CHAPTER 2. EXISTING AND FUTURE CONDITIONS

This chapter generally describes existing water resources facilities and conditions in the study area, and describes how they are expected to change in the foreseeable future. This information is included to provide an understanding of current water management operations that could be affected by developing additional water supplies in the upper San Joaquin River basin.

EXISTING CONDITIONS

The San Joaquin Valley is approximately 250 miles long, 30 to 60 miles across, and is bounded on the north by the Sacramento-San Joaquin Rivers Delta (Delta), on the south by the Tehachapi Mountains, on the east by the Sierra Nevada foothills, and on the west by the Coast Range. Irrigated agriculture has been the mainstay of the San Joaquin Valley economy since the first water diversions for irrigation began in the 1860s. Since that time, agricultural development in the Central Valley has grown to become a major contributor to the economy of both the State of California and the Nation. Three counties in the study area – Fresno, Kern, and Tulare – consistently rank among the Nation's top four counties in agricultural revenue. Exports of cotton, citrus, and produce also contribute substantially to the international market.

Hydrology

The San Joaquin River originates in the Sierra Nevada at an elevation over 10,000 feet above mean sea level and enters the San Joaquin Valley near Friant. Below Friant Dam, the river flows west to the center of the valley, then turns sharply north at Mendota Pool and flows through the valley to the Delta. Along the valley floor, the San Joaquin River receives flow from the Merced, Tuolumne, and Stanislaus rivers, and from smaller tributaries draining the east and west sides of the valley.

The California Data Exchange Center (CDEC) maintains estimates of unimpaired flow at four locations in the upper San Joaquin River Basin. Unimpaired flow is flow that would occur at a specific location if upstream facilities were not in place. Since 1980, estimates of unimpaired flow in the San Joaquin River are provided below Friant Dam only, where the estimated annual average unimpaired runoff is about 1,800 thousand acre-feet (TAF). As indicated in Table 2-1, annual runoff from the upper San Joaquin River basin (at Friant Dam) varies widely, ranging from a recorded low of about 362 TAF in 1977 to a recorded high of 4,642 TAF in 1983.

TABLE 2-1
RUNOFF IN THE UPPER SAN JOAQUIN RIVER BASIN

Station (CDEC ID)	Record Period	Annual Runoff (TAF)		
		Maximum	Average	Minimum
Big Creek below Huntington Lake (BHN)	2/1905 – 9/1980	297.8	110.6	14.4
San Joaquin South Fork near Florence (SFR)	10/1900 – 9/1980	248.9	652.5	71.3
San Joaquin River at Mammoth Pool (SJM)	10/1905 – 9/1980	2,964.1	1,323.8	307.9
San Joaquin River below Friant Dam (SJF)	10/1900 – present	4,641.9	1,830.3	361.6

Key:
CDEC – California Data Exchange Center
TAF – thousand acre-feet

Surface Water Resources in the Study Area

The east side of the San Joaquin Valley includes numerous streams and rivers that drain the western slope of the Sierra Nevada Mountains into the Central Valley. During the past 50 years, water resources of all major rivers have been developed through construction of dams and reservoirs for water supply, flood control, and hydropower generation. Table 2-2 provides a summary of major reservoirs in the eastern San Joaquin Valley and their purposes. With the exception of the San Joaquin River, the table lists only the largest water supply and flood control reservoir on each river.

The largest reservoir on the San Joaquin River is Millerton Lake, formed by Friant Dam. These facilities are part of the Friant Division of the CVP, and their operation affects the flow in the San Joaquin River significantly. Inflow to Millerton Lake is influenced by the operation of several upstream hydropower generation projects. Dams and reservoirs upstream of Millerton Lake are listed in Table 2-2 and shown in Figure 2-1.

Friant Division of the CVP

The Friant Division of the CVP provides water to over 1 million acres of irrigable land on the east side of the southern San Joaquin Valley, from near the Chowchilla River in the north to the Tehachapi Mountains in the south. Principal features of the Friant Division were completed in the 1940s, including Friant Dam and Millerton Lake northeast of Fresno on the San Joaquin River and the Madera and Friant-Kern canals, which convey water north and south to agricultural and urban water contractors. Figure 2-2 shows the locations of Friant Division contractors and other water districts in the San Joaquin Valley.

Millerton Lake, the largest reservoir in the upper San Joaquin River basin, has a storage capacity of 520 TAF. The dam is operated to supply water to agricultural and urban areas in the eastern San Joaquin Valley and to provide flood protection to downstream areas. Minimum storage for canal diversion is about 130 TAF, resulting in active conservation storage of about 390 TAF.

