San Joaquin Valley Conveyance Study

State of California

California Natural Resources Agency

Department of Water Resources

Division of Planning

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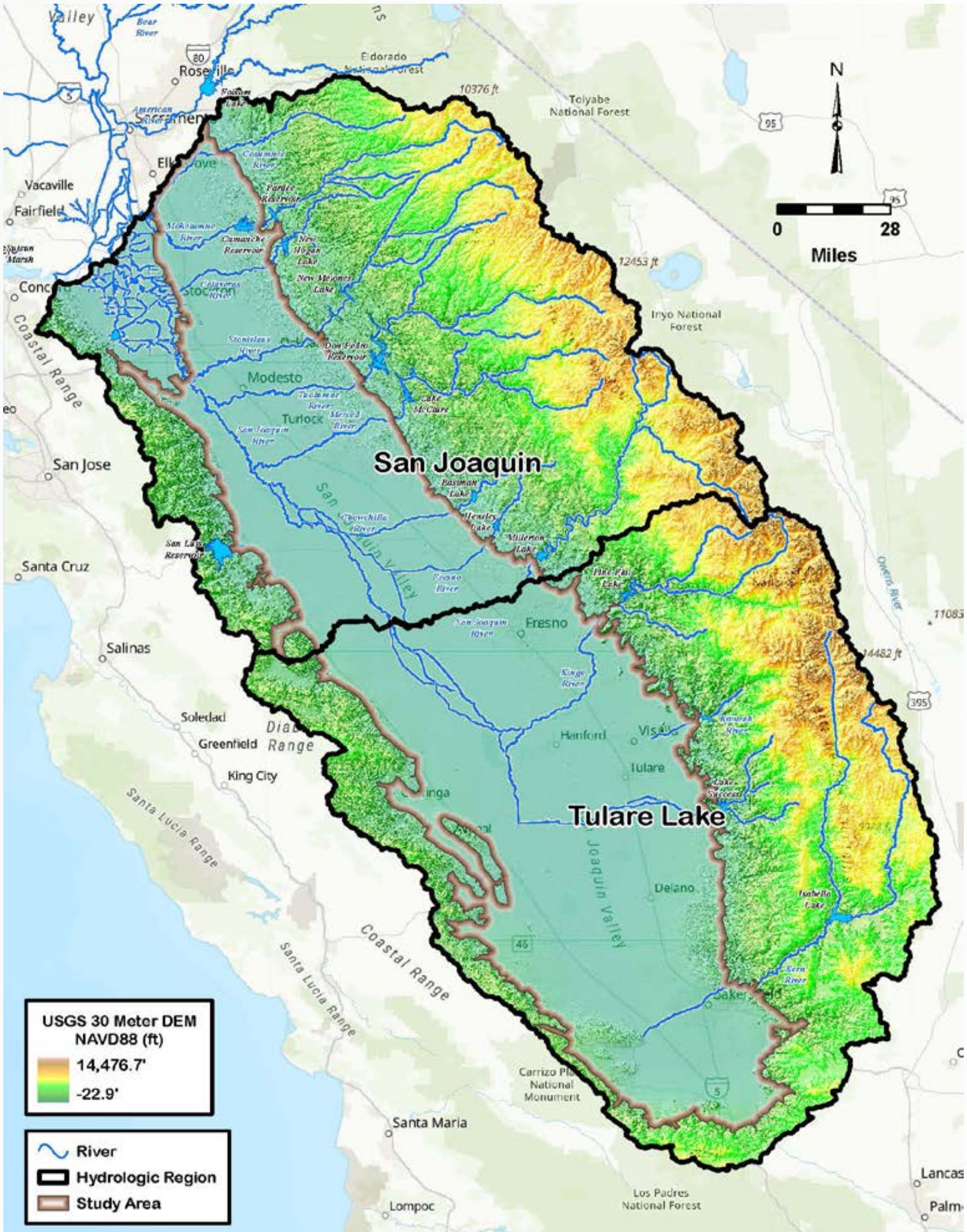
Executive Summary

Figure ES-1. Study Area



This San Joaquin Valley Conveyance Study analyzes water conveyance needs in the San Joaquin Valley (Figure ES-1). The purpose of this study is to:

- Describe the impacts of subsidence on San Joaquin Valley conveyance facilities.
- Evaluate the need for improved or expanded conveyance facilities throughout the San Joaquin Valley.

Supporting the Water Resilience Portfolio

This San Joaquin Valley Conveyance Study also supports Water Resilience Portfolio Action 19.3, "Conduct a feasibility analysis for improved and expanded capacity of federal, State, and local conveyance facilities to enhance water transfers and water markets. The analysis must incorporate climate change projections of hydrologic conditions."

Subsidence in the San Joaquin Valley

Subsidence in California has resulted in billions of dollars of impacts on water conveyance, flood management, transportation infrastructure, and groundwater wells (Borchers et al. 2014). Decades of groundwater extraction have caused widespread groundwater level declines. Groundwater level declines cause sediment compaction and lowering of land elevations that are permanent and irreversible.

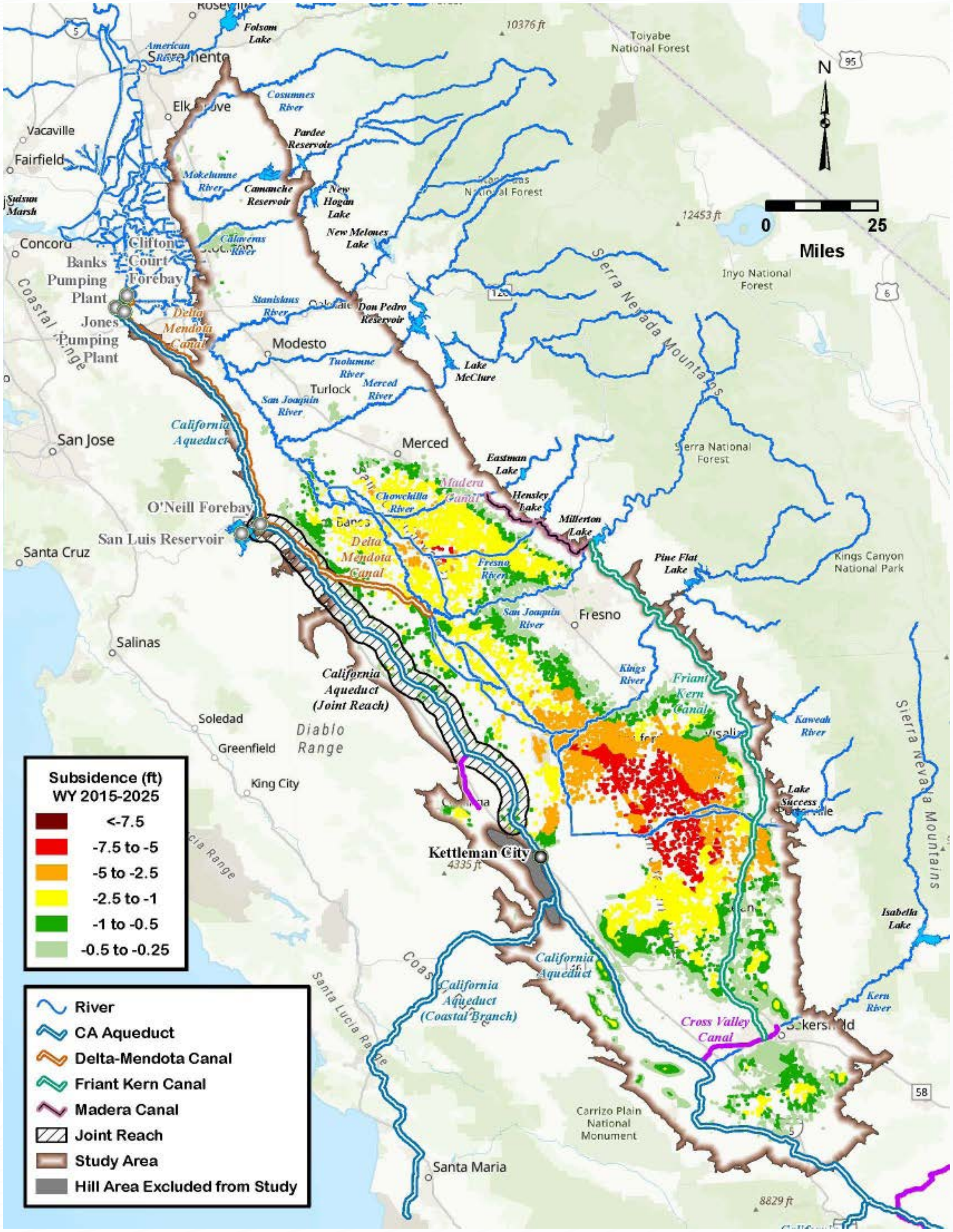
Subsidence is continuing to significantly reduce conveyance capacity in the San Luis Canal, California Aqueduct, Delta-Mendota Canal, and Friant-Kern Canal (Figure ES1). If subsidence continues at rates consistent with the past 10 years, it will have catastrophic effects on the ability to supply water to support California's economy. Lost conveyance capacity from subsidence reduces the system's ability to use and store wet-year flood flows, resulting in even greater reliance on limited groundwater reserves.

The top conveyance priority in the San Joaquin Valley is to minimize or stop subsidence by raising groundwater levels in subsided areas to elevations above critical head as quickly as possible, especially near State Water Project (SWP) and Central Valley Project (CVP) main conveyance facilities. Critical head is the groundwater level in fine-grained sediments below which permanent compaction, and therefore subsidence, will occur. All of the facilities highlighted below have ongoing subsidence repairs that are planned or are being implemented to restore lost conveyance capacity as a result of subsidence. Minimizing further subsidence by raising groundwater levels above critical head is needed to sustain lasting value from these repairs that will restore lost conveyance capacity. Impacts of subsidence in the San Joaquin Valley are highlighted below.

- Subsidence has lowered portions of the San Luis Canal and California Aqueduct and impacted conveyance capacity. The California Department of Water Resources' (DWR's) *State Water Project Delivery Capability Report 2023 Addendum: Impacts of Subsidence* found that 2023 levels of subsidence have resulted in a 44% reduction in California Aqueduct capacity and a 46% reduction in San Luis Canal capacity.
- Without additional operational adaptations or infrastructure improvements, the SWP's long-term average delivery capability could be reduced by as much as 87% in the next 20 years due to the combined effects of the continuation of moderate historical rates of subsidence and climate change.
- DWR's SWP Adaptation Strategy found that, if subsidence continues without remediation or aqueduct upgrades, the California Aqueduct would no longer be able to convey water south of southern Fresno County before 2085.
- Upper Delta-Mendota Canal capacity has reduced by approximately 870 cfs (a 20% reduction) and lower Delta-Mendota Canal capacity has reduced by approximately 1,031 cfs (a 30% reduction).

- Some sections of the Friant-Kern Canal are experiencing a reduction of up to 60% from design capacity (Friant Water Authority 2025).

