

DEVELOPING NEW WATER SUPPLIES IN FRESNO IRRIGATION DISTRICT THE WALDRON BANKING FACILITIES

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ABSTRACT

Fresno Irrigation District (FID) serves irrigation water to approximately 245,000 acres including the Cities of Fresno and Clovis, in California's Central San Joaquin Valley. As Clovis has developed they have looked for ways to diversify their water supply portfolio. Until recently, this mainly consisted of groundwater wells with some surface water supplies coming from FID. Clovis, in an effort to increase their dry year supplies, partnered with FID to develop the Waldron Banking Facilities.

Through the agreement developed between Clovis and FID, Clovis provided half of the capital to develop the project in return for half of the project yield. Clovis also has the first right of refusal, on an annual basis, for any yield developed from the project. The Waldron Banking Facilities are comprised of three groundwater banking facilities located in the western portion of the District. In exchange for the banked supplies, FID then provides an equivalent amount of surface water to Clovis (in the eastern portion of FID). To develop a new water supply for the City and FID, during wet years and other times when surplus surface water supplies are available these supplies are routed to the groundwater recharge basins. In dry years, these banked supplies are then recovered from the aquifer, and delivered to FID growers.

Two of the recharge basin sites were existing regulation basins, which were significantly expanded to add recharge capabilities. One of the sites is new, and placed at the bifurcation of one of FID's laterals. The recharge basin sites were strategically selected in order to provide an added benefit as regulation and storage basins that could be utilized during the irrigation season.

The project was built over the course of three years, in phases. Now complete, the project includes approximately 250 acres of recharge basins, new measurement and control sites, seven recovery wells, and a network of monitoring wells. This paper will discuss the financial aspects of the project, project planning issues, design considerations, and how the twelve construction contracts were developed, managed and executed.

NEW SUPPLIES

The Waldron Banking Facilities Project (Project) is an agricultural and urban project that provides water to urban suppliers, agricultural suppliers, and facilitates the environmental benefits of improving a river fishery. The Project is divided into three separate facilities

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totaling 250 acres (Waldron – 160 ac., Empire – 32 ac., Lambrecht – 58 ac.). Figure 1 is a map of the District showing the locations of the three sites, and the channels used to convey surface water to them.

The new supplies are developed by capturing flood waters and surplus supplies in above normal years and recovering them during below normal years, rather than letting those supplies go unused during the above normal years. The Project utilizes a combination of flood water, fisheries management water, allocations from the San Joaquin River during above normal years, and flood water from the San Joaquin River. A brief description of each source is described below.

Local Stream Flood Water. This includes water from Big Dry Creek, Mud Creek, Fancher Creek, Redbank Creek and Dog Creek.

Local Storm Water. Some of the storm water that falls within the Fresno-Clovis area is diverted into FID facilities as part of an agreement between Fresno Metropolitan Flood Control District (FMFCD), Clovis, Fresno, the County of Fresno and FID to route storm waters through the urban area. Stormwater is either diverted directly into FID's facilities, or collected into FMFCD storm basins and later pumped into FID's facilities.

Kings River Flood Water. Kings River flood water was estimated based on flow records kept by the Kings River Water Association for the James Bypass. These flows represent only the significant Army Corps of Engineers directed flood release from Pine Flat Dam, and do not account for minor flood releases of downstream intermittent stream flows.

San Joaquin River Section 215 Water. Flood water, called Section 215 water, from the San Joaquin River has also historically been made available to agencies that have the ability deliver it. FID diverts San Joaquin River water into its facilities from the Friant-Kern Canal.

Kings River Fisheries Management Program Framework Agreement Water. Under an agreement entitled, the *Kings River Fisheries Management Program Framework Agreement*, the District is required to maintain a minimum flowrate in certain sections of the Kings River to help establish a fishery along the river. FID is currently obligated to route a minimum of 45cfs daily during months when flows are below 90cfs to the headgates of FID's Fresno Canal.

San Joaquin River Class II Water. FID currently holds a contract for 75,000 AF of Class II San Joaquin River water that it receives from the Friant-Kern Canal. Class II water is not made available in below-normal years.

