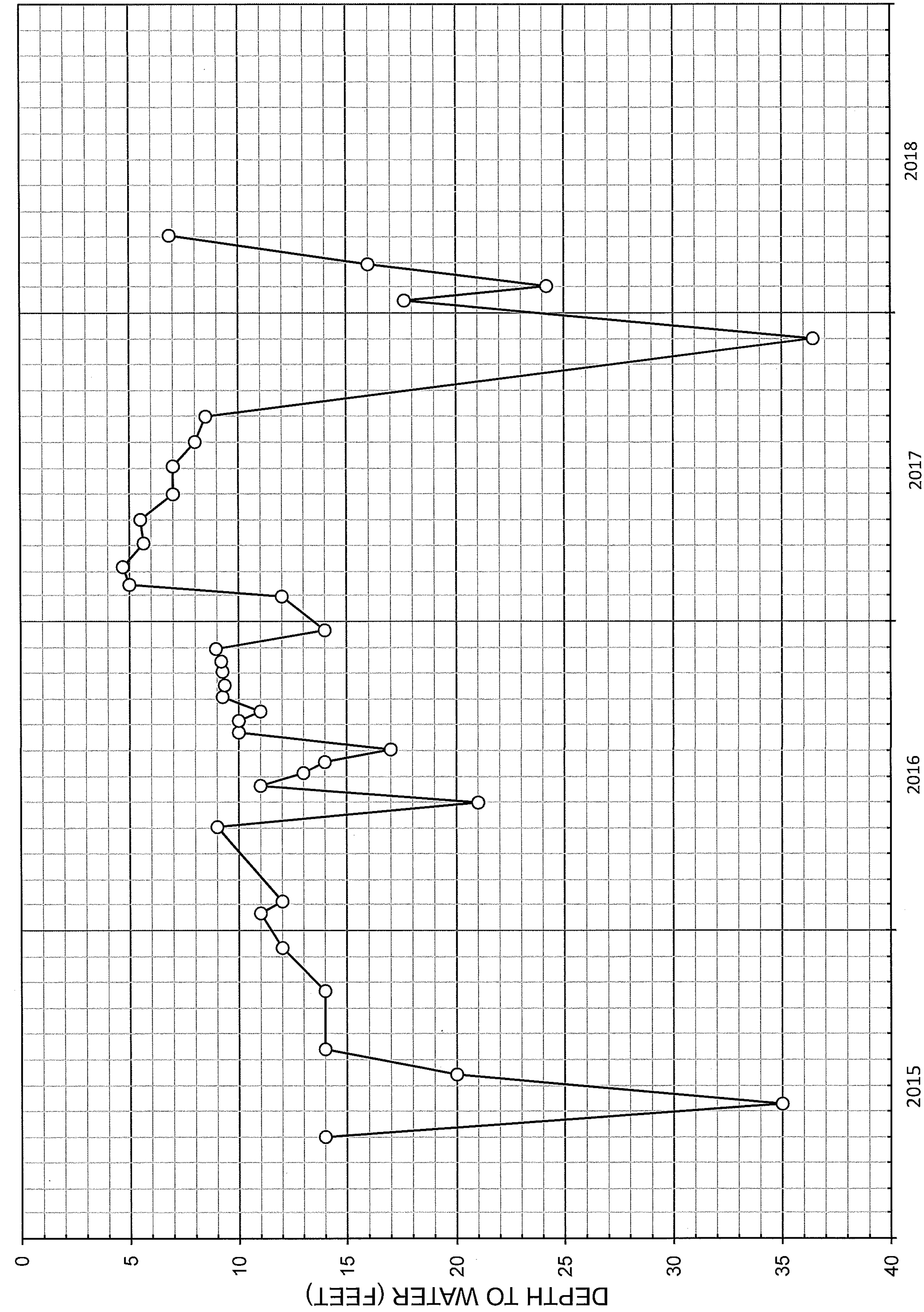

FIGURE 6-WATER-LEVEL HYDROGRAPH FOR TURNER ISLAND WD WELL NO. 3

PUMP TEST DATA

Pump test results are not available for the District Wells. However, reported pumping rates for these wells range from about 800 to 2,000 gpm.

PUMPAGE

Table 2 shows Turner Island WD pumpage for wells in the study area during 2010-16. The annual pumpage ranged from about 730 to 3,330 acre-feet, and the average pumping during this period was about 1,530 acre-feet per year. Of this pumpage, an average of 370 acre-feet per year was used for irrigation of crops in the District. The remaining 1,160 acre-feet per year was pumped to locations outside of the study area.