Figure ES-2. Cumulative Land Subsidence Over 10 Years (Water Years 2015–2025)



San Joaquin Valley Conveyance Needs Assessment

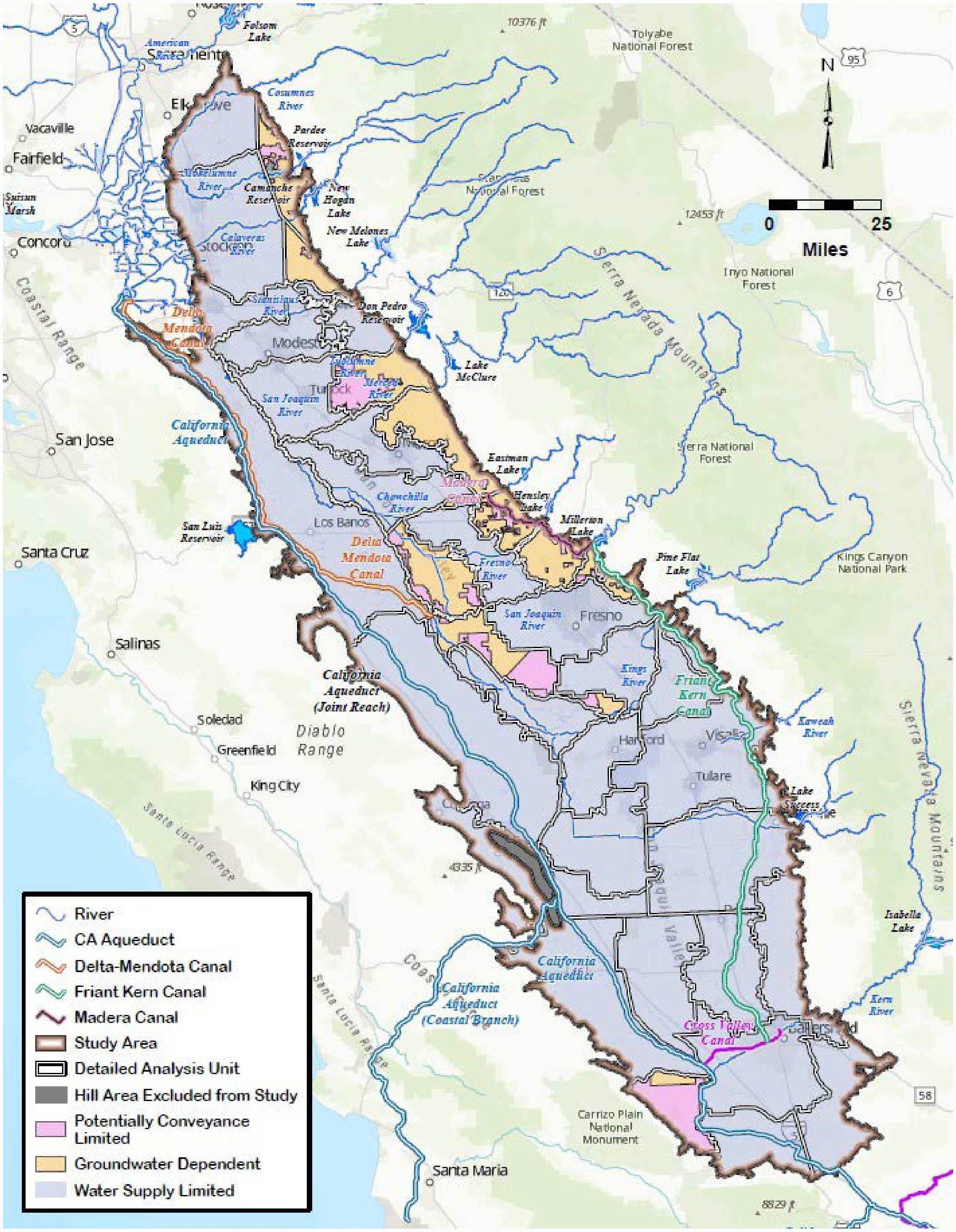
A reconnaissance analysis was performed as part of this study to assess whether surface water deliveries in the San Joaquin Valley were limited by conveyance capacity or by inadequate availability of surface water supplies relative to water demand.

Historical surface water delivery data from DWR's California Water Plan Water Balances Data and groundwater overdraft data from the California Central Valley Simulation Fine Grid (C2VSimFG) Model were used to determine whether surface water deliveries were limited by conveyance capacity or by surface water availability. This was analyzed for 38 detailed analysis units (DAUs) in the San Joaquin Valley.

While areas in the San Joaquin Valley are already losing conveyance capacity due to subsidence, it was important to identify other areas where surface water supplies might be limited by conveyance capacity. Surface water deliveries are a function of water supply availability, conveyance capacity, and demand. If an area has sufficient water supply and demand but lacks conveyance capacity, new or expanded conveyance infrastructure would increase surface water deliveries. However, if an area lacks sufficient water supply availability, new or expanded conveyance would have little value.

Figure ES-3 shows reconnaissance analysis results in a map of water supply-limited areas, and areas with potential conveyance limitations. The figure also includes white areas (identified as groundwater-dependent on the map) that are not part of an irrigation district because they lack surface water supplies and are therefore almost entirely dependent on groundwater for their water supply. Analysis is summarized following the map.

Figure ES-3. Conveyance Needs Assessment Results



As shown in the figure, 29 out of 38 DAUs were assessed to be water supply limited. The remaining nine DAUs were originally assessed as having a potential conveyance limitation. Additional information was gathered in these nine DAUs to better understand the geographic extent of their surface water supplies, conveyance infrastructure, and groundwater pumping to determine whether conveyance improvements or other actions would be most needed to reduce their reliance on groundwater. In six out of nine DAUs, only a small portion of the DAU area had access to surface water, and the remaining portion of the DAU was solely reliant on groundwater supplies. The six DAUs also lacked sufficient surface water supplies needed to benefit from potential new or enhanced conveyance improvements.

Outside of areas impacted by subsidence, the predominant pattern throughout the San Joaquin Valley is that surface water deliveries are not limited by conveyance capacity, but are most often limited by insufficient surface water supplies relative to demand. San Joaquin Valley conveyance facilities are infrequently being filled to their maximum capacity (except for conveyance facilities impacted by subsidence).

Water transfers generally take place in dry and critical years and are not limited by conveyance capacity, but are influenced by availability of transferable waters and regulatory approvals.

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Acronyms and Abbreviations

Term	Abbreviation
Banks Pumping Plant	Harvey O. Banks Pumping Plant
C2VSimFG	California Central Valley Simulation Fine Grid
CVP	Central Valley Project
DAU	detailed analysis units
Delta	Sacramento–San Joaquin Delta
DWR	California Department of Water Resources
FIRO	forecast-informed reservoir operations
Flood-MAR	flood-managed aquifer recharge
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
I-FIRM	Integrated Forecast-Informed Resources Management
Jones Pumping Plant	C.W. Bill Jones Pumping Plant
MAF	million acre-feet
Reclamation	U.S. Bureau of Reclamation
SGMA	Sustainable Groundwater Management Act
SWP	State Water Project
SWRCB	California State Water Resources Control Board
TAF	thousand acre-feet

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1 Introduction

This San Joaquin Valley Conveyance Study analyzes water conveyance needs in the San Joaquin Valley.

1.1 Purpose

The purpose of this San Joaquin Valley Conveyance Study is to:

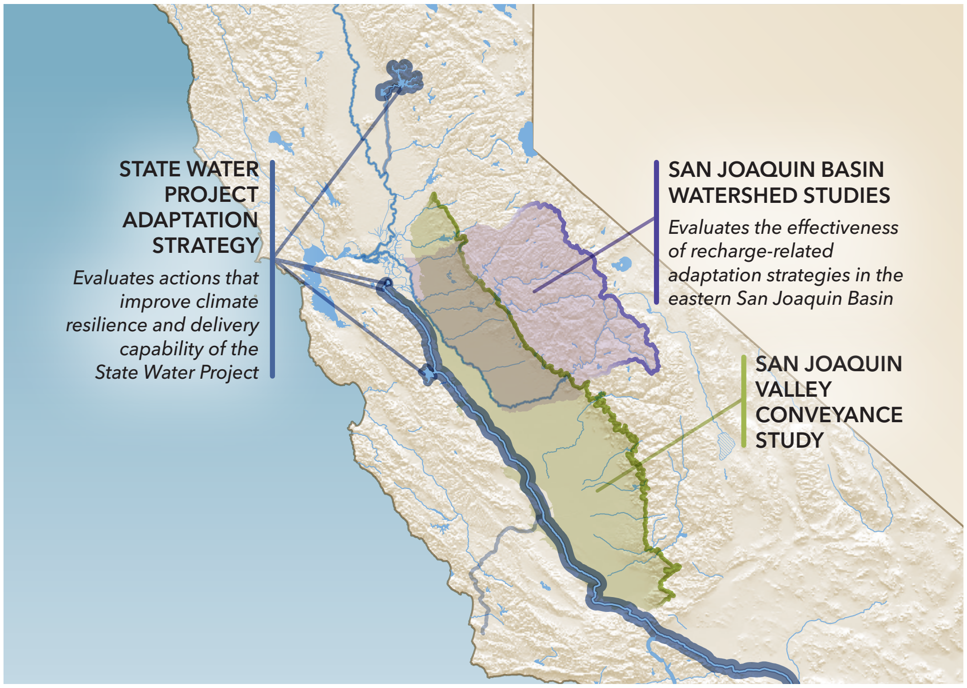
- Describe the impacts of subsidence on San Joaquin Valley conveyance facilities.
- Evaluate the need for improved or expanded conveyance facilities throughout the San Joaquin Valley.

This San Joaquin Valley Conveyance Study also supports Water Resilience Portfolio Action 19.3, "Conduct a feasibility analysis for improved and expanded capacity of federal, State, and local conveyance facilities to enhance water transfers and water markets. The analysis must incorporate climate change projections of hydrologic conditions." The Water Resilience Portfolio is a blueprint for helping California address the impacts of future climate change while addressing long-standing challenges that include declining fish populations, over-reliance on groundwater and a lack of safe drinking water in many communities.

1.2 Related Studies

This San Joaquin Valley Conveyance Study is related to two other foundational studies: the *State Water Project Adaptation Strategy: Reducing Vulnerabilities to Climate Change* (Adaptation Strategy) and the *San Joaquin Basin Flood-MAR Watershed Studies* (Watershed Studies) (California Department of Water Resources [DWR] in prep) (Figure 1-1). These foundational studies are described below.

Figure 1-1. Related Studies to the San Joaquin Valley Conveyance Study



1.2.1 State Water Project Adaptation Strategy

The State Water Project (SWP) Adaptation Strategy presents a forward-looking roadmap for adapting the SWP to the challenges posed by a changing climate. It evaluates 17 different adaptation strategies and quantitatively evaluates five major projects under future climate change. The SWP Adaptation Strategy found that:

- Continued maintenance and additional restoration of the infrastructure system—including repairing subsidence-damaged sections of the California Aqueduct—are first-priority measures.
- The Delta Conveyance Project, among evaluated strategies, is the single most effective strategy on its own, but also amplifies the impact of other strategies, making it the first adaptation priority.
- Forecast-informed reservoir operations (FIRO) at Oroville Dam is a safe and effective strategy that provides an increase in water supply at low cost and with few drawbacks.
- Additional south-of-Delta storage (whether groundwater or surface water) is a promising strategy, especially when paired with the Delta Conveyance Project, to capture surplus water that cannot be stored within San Luis Reservoir.
- A portfolio of strategies resulted in greater adaptation than the sum of its individual parts because each strategy provided unique benefits.

1.2.2 San Joaquin Basin Flood-MAR Watershed Studies

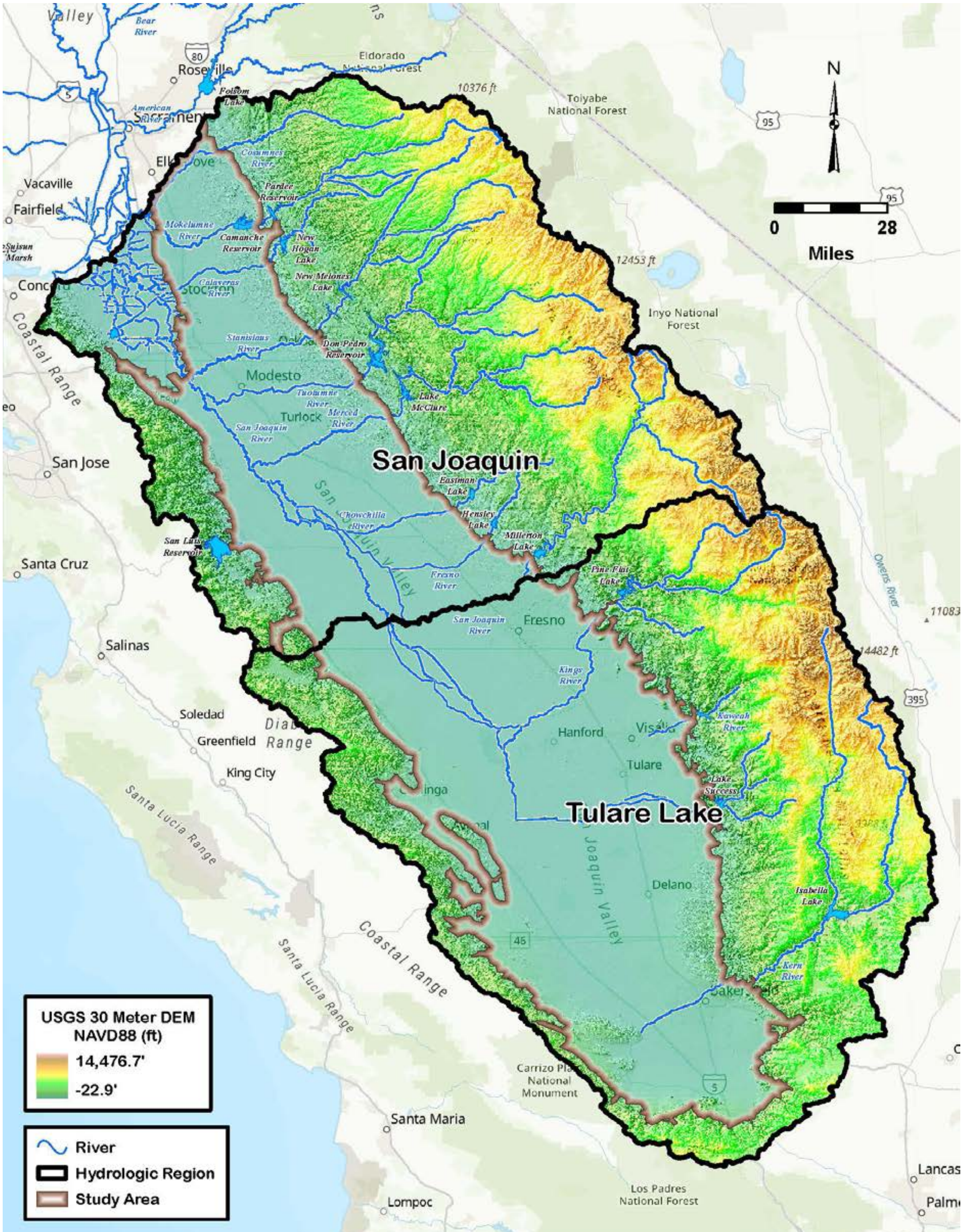
The Watershed Studies evaluated the effectiveness of groundwater recharge-related adaptation strategies in five eastern tributary watersheds of the San Joaquin Basin, including the Calaveras, Stanislaus, Tuolumne, Merced, and Upper San Joaquin watersheds. Two adaptation strategies evaluated were 1) recharge of available high flows, and 2) combining FIRO and flood-managed aquifer recharge (Flood-MAR) at each major reservoir to provide water supply, flood management, groundwater, and ecosystem benefits. The Watershed Studies found that:

- Climate change will increase stress on water supplies, flood risk, and ecosystems and cause increased reliance on already-stressed groundwater basins.
- FIRO creates operational flexibility, allowing the reservoir to safely capture and temporarily store high flows that would otherwise be lost.
- A strategy that combines FIRO with Flood-MAR provides transformative benefits to water supply, flood management, and ecosystems. These benefits include:
  - Providing 370 thousand acre-feet (TAF) of average annual applied recharge across all five watersheds.
  - Reducing peak flood flows by 30–60% in the Calaveras, Tuolumne, and Merced watersheds, resulting in more than a 36,000-cubic-foot-per-second (cfs) reduction in peak flood flows in the San Joaquin River at Vernalis.
  - Providing a 100-TAF average increase in groundwater storage per year, resulting in increased groundwater levels.
  - Enhancing instream spawning and rearing salmonid habitat, additional shorebird habitat, and better quality off-channel rearing habitat.

1.3 Study Area

The study area for this San Joaquin Valley Conveyance Study is the San Joaquin Valley, which includes the San Joaquin Hydrologic Region and the Tulare Lake Hydrologic Region. Figure 1-2 is a map of the San Joaquin Valley showing the study area and hydrologic regions.

Figure 1-2. San Joaquin Valley



1.4 Document Organization

This San Joaquin Valley Conveyance Study is organized in the following chapters:

- **Chapter 1: Introduction.** This chapter describes the purpose, study area, related studies, and organization of this San Joaquin Valley Study.
- **Chapter 2: Background.** This chapter provides historical context and some background about water management in the San Joaquin Valley.
- **Chapter 3: Conveyance Capacity Lost Due to Subsidence.** This chapter describes the current and projected future impacts of subsidence on the capacity of major conveyance facilities in the San Joaquin Valley.
- **Chapter 4: San Joaquin Valley Conveyance Needs Assessment.** This chapter includes a reconnaissance assessment to identify potential areas in need of new or improved conveyance facilities.
- **Chapter 5: Findings Summary.** This chapter summarizes key study findings.

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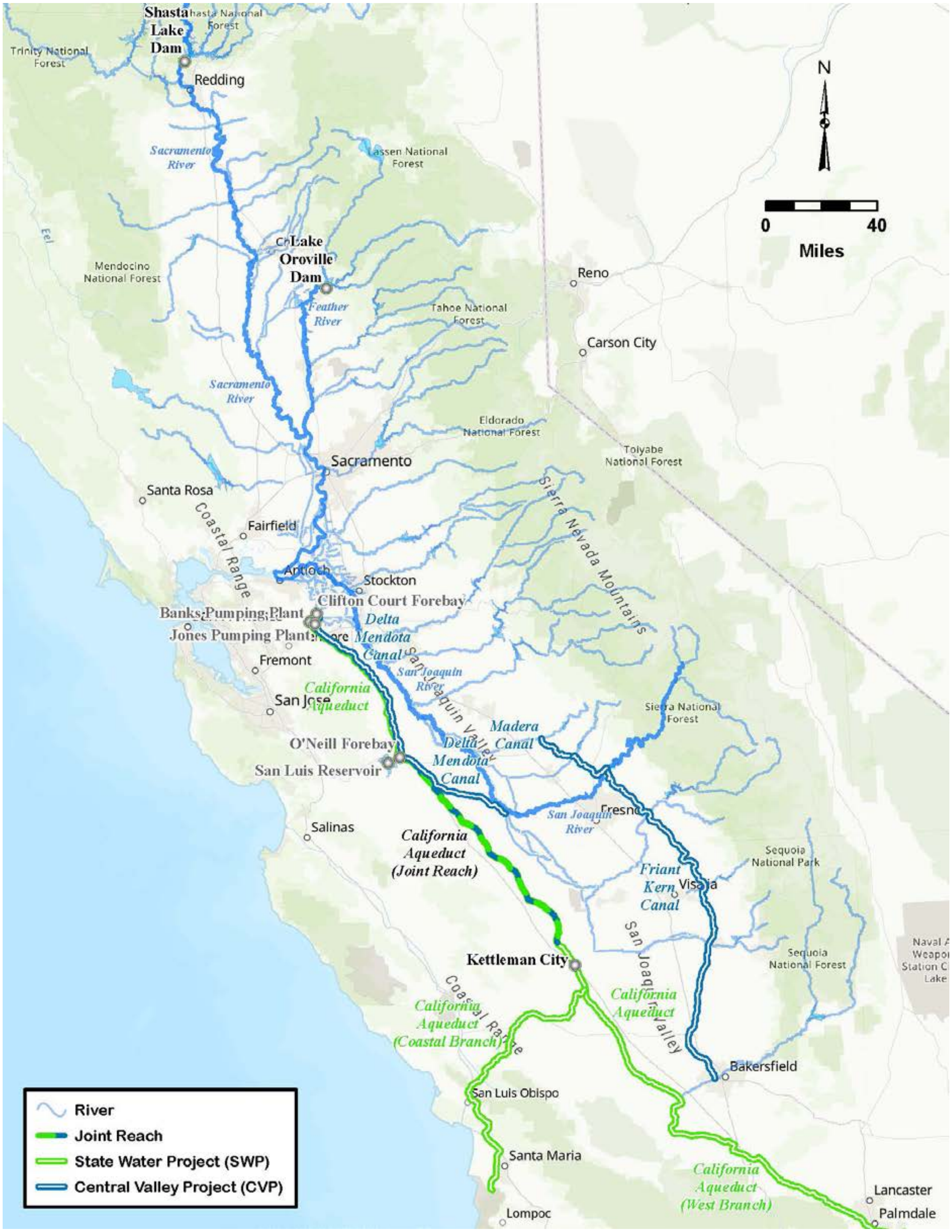
2 Background

California's water system has long been shaped by California's diverse hydrology and water demands. Following the mining boom in the late 1800s, many turned to agriculture, drawn by fertile soils in California's Sacramento and San Joaquin valleys. The two river valleys converge at the Sacramento–San Joaquin Delta (Delta) before flowing into San Francisco Bay. The region's rich soil combined with California's mediterranean climate of mild temperatures and long, dry summers created ideal conditions for agriculture. However, California's climate brings wide variation in precipitation and runoff, with cycles of drought and flooding.

With two-thirds of the state's water in the Sacramento Valley and only one-third in the San Joaquin Valley, uneven water availability, a growing population, and expanding agriculture created the need for new water supply facilities. As early as the 1920s, State water plans documented groundwater declines in some of California's most productive farmland. In response, large-scale infrastructure projects such as the SWP and Central Valley Project (CVP) were developed to provide surface water supplies to many areas of California including the San Joaquin Valley. These projects supported agricultural and urban growth by providing new surface water supplies that reduced dependence on groundwater.

In 1938, the federal government began construction of the CVP with Shasta Dam on the Sacramento River near Redding. Over the next 50 years, the CVP expanded into a network of 20 dams and reservoirs, capable of storing nearly 12 million acre-feet (MAF) of water. A key objective of the CVP's expansion was to address groundwater overdraft in the San Joaquin Valley, particularly through the construction of Friant Dam, the Friant-Kern Canal, and the Madera Canal, which divert flows from the San Joaquin River on the eastside of the San Joaquin Valley. Diversions from the Upper San Joaquin River impacted farmers on the west side of the San Joaquin Valley, who relied on lower San Joaquin River flows downstream. To compensate, these farmers agreed to an exchange contract, whereby they receive a distribution of Sacramento River water in "exchange" for San Joaquin River water. The 116-mile-long Delta-Mendota Canal was built to convey this exchange water and additional agricultural water supply from the Delta near Tracy to the west side of the San Joaquin Valley at Mendota Pool. Figure 2-1 is a map of the SWP and the CVP.

Figure 2-1. State Water Project and Central Valley Project



In 1961, California began construction of the SWP. The 3.5-MAF Lake Oroville reservoir, and the 2-MAF San Luis Reservoir were both constructed in 1967. Lake Oroville is the main structure that captures and stores runoff from the Sierra Nevada mountains to supply the SWP system. San Luis Reservoir was built for joint use by the SWP and federal CVP to store surplus flows pumped from the Delta. In 1968, the Harvey O. Banks Pumping Plant (Banks Pumping Plant) was completed, which is the starting point of the 400-mile California Aqueduct. The California Aqueduct connects to San Luis Reservoir, conveys water to the San Joaquin Valley, the Central Coast, and then conveys water further south to Southern California. The SWP is owned and operated by DWR but is primarily funded by 29 urban and agricultural water agencies who receive water from the project. Known as the SWP contractors, these contractors finance the project's operation and maintenance, capital improvements, environmental mitigation projects, and the repayment of bond issuances.

Surface water supplies from the SWP and the CVP supported a booming agricultural economy. However, agricultural and urban development highly altered the natural environment, leading to degraded habitat quantity and quality and the decline of many native species. Over the years, societal values shifted toward environmental preservation as evidenced by the passage of landmark environmental laws like the federal Endangered Species Act, the California Endangered Species Act, and the Central Valley Project Improvement Act. Since the early 1990s, the identification and listing of water-dependent species in the Delta has had a driving influence on operations of the SWP and the CVP.

The source of surface water supplies varies significantly across the San Joaquin Valley. On the eastern side of the San Joaquin Hydrologic Region, local tributaries and associated reservoirs provide most of the surface supply, while the western side of the San Joaquin River and the Tulare Hydrologic Region rely more heavily on imported water delivered from the Delta through the SWP and the CVP.

In recent decades, persistent droughts, regulatory changes, and increased agricultural demands have constrained surface water availability. The amount of imported water from the SWP and CVP has declined since the mid-1990s due in part to changing regulatory requirements on Delta outflow, Delta pumping, and water quality. Additionally, agricultural demands in the San Joaquin Valley have increased with conversion of annual crops (e.g., tomatoes, beans, corn) to permanent crops (e.g., almonds, citrus, walnuts, and similar) as shown in Figure 2-2. This further exacerbates differences between surface water availability and agricultural water demand. With annual demands consistently exceeding available surface water supply, groundwater pumping has been used to bridge the gap, leading to widespread groundwater overdraft.

