

= Central Valley Project =

The Central Valley Project (CVP) is a federal water management project in the U.S. state of California under the supervision of the United States Bureau of Reclamation . It was devised in 1933 in order to provide irrigation and municipal water to much of California 's Central Valley ? by regulating and storing water in reservoirs in the water @-@ rich northern half of the state , and transporting it to the water @-@ poor San Joaquin Valley and its surroundings by means of a series of canals , aqueducts and pump plants , some shared with the California State Water Project (SWP) . Many CVP water users are represented by the Central Valley Project Water Association .

In addition to water storage and regulation , the system has a hydroelectric capacity of over 2 @,@ 000 megawatts , provides recreation , and provides flood control with its twenty dams and reservoirs . It has allowed major cities to grow along Valley rivers which previously would flood each spring , and transformed the semi @-@ arid desert environment of the San Joaquin Valley into productive farmland . Freshwater stored in Sacramento River reservoirs and released downriver during dry periods prevents salt water from intruding into the Sacramento @-@ San Joaquin Delta during high tide . There are eight divisions of the project and ten corresponding units , many of which operate in conjunction , while others are independent of the rest of the network . California agriculture and related industries now directly account for 7 % of the gross state product for which the CVP supplied water for about half .

Despite the benefits of the Project , many CVP operations have resulted in disastrous environmental and historical consequences . The salmon population in four major California rivers have declined as a result , and many natural river environments , such as riparian zones , meanders and sandbars no longer exist . Many archaeological and historic sites , as well as Native American tribal lands , now lie submerged under reservoirs for the CVP , which has received heavy criticism for promoting high @-@ water @-@ demand irrigated industrial farming that in turn has polluted rivers and groundwater . USBR has also been known to stretch the boundaries of many state and federal regulations in its operations of the CVP . The Central Valley Project Improvement Act , passed in 1992 , intends to alleviate some of the problems associated with the CVP with programs like the Refuge Water Supply Program .

In recent years , a combination of drought and regulatory decisions passed based on the Endangered Species Act of 1973 have forced Reclamation to turn off much of the water for the west side of the San Joaquin Valley in order to protect the fragile ecosystem in the Sacramento @-@ San Joaquin Delta and keep alive the dwindling fish populations of Central Valley rivers .

= = Overview = =

= = = Operations = = =

The CVP stores about 13 @,@ 000 @,@ 000 acre feet (16 @,@ 000 @,@ 000 dam³) of water in 20 reservoirs in the foothills of the Sierra Nevada , the Klamath Mountains and the California Coast Ranges , and passes about 7 @,@ 400 @,@ 000 acre feet (9 @,@ 100 @,@ 000 dam³) of water annually through its canals . Of the water transported , about 5 @,@ 000 @,@ 000 acre feet (6 @,@ 200 @,@ 000 dam³) goes to about 3 @,@ 000 @,@ 000 acres (1 @,@ 200 @,@ 000 ha) of irrigated agricultural fields , 600 @,@ 000 acre feet (740 @,@ 000 dam³) supplies municipal uses , and 800 @,@ 000 acre feet (990 @,@ 000 dam³) is released into rivers and wetlands in order to comply with state and federal ecological standards .

Two large reservoirs , Shasta Lake and Trinity Lake , are formed by a pair of dams in the mountains north of the Sacramento Valley . Water from both of these lakes are released into the Sacramento River , which flows to the Sacramento @-@ San Joaquin Delta , at controlled rates . There , before it can flow on to San Francisco Bay and the Pacific Ocean , some of the water is intercepted by a diversion channel and transported to the Delta @-@ Mendota Canal , which conveys water southwards through the San Joaquin Valley , supplying water to San Luis Reservoir (a SWP @-@

shared facility) and the San Joaquin River at Mendota Pool in the process , eventually reaching canals that irrigates farms in the valley . Friant Dam crosses the San Joaquin River upstream of Mendota Pool , diverting its water southwards into canals that travel into the Tulare Lake area of the San Joaquin Valley , as far south as the Kern River . Finally , New Melones Lake , a separate facility , stores water flow of a San Joaquin River tributary for use during dry periods . Other smaller , independent facilities exist to provide water to local irrigation districts .

