SYSTEM-WIDE CONJUNCTIVE WATER MANAGEMENT

DESIGNING SUCCESSFUL GROUNDWATER BANKING PROGRAMS IN THE CENTRAL VALLEY:

LESSONS FROM EXPERIENCE

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The Natural Heritage Institute is a non-profit natural resource conservation organization comprised of technical and legal specialists and dedicated to the improvement of the laws and institutions that manage our natural heritage both domestically and internationally.

INTRODUCTION

The Central Valley of California, one of the most transformed landscapes on the planet, reveals its history in the manipulation of its waters. The integrated Central Valley water system encompasses most of California, less the drainages east of the Sierra and west of the coastal ranges. Functionally, it runs from Trinity, Shasta and Plumas Counties in the north to the Mexican border in the south and comprises the largest complex of dams, pumps and canals in the world.

As for over-subscribed water systems throughout the American West, policymakers in the Central Valley of California must now devise ways to expand the benefits of a fixed endowment of water and its storage and delivery infrastructure to meet future needs in every sector. The imperative to find "new" water is driven by Congressional mandates, the CALFED Bay Delta Restoration Program planning process and stakeholder demands. Under the Central Valley Project Improvement Act (CVPIA), the Department of Interior is commanded to "develop and implement" a "least-cost" program to supplement and replace the Central Valley Project (CVP) water dedicated to fish and wildlife restoration through, inter alia, improvements in reservoir operations, water banking and conjunctive use (§§3406(b)(3) and 3408(j)). The CVPIA's Anadromous Fish Restoration Program (AFRP) will require water for instream flow enhancement. The new Environmental Water Account—perhaps the singular triumph of the CALFED Bay-Delta Restoration Program—will require some 350,000 acre-feet of water per year for restoration of aquatic habitats. CALFED's commitment to restoration of fishery flows in the San Joaquin River below Friant Dam will also require "new" water if current contract deliveries from the Friant Unit of the CVP are to be maintained. The CVP is unable to make full deliveries under its contracts with agricultural water districts south of the delta in most years. And, municipal water supply agencies are seeking dilution water to improve water quality instead of making large investments in treatment facilities. In response to these needs, a core objective of the CALFED Program is to improve water supply reliability for all sectors. Groundwater banking comprises the largest component of the new storage envisioned.

This paper illuminates the institutional arrangements for actualizing that opportunity. Particularly, we are interested in arrangements to integrate groundwater storage into the existing surface water storage and delivery system of the Central Valley. Such groundwater banking projects would actively recharge the aquifer with imported foreign surface water originating from a source not hydrologically connected to the groundwater banking site.[1] In this important respect, such projects are to be distinguished from the conventional development of native groundwater for purely local use.

The scenario of greatest interest involves reoperation of the eleven existing terminal reservoirs of the Central Valley tributaries. These reservoirs are owned and operated by the U.S. Bureau of Reclamation, the California Department of Water Resources, the U.S. Army Corps of Engineers and several municipal and agricultural water districts. The storage and release regime of these reservoirs would be modified to allow them to capture a larger fraction of the peak flow events as they move through the system, and carry this water over for use in years of lower than average run-off. This additional storage capacity would be created by moving a substantial portion of the reservoir water into groundwater basins with currently unutilized aquifer storage capacity, such as cones of depression from historic groundwater exploitation. Thus, reservoirs would be reoperated to provide source water to recharge the groundwater banks with water that would otherwise spill for flood control. The sequence could also be reversed in the case of full aquifers, most commonly found in the Sacramento Valley, such that native groundwater is first extracted and exported to create storage space, and then subse-

quently replenished from an imported surface source. The imported or "new" water would be injected underground or applied to spreading grounds where it could percolate into the aquifer. Later, the banked water would be recovered and reintegrated into the existing (or enhanced) water delivery system to provide supply benefits to non-overlying users during drier years. The recharge and recovery would be conducted by (or under contract with) an overlying landowner, water district or groundwater management authority. The Kern Water Bank and the Arvin Edison/MWD arrangement are examples of this type of conjunctive use project.