Figure 2-2. Irrigated Crop Acres by Type vs. Agricultural Groundwater Use in San Joaquin Valley (Water Years 2002–2021)

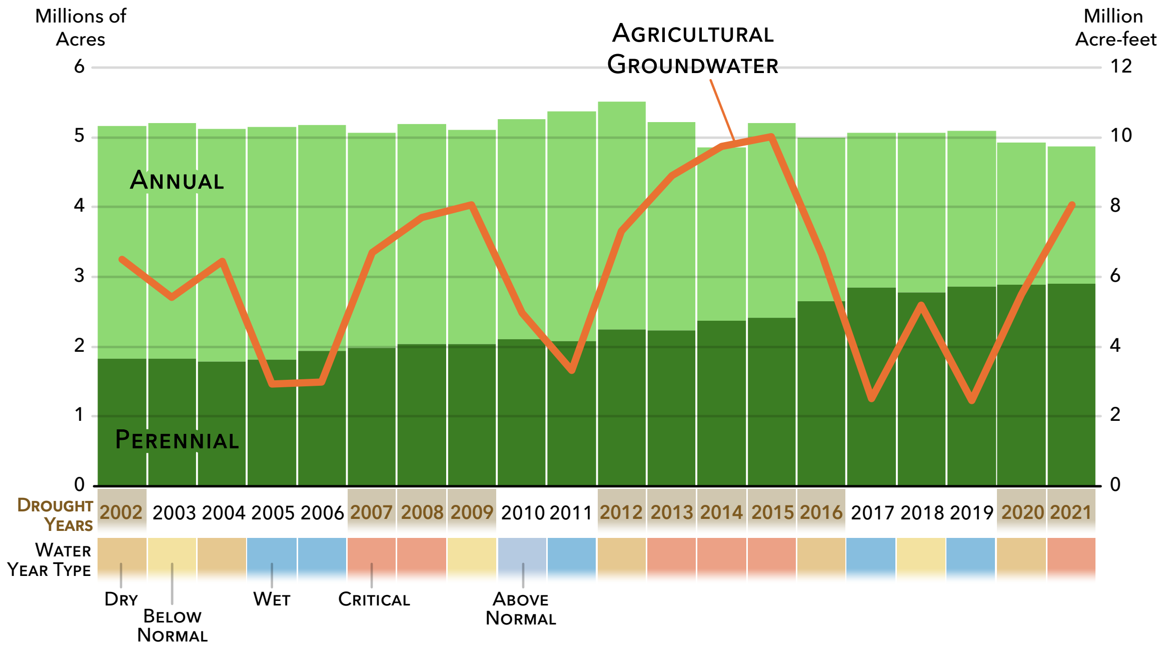
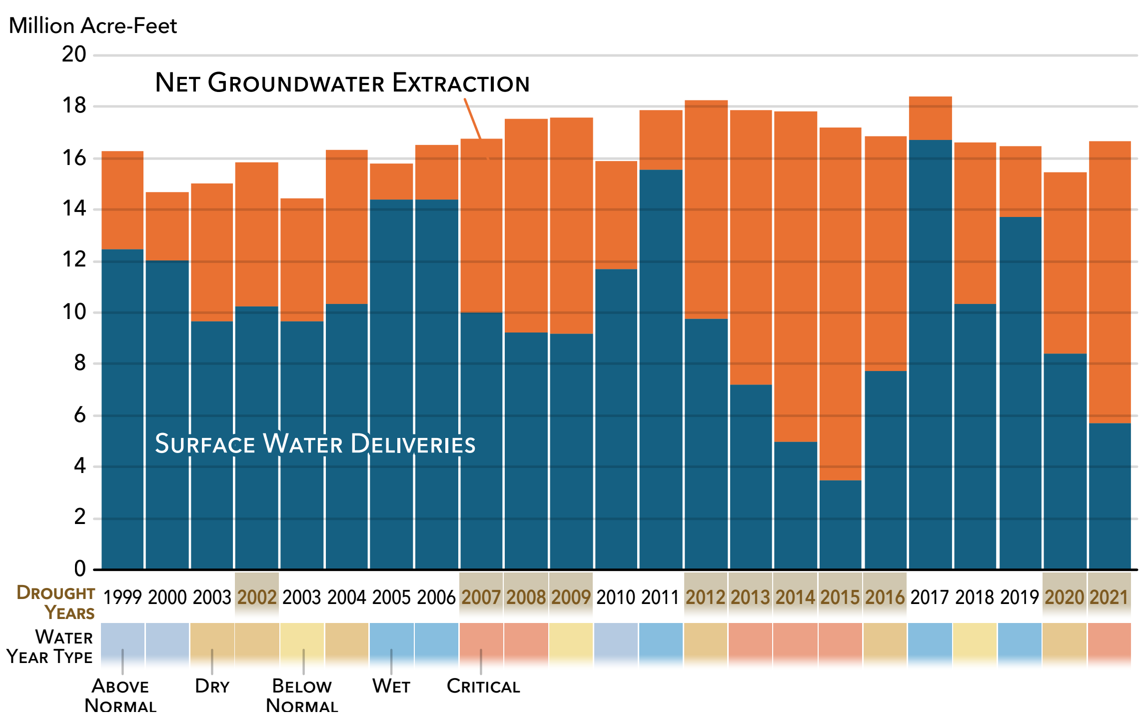


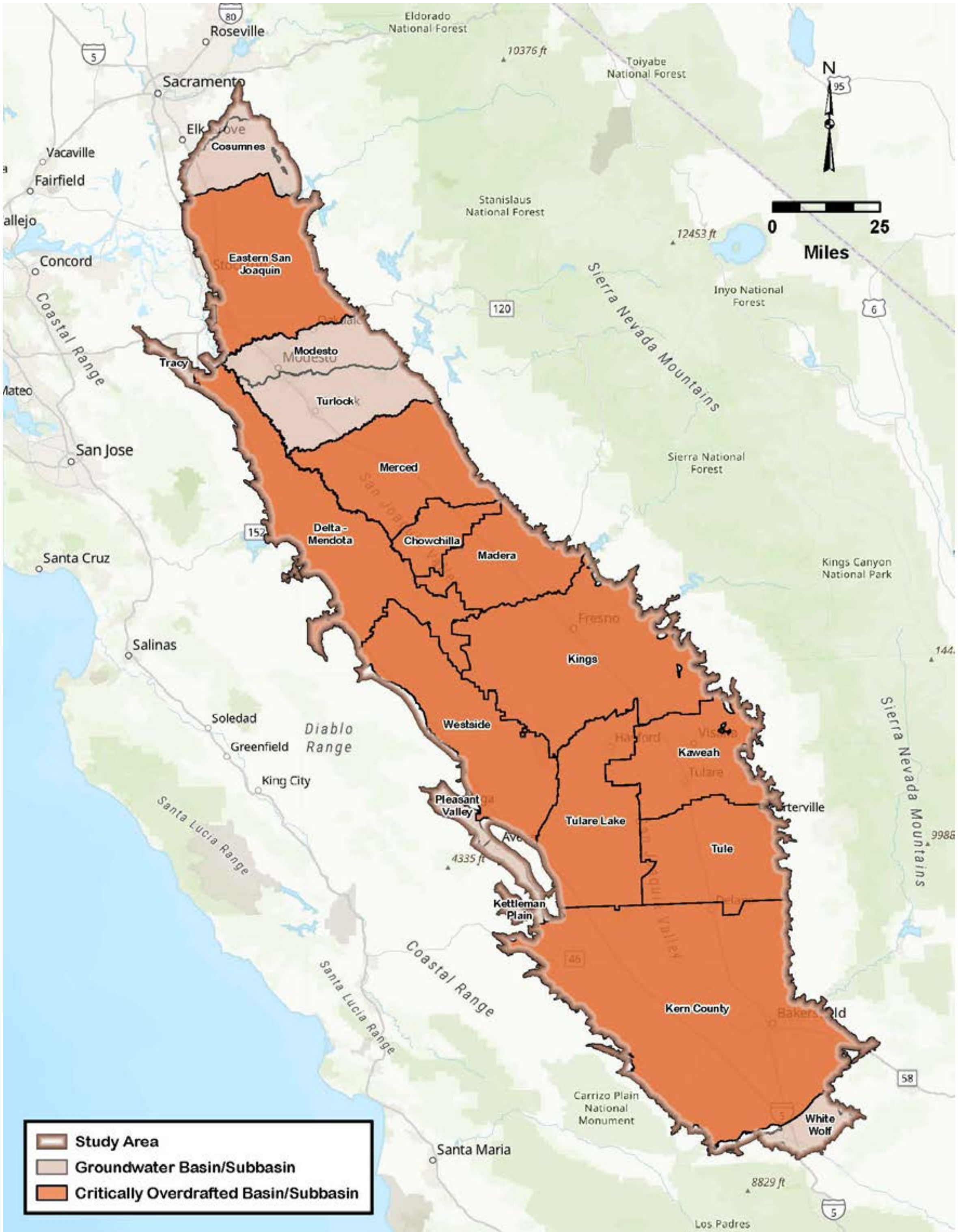
Figure 2-3 shows annual surface water deliveries and groundwater pumping in the San Joaquin Valley. Surface water deliveries vary widely by water year type, and groundwater pumping is used to meet the remaining water demand. As a result of continued groundwater pumping, groundwater levels have declined for decades, and many areas are now critically overdrafted.

Figure 2-3. Surface Water Deliveries and Net Groundwater Extraction in San Joaquin Valley



The San Joaquin Valley has the largest imbalance between groundwater pumping and replenishment in the state. Figure 2-4 shows that 11 of 15 groundwater basins in the San Joaquin Valley are critically overdrafted groundwater basins as defined by DWR.

Figure 2-4. Critically Overdrafted Groundwater Basins



Total groundwater overdraft in the San Joaquin Valley ranges from 1.5 MAF per year to 2.1 MAF per year. During droughts, the valley experiences sharp declines in groundwater storage followed by marginal recovery in wet years. For example, during the 2012–2016 drought, groundwater storage overdraft ranged from 19.1 to 27.2 MAF. Post-drought recovery between 2017 and 2019 ranged from 2.2 to 5.8 MAF (Alam et al. 2021) with an average recovery percentage below 20%.

In 2014, the Sustainable Groundwater Management Act (SGMA) established a statewide framework to protect and sustainably manage groundwater resources. SGMA requires local agencies to create Groundwater Sustainability Agencies (GSAs) and develop Groundwater Sustainability Plans (GSPs) for medium- to high-priority basins, ensuring a balance between groundwater extraction and recharge. With climate change and prolonged droughts posing ongoing risks, SGMA provides a long-term strategic framework to ensure groundwater remains a reliable resource for California's future by mandating sustainable management at the local level.

Under SGMA, local GSAs must create long-term plans to achieve sustainable groundwater management. These plans must assess historical, current, and projected water demands and supplies as codified in Water Code Section 10727.2[a][3], incorporating water budgets to guide decision-making.

SGMA mandates that GSPs must prevent locally defined significant and unreasonable effects of six key undesirable outcomes:

- Chronic declines in groundwater levels
- Reductions in storage
- Seawater intrusion
- Water quality degradation
- Land subsidence
- Depletion of interconnected surface waters

SGMA requires that groundwater sustainability must be achieved by 2040 for critically overdrafted basins, and by 2042 for all other high- and medium-priority basins. SGMA compliance in the San Joaquin Valley will require a combination of water supply increases and strategic demand management to bring groundwater basins into long-term sustainability. Demand management involves the repurposing or fallowing of farmland, which can cause significant consequences to local agricultural economies.

Climate change is further constraining water supplies and increasing flood risk in the San Joaquin Valley. Climate change shifts runoff events to earlier in the winter and spring, intensifying winter storms, reducing spring snowmelt runoff, and prolonging dry periods. These climate shifts are compressing the water year into shorter, more volatile periods, transforming precipitation patterns from the gradual, manageable releases of snowmelt to rapid, overwhelming winter runoff events. Flood risk in the high-elevation, snow-dominated watersheds of the San Joaquin Valley is expected to increase with warmer weather that intensifies rainfall-driven events and causes more rapid snowmelt. Climate change could reduce SWP deliveries by as much as 25% within the next 20 years—without considering reductions related to canals damaged by subsidence. These factors will put increased stress on multi-purpose water infrastructure and widen the gap between available water supplies and water demands in the San Joaquin Valley.

3 Conveyance Capacity Lost Due to Subsidence

Subsidence in California has resulted in billions of dollars of impacts on water conveyance, flood management, transportation infrastructure, and groundwater wells (Borchers et al. 2014). Decades of groundwater extraction have caused widespread groundwater level declines. Groundwater level declines cause sediment compaction and lowering of land elevations that are permanent and irreversible. Figure 3-1 shows cumulative land subsidence from Water Years 2015–2025 in the San Joaquin Valley.