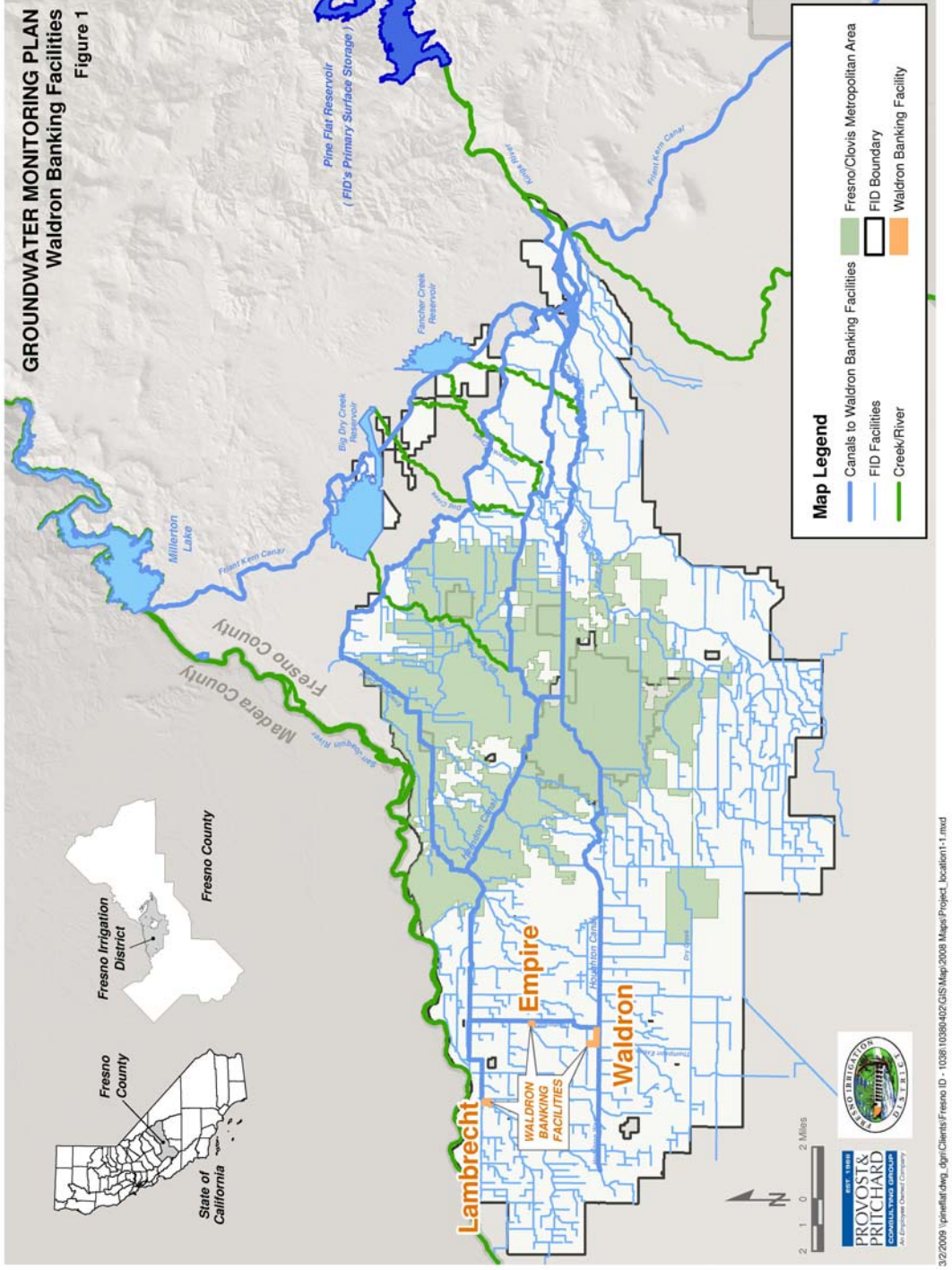


Figure 1. Map of the Waldron Banking Facilities

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A review of the records from the 50 years prior to the study showed that on average approximately 11,500 AF could be routed to the Project for recharge. Leaving 10% of the recharged water behind to account for losses and mitigate potential impacts to adjacent landowners, the Project would net approximately 10,350 AF on an average annual basis.