Alternatively, the recharge could be accomplished through substitution of surface water supplies for existing groundwater usage, with recovery accomplished by reversing the arrangement. From an aquifer mass balance standpoint, such *in lieu* storage arrangements are indistinguishable from active recharge. In effect, groundwater users agree to forbear pumping groundwater during wetter years and instead use surface water imports to which they would not otherwise have access. The conjunctive use program then purchases groundwater pumped by overlying landowners during drier years, over and above their customary extractions, and exports it from the basin. This differs from groundwater substitution projects, which do not involve the export of groundwater or its replenishment through imported recharge water. In lieu banking may be more appropriate than recharge by percolation in areas with low-permeability soils, such as the east side of the Sacramento Valley. The Semitropic Groundwater Banking Program in the San Joaquin Valley is an example of *in lieu* recharge.

Active recharge and *in lieu* groundwater banking must, as a practical necessity, be developed with the cooperation and consent of overlying landowners, water districts and groundwater management authorities. Indeed, the recharge and recovery operations will generally be conducted by such local interests. These arrangements will require the consent and participation of at least four types of entities: (1) the reservoir owner who would consent to change the current storage and release regime in order to generate source water for groundwater banking; (2) the local groundwater management authority which would participate by, in effect, "renting" aquifer space for temporary storage of the imported recharge water;[2] (3) the operators of the infrastructure needed to move the water from reservoir to groundwater bank to point of end-use; and (4) the end-use beneficiaries who would pay for the new yield and thereby generate a revenue stream to compensate the reservoir owner and the groundwater banker. With the concurrence of these stakeholders, a project is likely to succeed in spite of the institutional complexities described in this paper. Without that concurrence, a project is likely to fail even if these complexities are overcome.

The terms, conditions and assurances to satisfy the second category of participant—the local groundwater management authority and its existing groundwater users—are at once the most elusive and the most critical elements for success. "Local control" of the banking operations is axiomatic but not well defined in practice. Institutional design is an exercise in defining who controls what and how, that is, in detailing the mechanisms for local control. Designing workable mechanisms for local operation of groundwater banks should be markedly easier where the local groundwater users do not have rights to the recovered groundwater because it has been imported into the basin, compared to the case where local groundwater is developed for export.

There is no realistic prospect of "outside" interests imposing a water bank on reluctant local communities. The need for institutional arrangements that can avoid or arbitrate disputes arises not because of the threat that "outsiders" may seek to impose a water bank on unwilling local groundwater communities, but because of the very real possibility of disagreements among the local landowners themselves. Indeed, that has been the etiology of most

groundwater banking controversies historically in California, such as the Department of Water Resources' 1994 Emergency Drought Water Bank in Butte County and the Madera Ranch and Azurix projects in Madera County. However, projects will also require consensual contractual arrangements with to two types of "outsiders": a source water rights holder (i.e., a reservoir operator) and one or more end-use beneficiaries. Sufficient financial and/or hydrologic rewards must accrue to each of these parties in order to induce their participation in the banking scheme.

The keystone technical issues in groundwater banking include determining the aquifer baseline conditions, including the extent of unsaturated aquifer space, and recovering the imported water without causing injury to other groundwater users. These issues are fraught with uncertainty. Aquifer geometries are usually rather poorly defined, and subsurface water interacts with surface flows. Water in aquifers is not static, but is in perpetual slow motion along gradients and in response to differential hydrostatic pressures. Artificial recharge alters the hydrostatic pressures within the groundwater basin and may cause some of the native groundwater to become unrecoverable to overlying landowners (by migrating to a salt sink or a surface water body, for example). There is no guarantee that any particular molecule deposited in a groundwater bank in one year will be physically available to extract in a future year. Indeed, it is presumed that some percentage of the banked water cannot be recovered without causing adverse impacts on other users of groundwater in the same basin. That percentage is itself uncertain. However, the potential for injury to other groundwater users may be mitigated or avoided by adjusting the rates, volumes and locations of the extraction wells and the residence time of the banked water. Under the "extract then replenish" scenario, care must be taken not to deplete hydrologically connected streamflows[3] or lower the groundwater table below the level of existing wells.

