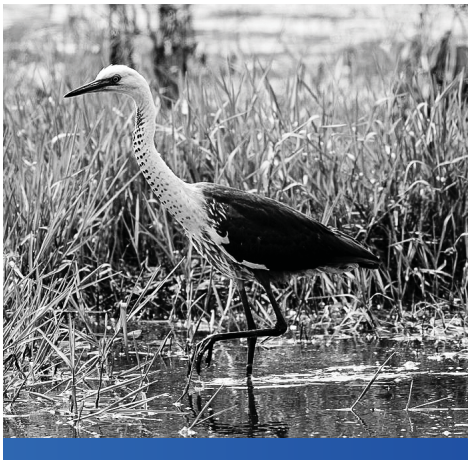
# Kern Fan Groundwater Storage Project

## FEASIBILITY REPORT

## Appendix B: Modeling Technical Report

October 21, 2019
Updated April 13, 2020
Revised September 23, 2020



Irvine Ranch WATER DISTRICT

Rosedale-Rio Bravo WATER STORAGE DISTRICT

MBK ENGINEERS
Water Resources ◆ Flood Control ◆ Water Rights

# TECHNICAL MEMORANDUM

**DATE:** September 22, 2020

**TO:** Paul Weghorst, Fiona Sanchez, and Kellie Welch of Irvine Ranch Water District

**PREPARED BY:** Lee Bergfeld, P.E., and Shankar Parvathinathan, P.E., of MBK Engineers

**SUBJECT:** Analysis of Kern Fan Groundwater Storage Project for Water Infrastructure Improvements for the Nation (WIIN) Act Funding

## Introduction

This technical memorandum presents information and results for the numerical modeling analysis for the Kern Fan Groundwater Storage Project (Project). The Project will recharge and store up to 40,000 acre-feet (af) of Section 215 water from the Friant Division of the Central Valley Project (CVP) on the San Joaquin River (SJR). The Project will use a portion of the stored water to provide Level 4 water supply to the Kern National Wildlife Refuge (NWR).

## Project Operations Overview

The Project will operate by recharging and storing available Section 215 water from the SJR. Section 215 refers to a section in the *Reclamation Reform Act of 1982*, which defines temporary water supplies and allows non-storable water to be applied to lands otherwise ineligible to receive federal water. Available Section 215 water is used in this document to describe Section 215 supplies that are above, and in addition to, existing and projected demands for Section 215 water within the Friant Division. Available Section 215 water is also referred to as SJR Surplus supply in this document.

Section 215 water will be delivered to the Project utilizing available capacity in the Friant-Kern Canal (FKC) and the Kern River. The Project includes approximately 1,200 acres of spreading basins, with a recharge rate of approximately 13,000 to 26,000 af per month, depending on antecedent conditions, and an extraction capacity of 45,000 af per year. The Project assumes

priority for storing and extracting Article 21 water[1] from the California Aqueduct, with the remaining recharge and extraction capacities available for operating SJR Surplus.

Figure 1 presents a schematic of the Project storage accounts. The total storage capacity of the Project is 140 thousand acre-feet (TAF), with 100 TAF dedicated for Article 21 water and 40 TAF for SJR Surplus. Article 21 water will be split between three accounts: ecosystem, Irvine Ranch Water District (IRWD), and Rosedale-Rio Bravo Water Storage District (Rosedale). Similarly, SJR Surplus water is split between three accounts: refuge, IRWD, and Rosedale. Water will be stored in the Project based on the percent of storage capacity dedicated to each account, i.e., 37.5% to IRWD, 37.5% to Rosedale, and 25% to ecosystem/refuge. An overview of operations is provided in the following sections.