TABLE 2-2
RESERVOIRS ON THE EAST SIDE OF THE SAN JOAQUIN VALLEY

Name	River or Creek	Owner	Storage (TAF)	Year Built	Operational Objectives				
					FC	WS	HP	RF	WQ
Reservoirs in the Upper San Joaquin River Watershed									
Millerton	San Joaquin	USBR	520	1942	X	X	n/a	n/a	n/a
Kerckhoff	San Joaquin	PG&E	4	1920	n/a	n/a	X	X	n/a
Redinger	San Joaquin	SCE	35	1951	n/a	n/a	X	X	n/a
Florence	South Fork San Joaquin	SCE	64	1926	n/a	n/a	X	X	n/a
Huntington	Big Creek	SCE	89	1917	n/a	n/a	X	X	n/a
Shaver	Stevenson Creek	SCE	135	1927	n/a	n/a	X	X	n/a
Thomas Edison	Mono Creek	SCE	125	1954	n/a	n/a	X	X	n/a
Mammoth Pool	San Joaquin	SCE	123	1960	n/a	n/a	X	X	n/a
Reservoirs in Other San Joaquin Valley Watersheds									
New Melones	Stanislaus	USBR	2,420	1978	X	X	X	X	X
Don Pedro	Tuolumne	MID/TID	2,030	1970	x	X	X	X	n/a
Lake McClure	Merced	MID	1,025	1967	X	X	X	X	n/a
Eastman	Chowchilla	Corps	150	1975	X	X	n/a	n/a	n/a
Hensley	Fresno	Corps	90	1975	X	X	n/a	n/a	n/a
Pine Flat	Kings	Corps	1,000	1954	X	X	n/a	n/a	n/a
Kaweah	Kaweah	Corps	143	1962	X	X	n/a	n/a	n/a
Success	Tule	Corps	82	1961	X	X	n/a	n/a	n/a
Isabella	Kern	Corps	568	1953	X	X	n/a	n/a	n/a

Key:
Owners

Corps	U.S. Army Corps of Engineers
MID	Merced Irrigation District
MID/TID	Modesto Irrigation District/Turlock Irrigation District
PG&E	Pacific Gas and Electric
SCE	Southern California Edison
USBR	Bureau of Reclamation

Operational Objectives

FC	Flood control (these reservoirs have dedicated flood control storage space)
HP	Hydropower generation
RF	Downstream river instream flow requirements
WQ	Delta water quality
WS	Water supply for irrigation, domestic, municipal, and industrial uses

n/a – operational objective not applicable
TAF – thousand acre-feet
Notes:
1. Enlargement of Kaweah and Success lakes has been authorized. Existing capacity listed.