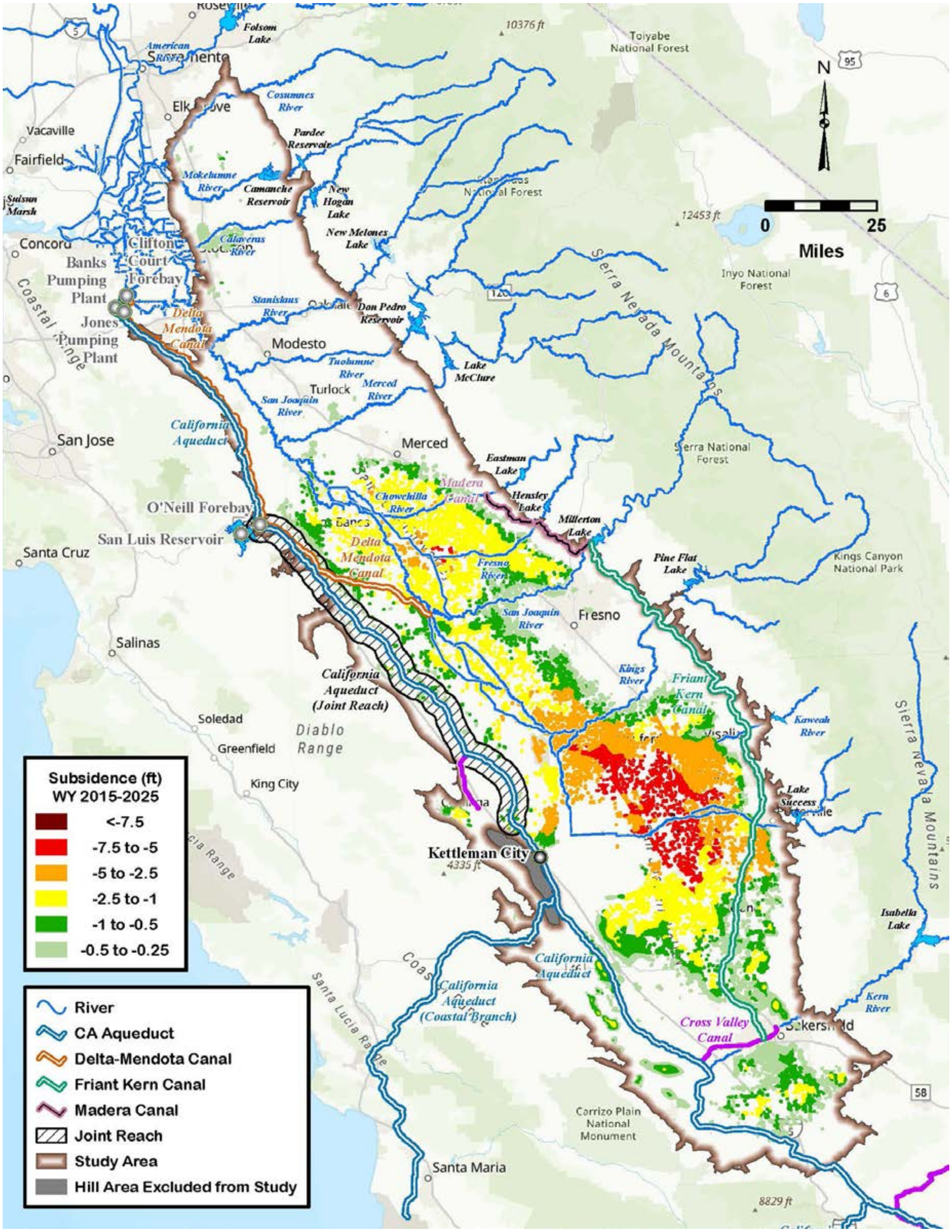
Subsidence reduces conveyance capacity by:

- Flattening slopes, as gravity-fed canals rely on precise gradients and subsidence creates low points that slow water movement.
- Damaging infrastructure, as sinking cracks or misaligns canals, reducing capacity.
- Increasing maintenance, as repairs, sediment removal, and realignment are needed to restore function.
- Causing flooding and seepage, as uneven canal beds lead to water loss and localized overflow.

These impacts diminish conveyance reliability, requiring costly interventions to sustain water deliveries.

Critical components of California's conveyance infrastructure such as the California Aqueduct, San Luis Canal, Delta-Mendota Canal, and Friant-Kern Canal are already experiencing reductions in conveyance capacity due to subsidence. In addition to these SWP and CVP conveyance facilities, subsidence is also impacting many local conveyance facilities. If subsidence continues at rates consistent with the last 10 years, it will have catastrophic effects on the ability to supply water to support California's economy.

Figure 3-1. Cumulative Land Subsidence over 10 Years (Water Years 2015–2025)



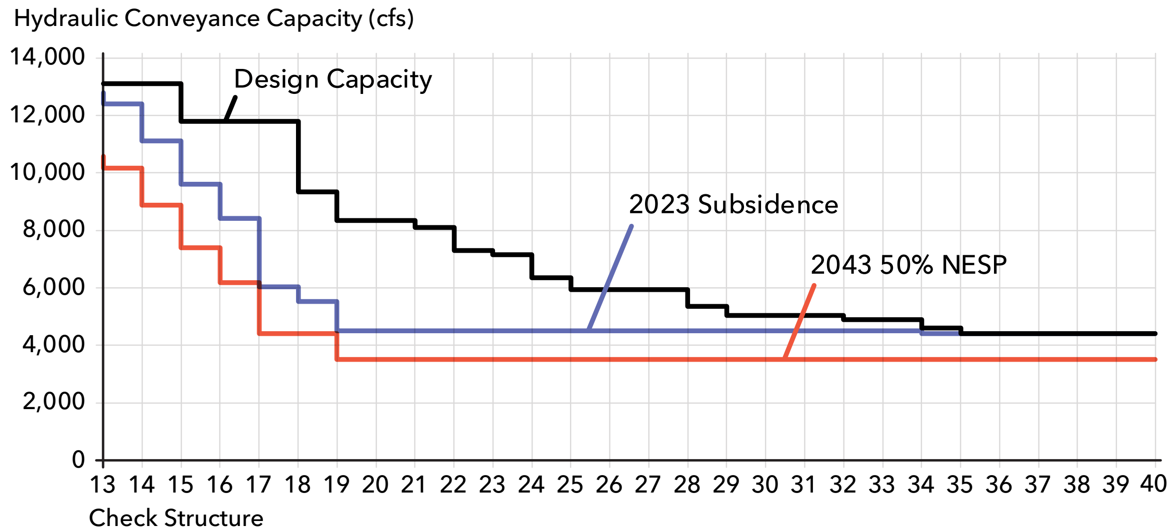
3.1 California Aqueduct and San Luis Canal

The California Aqueduct is a key feature of the SWP. The Banks Pumping Plant exports water from the Delta at the Clifton Court Forebay to the California Aqueduct. Water flows south into the San Luis Joint-Use Complex, which was designed and constructed by the federal government and is operated and maintained by DWR. The San Luis Canal extends 102.5 miles from O'Neill Forebay near Los Banos in a southeasterly direction to a point west of Kettleman City. The principal purpose of the CVP portion of the facility is to provide approximately 1.25 MAF of water as a supplemental irrigation supply to roughly 600,000 acres located in the western portion of Fresno, Kings, and Merced counties. After Kettleman City, the California Aqueduct conveys SWP water to serve Kern County, San Luis Obispo, Santa Barbara and Southern California. The California Aqueduct/San Luis Canal is a 100% concrete-lined canal with an original design capacity ranging from 13,100 cfs at the upstream end and 8,350 cfs at the downstream end.

Subsidence has lowered portions of the San Luis Canal and California Aqueduct and impacted conveyance capacity. Some sections of the San Luis Canal have experienced subsidence greater than 8 feet since it was constructed in 1968. Major remediations to the California Aqueduct occurred in 1989, 1996 and 2021; major remediations to the San Luis Canal occurred in 1970, 1982, and 2018 (DWR 2023a). DWR's *State Water Project Delivery Capability Report 2023 Addendum: Impacts of Subsidence* found that 2023 levels of subsidence have resulted in a 44% reduction in California Aqueduct capacity and a 46% reduction in San Luis Canal capacity. As a result of subsidence, both the California Aqueduct and the San Luis Canal are no longer able to convey original design flows or make deliveries to certain users if operated in accordance with the original operating criteria (i.e., freeboard).

Figure 3-2 shows the hydraulic conveyance capacity of the California Aqueduct under a 2043 future scenario that includes a moderate level of climate change and the continuation of a modest portion of the historical rates of subsidence. Without additional operational adaptations or infrastructure improvements, the SWP's long-term average delivery capability could be reduced by as much as 87% in the next 20 years due to the combined effects of the continuation of moderate historical rates of subsidence and climate change. Results show decreased average annual SWP deliveries ranging from 400 TAF to 1.8 MAF. Impacts to conveyance are greatest during months in which the San Luis Canal and the California Aqueduct would typically operate at or near their design capacity. Failure to halt subsidence and fix canal chokepoints limit the State's ability to move water into surface or groundwater storage in wet years and cuts into supplies the state needs to endure dry years. The SWP Adaptation Strategy found that, if subsidence continues without remediation or aqueduct upgrades, the California Aqueduct would no longer be able to convey water south of southern Fresno County before 2085.

Figure 3-2. California Aqueduct Hydraulic Conveyance Capacity under 2043 50% Level of Concern Climate Change Conditions

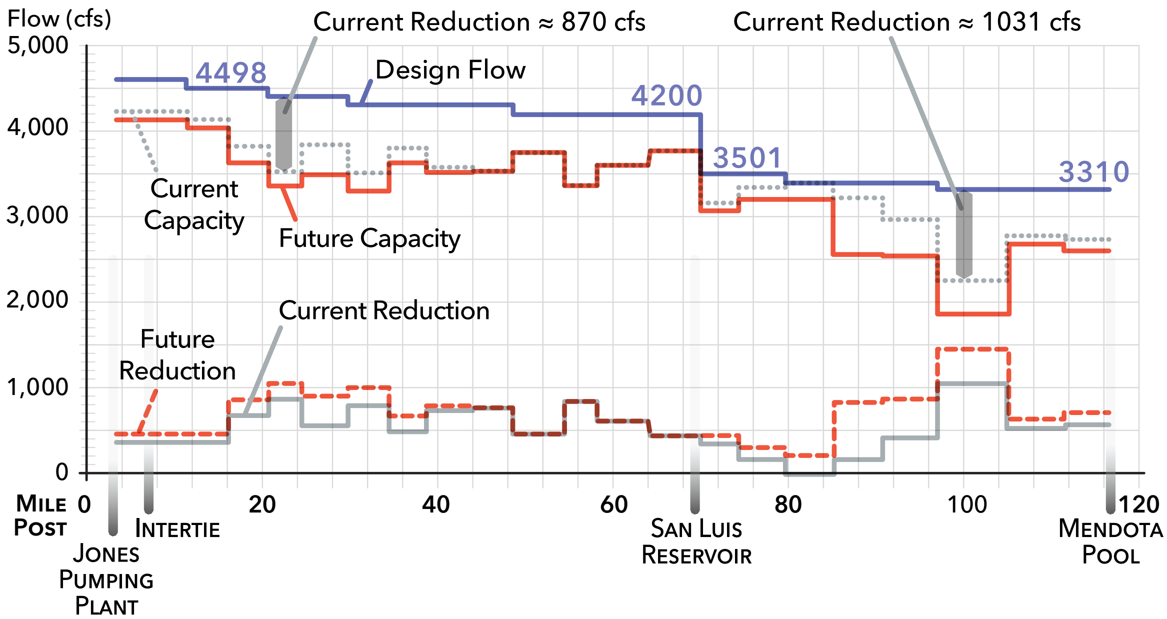


Note: NESP = non-exceedance subsidence percentile

3.2 Delta-Mendota Canal

The Delta-Mendota Canal is one of the major components of the CVP. The original design capacity of the Delta-Mendota Canal is 4,600 cfs at the upstream end and 3,210 cfs at the downstream end. Since its construction, the Delta-Mendota Canal has been impacted by subsidence from groundwater pumping. In 1969 and 1977, the U.S. Bureau of Reclamation (Reclamation) remediated the canal for subsidence issues. However, subsidence has continued, and the Delta-Mendota Canal is no longer able to convey original design flows while operating in accordance with Reclamation's safety standards and guidelines (Reclamation et al. 2023). These limits on conveyance capacity have introduced operational constraints that can affect deliveries to south-of-Delta CVP contractors. Figure 3-3 shows design flows and actual flow capacities in the Delta-Mendota Canal for current conditions and with projected 2070 subsidence conditions (Reclamation and San Luis and Delta-Mendota Water Authority 2023). Upper Delta-Mendota Canal capacity has reduced by approximately 870 cfs (a 20% reduction) and lower Delta-Mendota Canal capacity has reduced by approximately 1,031 cfs (a 30% reduction). A future 2070 subsidence condition, which was included as the No Action Alternative in the *Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study* (Reclamation et al. 2023) resulted in a 44% reduction in canal capacity compared to design capacity.

Figure 3-3. Delta-Mendota Canal Design and Actual Flow Capacities for Current and Future 2070 Subsidence Conditions



3.3 Friant-Kern Canal

The Friant-Kern Canal conveys water supplies stored in Millerton Lake from the San Joaquin River to water districts in Fresno, Tulare, and Kern counties. The canal extends 152 miles south from Friant Dam in Fresno County to the Kern River in Kern County 4 miles west of Bakersfield. The canal was constructed with an initial diversion capacity of 5,300 cfs, which gradually decreases to 2,500 cfs at its terminus. Almost 85% of the canal is concrete-lined.