= = History = =

Despite the rich soils and favorable weather of the 42 @, @ 000 @-@ square @-@ mile (110 @, @ 000 km²) Central Valley , inhabitants of the valley who were unfamiliar with its natural rainfall patterns and started to practice intense irrigated agriculture on the arid land soon found themselves troubled by frequent floods in the Sacramento Valley and a general lack of water in the San Joaquin Valley . The Sacramento River , which drains the northern part , receives between 60 @-@ 75 % of the precipitation in the Valley , despite the Sacramento Valley covering less area than the much larger San Joaquin Valley , drained by the San Joaquin River , which receives only about 25 % of the rainfall . Furthermore , cities drawing water from the Sacramento @-@ San Joaquin Delta faced problems in dry summer and autumn months when the inflowing water was low . In order to continue to sustain the valley 's economy , there needed to be systems to regulate flows in the rivers and equally distribute water among the north and south parts of the valley .

In 1873 , Barton S. Alexander completed a report for the U.S. Army Corps of Engineers that was the first attempt at creating a Central Valley Project . In 1904 , the Bureau of Reclamation (then the Reclamation Service) first became interested in creating such a water project , but did not get far involved until a series of droughts and related disasters occurred in the early 1920s . The State of California passed the Central Valley Project Act in 1933 , which authorized Reclamation to sell revenue bonds in order to raise about \$ 170 million for the project . Unfortunately , because of insufficient money in the state 's treasury and the coincidence with the Great Depression , California turned to the national government for funding to build the project . This resulted in several transfers of the project between California and the federal government , and between Reclamation and the Army Corps of Engineers . The first dams and canals of the project started going up in the late 1930s , and the last facilities were completed in the early 1970s . Other features of the project were never constructed , some lie partly finished , or are still awaiting authorization .

= = Facilities in the Sacramento Valley = =

= = Sacramento River = =

Shasta Division consists of a pair of large dams on the Sacramento River north of the city of Redding . The Shasta Dam is the primary water storage and power generating facility of the CVP . It impounds the Sacramento River to form Shasta Lake , which can store over 4 @, @ 500 @, @ 000 acre feet (5 @, @ 600 @, @ 000 dam³) of water , and can generate 680 MW of power . Shasta Dam functions to regulate the flow of the Sacramento River so that downstream diversion dams and canals can capture the flow of the river more efficiently , and to prevent flooding in the Sacramento @-@ San Joaquin Delta where many water pump facilities for San Joaquin Valley aqueducts are located . The Keswick Dam functions as an afterbay (regulating reservoir) for the Shasta Dam , also generating power .

The Sacramento Canals Division of the CVP takes water from the Sacramento River much farther downstream of the Shasta and Keswick Dams . Diversion dams , pumping plants , and aqueducts provide municipal water supply as well as irrigation of about 98 @, @ 000 acres (4 @, @ 000 @, @ 000 dam²) . The Red Bluff Diversion Dam diverts part of the Sacramento River into the 110 @-@ mile (180 km) Tehama @-@ Colusa Canal , the 21 @-@ mile (34 km) Corning Canal and a small reservoir formed by Funks Dam . Five pump plants take water from the canal and feed it to the

Colusa County water distribution grid .

= = = Trinity River = = =

Trinity River Division is the second large CVP department for the northern Sacramento Valley . The primary purpose of the division is to divert water from the Trinity River into the Sacramento River drainage downstream of Shasta Dam in order to provide more flow in the Sacramento River and generating peaking power in the process . Trinity Dam forms Trinity Lake , the second largest CVP water @-@ storage reservoir , with just over half the capacity of Shasta and a generating capacity of 140 MW . Lewiston Dam , downstream of Trinity Dam , diverts water into the Clear Creek Tunnel , which travels to empty into a third reservoir , Whiskeytown Lake on Clear Creek , a tributary of the Sacramento River , generating 154 MW of power in the process . Whiskeytown Lake (formed by Clair . A Hill Whiskeytown Dam) in turn provides water to the Spring Creek Tunnel , which travels into the lowermost extreme of Spring Creek , a stream that flows into Keswick Reservoir , generating another 180 MW of electricity . From there the water from the Trinity River empties into Keswick Reservoir and the Sacramento River . In 1963 , the Spring Creek Debris Dam was constructed just upstream of the outlet of the Spring Creek Tunnel , to prevent acid mine drainage from the Iron Mountain Mine from continuing downstream and contaminating the river .

= = = American River = = =

The American River Division is located in north @-@ central California , on the east side of the Great Central Valley . Its structures use the water of the American River , which drains off the Sierra Nevada and flows into the Sacramento River . The division is further divided into three units : the Folsom , Sly Park and Auburn @-@ Folsom South . The American River Division stores water in the American River watershed , to both provide water supply for local settlements , and supply it to the rest of the system . The dams also are an important flood control measure . Hydroelectricity is generated at Folsom and Nimbus dams , and marketed to the Western Area Power Administration .