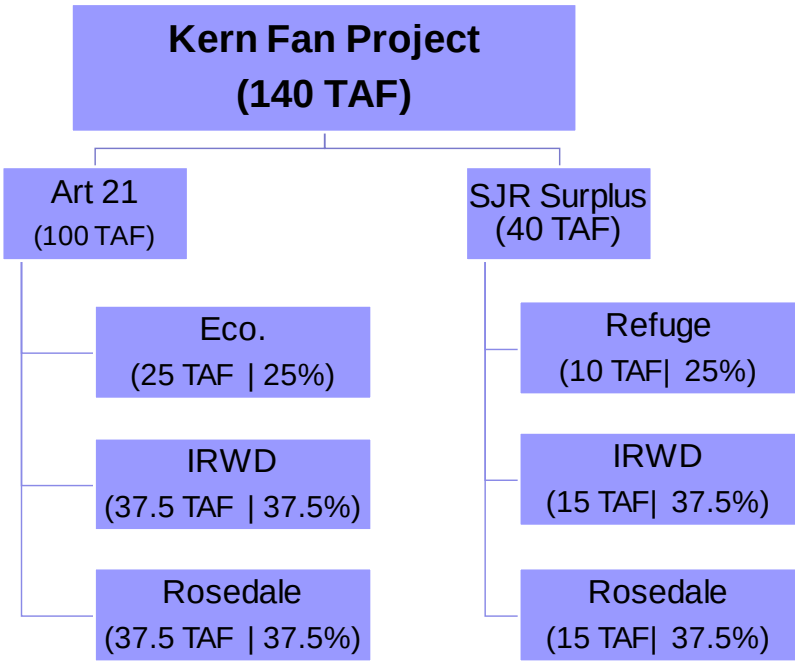



**Figure 1. Kern Fan Project Storage Accounts**

Available Section 215 water will be delivered to the Project by diverting the water into the FKC at Friant Dam, and conveying the water to the terminus of the FKC where it will be released into the Kern River. Water will be conveyed down the Kern River to an existing turnout, operated by Rosedale, with a diversion capacity of approximately 125 cfs. Water will be diverted through the turnout to the Project recharge basins.

SJR Surplus stored in the Refuge account will be extracted using Project wells and conveyed to the Kern NWR to provide Level 4 supply. The Project will target refuge deliveries from October

[1] The Project will recharge and store up to 100,000 af of Article 21 water from the Sacramento-San Joaquin Delta (Delta), when available and in accordance with an agreement under development, as part of the state's Water Storage Investment Program (WSIP).

through December, the months of peak demand at the refuge. These months were identified by review of historical deliveries to Kern NWR for the past two decades. The Project will deliver up to 1,200 af of Level 4 supply in a year.

## Analytical Approach

The analytical approach involves the use of CalSim II model results to depict the without-Project (Baseline) scenario. The CalSim II model simulates operations of the CVP and the State Water Project (SWP) in order to meet existing environmental and regulatory requirements, contract obligations, and other system requirements. The operation of the Project is then simulated in a spreadsheet model that layers the Project onto the Baseline operation of the CVP and SWP, as simulated in CalSim II. The spreadsheet model simulates the with-Project scenario. The Project benefits and effects are determined and quantified through comparison of the with-Project and without-Project scenarios.

The Baseline scenario for this analysis is the Biological Opinion Model published by the U.S. Bureau of Reclamation (Reclamation), dated October 2019. This model includes Early Long-Term[2] (ELT) climate change that represents year 2025 conditions and 15 centimeters of sea-level rise. The Baseline model assumes full San Joaquin River Restoration flows and completion of the FKC Capacity Correction Project. This model was modified to include additional demands for groundwater recharge within the Friant Division. These demands are intended to represent the additional demands with the Friant Division as a result of the Sustainable Groundwater Management Act. Assumptions for these additional demands were developed by Reclamation with input from the Friant Water Authority during analysis conducted in 2019 for the Voluntary Agreements.

The Project is simulated using a monthly time-step, spreadsheet operations model to simulate 82 years of historical hydrology, adjusted for climate change, and utilizes the CalSim II baseline depiction of CVP/SWP operations.