Original design assumptions regarding the canal's roughness were found to be inaccurate shortly after construction. As a result, the Friant-Kern Canal operating capacity is less than designed. Capacity has been further reduced by additional canal surface roughness due to age, vegetation in canal sections, changes in water delivery patterns, localized seepage through embankments, and regional land subsidence. Some sections of the canal have experienced subsidence greater than 10 feet since it was constructed in 1951. In the 1970s and 1980s, Reclamation made repairs to segments of the Friant-Kern Canal to address conveyance capacity restrictions that had resulted from subsidence (Reclamation 2020).

Friant-Kern Canal's diminished capacity resulted in up to 300 TAF of reduced water deliveries in 2017. Some sections are experiencing a reduction of up to 60% from design capacity (Friant Water Authority 2025). The capacity reduction causes the water surface to encroach on the operating freeboard, and at times, to approach the top of the existing concrete liner. Operating canals at reduced freeboard increases seepage, which can damage the liner and increase risk of embankment failure. Higher water surface elevations can also adversely affect bridges, utilities, and other infrastructure. During wet years, reduced Friant-Kern Canal capacity limits the delivery of surface water supplies that could be used for groundwater recharge, thereby causing an even greater reliance on limited groundwater supplies.

The **Friant-Kern Canal Middle Reach Capacity Correction Project**, in the *Final Environmental Impact Statement/Environmental Impact Report* included a No Action Alternative in which continued subsidence would further sink the canal approximately 9.5 feet below current elevations at the most severe location and further reduce Friant-Kern Canal capacity. This would result in reduced CVP deliveries by nearly 180 TAF annually by 2070.

3.4 Addressing Subsidence

The top conveyance priority in the San Joaquin Valley is to minimize or stop subsidence impacts, especially near SWP and CVP main conveyance facilities. The key to minimizing ongoing subsidence and avoiding future subsidence is a recovery of groundwater levels to elevations above critical head as high and as quickly as possible. Critical head is the groundwater level in fine-grained sediments below which permanent compaction, and therefore subsidence, will occur. All of these facilities have ongoing subsidence repairs that are planned or are being implemented to restore lost conveyance capacity as a result of subsidence. Minimizing further subsidence by raising groundwater levels above critical head is needed to sustain lasting value from these repairs that will restore lost conveyance capacity.

Best management practices for identifying critical head elevations and managing subsidence are included in DWR's *DRAFT Best Management Practices of the Sustainable Management of Groundwater: Land Subsidence* (DWR 2025). GSAs are tasked with establishing subsidence monitoring, identifying affected or at-risk infrastructure, and refining subsidence sustainable management criteria. Successful SGMA implementation will play a major role in creating sustainable groundwater levels needed to minimize future subsidence.

4 San Joaquin Valley Conveyance Needs Assessment

While areas in the San Joaquin Valley are already losing conveyance capacity due to subsidence, it was important for the purposes of this study to identify other areas where surface water supplies might be limited by conveyance capacity. Surface water deliveries are a function of water supply availability, conveyance capacity, and demand. If an area has sufficient water supply and demand but lacks conveyance capacity, new or expanded conveyance infrastructure would increase surface water deliveries. However, if an area lacks sufficient water supply availability, new or expanded conveyance would have little value.

A reconnaissance analysis was performed to assess whether surface water deliveries in the San Joaquin Valley were limited by conveyance capacity or by inadequate availability of surface water supplies relative to water demand.

4.1 Approach

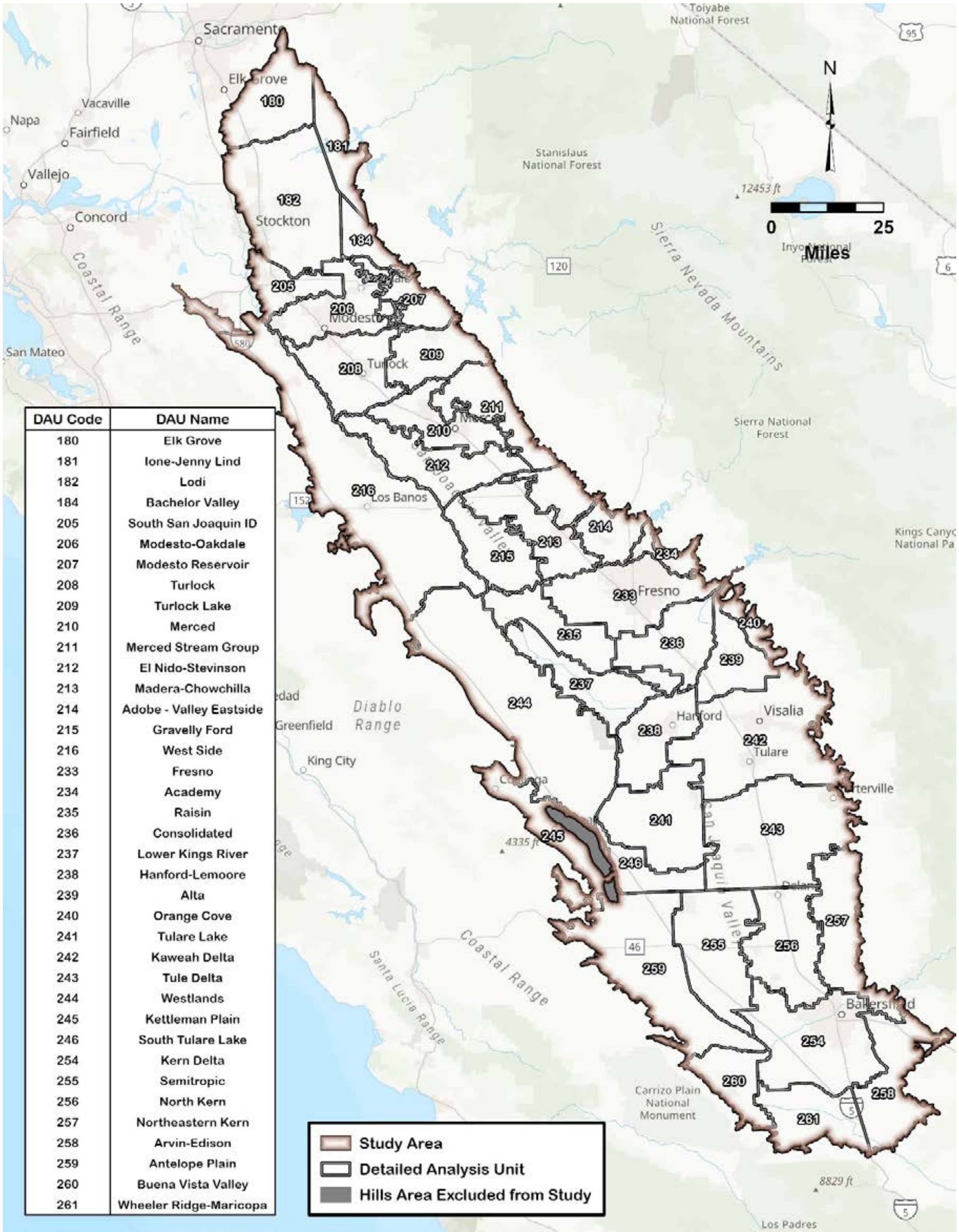
Historical surface water delivery data from DWR's California Water Plan Water Balances Data and groundwater overdraft data from the California Central Valley Simulation Fine Grid (C2VSimFG) Model were used to determine whether surface water deliveries were limited by conveyance capacity or by surface water availability. This was analyzed for 38 detailed analysis units (DAUs) in the San Joaquin Valley, as shown in Figure 4-1.

The maximum annual surface water supply delivered from 2002 through 2015 was used as a proxy for existing conveyance capacity.[1] Using maximum annual surface water supply delivered as a proxy for existing conveyance capacity is most applicable for conveyance facilities that were not greatly impacted by subsidence from 1989 to 2015. This reconnaissance analysis is therefore complementary to the information presented in Chapter 3, which focused on conveyance facilities impacted by subsidence.

Analysis included major conveyance facilities in the San Joaquin Valley and did not focus on local conveyance infrastructure at the individual field scale (e.g., diversions, main canals, or laterals). More-detailed studies that explicitly account for local conveyance infrastructure are needed to identify and evaluate the feasibility of site-specific local conveyance priorities.

[1] Existing conveyance capacity could be greater than maximum historical surface water supplies delivered if factors other than conveyance constrained the maximum historical annual delivery.

Figure 4-1. Map of Detailed Analysis Units



DAU Code	DAU Name
180	Elk Grove
181	Ione-Jenny Lind
182	Lodi
184	Bachelor Valley
205	South San Joaquin ID
206	Modesto-Oakdale
207	Modesto Reservoir
208	Turlock
209	Turlock Lake
210	Merced
211	Merced Stream Group
212	El Nido-Stevinson
213	Madera-Chowchilla
214	Adobe - Valley Eastside
215	Gravelly Ford
216	West Side
233	Fresno
234	Academy
235	Raisin
236	Consolidated
237	Lower Kings River
238	Hanford-Lemoore
239	Alta
240	Orange Cove
241	Tulare Lake
242	Kaweah Delta
243	Tule Delta
244	Westlands
245	Kettleman Plain
246	South Tulare Lake
254	Kern Delta
255	Semitropic
256	North Kern
257	Northeastern Kern
258	Arvin-Edison
259	Antelope Plain
260	Buena Vista Valley
261	Wheeler Ridge-Maricopa

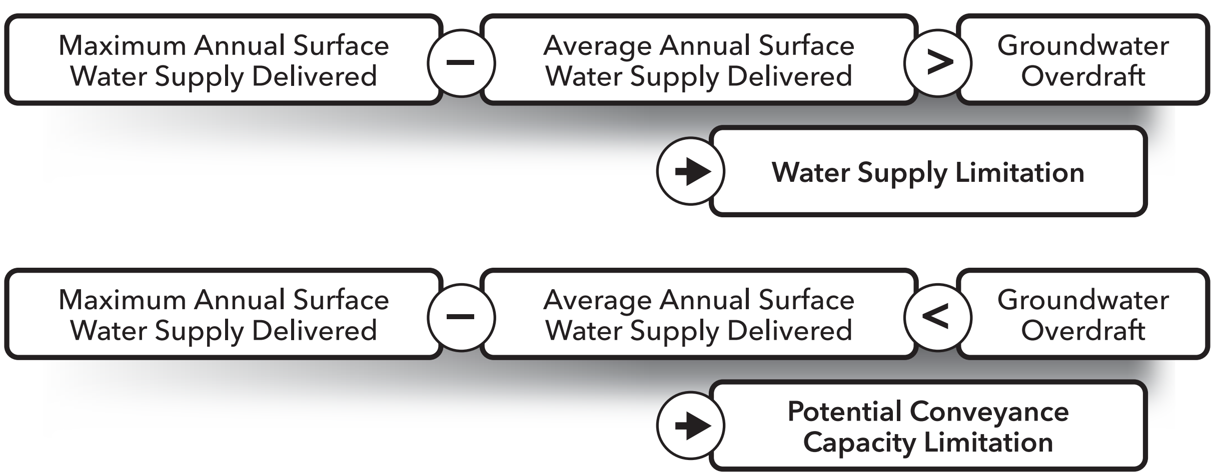
Next, the maximum annual historical surface water supply delivered was compared to the average annual surface water supply delivered (refer to Figure 4-2 for a flow chart of the assessment approach). The difference between these values represents the average "unused" conveyance capacity, an indicator of how much additional water could have been delivered if additional surface water supplies had been available. This average unused conveyance capacity was then compared to groundwater overdraft, which is an indicator for water demand in excess of surface water supplies. When water demand in an area exceeds available surface water supplies, groundwater pumping is used to close the gap.

If the average annual unused conveyance capacity was greater than average groundwater overdraft, then the area was characterized as "surface water supply-limited." The primary constraint in meeting demand is an insufficient quantity of surface water supplies instead of existing conveyance capacity. Existing facilities could theoretically offset groundwater overdraft if additional surface supplies were reliably available.

If average annual unused conveyance capacity was less than average groundwater overdraft, then the area had a potential conveyance capacity limitation and was flagged for additional analysis. Even if conveyance facilities were fully utilized with surface water supplies, they would be insufficient to fully address groundwater overdraft.

Additional analysis determined whether new or enhanced conveyance could help increase surface water deliveries to reduce groundwater overdraft in these DAUs.

Figure 4-2. Reconnaissance Conveyance Assessment Approach



This approach provided a systematic framework for evaluating DAUs and prioritizing where infrastructure improvements could be most beneficial.

4.2 Results

Tables 4-1 and 4-2 present estimates of maximum and average surface water deliveries and net changes in groundwater storage; negative values indicate overdraft. This information was used to identify whether areas were potentially limited by conveyance capacity or by insufficient surface water supplies relative to demand. In many locations, there was a large difference between the maximum surface water delivered and the average surface supply delivered, resulting in a large average unused conveyance capacity.