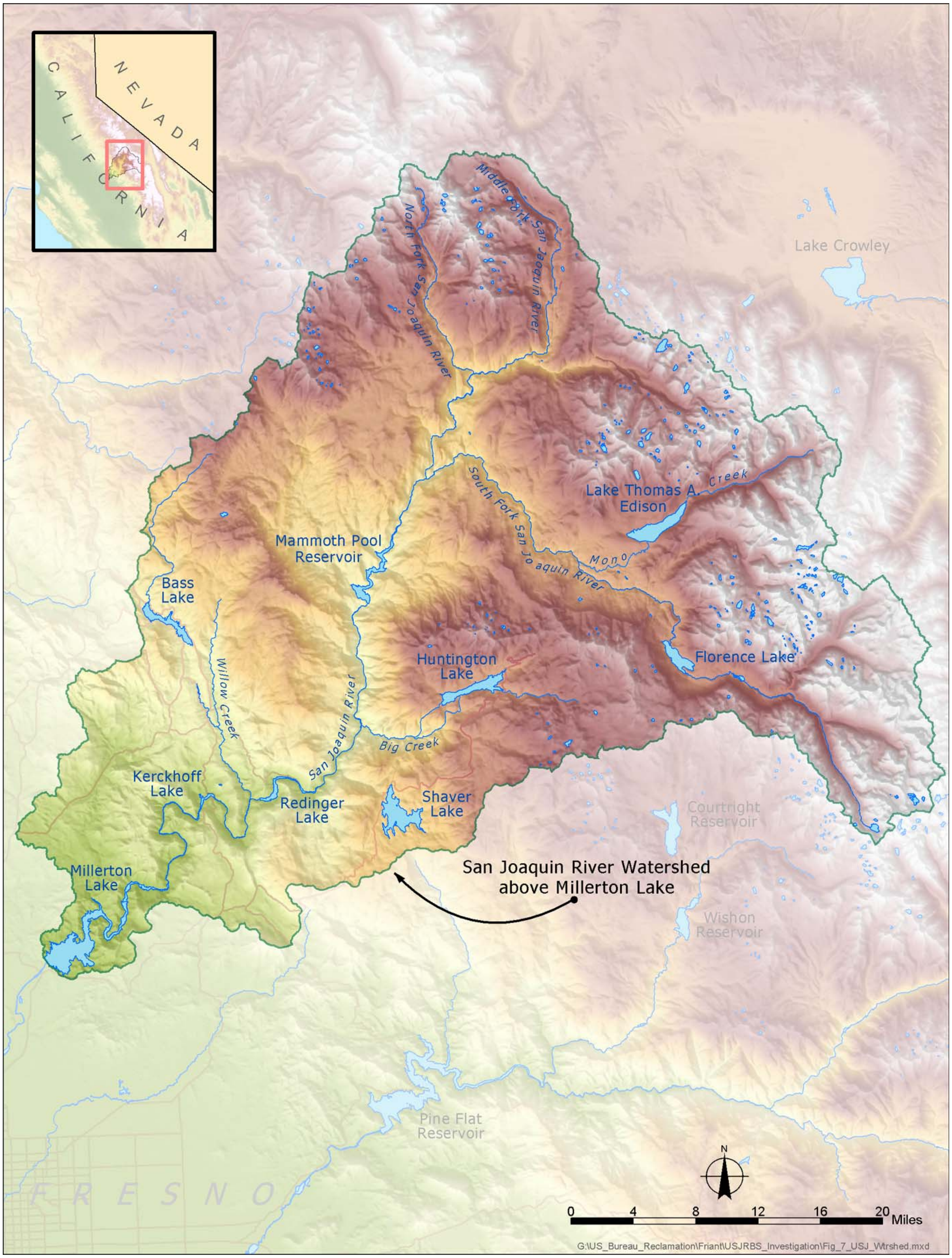

FIGURE 2-1. RESERVOIRS UPSTREAM OF MILLERTON LAKE

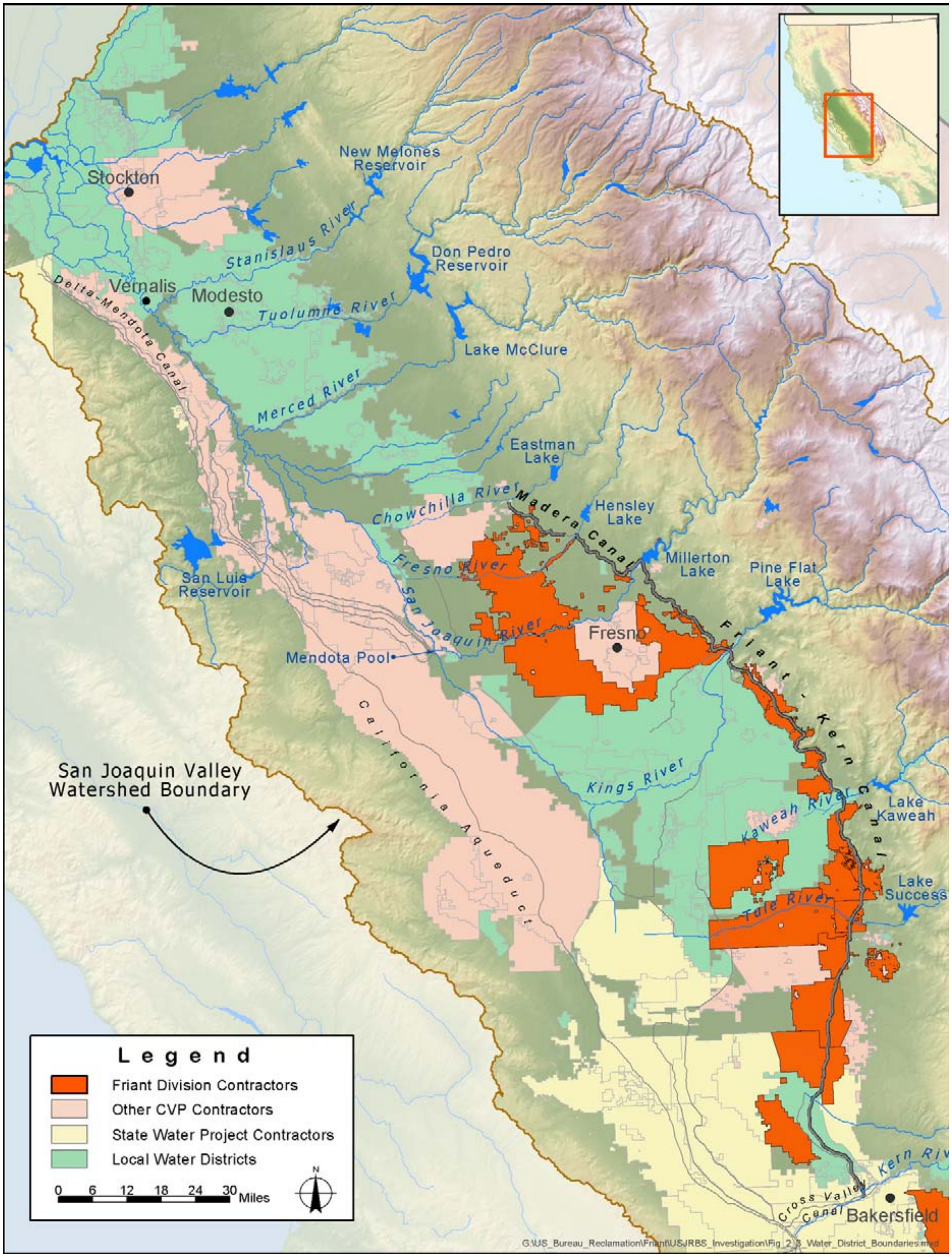

FIGURE 2-2. WATER DISTRICTS IN THE SAN JOAQUIN VALLEY

During the flood season of October through March, up to 170 TAF of available storage space must be maintained for control of rain floods. Under present operating rules, up to 85 TAF of the flood control storage required in Millerton Lake may be provided by an equal amount of space in Mammoth Pool (Figure 2-3).

The limited active conservation storage and the requirement for flood space reservation result in very little opportunity for carryover storage. Millerton Lake is operated as an annual reservoir with no specific provision for carryover storage. Annual water allocations and release schedules are developed with the intent of drawing reservoir storage to minimum levels by the end of September. When demands are lower or inflow is greater than typical, end-of-year storage may be above minimum levels, resulting in incidental carryover storage.