### Spreadsheet Model Assumptions

The spreadsheet model calculates the available Section 215 water at Friant Dam. The spreadsheet model simulates the availability of Section 215 at the Project using the following constraints:

a. Unstorable flows (flood control releases) from Friant Dam after consideration of current and future Friant Division demands for Section 215

b. Available capacity to convey the Section 215 water to the most downstream end of the Friant-Kern Canal and into the Kern River

c. Estimated conveyance loss of 3%

[2] ELT is developed based on 30 years of simulated climate data for the period 2011-2040 centered around 2025.

d. An additional assumed demand for groundwater recharge of 750 cfs that is met before the Project

e. 125 cfs of available capacity to move water from the Kern River to the Project

Water is simulated as recharged and stored in the Project in each of the three accounts: refuges, IRWD, and Rosedale. Water stored in each account is subject to a loss percentage of 12.5% for refuges, 15% for IRWD, and 10% for Rosedale. These losses include an estimated 6% loss for evaporation. Project recharge rates are simulated as a function of recharge in preceding months based on information provided by IRWD (Figure 2).

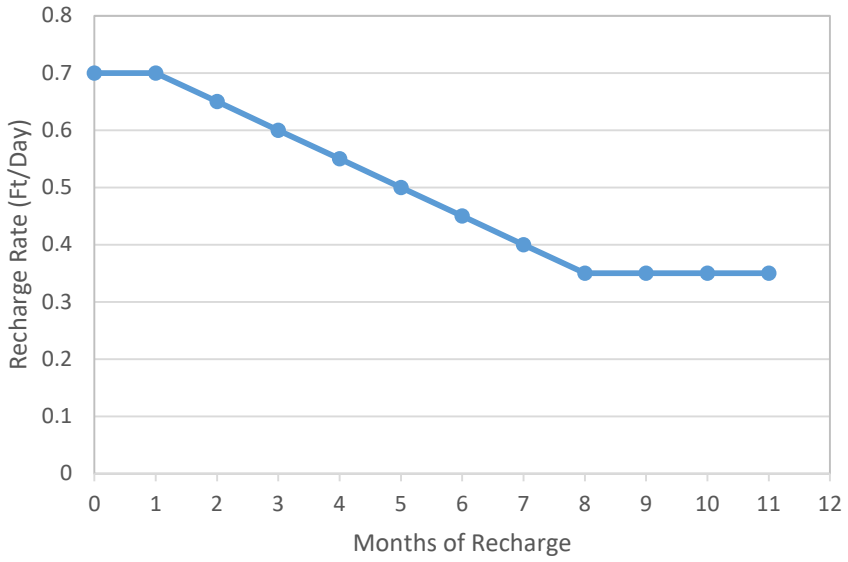



**Figure 2. Kern Fan Project Recharge Rate**

## Available Water Supply

This section presents a summary of available Section 215 water for the Project. Table 1 is a summary of the availability of Section 215/SJR Surplus at different steps during the calculation of the water supply recharged at the Project.

On an average annual basis, there is 126 TAF per year of available Section 215 at Friant Dam, out of which approximately 50 TAF per year can be conveyed to the end of the FKC. Out of the 50 TAF per year, 4 TAF per year is available at the Project for recharge after considering the additional 750 cfs of demand and the conveyance constraint of 125 cfs capacity to move water from the Kern River to the Project.

Table 1 also shows the average annual SJR Surplus water that is recharged at the Project into the three accounts. On an average annual basis, nearly 1.9 TAF per year of water is recharged, resulting in a recovery of 1.5 TAF per year from the three accounts.