Table 4-1. Conveyance Assessment Results for the San Joaquin Hydrologic Region

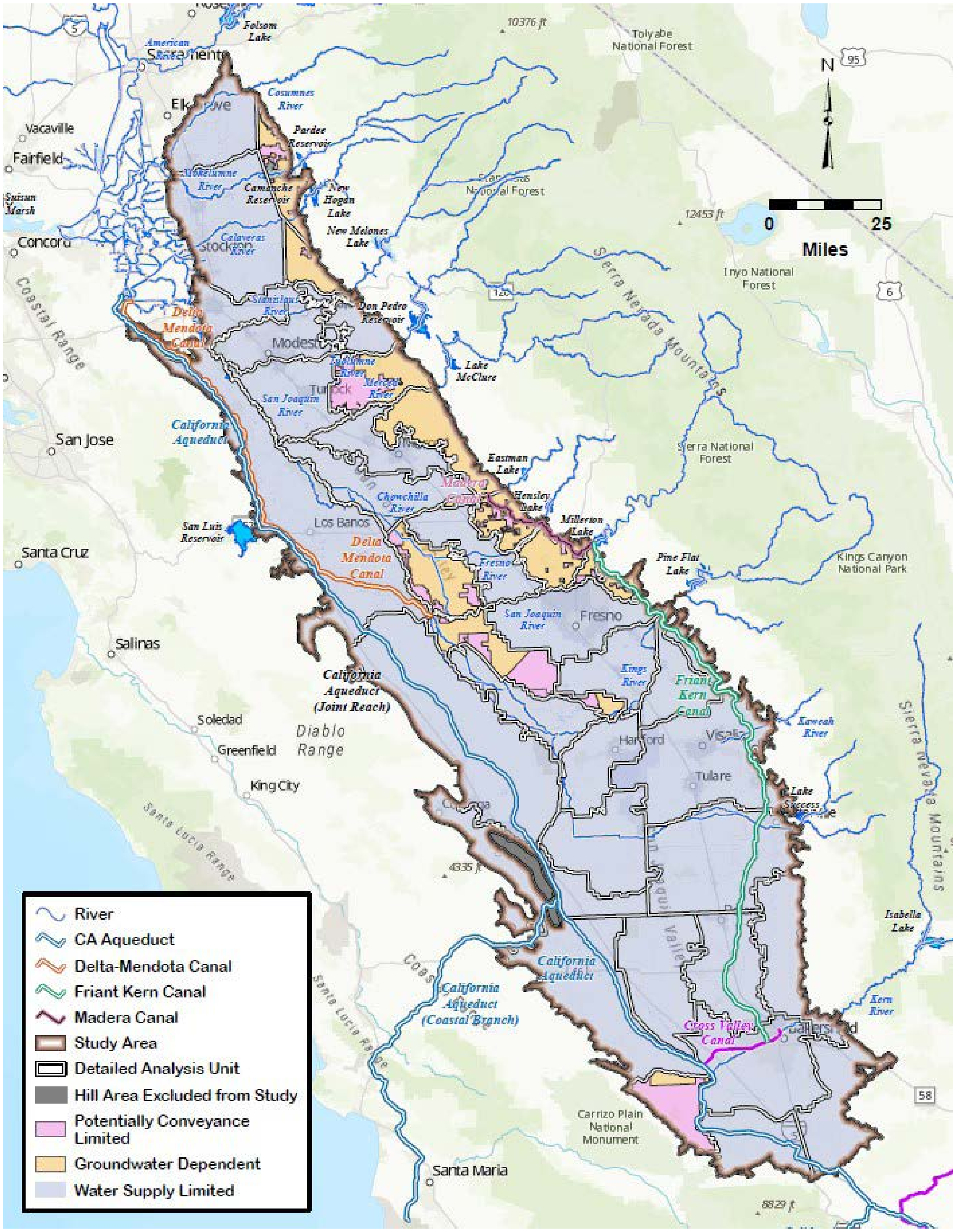
DAU	Maximum Annual Surface Water Supply (acre-feet)	Average Annual Surface Water Supply (acre-feet)	Average Unused Conveyance Capacity (acre-feet)	Groundwater Change in Storage Annual Average (acre-feet)	Water Supply-Limited or Potentially Conveyance-Limited
Adobe-Valley Eastside	8,800	5,964	2,836	(42,669)	Potentially Conveyance-Limited
Bachelor Valley	100	7	93	(5,267)	Potentially Conveyance-Limited
El Nido-Stevinson	177,100	131,764	45,336	(28,229)	Water Supply Limitation
Elk Grove	65,600	46,436	19,164	(6,788)	Water Supply Limitation
Gravelly Ford	74,700	61,786	12,914	(15,043)	Potentially Conveyance-Limited
Ione-Jenny Lind	22,100	16,336	5,764	(9,671)	Potentially Conveyance-Limited
Lodi	524,300	338,143	186,157	(36,438)	Water Supply Limitation
Madera-Chowchilla	415,300	230,357	184,943	(50,438)	Water Supply Limitation
Merced	710,000	435,993	274,007	(40,135)	Water Supply Limitation
Merced Stream Group	6,300	450	5,850	(18,444)	Potentially Conveyance-Limited
Modesto Reservoir	467,800	146,464	321,336	(1,542)	Water Supply Limitation
Modesto-Oakdale	644,400	585,807	58,593	(19,252)	Water Supply Limitation
South San Joaquin Irrigation District	277,200	205,000	72,200	(8,091)	Water Supply Limitation
Turlock	673,200	576,043	97,157	(19,715)	Water Supply Limitation
Turlock Lake	87,400	82,079	5,321	(10,576)	Potentially Conveyance-Limited
West Side	1,669,700	1,319,971	349,729	(102,860)	Water Supply Limitation
Total	**5,824,000**	**4,183,600**	**1,641,400**	**(415,158)**	-

Table 4-2. Conveyance Assessment Results for the Tulare Hydrologic Region

DAU	Maximum Annual Surface Water Supply (acre-feet)	Average Annual Surface Water Supply (acre-feet)	Average Unused Conveyance Capacity (acre-feet)	Groundwater Change in Storage Annual Average (acre-feet)	Water Supply-Limited or Potentially Conveyance-Limited
Academy	12,600	9,400	3,200	(5,337)	Potentially Conveyance-Limited
Alta	244,400	138,207	106,193	(33,093)	Water Supply Limitation
Antelope Plain	412,800	257,450	155,350	(81,042)	Water Supply Limitation
Arvin-Edison	348,600	165,257	183,343	19,526	Water Supply-Limited
Buena Vista Valley	18,000	6,200	11,800	(22,515)	Potentially Conveyance-Limited
Consolidated	538,900	256,421	282,479	(43,585)	Water Supply Limitation
Fresno	774,400	454,000	320,400	(57,648)	Water Supply Limitation
Hanford-Lemoore	216,600	141,536	75,064	(74,966)	Water Supply Limitation
Kaweah Delta	1,005,600	485,771	519,829	(150,834)	Water Supply Limitation
Kern Delta	1,034,400	448,929	585,471	(119,116)	Water Supply Limitation
Kettleman Plain	17,700	10,464	7,236	5,111	Water Supply Limitation
Lower Kings River	393,800	167,650	226,150	(51,704)	Water Supply Limitation
North Kern	720,200	332,786	387,414	(105,213)	Water Supply Limitation
Northeastern Kern	102,600	60,171	42,429	(19,237)	Water Supply Limitation
Orange Cove	43,100	34,200	8,900	(5,961)	Water Supply Limitation
Raisin	72,600	46,450	26,150	(41,403)	Potentially Conveyance-Limited
Semitropic	534,700	251,686	283,014	(47,379)	Water Supply Limitation
South Tulare Lake	61,600	38,600	23,000	(9,000)	Water Supply Limitation
Tulare Lake	435,900	214,979	220,921	(26,586)	Water Supply Limitation
Tule Delta	584,100	357,493	226,607	(148,890)	Water Supply Limitation
Westlands	1,138,300	760,757	377,543	(55,826)	Water Supply Limitation
Wheeler Ridge-Maricopa	139,600	94,771	44,829	4,630	Water Supply Limitation
Total	**8,850,500**	**4,733,179**	**4,117,321**	**(1,070,067)**	-

Figure 4-3 is a map of water supply-limited areas, and areas with potential conveyance limitations. The figure also includes white areas (identified as groundwater-dependent on the map) that are not part of an irrigation district because they lack surface water supplies and are therefore almost entirely dependent on groundwater for their water supply.

Figure 4-3. Conveyance Needs Assessment Results



Outside of areas impacted by subsidence, the predominant pattern throughout the San Joaquin Valley is that surface water deliveries are not limited by conveyance capacity, but are most often limited by insufficient surface water supplies relative to demand. The data show that San Joaquin Valley conveyance facilities included in this analysis are rarely being filled to their maximum capacity (except for conveyance facilities impacted by subsidence). For example, from 2002 to 2015 across all DAUs in the Tulare Basin, annual surface water deliveries reached 95% or more of maximum surface water deliveries in less than 9% of years. In the San Joaquin Basin, this threshold was met in less than 15% of years. Lack of reliable surface water supplies is a greater need in the San Joaquin Valley over new or expanded conveyance improvements.

Nine DAUs had an average unused conveyance capacity that was less than their annual groundwater overdraft, and were therefore identified as potentially conveyance-limited. Additional information was gathered in these areas to better understand the geographic extent of their surface water supplies, conveyance infrastructure, and groundwater pumping to determine whether conveyance improvements or other actions would be most needed to reduce their reliance on groundwater.

In six out of nine DAUs, only a small portion of the DAU area had access to surface water, and the remaining portion of the DAU was solely reliant on groundwater supplies. This explains why groundwater overdraft exceeded unused conveyance capacity in these DAUs. Only one of nine DAUs was identified to potentially benefit from conveyance improvements (Turlock Lake) and in one other DAU (Buena Vista Valley) there is insufficient information to determine if the area is water supply- or conveyance-limited and whether the area would benefit from potential new or enhanced conveyance. Table 4-3 describes the additional assessment of conveyance limitations.

Table 4-3. Assessment of Conveyance Limitations

Basin	DAU	Adjusted G'water Change in Storage Average Annual (acre-feet)	% of G'water/ Total Water Supply (volume)	% of Area Served by Surface Water/ Total DAU (area)	Districts in DAUs	DAU Assessment
San Joaquin Basin	Ione–Jenny Lind	-3,906	23%	13%	Stockton East Water District, Amador Water Agency, Jackson Irrigation District, and Calaveras County Water District	Only a minor portion of the analysis unit is served by surface water, while the remaining portion of the analysis unit is dependent on groundwater (Calaveras County Water District 2021; EKI Environment & Water 2021). The Calaveras County Water District's *2020 Urban Water Management Plan Update* notes that the Jenny Lind and Wallace service areas are isolated and mostly reliant on groundwater, with limited surface water supply from the Calaveras River. The EKI Environment & Water 2021 *Groundwater Sustainability Plan for the Cosumnes Subbasin* describes declining groundwater storage, local supply vulnerabilities, and continued dependence on groundwater pumping in Amador County.
	Bachelor Valley	-5,175	~100%	3%	Rock Creek Water District, Oakdale Irrigation District and Stockton East Water District	Only a minor portion of the analysis unit is served by surface water. The majority of the analysis unit is solely dependent on groundwater. Surface water deliveries are limited to isolated service areas (i.e., Stockton East Water District, Oakdale Irrigation District, and Rock Creek Water District) that operate independent systems without interties or regional conveyance connections (Eastern San Joaquin Groundwater Authority 2024). As a result, opportunities to redistribute or supplement supplies are limited, and overall surface water availability is minimal, with an average annual water supply of only 7 AF.
	Turlock Lake	-5,254	72%	46%	Eastside Water District (East Turlock GSA) and Turlock Irrigation District	Conveyance improvements could potentially increase water supplies to the area. Much of the area is located east of Turlock Irrigation District and could potentially benefit from water supplied by Turlock Irrigation District (West Turlock Subbasin Groundwater Sustainability Agency and East Turlock Subbasin Groundwater Sustainability Agency 2024).
	Merced Stream Group	-12,594	99%	5%	Merced Irrigation District and Chowchilla Water District	Only a minor portion of the analysis unit is served by surface water. The majority of the analysis unit is solely dependent on groundwater. Much of the area consists of rangeland, while lands closer to the basin boundary transition into urban and cropland areas that also rely primarily on groundwater for supply (Merced GSA 2025).