PROJECT FUNDING

While 10,350 AF of supply represents about 2 to 3% of FID's dry year supply from the Kings River, it represents a significant dry year supply to the City of Clovis (Clovis). Clovis typically uses 25 TAF in a normal year, 70% is derived from surface water and 30% from groundwater wells.

In planning for new growth, Clovis recognized the need to develop a new water supply and further increase their dry year supply. This need for new water supplies led Clovis to partner with FID to develop the Project. As partners in the Project, Clovis agreed to fund half of the capital cost of the Project in exchange for half of the Project's yield. Clovis is given first right of refusal for water each year. Clovis is guaranteed 90% of the available banked water in any given year, up to 9,000 AF. If Clovis does not take water in a year, FID has the ability to use the water to serve their growers.

In 2000, California voters approved Proposition 13, the *Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Act* (Prop 13). FID submitted a grant application under Prop. 13's Groundwater Storage Program to fund their half of the Project's costs. FID was awarded the grant and signed the contract to commence with the Project in 2004. The contract required that the Project be finished by the end of 2008.

DESIGN AND CONSTRUCTION

Design

The Project's design took into account a number of factors such as how quickly to get water into the basins, and recovered from the aquifer. In addition, the District wanted to make the best use of its capital investment, so each of the sites were designed to include flow regulation capabilities. Upgrades to the control gates and SCADA improvements were included.

Location. The Projects were sited such that they would:

1. Have geology favorable to groundwater banking.
2. Be far enough upstream in the District's distribution system that all of the recovered water could be used to satisfy downstream irrigation demands.
3. Be strategically located to regulate flows on main canals.

Recharge. The sites' primary purpose is water banking with flow regulation and operational storage a secondary benefit. Geologic explorations of each site were

conducted to verify the shallow soil profiles would be conducive to recharge. Explorations of the deeper aquifer were also performed to determine the zones in which to draw the stored water. The geologic investigations and infiltration tests showed the sites' could sustain recharge rates between 0.35 and 0.5 ft per day. The recharge goal between the three sites was to place up to 13,000 AF (in anticipation of above average conditions) in the ground in approximately 8 months, or an average of 1,600 AF per month (0.21 feet per day). All of the sites had estimated sustainable recharge rates which were higher than the 0.21 feet per day needed which gave the District the ability to shorten the recharge season when needed.

Recharge could come in highly irregular flows and short bursts. Also when recharge basins when being filled for the first time will percolate at much higher rates. Recognizing the potential for the need to take high flows in short bursts, many design features were incorporated. The turnouts to each site were designed for relatively high flows, the sites divided into smaller cells, and sediment handling.

Table 1 below lists the sustainable recharge rate, acreage, and delivery inflow for each site. As the table shows, the design inflows are a minimum of about four times higher than the sustainable recharge flow. At the Empire and Lambrecht sites, the design inflows were based on the maximum flow that could be routed to the sites.

Table 1. Summary of Recharge and Inflow Rates.

Site	Sustainable Recharge Rate (ft/day)	Acreage	Sustainable Recharge Inflow (cfs)	Design Inflow (cfs)
Waldron	0.35	160	32	130
Empire	0.35	32	6	60
Lambrecht	0.50	58	15	90

Each site was divided into a number of cells. This gives the District the operational flexibility to fill basins in a sequence which would maximize surface storage using the least amount of acreage. This reduces evaporation losses and helps to minimize maintenance activities such as discing and spraying to control weeds, in years when large volumes of recharge water is not available. Without dividing the sites into smaller cells, water would be spread over much larger areas.

Also, given the source of the recharge water (floodwater, urban stormwater) it was anticipated that high sediment loads and trash would be delivered with the water. To mitigate the sediment one cell at each site was dedicated as a sediment cell. Dedication of the sedimentation cell also keeps sediment in one portion of the facility reducing maintenance, and reducing the potential for fine sediment sealing off the recharge cells. The sediment cell was designed with partial levees to create a labyrinth in which to slow water flow through the basin. The discharge out of the sedimentation cell to the other cells utilized a weir. This was done so that water from the top one foot of the sediment cell (the clearest water) would be delivered to the other recharge cells. Figure 2 is an example of the sedimentation cell configuration.