**Table 1. Summary of Water Available, Recharged, and Extracted**

| Component | TAF/Year |
|---|---|
| **Available Section 215 Water at Friant Dam**[3] | 126.1 |
| **Potential Section 215 Water at end of FKC Canal**[4] | 50.1 |
| **Potential Section 215 Water available at Project**[5] | 4.1 |
| **SJR Surplus Water Recharged**[6] | 1.9 |
| **Refuges** | 0.5 |
| **IRWD** | 0.5 |
| **Rosedale** | 0.8 |
| **SJR Surplus Water Extracted** | 1.5 |
| **Refuges** | 0.4 |
| **IRWD** | 0.4 |
| **Rosedale** | 0.8 |

Figure 3 shows a summary of SJR supply by Sacramento Valley Water Year Type at the Project. On an average annual basis, available SJR supply at the Project diversion is 4 TAF with most of the supply available during Wet years. Figure 4 shows a summary of SJR supply by month. SJR supply is available between December and May. Figure 5 shows available SJR supply for each year of the simulation.

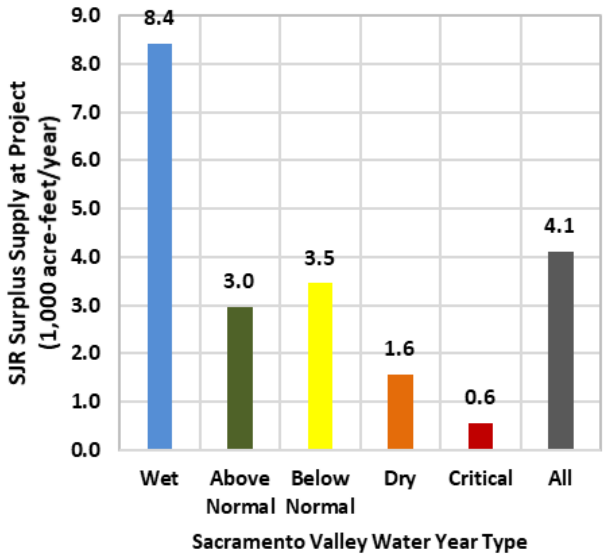



**Figure 3. Average Annual Available SJR Supply at Project by Water Year Type**

[3] Calculated as sum of flows in CalSim II arcs C18A and C18F.
[4] Assumes FKC Capacity Correction.
[5] Calculated after deducting 750 cfs of additional demand and 125 cfs conveyance constraint
[6] Limited by recharge capacity at Project