The Folsom Unit consists of Folsom Dam , its primary water storage component , and Nimbus Dam , which serves as its downstream forebay . The Folsom Dam is located on the American River , and stores 1 @, @ 010 @, @ 000 acre feet (1 @, @ 250 @, @ 000 dam³) of water in its reservoir , Folsom Lake . Folsom Lake covers 11 @, @ 550 acres (4 @, @ 670 ha) and is located inside the Folsom Lake State Recreational Area . Eight additional earthfill saddle dams are required to keep the reservoir from overflowing . The dam also generates 200 MW from three generators . About 7 mi (11 km) downstream of Folsom Dam is the Nimbus Dam , forming Lake Natoma . The dam generates 7 @. @ 7 MW from two Kaplan turbines on the north side of the river . The Nimbus Fish Hatchery is located downstream of Nimbus Dam , to compensate for the two dams ' destruction of American River spawning grounds .

The Sly Park Unit includes Sly Park Dam , Jenkinson Lake , the Camp Creek Diversion Dam , and two diversion tunnels . The Sly Park Dam and its similarilly @-@ sized auxiliary dam form Jenkinson Lake , which covers 650 acres (260 ha) . Jenkinson Lake feeds the Camino Conduit , a 5 mi (8 @. @ 0 km) aqueduct . The Camp Creek Diversion Dam diverts some water from Camp Creek into Jenkinson Lake .

The third unit is the Auburn @-@ Folsom South Unit , consisting of several dams on American River tributaries . These include Sugar Pine Dam and Pipeline (supplying water to Foresthill) , and the uncompleted Folsom South Canal . The primary component of the unit , concrete thin @-@ arch Auburn Dam , was to be located on the North Fork of the American , but was never built because of the significant risk of earthquakes in the area , and general public opposition to the project . However , the high Foresthill Bridge , built as part of the preliminary work for Auburn Dam , still stands . County Line Dam , about 10 miles (16 km) south of Folsom Dam , was also never built .

= = Facilities in the San Joaquin Valley = =

== Delta and canal system ==

One of the most important parts of the CVP's San Joaquin Valley water system is the series of aqueducts and pumping plants that take water from the Sacramento @-@ San Joaquin Delta and send it southwards to supply farms and cities . The Delta Cross Channel intercepts Sacramento River water as it travels westwards towards Suisun Bay and diverts it south through a series of man @-@ made channels , the Mokelumne River , and other natural sloughs , marshes and distributaries . From there , the water travels to the C.W. Bill Jones Pumping Plant , which raises water into the Delta @-@ Mendota Canal , which in turn travels 117 miles (188 km) southwards to Mendota Pool on the San Joaquin River , supplying water to other CVP reservoirs about midway . A facility exists at the entrance of the pump plant in order to catch fish that would otherwise end up in the Delta @-@ Mendota Canal . A second canal , the Contra Costa Canal , captures freshwater near the central part of the delta , taking it 48 miles (77 km) southwards , distributing water to the Clayton and Ygnacio Canals in the process , and supplying water to Contra Loma Dam , eventually terminating at Martinez Reservoir .

== San Joaquin River ==

The CVP also has several dams on the San Joaquin River ? which has far less average flow than the Sacramento ? in order to divert its water to southern Central Valley aqueducts . The Friant Dam , completed in 1942 , is the largest component of the Friant Division of the CVP . The dam crosses the San Joaquin River where it spills out of the Sierra Nevada , forming Millerton Lake , which provides water storage for San Joaquin Valley irrigators as well as providing a diversion point for a pair of canals , the Friant @-@ Kern Canal and the Madera Canal . The Friant @-@ Kern Canal sends water southwards through the Tulare Lake area to its terminus at Bakersfield on the Kern River , supplying irrigation water to Tulare , Fresno , and Kern counties . The Madera Canal takes water northwards to Madera County , emptying into the Chowchilla River .

== Stanislaus River ==

On the Stanislaus River , a major tributary of the San Joaquin , lies the relatively independent East Side Division and New Melones Unit of the CVP . The sole component of the division / unit is New Melones Dam , forming New Melones Lake , which , when filled to capacity , holds nearly 2 @,@ 400 @,@ 000 acre feet (3 @,@ 000 @,@ 000 dam³) of water , about equal to the storage capacity of Trinity Lake . The dam functions to store water during dry periods and release it downstream into the northern San Joaquin Valley according to water demand . The dam generates 279 MW of power with a peaking capacity of 300 MW .