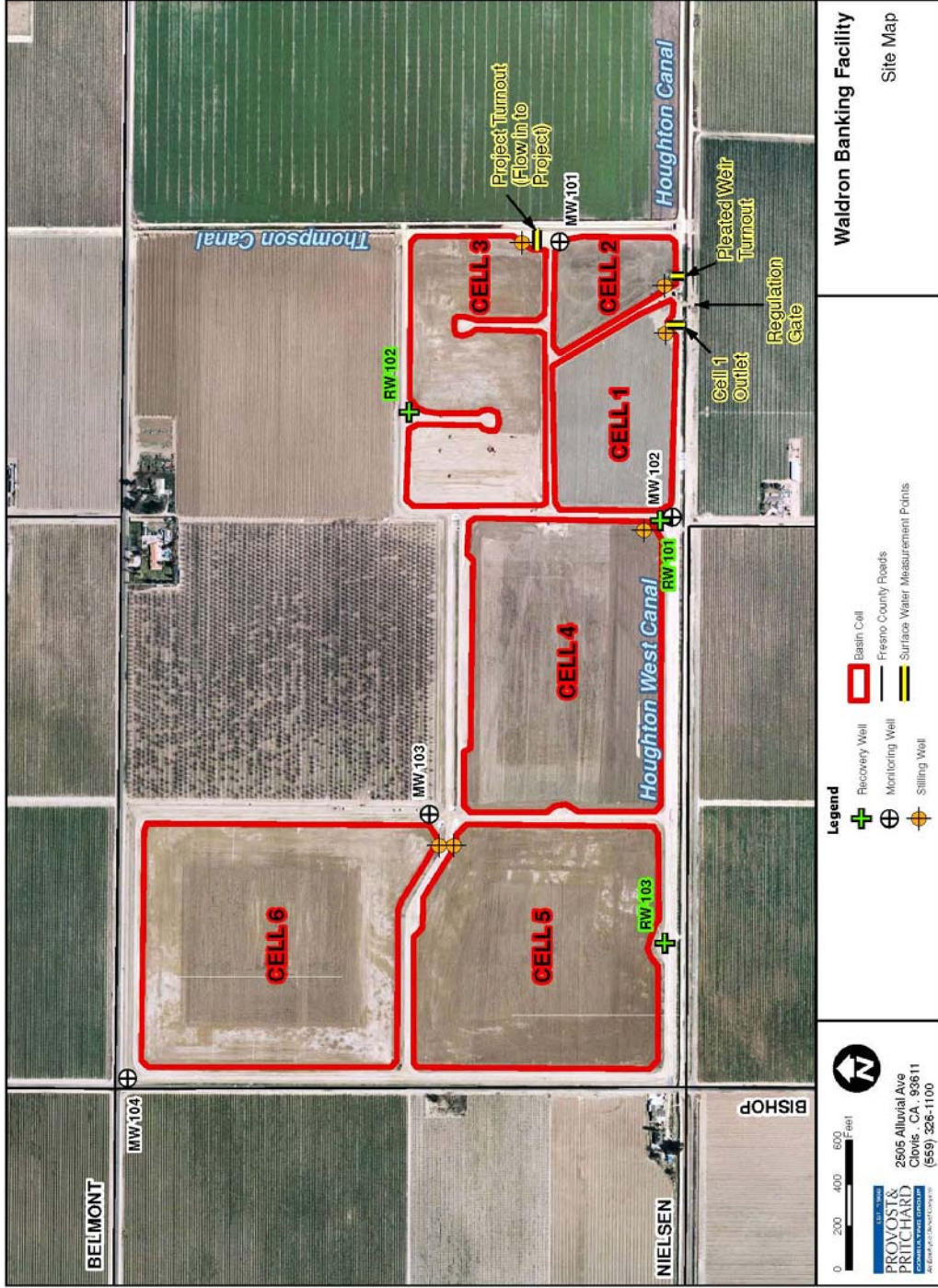


Figure 2. Site Layout

SCADA and Controls. Each site was located at a bifurcation in a canal system. The Waldron and Lambrecht sites had regulation capabilities. The Empire site added the benefit of a third regulation site. At each location, flows were able to be “reset” at each canal’s headgate. Excess flows are directed into the basin through the use of a long-crested weir upstream of the canal headgates. Deficits in flows are made up through discharges from the basins to one of the canals at the bifurcation. Flow measurements are taken to control the gates and provide operational information. The flows are also totalized so that the net deliveries to the basins can be recorded and properly credited towards recharge.