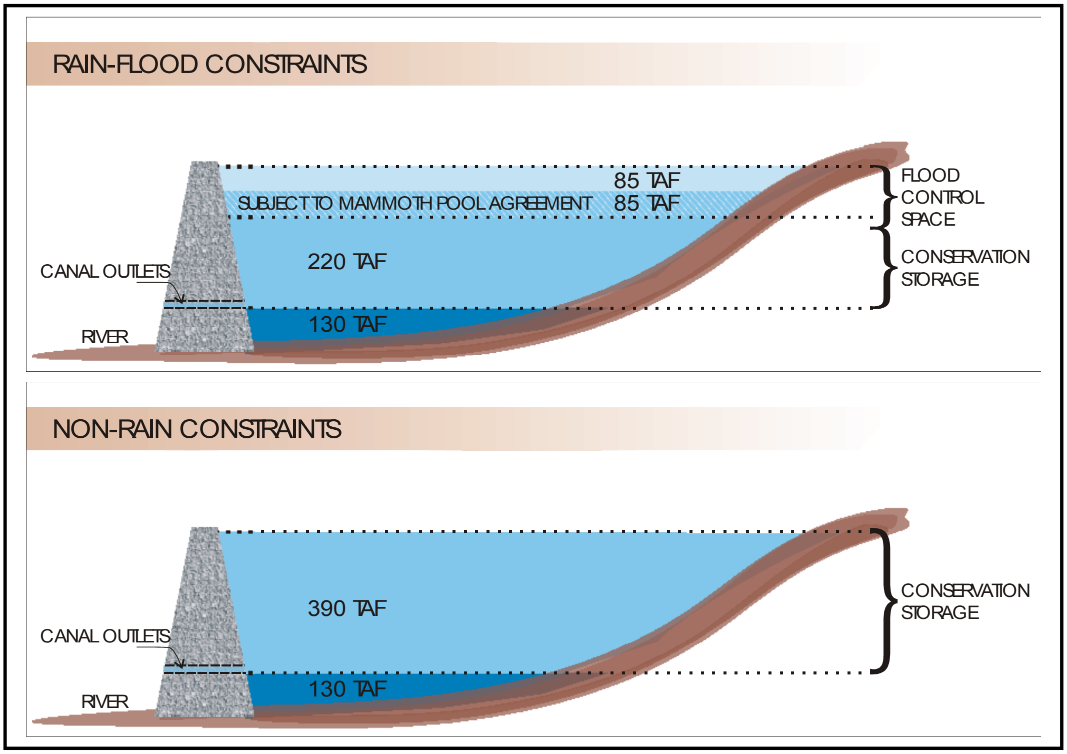

FIGURE 2-3. SCHEMATIC OF MILLERTON STORAGE REQUIREMENTS

Reclamation obtained the majority of the water rights on the San Joaquin River, allowing for the diversion of water at Friant Dam through purchase and exchange agreements with entities that held those rights at the time the project was developed. The agreement involving the largest amount of water requires annual delivery of approximately 800 TAF of water to Mendota Pool to water rights holders along the San Joaquin River. This obligation is met with water exported from the Delta via the Delta-Mendota Canal in accordance with San Joaquin River exchange contracts. If Delta water is not available to meet these commitments, Reclamation would be required to release water from Friant Dam to meet these water rights obligations. With the exception of flood control operations, water released from Friant Dam to the San Joaquin River is limited to that necessary to satisfy riparian water rights along the San Joaquin River between Friant Dam and Gravelly Ford.

Friant Division Contract Types and Water Deliveries

The Friant Division was designed and is operated to support conjunctive water management in an area that was subject to groundwater overdraft prior to construction of Friant Dam and which remains in a state of overdraft today. Reclamation employs a two-class system of water allocation to take advantage of water during wetter years. (Table 2-3 lists Friant Division contract amounts for each contractor.)

Class 1 contracts, which are based on a firm water supply, are generally assigned to municipal and industrial (M&I) and agricultural water users who have limited access to good-quality groundwater. These lands primarily include upslope areas planted in citrus or deciduous fruit trees. During project operations, the first 800 TAF of annual water supply are delivered under Class 1 contracts.

Class 2 water is a supplemental supply and is delivered directly for agricultural use or for groundwater recharge, generally in areas that experience groundwater overdraft. Class 2 contractors typically have access to good quality groundwater supplies and can use groundwater during periods of surface water deficiency. Many Class 2 contractors are in areas with high groundwater recharge capability and operate dedicated groundwater recharge facilities. Figure 2-4 shows the locations of Friant Division contractors and the percentage of Class 1 to total contract amounts.

In addition to Class 1 and Class 2 water deliveries, Reclamation is authorized to deliver water that would otherwise be released for flood control purposes. Section 215 of the Reclamation Reform Act of 1982 authorizes the delivery of unstorable irrigation water that would be released in accordance with flood control criteria or unmanaged flood flows. Delivery of Section 215 water has enabled groundwater replenishment at levels higher than could otherwise be supported with Class 1 and Class 2 contract deliveries.

Historically, the Friant Division has delivered an average of about 1,300 TAF of water annually. Since 1949, median annual release from Friant Dam to the San Joaquin River has been about 129 TAF, which is slightly more than the 117 TAF released annually to meet downstream water right diversions above Gravelly Ford.

Figure 2-5 shows the historical allocation of water to Friant Division contractors, estimated by applying historical allocation percentages to total Class 1 and Class 2 contracts amounts. As shown, annual allocation of Class 1 and Class 2 water varies widely in response to hydrologic conditions.