== Offstream storage and aqueducts ==

The CVP has a significant amount of facilities for storing and transporting water on the west side of the San Joaquin Valley , in the foothills of the California Coast Ranges . The West San Joaquin Division and San Luis Unit consist of several major facilities that are shared with the federal California State Water Project (SWP) . San Luis Dam (or B.F. Sisk Dam) is the largest storage facility , holding 2 @,@ 000 @,@ 000 acre feet (2 @,@ 500 @,@ 000 dam³) of water . Although called an offstream storage reservoir by BoR , the reservoir floods part of the San Luis Creek valley . San Luis Creek , however , is not the primary water source for the reservoir . Downstream of San Luis Reservoir is O 'Neill Forebay , which is intersected by the Delta @-@ Mendota Canal , a separate CVP facility . Water is pumped from the canal into the Forebay and uphill into San Luis Reservoir , which functions as an additional water source during dry periods .

Water released from San Luis and O 'Neill reservoirs feeds into the San Luis Canal , the federally built section of the California Aqueduct , which carries both CVP and SWP water . The San Luis

Canal terminates at Kettleman City , where it connects with the state @-@ built section of the California Aqueduct . With a capacity of 13 @,@ 100 cubic feet per second (370 m³ / s) , it is one of the largest irrigation canals in the United States . The Coalinga or Pleasant Valley Canal branches off the San Luis Canal towards the Coalinga area . A pair of separate dams , Los Baños Detention Dam and Little Panoche Detention Dam , provide flood control in the Los Baños area . The San Luis Drain was a separate project by BoR in an attempt to keep contaminated irrigation drainage water out of the San Joaquin River , emptying into Kesterson Reservoir where the water would evaporate or seep into the ground . Because of environmental concerns , the system was never completed .

The CVP also operates a San Felipe Division to supply water to 63 @,@ 500 acres (25 @,@ 700 ha) of land in the Santa Clara Valley west of the Coast Ranges . San Justo Dam stores water diverted from San Luis Reservoir through the Pacheco Tunnel and Hollister Conduit , which travel through the Diablo Range . A separate canal , the Santa Clara Tunnel and Conduit , carries water to the Santa Clara Valley .

= = Controversy = =

Once , profuse runs of anadromous fish ? salmon , steelhead , and others ? migrated up the Sacramento and San Joaquin Rivers to spawn in great numbers . The construction of CVP dams on the two rivers and many of their major tributaries ? namely Friant Dam and Shasta Dam ? mostly ended the once @-@ bountiful Central Valley salmon run . From north to south , the Sacramento upriver of Shasta Dam , the American upriver of Folsom Dam , the Stanislaus upriver of New Melones Dam , and the San Joaquin upriver of Mendota ? have become inaccessible to migrating salmon . In three of these cases , it is because the dams are too high and their reservoirs too large for fish to bypass via fish ladders . The San Joaquin River , however , had a different fate . Almost 60 mi (97 km) of the river is dry because of diversions from Friant Dam and Millerton Lake . Even downstream of Mendota , where the Delta @-@ Mendota Canal gives the river a new surge of water from the Sacramento @-@ San Joaquin Delta , irrigation runoff water , contaminated with pesticides and fertilizer , has caused the river to become heavily polluted . To make matters worse , efforts by the California Department of Fish and Game to route the San Joaquin salmon run into the Merced River in the 1950s failed , because the salmon did not realize the Merced as their " home stream " .