The SCADA system not only controls the gates, but monitors and reports much of the data about the site to the District Office. Information related to the canal water levels, canal flows, deliveries into and out of the sites, water levels in each recharge cell, recovery well pumping flows, and power consumption. In the future, the District plans to put data loggers in each of the on-site wells to collect daily groundwater level information, and potentially add remote starting capabilities to the wells.

Recovery. Seven wells were built for the Project. They can recover up to 12,000 AF of stored water in four months. All three sites are in cropped areas and many of the growers have their own wells. The wells can pump between 2,000 and 4,000 gpm with average pumping depths of about 180 feet. All of the wells are equipped with flowmeters that totalize the amount pumped. The recovery wells were drilled at lower depths than the surrounding wells in an effort to minimize interference. Typically, the nearby irrigation wells are completed to a depth around 300 to 400 feet. The recovery wells were completed to a minimum depth of 500 feet. Table 2 below lists the recovery capability for each site.

Table 2. Recovery Ability Summarized by Site

Site	Recovery Flow (cfs)	Number of Wells
Waldron	22	3
Empire	6	1
Lambrecht	22	3

A monitoring network was also developed around the sites. The network involves on-site and off-site wells. A total of 10 monitoring wells were built at the sites to collect more detailed information about how the Project is affecting local groundwater conditions. The District collects water levels at least monthly in the monitoring network. The data is used to determine groundwater elevations, and determine groundwater flow direction. This includes determining the extents of pumping depression or recharge mounds, if any, which could result from the Project operations. Figure 3 shows both the recovery wells and monitoring wells at the Waldron Site. Groundwater flow in this area is typically in the southwestern direction.