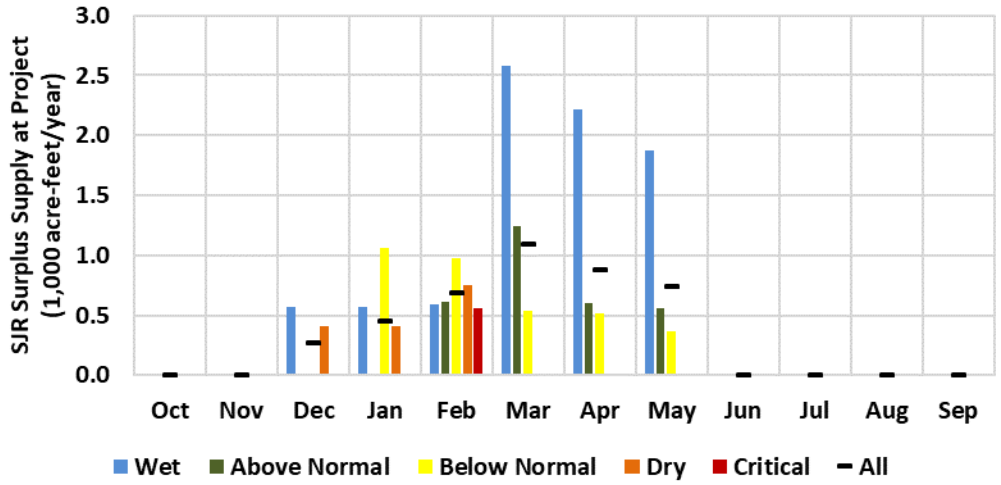



**Figure 4. Average Monthly Available SJR Supply at Project by Water Year Type**

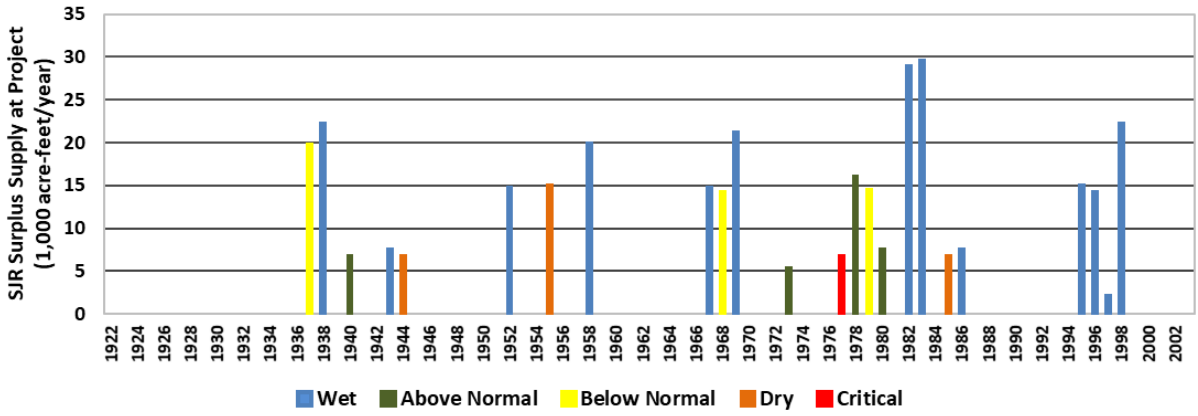



**Figure 5. Annual Available SJR Supply at Project by Year**

## Results

Annual average Project recharge is approximately 1.9 TAF and occurs primarily in Wet, Above Normal, and Below Normal years. Table 2 shows the distribution of 1.9 TAF into the different accounts. As shown in Table 2, overall extraction of SJR Surplus water is 1.5 TAF annually, with approximately 400 acre-feet for Level 4 supply to the Kern NWR, 400 acre-feet for IRWD, and 800 acre-feet for Rosedale. The difference between the volume of water recharged and extracted includes the losses and the volume of water that remains in storage accounts at the end of the simulation.

**Table 2. Kern Fan Project Recharge and Extraction of SJR Supply**

| | Recharge (TAF/Year) | | | Extraction (TAF/Year) | | |
|---|---|---|---|---|---|---|
| WY Type | Refuge | IRWD | Rosedale | Refuge | IRWD | Rosedale |
| Wet | 1.0 | 1.0 | 1.4 | 0.0 | 0.0 | 0.0 |
| Above Normal | 0.2 | 0.3 | 0.6 | 0.0 | 0.0 | 0.0 |
| Below Normal | 0.4 | 0.4 | 0.7 | 0.5 | 0.0 | 0.0 |
| Dry | 0.3 | 0.4 | 0.5 | 0.8 | 0.7 | 2.6 |
| Critical | 0.1 | 0.1 | 0.4 | 0.6 | 1.6 | 1.2 |
| All Years | 0.5 | 0.5 | 0.8 | 0.4 | 0.4 | 0.8 |

Figure 6 through Figure 8 are monthly plots of simulated storage in the refuge, IRWD, and Rosedale accounts, respectively. The plots show the maximum storage of 10 TAF for the refuge account, and 15 TAF each for IRWD and Rosedale accounts. Each account is utilized to different degrees depending on the demands. The refuge account is exercised more frequently than other accounts with extraction and delivery to Kern NWR occurring in 27 years during the 82-year simulation.