Not only on the San Joaquin River have CVP facilities wreaked environmental havoc . On the Sacramento River , Red Bluff Diversion Dam in Tehama County , while not as large or as impacting as Friant Dam , was once a barrier to the migration of anadromous fish . The original fish passage facilities of the dam continually experienced problems from the beginning of operation in 1966 , and introduced species that prey on young smolt often gather at the base of the dam , which reduced the population of outmigrating juvenile salmon into the Pacific . The Red Bluff Diversion Dam has since been replaced with a fish screen and pumping plant , thus allowing unimpaired passage through Red Bluff . Further upstream , Keswick and Shasta Dams form total barriers to fish migration . Even out of the Central Valley watershed , the CVP 's diversion of water from the Trinity River from Lewiston Dam into Whiskeytown Lake has significantly hurt the Klamath River tributary 's salmon run . Over three @-@ quarters of the river 's flow is diverted through the Clear Creek Tunnel and away from the Trinity River , causing the river below the dam to become warm , silty , shallow and slow @-@ flowing , attributes that hurt young salmon . Furthermore , the Trinity Dam forms a blockade that prevents salmon from reaching about 109 miles (175 km) of upriver spawning grounds . In the early years of the 21st century , the Bureau of Reclamation finally began to steadily increase the water flow downstream from Lewiston Dam . While providing less water for the CVP altogether , the new flow regime allows operations to meet the line drawn by Reclamation itself in 1952 stating that at least 48 % of the river 's natural flow must be left untouched in order for Trinity River salmon to survive . The lack of flow in the Trinity up to then was also a violation of the authorization that Congress made over the operation of the dam . The " ... legislation required that enough be left in the Trinity for in @-@ basin needs , including preservation of the salmon fishery . "

In the early years of the 21st century , the Bureau of Reclamation studied the feasibility of raising

Shasta Dam . One of the proposed heights was 18 @. @ 5 feet (5 @. @ 6 m) greater than its current size , thus increasing the storage capacity of Shasta Lake by 636 @, @ 000 acre feet (784 @, @ 000 dam³) . The agency also proposed a smaller raise of 6 @. @ 5 ft (2 @. @ 0 m) that would add 290 @, @ 000 acre feet (360 @, @ 000 dam³) . Previously , a 200 ft (61 m) raise of the dam , increasing storage to 13 @, @ 890 @, @ 000 acre feet (17 @, @ 130 @, @ 000 dam³) , was considered , but deemed uneconomical . When Shasta Dam was first built , it was actually planned to be two hundred feet higher than it is now , but Reclamation stopped construction at its present height because of a shortage of materials and workers during World War II . The raising of the dam would further regulate and store more Sacramento River water for dry periods , thus benefiting the entire operations of the CVP , and also generating additional power . However , the proposed height increase was fought over for many reasons . Raising the dam would cost several hundred million dollars and raise the price of irrigation water from Shasta Lake . It would drown most of the remaining land belonging to the Winnemem Wintu tribe ? 90 percent of whose land already lies beneath the surface of the lake ? and flood several miles of the McCloud River , protected under National Wild and Scenic River status . Buildings , bridges , roads and other structures would have to be relocated . The added capacity of the reservoir would change flow fluctuations in the lower Sacramento River , and native fish populations , especially salmon , would suffer with the subsequent changes to the ecology of the river .

New Melones Dam has come under even greater controversy than Shasta Dam , mainly because of the project 's conflicts with federal and state limits and its impact on the watershed of the Stanislaus River . The original Melones Dam , submerged underneath New Melones Lake (hence the name New Melones Dam) is the source of one of these problems . The disused Melones Dam blocks cold water at the bottom of the lake from reaching the river , especially in dry years when the surface of the lake is closer to the crest of the old dam . This results in the river below the dam attaining a much higher temperature than usual , hurting native fish and wildlife . To solve this problem , Reclamation shuts off operations of the dam 's hydroelectric power plant when water levels are drastically low , but this results in power shortages . Originally , after the dam was constructed , the State of California put filling the reservoir on hold because of enormous public opposition to what was being inundated : the limestone canyon behind the dam , the deepest of its kind in the United States , contained hundreds of archaeological and historic sites and one of California 's best and most popular whitewater rafting runs . Thus the reservoir extended only to Parrot 's Ferry Bridge , 9 mi (14 km) below its maximum upriver limit , until the El Niño event of 1982 @-@ 1983 , which filled it to capacity within weeks and even forced Reclamation to open the emergency spillways , prompting the state and federal governments to repeal the limits they had imposed on the reservoir . Furthermore , the project allows a far smaller sustainable water yield than originally expected , and Reclamation calls the dam " a case study of all that can go wrong with a project " .

In response to these environmental problems , Congress passed in 1992 the Central Valley Project Improvement Act (CVPIA) , Title 34 of Public Law 102 @-@ 575 , to change water management practices in the CVP in order to lessen the ecological impact on the San Joaquin and Sacramento Rivers . Actions mandated included the release of more water to supply rivers and wetlands , funding for habitat restoration work (especially for anadromous fish spawning gravels) , water temperature control , water conservation , fish passage , increasing the service area of the CVP 's canals , and other items .