Water quality, too, is often an issue in groundwater banking. Commingling lower quality recharge water with *in situ* groundwater may constitute a legally cognizable injury to other groundwater users. This could be a problem with recycled municipal wastewater or surface water routed through the Sacramento-San Joaquin Delta, for instance. Even pure recharge water could mobilize salts and agricultural chemicals in groundwater basins that have historically been heavily irrigated. Where feasible, conveying reservoir water directly into groundwater banks, without routing it through the Sacramento-San Joaquin Delta, should avoid water problems since Sierra snowmelt is the cleanest water in the system.

Commonly, impacts that would otherwise constitute legally cognizable injury may be mitigated or avoided through implementation of a "physical solution", which may be incorporated into the project design or imposed by the State Water Resources Control Board or a court.[4] For example, water users could be made whole through delivery of an alternate source of water of equal quality and quantity to that which they are entitled. Additionally, a well owner who has to sink a deeper well could be reimbursed for the increased well construction and pumping costs. Of course, there may also be limitations independent of the no injury rule on the extent to which adverse environmental impacts are allowed. Depending on the nature and severity of the change, adverse impacts on groundwater quality may not be allowable even if the affected well owners accept compensation.

As an early step in designing workable institutional arrangements, this system-wide investigation studied seven historic conjunctive use projects—some successful and some not. Our purpose in studying these cases was to distill the variables in the design and execution of conjunctive use projects that militate in favor of success of a project. The next section of this report explains the scope and methodology of the case analyses. Section Three presents the

Findings and Conclusions that we have distilled from the case studies. Section Four discusses the outstanding legal issues and uncertainties that may warrant attention from the State Water Resources Control Board or the State Legislature to facilitate conjunctive water management in California. In Section Five, the eight cases are presented in detail.

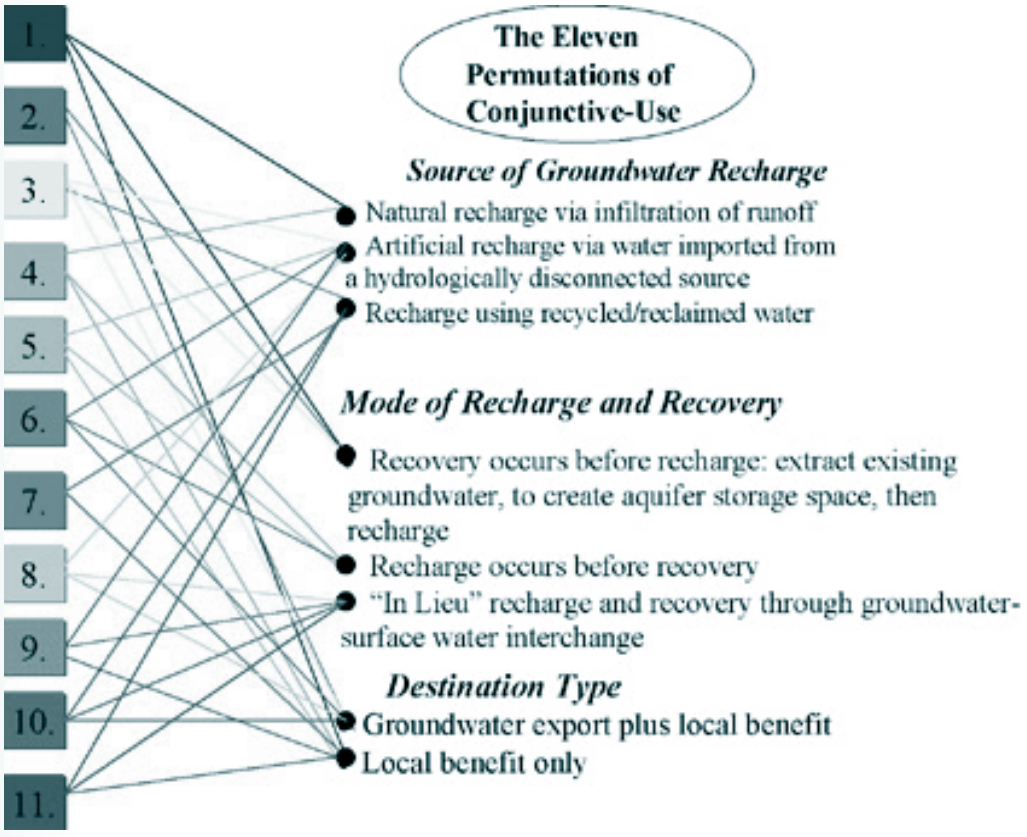
Finally, in Section Six, we sketch hypothetical arrangements based on our research and findings. These arrangements represent the study team's best judgment as to how a program could be set up to satisfy local interests and concerns such that groundwater management authorities would be willing—even eager—to participate in actively recharged groundwater banking projects. The hypothetical arrangements will be the subject of detailed discussions with the local groundwater communities—water users, water districts, groundwater management officials, political leaders and other stakeholders—in a series of "ground-truthing" sessions. In these, we will present the hypothetical arrangements and solicit comments, criticisms and (most important) counterproposals on the essential features and details of institutional arrangements. The end product of this process will be a high-confidence portrait of an ideal local institutional arrangement that should greatly improve the prospects for successful groundwater banking projects throughout the Central Valley waterscape.