TABLE 2-3
FRIANT DIVISION LONG-TERM CONTRACTS

CONTRACT TYPE/CONTRACTOR	Class 1	Class 2	Cross Valley
Friant-Kern Canal Agricultural			
Arvin-Edison WSD	40,000	311,675	
Delano-Earlimart	108,800	74,500	
Exeter ID	11,500	19,000	
Fresno ID	0	75,000	
Garfield WD	3,500	0	
International WD	1,200	0	
Ivanhoe ID	7,700	7,900	
Lewis Creek WD	1,450	0	
Lindmore ID	33,000	22,000	
Lindsay-Strathmore ID	27,500	0	
Lower Tule River ID	61,200	238,000	
Orange Cove ID	39,200	0	
Porterville ID	16,000	30,000	
Saucelito ID	21,200	32,800	
Shafter-Wasco ID	50,000	39,600	
Southern San Joaquin MUD	97,000	50,000	
Stone Corral ID	10,000	0	
Tea Pot Dome WD	7,500	0	
Terra Bella ID	29,000	0	
Tulare ID	30,000	141,000	
Total Friant-Kern Canal Agricultural	**595,750**	**1,041,475**	
Madera Canal Agricultural			
Chowchilla WD	55,000	160,000	
Madera ID	85,000	186,000	
Total Madera Canal Agricultural	**140,000**	**346,000**	
San Joaquin River Agricultural			
Gravelly Ford WD	0	14,000	
Total Friant Division Agricultural	**735,750**	**1,401,475**	
Friant Division M&I			
City of Fresno	60,000		
City of Orange Cove	1,400		
City of Lindsay	2,500		
Fresno County Water Works District No. 18	150		
Madera County	200		
Total Friant Division M&I	**64,250**		
Total Friant Division Contracts	**800,000**	**1,401,475**	
Cross Valley Canal Exchange			
Fresno County			3,000
Tulare County			5,308
Hills Valley ID			3,346
Kern-Tulare WD			40,000
Lower Tule River ID			31,102
Pixley ID			31,102
Rag Gulch WD			13,300
Tri-Valley WD			1,142
Total Cross Valley Canal Exchange			**128,300**

Key:
M&I – Municipal and Industrial; ID – Irrigation District; WD – Water District; WSD – Water Storage District
Source: Friant Water Users Authority Informational Report