Basin	DAU	Adjusted G'water Change in Storage Average Annual (acre-feet)	% of G'water/ Total Water Supply (volume)	% of Area Served by Surface Water/ Total DAU (area)	Districts in DAUs	DAU Assessment
San Joaquin Basin	Adobe-Valley Eastside	-39,834	98%	13%	Chowchilla Water District, Fresno Irrigation District, Madera Irrigation District, and City of Fresno	Only a minor portion of the analysis unit is served by surface water. The majority of the analysis unit relies on groundwater and is experiencing overdraft throughout the basin. The *Technical Memorandum: Domestic Well Inventory for the Madera Subbasin* (Luhdorff & Scalmanini Consulting Engineers 2022) found that only 12% of well completion reports and 7% of well permits occur within public water system service areas, indicating that most wells are located outside these boundaries and rely exclusively on groundwater.
	Gravelly Ford	-2,128	83%	22%	Chowchilla Water District, Gravelly Ford Water District, Central California Irrigation District and Firebaugh Canal Water District (Exchange Contractors)	Much of this area relies on groundwater and is not served by surface water, as many nearby disadvantaged communities depend primarily on pumped groundwater that is recharged by surface water deliveries from the Exchange Contractors (San Joaquin River Exchange Contractors Water Authority 2025). The east side of this area has limited conveyance capacity and minimal supply sources from eastside tributaries, and no contracts for CVP supply from the Delta (San Joaquin River Exchange Contractors GSA 2024). The Exchange Contractors, located in the western portion of this area, hold the most senior surface water rights under the 1939 exchange contract with Reclamation, which guarantees substitute water deliveries through the Delta-Mendota Canal in exchange for historical San Joaquin River diversions (San Joaquin River Exchange Contractors GSA 2024; Moskal 2022).
Tulare Basin	Raisin	-15,253	92%	47%	Consolidated Irrigation District, Fresno Irrigation District, James Irrigation District, Laguna Irrigation District, Raisin City Water District, and Westlands Water District	This location is in the western portion of Kings River service area, which has junior water rights compared to eastern portion; therefore, it only gets wetter-year supply. There are no contracts for SWP or CVP supplies for this area. Conveyance improvements would not be beneficial due to limited water supply availability. Reclamation's 1981 *Report on Mid-Valley Canal Water Supply Studies* evaluated the potential for conveyance improvement near the Raisin City Water District DAU but was found to be infeasible (Reclamation 1981; Kings River Water Association 2018; Kings Subbasin GSAs 2022).

Basin	DAU	Adjusted G'water Change in Storage Average Annual (acre-feet)	% of G'water/ Total Water Supply (volume)	% of Area Served by Surface Water/ Total DAU (area)	Districts in DAUs	DAU Assessment
Tulare Basin	Academy	-2,137	70%	24%	Fresno Irrigation District, Madera Irrigation District, City of Clovis, and City of Fresno	Much of this area relies on groundwater and is not served by surface water. Outside of the Fresno Irrigation District and Madera Irrigation District service areas, most lands are non-districted and lack surface water conveyance infrastructure, depending primarily on groundwater pumping for supply (Kings River Water Association 2018; Fresno Irrigation District 2021; Madera Irrigation District 2021).
	Buena Vista Valley	-10,715	70%	82%	Buena Vista Water Storage District, North Kern Water Storage District, West Kern Water District, and Wheeler Ridge–Maricopa Water Storage District	It is undetermined whether this area would benefit from conveyance improvements. The districts are primarily supplied by imported surface water from the SWP under contracts through the Kern County Water Agency (West Kern Water District 2023; Wheeler Ridge–Maricopa Water Storage District 2021). Except in drought years, imported SWP surface supplies are sufficient for most crops within the Wheeler Ridge–Maricopa Water Storage District's surface water service area and negate the need for groundwater pumping. This area uses groundwater banking to buffer dry-year shortages, the Kern Water Bank, the Berrenda Mesa Project, and the Pioneer Project (Kern Water Bank Authority 2025; Wheeler Ridge–Maricopa Water Storage District 2021).

The majority of these nine DAUs lacked sufficient surface water supplies needed to benefit from potential new or enhanced conveyance improvements. In addition to lacking water conveyance, many areas lacked a reliable surface water source and would need a new water supply contract. New water rights would be difficult to obtain since existing water rights are already over-allocated in the San Joaquin Valley. Even if obtained, water rights would be junior in right to existing water rights holders.

For many of these areas, a regional strategy that restores groundwater levels of the surrounding groundwater basin would likely be more effective than attempting to secure new surface water supplies and investing in new conveyance facilities. Delivering surface water to areas with existing conveyance or demand management actions could help groundwater levels recover throughout the groundwater basin, indirectly supporting nearby areas that are solely dependent on groundwater. Investing in new conveyance facilities to bring surface water to new areas is often less practical than achieving a sustainable water balance throughout a region through some combination of increased water supplies and strategic demand management.

Even though some conveyance needs were identified during this reconnaissance analysis, site-specific studies that explicitly model local conveyance infrastructure could identify and evaluate the need for new or expanded conveyance facilities on a more-detailed basis, increasing surface water supplies to an area to change it from water supply-limited to conveyance capacity-limited. The Watershed Studies show that increasing water supply (through FIRO) can shift water supply-constrained areas into becoming conveyance-constrained. Several local conveyance improvements were identified as part of the Watershed Studies and were included in the Integrated Forecast-Informed Resources Management (I-FIRM) strategy described in the Watershed Studies (DWR in prep).

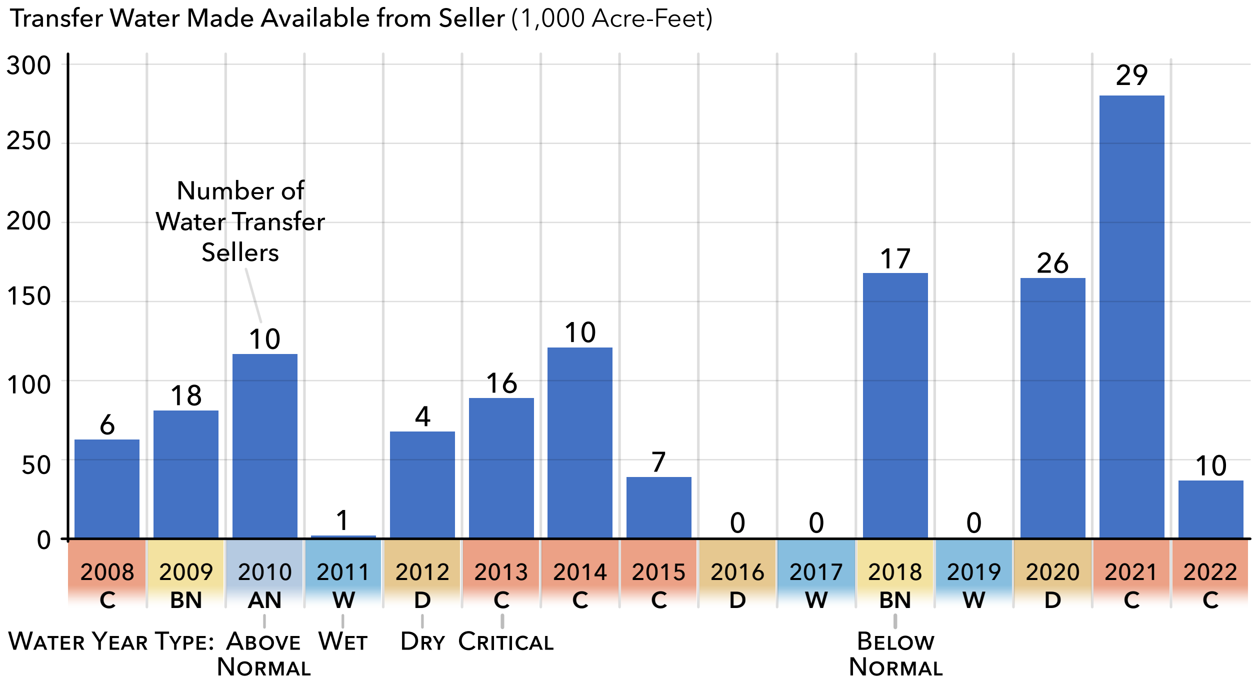
4.3 Conveyance and Water Transfers

As part of Water Resilience Portfolio Action 19.3, analysis of improved and expanded conveyance facilities was focused on opportunities to enhance water transfers and water markets. Water transfers in California are governed by principles to protect existing water rights, fish and wildlife, and third-party interests. Transfers typically occur through three mechanisms: cropland idling or crop shifting, groundwater substitution, and reservoir storage releases, with oversight by DWR, Reclamation, and the California State Water Resources Control Board (SWRCB) (SWRCB 1999; DWR and Bureau of Reclamation 2011).

While conveyance constraints across the Delta can limit opportunities in wetter years, during droughts the controlling factors are often hydrologic and regulatory (that is, the need to demonstrate “no injury” to other legal users, comply with environmental restrictions, and ensure refill criteria for storage releases) (Water Transfer Workgroup 2002). Consequently, transfer market participation in dry years is shaped more by the availability of transferable water and regulatory approvals than by physical conveyance capacity.

Figure 4-4 shows that water transfers occur much more frequently in dry and critical years than in wet and above-normal years. In dry and critical years, more buyers seek reliability, and more sellers can generate transferable supplies via cropland idling or crop shifting and groundwater substitution. In wet years, participation rates fall as surface water supplies are ample and Delta export windows are frequently limited by fishery and water quality requirements. In dry years, surface water supplies are usually insufficient to fully utilize available conveyance. Through-Delta export conveyance capacity is also not a limiting factor for water transfers (DWR 2023b). This pattern reinforces that, during droughts, regulatory restrictions and transferable supply—not conveyance capacity limitations—primarily drive water transfer market activity.

Figure 4-4. Annual Number and Volume of Water Transfers Sellers by Water Year Type



5 Findings Summary

Key findings from this San Joaquin Valley Conveyance Study are summarized below.

Conveyance Capacity Lost Due to Subsidence

- Subsidence is continuing to significantly reduce conveyance capacity in the San Luis Canal, California Aqueduct, Delta-Mendota Canal, and Friant-Kern Canal. If subsidence continues at rates consistent with the past 10 years, it will have catastrophic effects on the ability to supply water to support California's economy.
- Lost conveyance capacity from subsidence reduces California's ability to use and store wet-year flood flows, resulting in even greater reliance on limited groundwater reserves.
- The top conveyance priority in the San Joaquin Valley is to minimize or stop subsidence by raising groundwater levels in subsided areas to elevations above critical head as quickly as possible, especially near SWP and CVP main conveyance facilities.

San Joaquin Valley Conveyance Needs Assessment

- Outside of areas impacted by subsidence, many San Joaquin Valley areas are constrained by inadequate surface water supply availability relative to demand, and not by conveyance capacity. The primary need is more surface water supplies over new or expanded conveyance.
- San Joaquin Valley conveyance facilities are infrequently being filled to their maximum capacity (except for conveyance facilities impacted by subsidence).
- Water transfers are generally not limited by conveyance capacity, but are influenced by the availability of transferable waters and regulatory approvals.

6 Web Links

Agreement Between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the State Water Project and the Central Valley Project https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Files/Coordinated-Agreement-between-Reclamation-and-DWR_a_y20.pdf

Bulletin 118 Critically Overdrafted Basins https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118/Critically-Overdrafted-Basins

California Central Valley Simulation Fine Grid (C2VSimFG) Model https://data.ca.gov/dataset/california-central-valley-groundwater-surface-water-simulation-model-fine-grid-c2vsimfg

California Water Plan Water Balances Data https://data.cnra.ca.gov/dataset/water-plan-water-balance-data

Central Valley Project Improvement Act https://www.fws.gov/project/CVPIA

Delta Conveyance Project https://www.deltaconveyanceproject.com/about-the-delta-conveyance-project

Final Environmental Impact Statement/Environmental Impact Report, Friant-Kern Canal Middle Reach Capacity Correction Project https://friantwater.org/s/FKC_EIS_EIR_Final.pdf

Friant-Kern Canal Middle Reach Capacity Correction Project https://friantwater.org/fkc-mrccp

How Much Water Is Available for Groundwater Recharge in the Central Valley? https://www.ppic.org/publication/how-much-water-is-available-for-groundwater-recharge-in-the-central-valley/

State Water Project Adaptation Strategy: Reducing Vulnerabilities to Climate Change https://cadwr.app.box.com/file/1955782228667?s=yfrzk3xxwic3xxiljhl2qqh6m4l7ymth

State Water Project Delivery Capability Report 2023 Addendum: Impacts of Subsidence https://cawaterlibrary.net/wp content/uploads/2025/05/dcr2023_impacts_of_subsidence_20250506.pdf

Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/1995wqcp/docs/1995wqcpb.pdf

Water Resilience Portfolio https://resources.ca.gov/Initiatives/Building-Water-Resilience/portfolio

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