SLCC WATER DELIVERIES

Water deliveries to the District from the San Luis Canal Co. for 2003-16 are provided in Table 3. From 1,600 to 1,700 acres of land were irrigated with this water each year. The annual amount of surface water delivered ranged from 3,100 acre-feet to 6,500 acre-feet. The surface water deliveries averaged about 5,100 acre-feet per year. During the dry years of 2014-16, the District wells were used to supplement the SLCC deliveries.

TABLE 2-PUMPAGE FROM TURNER ISLAND WD WELLS

Year	GW Pumped to Outside Basin (ac-ft)	GW Pumped to Crops (ac-ft)	Total GW Pumped (ac-ft)
2010	731	0	731
2011	760	0	760
2012	1,142	0	1,142
2013	871	0	871
2014	2,553	775	3,328
2015	1,507	982	2,489
2016	557	865	1,422

TABLE 3-SLCC CANAL WATER DELIVERIES AND CROP EVAPOTRANSPIRATION

Water Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Acreage	1,600	1,600	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,600	1,600	1,600	1,600	1,600
Surface Water Applied (ac-ft)	6,300	5,700	6,000	6,500	6,300	5,800	4,900	4,700	5,200	4,300	5,000	3,800	3,100	3,500
Groundwater Applied (ac-ft)	-	-	-	-	-	-	-	-	-	-	-	800	1,000	900
Total Applied Water (ac-ft)	6,300	5,700	6,000	6,500	6,300	5,800	4,900	4,700	5,200	4,300	5,000	4,600	4,000	4,400
ETc (ac-ft)	4,500	4,200	3,700	4,700	4,400	3,800	3,700	3,500	4,400	4,200	4,300	4,000	2,600	3,900
ETiw (ac-ft)	3,600	3,200	2,700	3,600	3,700	3,200	2,900	2,600	3,500	3,400	3,400	3,200	1,900	3,000

CONSUMPTIVE USE

Table 3 also shows the evapotranspiration of applied water for 2003-16. These estimates were taken from the ITRC water use and ITRC metric data. The annual evapotranspiration of applied water ranged from 1,900 to 3,700 acre-feet. The average evapotranspiration of applied water was 3,100 acre-feet per year. There was thus an average surplus of about 2,000 acre-feet per year of the amount of surface water compared to the evapotranspiration of applied water by crops.

CHANGE IN GROUNDWATER STORAGE

Based on long-term water-level hydrographs for wells in the area, there has been no long-term change in groundwater storage in the District.

WATER BUDGET

An average of 5,100 acre-feet of water was delivered to the District from the SLCC during 2003-16. This exceeded the average evapotranspiration of applied water (3,100 acre-feet per year) by an average of 2,000 acre-feet per year. The average groundwater pumpage was 1,530 acre-feet per year. An average of 1,160 acre-feet per year of groundwater was pumped to locations outside of the study area during 2010-16. The net difference in the water budget (excluding groundwater flows) was an average surplus of about 470 acre-feet per year.

LAND SUBSIDENCE

Figure 7 shows land subsidence in the area for December 2011-July 2013. One of the GPS stations (T987 CADWR) used in preparing this map was near Sandy Mush Road and the Eastside Bypass, near the Crane Ranch. Subsidence of 0.1 to 0.2 foot per year was indicated beneath most of the Turner Island Ranch and the Crane Ranch over this period. The greatest subsidence has been south of Washington Road, in the El Nido and Red Top areas. Land subsidence in the Red Top area has been reduced by decreasing lower aquifer pumpage by various means, including imported surface water, and development of more upper aquifer wells.

GROUNDWATER QUALITY

Table 4 shows the results of chemical analyses of water from from two of the TIWD wells, based on samples collected by KDSA in December 2013. Well No. 2 taps the upper aquifer and Well No. 4 taps the lower aquifer. The total dissolved solids (TDS) concentration in water from Well No. 2 was 1,310 mg/l and the water was of the sodium chloride type. The chloride concentration was 444 mg/l. For the lower aquifer, the lowest TDS concentrations in the vicinity are for wells near the San Joaquin River. The TDS concentration in water from Well No. 4 was 1,990 mg/l and the water