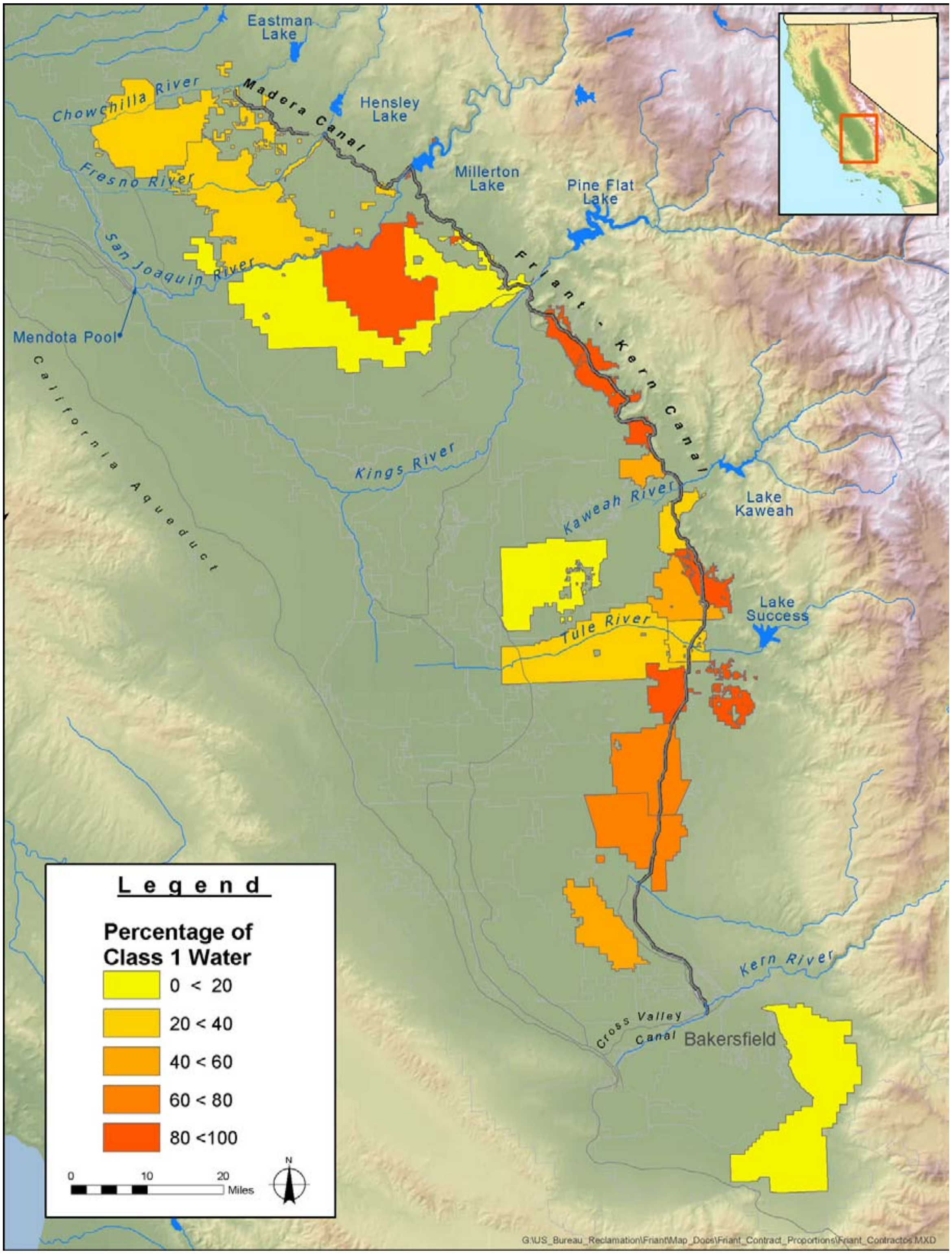

FIGURE 2-4. PERCENT OF CLASS 1 CONTRACT AMOUNTS FOR FRIANT DIVISION CONTRACTORS

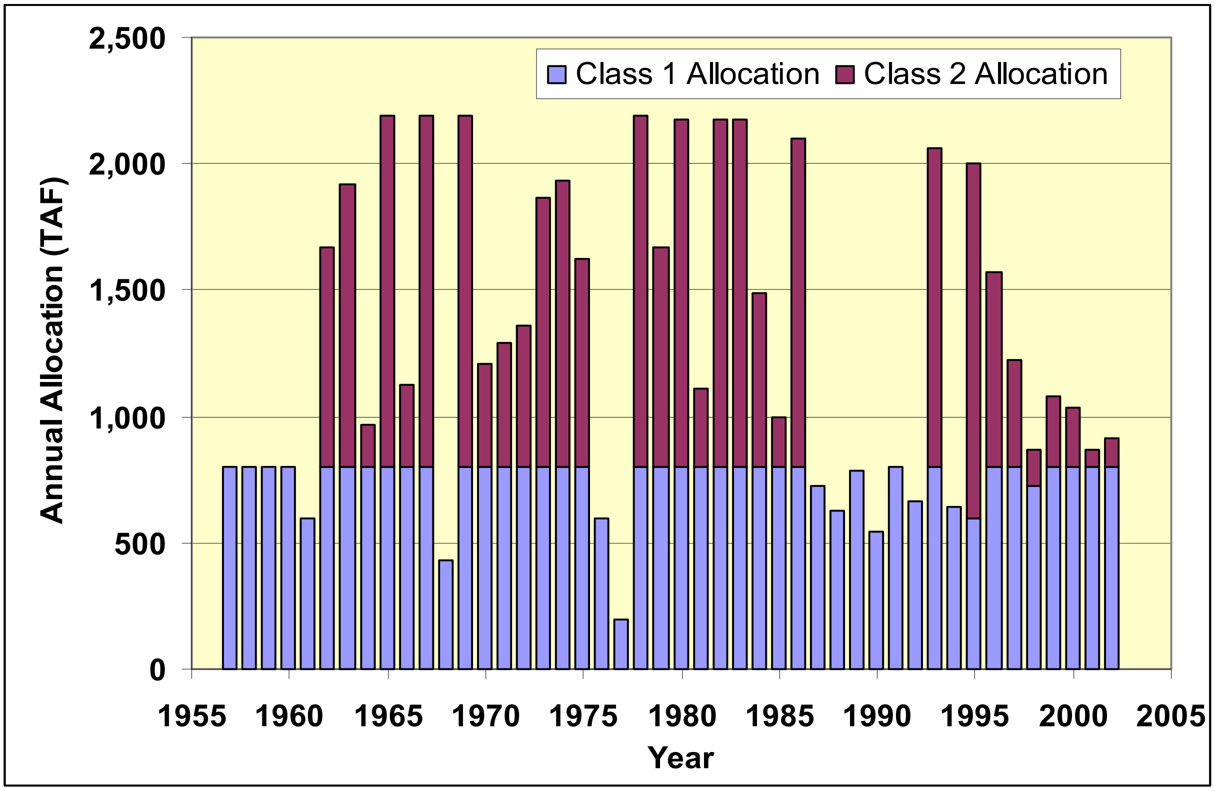

FIGURE 2-5. HISTORICAL ALLOCATION TO FRIANT DIVISION CONTRACTS

During the period from 1957 through 2002, annual allocations of Class 1 water were typically at or above 75 percent of contract amounts, except in three extremely dry years. In this same period, full allocation of Class 2 water supplies occurred in about one-fourth of the years. During the extended drought from 1987 through 1992, no Class 2 water was available and Class 1 allocations were below full contract amounts, except in one year. During this and other historical drought periods, water contractors relied heavily on groundwater to meet water demands.

In addition to the Class 1, Class 2, and conjunctive management aspects of Friant Division operations, a productive program of transfers between districts takes place annually. This program provides opportunities to improve water management within the Friant service area. In wet years, water surplus to one district's need can be transferred to other districts with the ability to recharge groundwater. Conversely, in dry years, water is returned to districts with little or no groundwater supply, thereby providing an ongoing informal groundwater banking program within the Friant Division.

The Cross-Valley Canal, a locally financed facility completed in 1975, enables delivery of water from the California Aqueduct to the east side of the southern San Joaquin Valley near the City of Bakersfield. A complex series of water purchase, transport, and exchange agreements allows the exchange of equivalent amounts of water between Arvin-Edison Water Storage District, near Bakersfield, and eight entities with contracts for CVP water exported from the Delta. When conditions permit, water is delivered to Arvin-Edison from the California Aqueduct in exchange for water that would have been delivered from Millerton Lake.

Hydropower Facilities Upstream of Millerton Lake

The upper San Joaquin River basin is highly developed for hydropower generation. Upstream of Millerton Lake, Pacific Gas & Electric (PG&E) and Southern California Edison (SCE) own several hydropower generation facilities, as shown in Figure 2-6. Both the PG&E and SCE systems consist of a series of diversion reservoirs that provide water through tunnels to downstream powerhouses. Table 2-4 summarizes generation capacity and date of installation for PG&E and SCE power facilities from Millerton Lake upstream to Redinger Lake. This table also summarizes annual reported energy generation from the PG&E and SCE facilities for 1994 through 2002. As indicated by minimum and maximum values, annual energy generation varies widely.