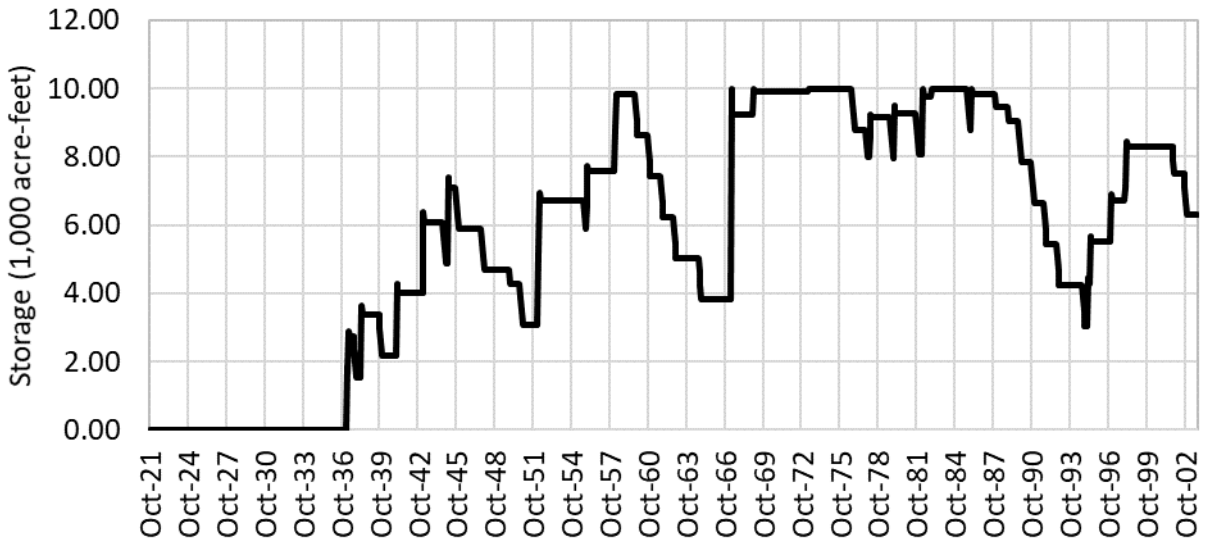



**Figure 6. Monthly Simulated Storage in Refuge Account**

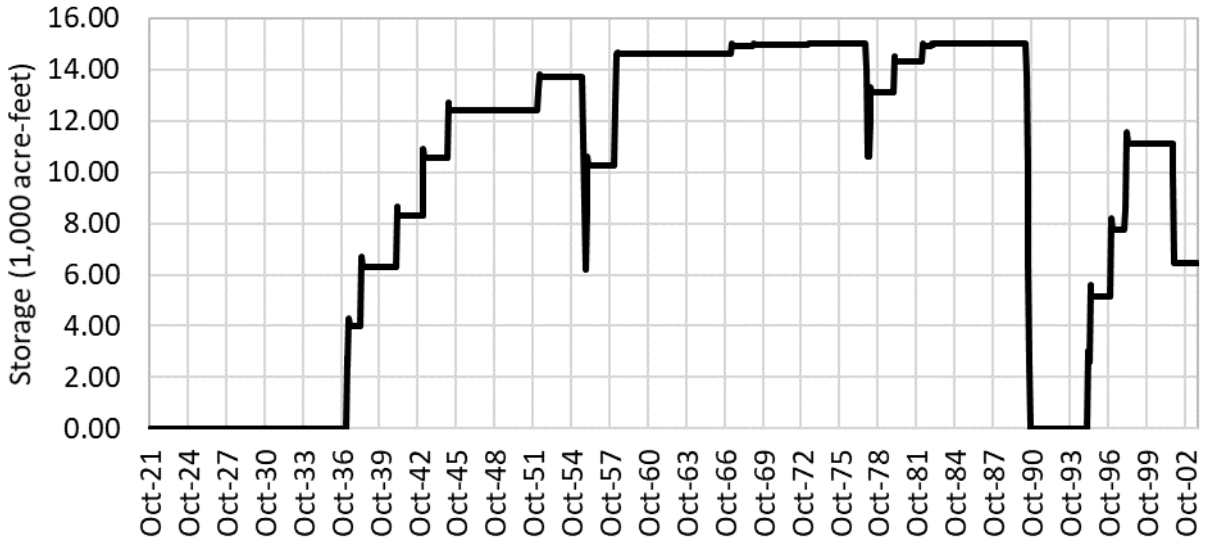



**Figure 7. Monthly Simulated Storage in IRWD Account**

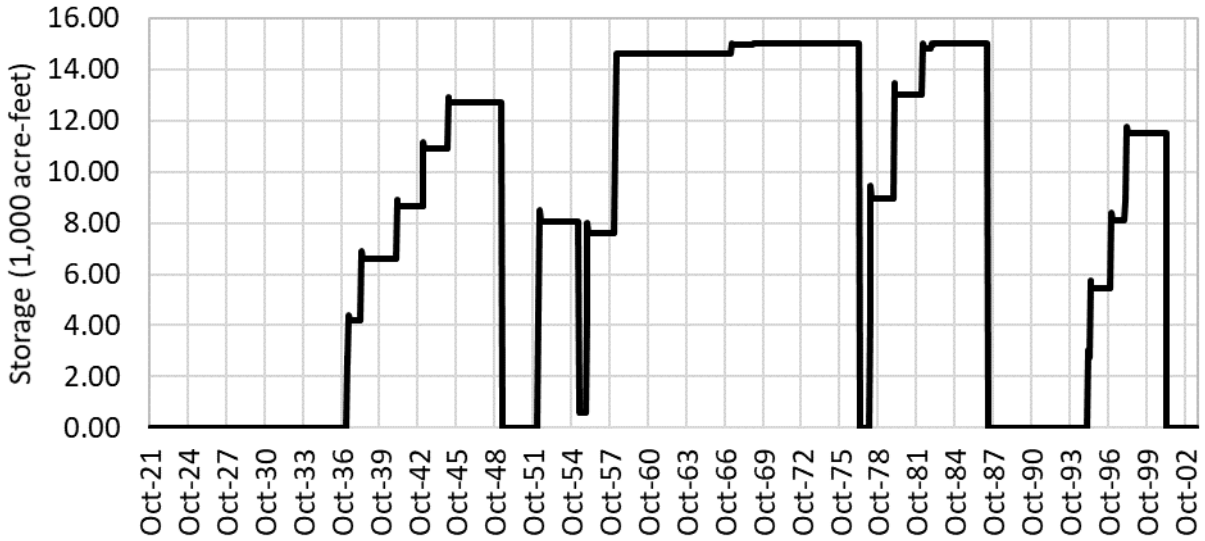



**Figure 8. Monthly Simulated Storage in Rosedale Account**

Simulated storage in the IRWD and Rosedale accounts reflect the use of the water by these two agencies. The spreadsheet model simulates the use of the water based on SWP Table A allocations, with more water used when Table A allocations are lower. IRWD will physically extract the water and Rosedale will manage water stored in the Project account as another source in their water supply portfolio.

Figure 9 shows the annual average Level 4 deliveries to the Kern NWR by Sacramento Valley water year type. Figure 10 shows the same data as an average by month and water year type, with the deliveries occurring during October through December in Below Normal, Dry, and

Critical years. Figure 11 shows that Project deliveries of Level 4 supplies to Kern NWR occur in 27 years of the 82-year simulation.