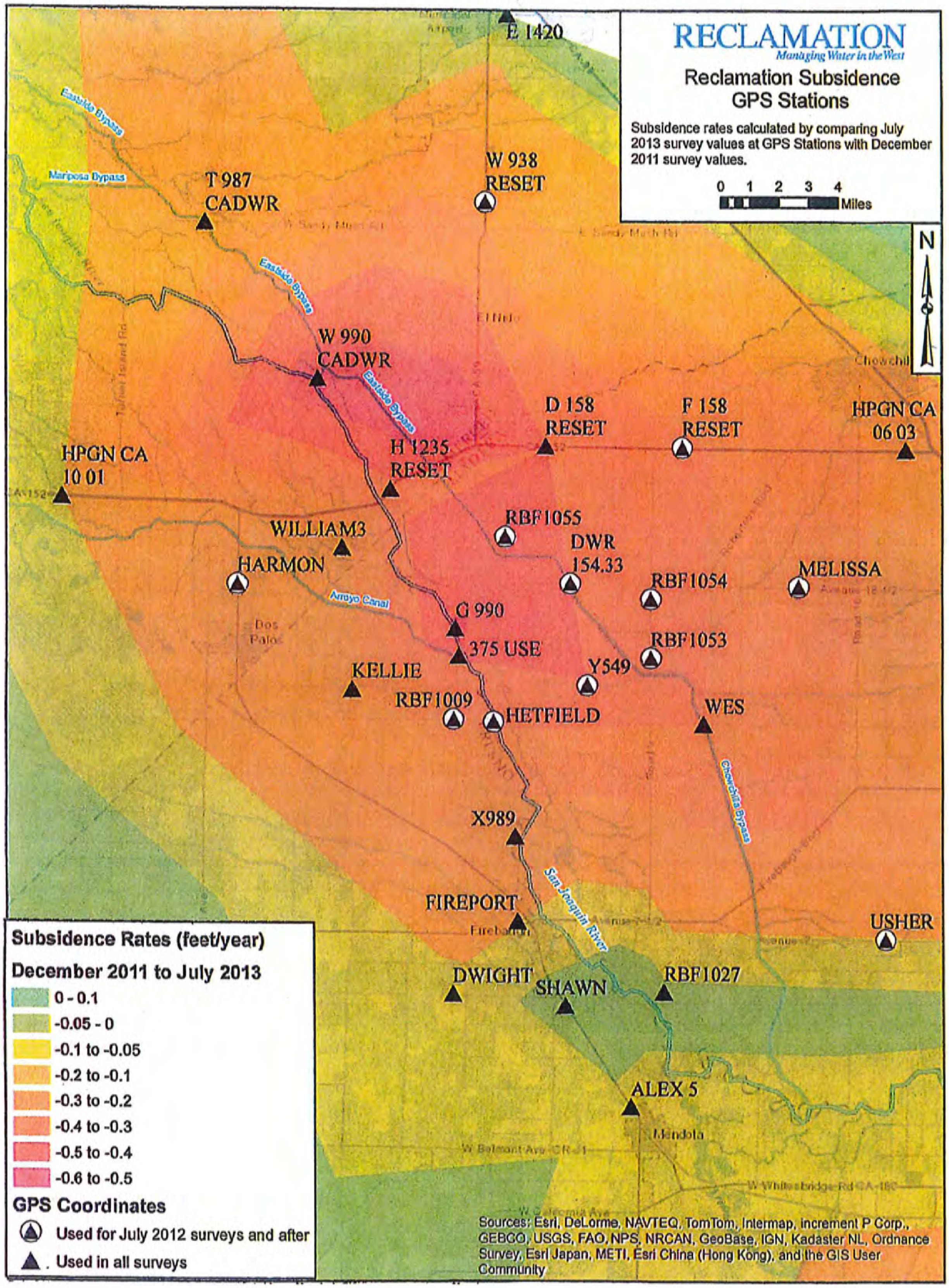

FIGURE 7-LAND SUBSIDENCE (DECEMBER 2011-JULY 2013)

TABLE 4-CHEMICAL ANALYSES OF TURNER ISLAND W.D. WELLS

Constituent (mg/l)	Well No. 2	Well No. 4
Calcium	101	160
Magnesium	47	72
Sodium	243	388
Potassium	4	3
Carbonate	<10	<10
Bicarbonate	230	220
Sulfate	240	360
Chloride	444	790
Nitrate	<1	1
SAR	5.0	6.4
Boron	0.2	0.2
pH	7.4	7.4
Electrical Conductivity (micromhos/cm @ 25°C)	1,960	3,000
Total Dissolved Solids (@ 180°C)	1,310	1,990
Date Sampled	12/3/13	12/3/13
Perforated Interval	60-180	230-450

Analyses by FGL Environmental of Santa Paula.

was also of the sodium chloride type. The chloride concentration was 790 mg/l. Sampling of other lower aquifer wells in the area indicates that TDS concentrations are lower to the northeast, and highest to the southwest and south. Also, TDS and chloride concentrations are higher in the deeper groundwater.