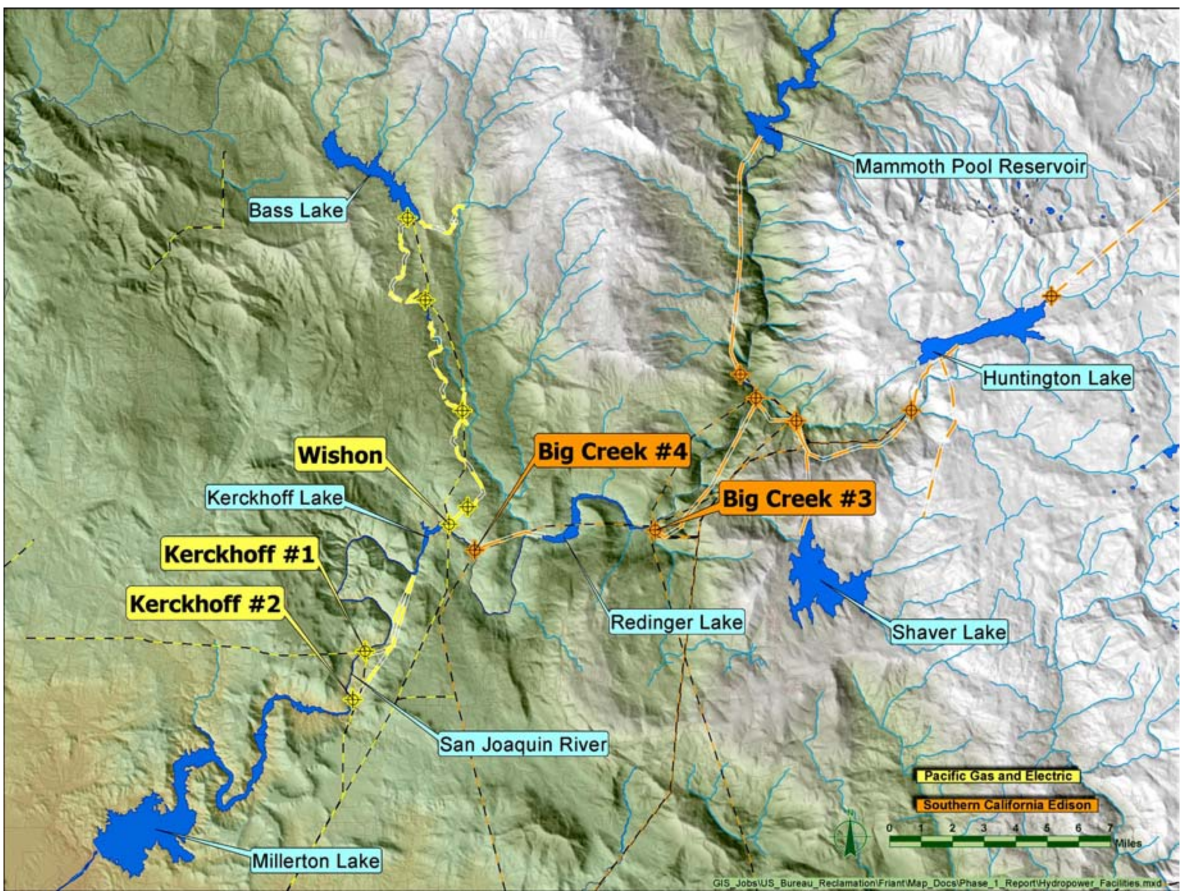

FIGURE 2-6. HYDROPOWER FACILITIES UPSTREAM OF MILLERTON LAKE

TABLE 2-4
HYDROELECTRIC GENERATION ABOVE MILLERTON LAKE

	Pacific Gas & Electric			Southern California Edison	
	Wishon	**Kerckhoff**	**Kerckhoff No. 2**	**Big Creek No.3**	**Big Creek No. 4**
FERC Proj. No.	1354	96	96	120	2017
Number of units	4	3	1	7	2
Capacity (MW)	20	38	155	175	100
Year Commissioned	1919	1920	1983	1923	1952
Reported Annual Generation, Exclusive of Plant Use (GWh)[1]					
1994	28[2]	10[2]	276[2]	567	294[2]
1995	113	116[3]	803[2]	1,196[3]	623[3]
1996	94	52	697	1,050	608
1997	45	72	696	898	590
1998	118[3]	76	73	1,095	613
1999	73	32	411	540[2]	436
2000	74	38	482	838	449
2001	48	11	317	571	301
2002	55	20	368	717	353
Avg. 1994-2002	**72**	**47**	**532**	**830**	**474**

Key:
FERC – Federal Energy Regulatory Commission; GWh – gigawatt-hour; MW – megawatt
Notes:
1. Data sources - annual FERC Licensee reports.
2. Minimum during period of record.
3. Maximum during period of record.

Groundwater Resources

The San Joaquin Valley Groundwater Basin 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 erosion of surrounding mountains. Continental deposits form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough, which is generally oriented along a north-south alignment (DWR, 2003).

Groundwater is a major source of agricultural and urban water supplies in the study area. Figure 2-7 shows the locations of groundwater basins underlying the San Joaquin Valley within the study area. Typical groundwater production conditions for each sub-basin are listed in Table 2-5, based on information from DWR Bulletin 160-98. At a 1995 level of development, annual average groundwater overdraft is estimated at about 240,000 acre-feet per year in the San Joaquin River hydrologic region and at about 820,000 acre-feet per year in the Tulare Lake hydrologic region (Bulletin 160-98).