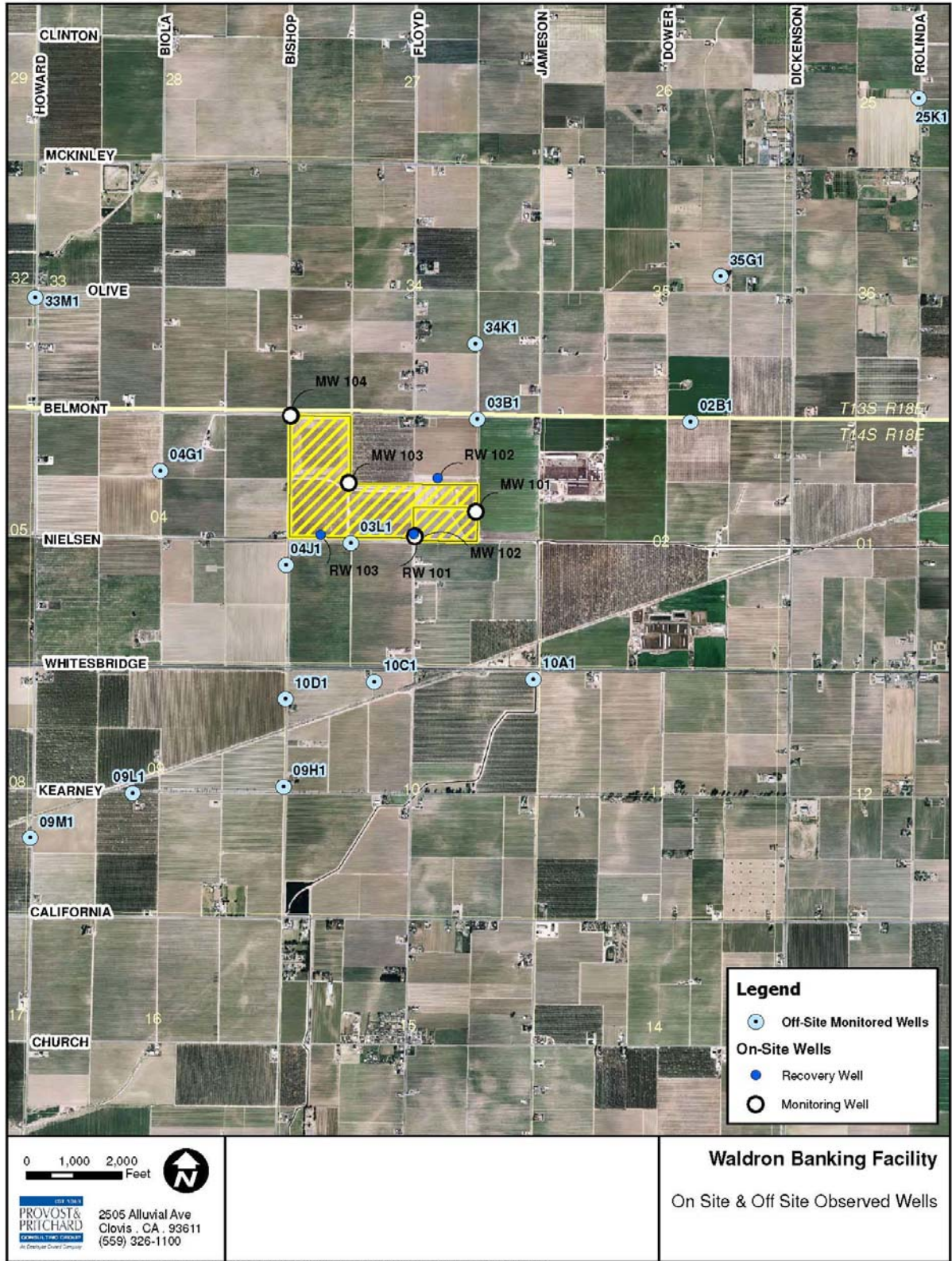


Figure 3. On Site and Off Site Observed Wells

Monitoring Committee. Given the fact that groundwater banking was new to FID, they wanted to involve adjacent landowners in the operations. A monitoring committee was established for the entire Project which included four representatives from the areas around each groundwater banking sites, and representatives from FID and Clovis. The monitoring committee meets at least annually to review the operational data, including recharged volumes, recovered volumes, groundwater levels, and groundwater quality. The main goal of the monitoring committee is to review the data and provide input related to the operations of the Project.

Construction

At the time the Project was ready for public bidding, housing developments were in their prime. This pushed labor and materials costs higher than they had been when the Project was first contemplated. This led the District to break the Project into multiple contracts, based on type of work. This was an attempt to secure lower prices by contracting directly with the companies doing the work, instead hiring a general contractor who would then subcontract the work. In total twelve contracts were bid, awarded, and completed. In general the contracts were broken up into the following categories:

- Demolition and Site Preparation
- Earthwork
- Structures
- Well Drilling
- Well Equipping

Because the work was split into multiple contracts, planning the sequence of which contracts would be underway at any time was critical. Construction began in January 2006 and was recently completed in October 2008. The construction for the Project followed typical construction procedures and methodologies. Typically no more than two contractors were working on-site at any time.

Demolition and Site Preparation work started the construction phase of the Project. At each of the sites, vineyards had to be cleared and irrigation systems abandoned. It was critical that the large root from the vines and all of the irrigation lines be removed so as not to compromise the integrity of the levees. Earthwork commenced shortly thereafter. The earthwork contractor moved approximately 150,000 cubic yards of material to build the Project levees. To make this work more cost-effective, the contractors were allowed to make deeper cuts close to the levees rather than skimming from the surface of each cell. Earthwork was also scheduled during the irrigation season so that construction water could be provided to the contractor, thus saving money.

Upon completion of the earthwork contract the structures and first round of well drilling work commenced. The structures work started just before the District's maintenance

season when all of the canals are dewatered for maintenance. Well drilling was split into two contracts to see what flows could be produced by the first wells, and determine how many wells would be needed to meet the recovery flow rate goals. To finish the work, the second well drilling contract was let and then the well equipping contracts.

SUMMARY

In seven years, FID and Clovis were able to bring the Project from a conceptual study to a fully operational facility yielding new water supply. In just three years of limited operations, approximately 20,000 AF have been recharged between the facilities. California faces many political and environmental challenges and constraints along with an ever increasing competition for water. Projects like this, where agricultural and urban interests can partner together to develop new supplies will continue to be necessary in order to sustain urban growth and continue to meet the needs of the agricultural industry.