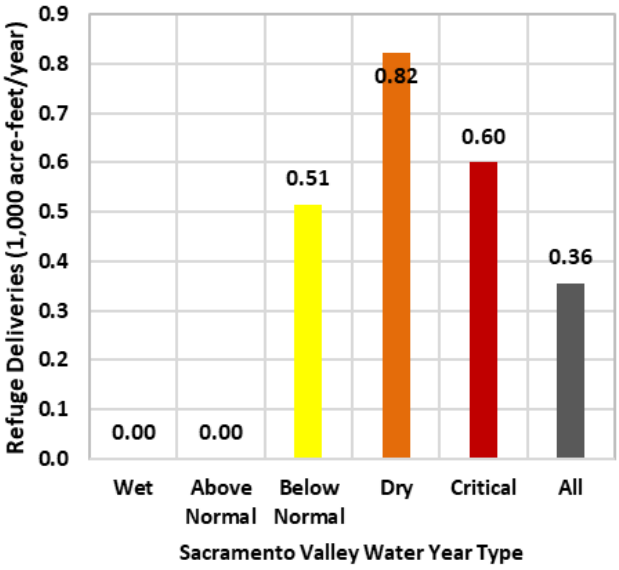



**Figure 9. Annual Average Project Delivery of Level 4 Supply to Kern NWR by Water Year Type**

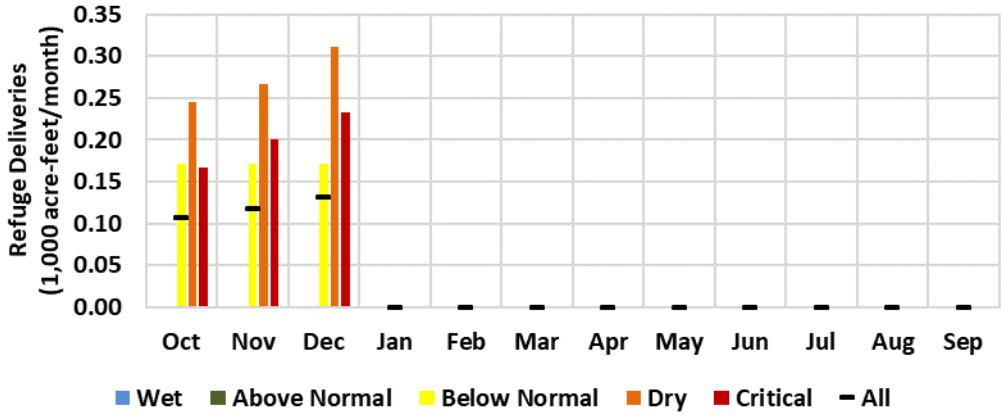



**Figure 10. Average Monthly Project Delivery of Level 4 Supply to Kern NWR by Water Year Type**

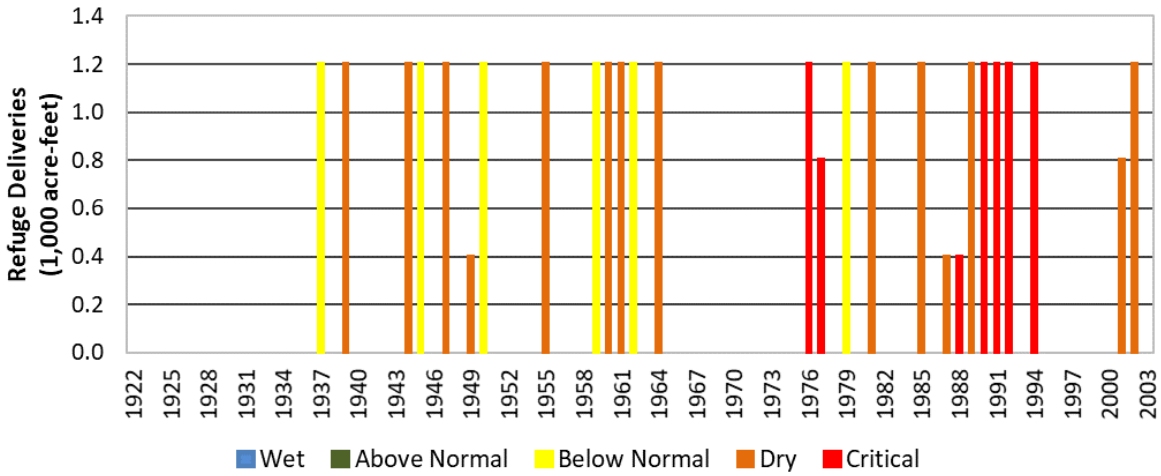



**Figure 11. Annual Project Delivery of Level 4 Supply to Kern NWR by Year**