TABLE 2-5
PRODUCTION CONDITIONS IN SAN JOAQUIN VALLEY GROUNDWATER SUBBASINS

Basin Number[1]	Basin Name	Extraction (TAF/year)	Well Yields (gpm)	Pumping Lifts (feet)
San Joaquin River Basin				
765	Modesto	230	1,000 – 2,000	90
776	Delta-Mendota	510	800 – 2,000	35 – 150
778	Turlock	450	1,000 – 2,000	90
784	Merced	560	1,500 – 1,900	110
795	Madera	570	750 – 2,000	160
796	Chowchilla	260	1,500 – 1,900	110
Tulare Lake Basin				
821	Kings	1,790	500 – 1,500	150
831	Westside	210	800 – 1,500	200 - 800
849	Kaweah	760	1,000 – 2,000	125 - 250
861	Tulare Lake	670	300 – 1,000	270
898	Tule	660	n/a	150 - 200
891	Pleasant Valley	100	n/a	350
1058	Kern	1,400	1,500 – 2,500	200 - 250

Source: California Department of Water Resources Bulletin 160-98.
Key:
gpm – gallons per minute; n/a – data not available; TAF – thousand acre-feet
Note:
1. Groundwater basin number as shown on Figure 2-7.

FUTURE WITHOUT-PROJECT CONDITIONS

CALFED agencies are developing a consistent set of assumptions regarding future without-project conditions for use in several CALFED studies. As the feasibility study proceeds, the study team will continue to coordinate with the Bay-Delta Authority and other CALFED agencies to define the future without-project condition assumptions. Potential projects and actions that will be considered include conjunctive management actions that would be implemented independently of new storage development, water conveyance improvements, demand management actions, water exchanges and transfers, and other regional actions that would affect demand, allocation, and distribution of water resources.

Local water users and other entities have been considering potential projects and actions that would help address current and potential future water needs, provide water for other purposes (such as restoration of the San Joaquin River), and improve flood protection along the San Joaquin River. Many initiatives under investigation have not been sufficiently developed to assure their completion.

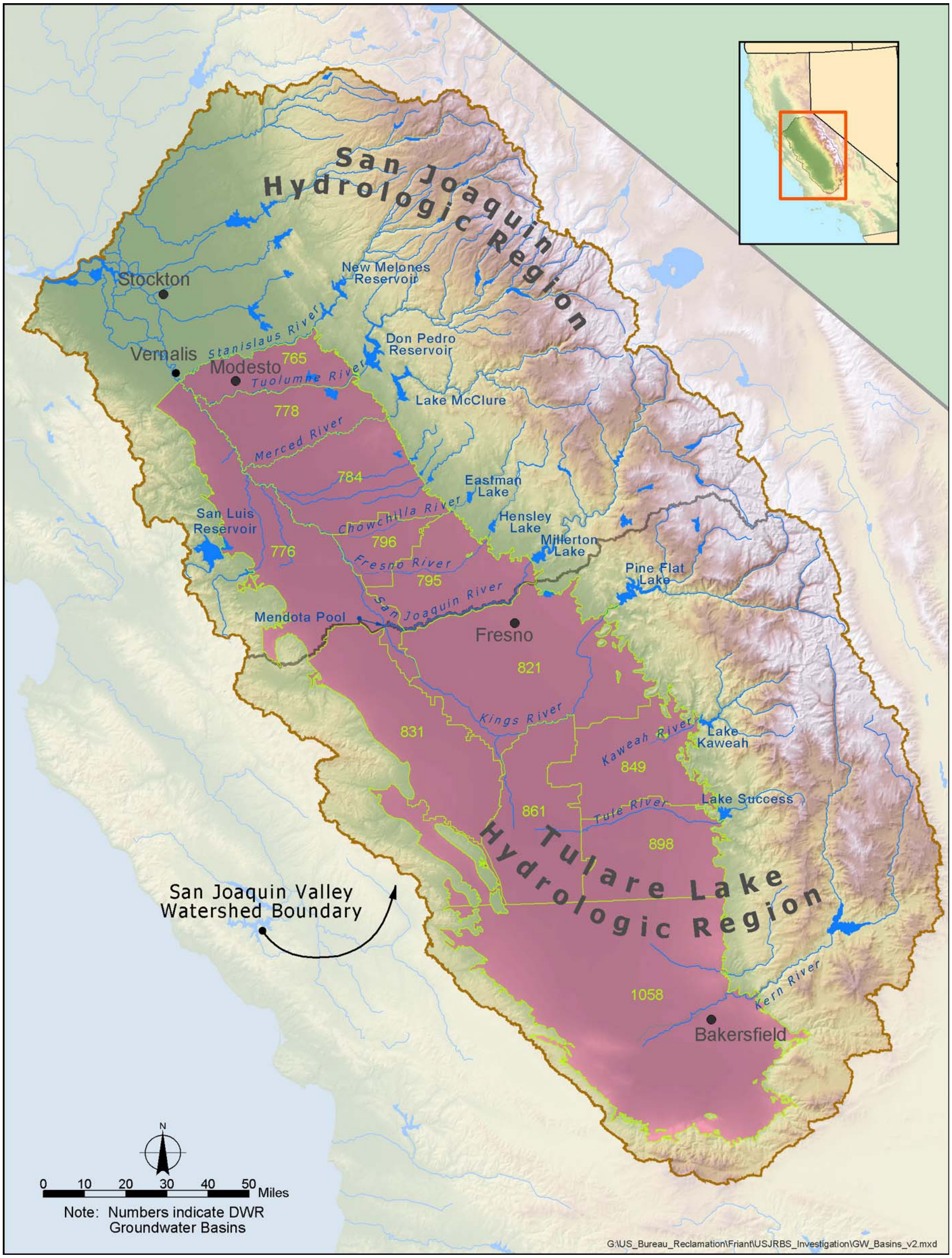

FIGURE 2-7. SAN JOAQUIN VALLEY GROUNDWATER SUBBASINS