SCOPE AND METHODOLOGY

As noted, our purpose in studying the current, high-profile efforts at conjunctive water management in the Central Valley is to emulate the design features that make for successful projects and avoid those that tend to produce failures. For this analysis, we are primarily interested in the institutional factors, but also remain alert to hydrologic, economic or geographic attributes that appear to correlate strongly with success. The term "institutional factors" refers to the mechanisms that:

- Create and protect the legal rights of the conjunctive water manager to obtain water from the surface reservoir or stream, convey it to the groundwater banking site, recharge the groundwater, extract the stored water and reconvey it to points of end-use;
- Avoid, minimize, mitigate or compensate for adverse impacts on those holding rights to the waters, reservoirs, conveyance systems, aquifers, and overlying lands involved in conjunctive water projects; and
- Anticipate and avoid or mitigate potential environmental impacts associated with moving water into and out of groundwater banks.

In tracking these features and variables, the case studies are conscious of the differences in projects with respect to sources of groundwater recharge, modes of banking, and end-use destinations. By combining the alternatives for each of these components, it is possible to describe eleven different types of groundwater storage projects. Depending on their features, these may call for rather different institutional arrangements. The permutations are displayed graphically below:



It is important to note that actively recharged groundwater banks—the species of conjunctive use that is the focus of the system-wide conjunctive water management investigation—involve only three of these possible eleven options. These are the options that provide the largest yield benefits to the broadest range of water stakeholders, are more likely to benefit than harm existing groundwater users, and provide the greatest potential for environmental restoration. As we have previously noted, the system-wide program would utilize artificial recharge from water imported from a hydrologically disconnected source—namely, a terminal reservoir. The destination of most (but not all) of the stored groundwater would be the integrated Central Valley water system, not just the overlying lands. To be sure, some of the water may be left behind to compensate the local groundwater basin for providing temporary storage services, but the objective of the program is to provide system-wide benefits. In regard to the sequence of recharge and recovery, three alternatives would be utilized:

- Where a pre-existing cone of depression exists, the aquifer would be recharged first and discharged later.
- Where the aquifer is already full, extraction would occur first (to create storage space) and then the "hole" would be replenished with imported recharge water.
- In areas where soils are relatively impermeable to percolation and excess capacity exists to deliver both surface water and to utilize groundwater (or where that condition could easily be created), recharge and recovery could be accomplished through *in lieu* arrangements. In these projects, groundwater would be banked by substituting surface water for groundwater that would otherwise be pumped. It would then be extracted by substituting groundwater pumping for a surface water delivery that would otherwise be provided.

None of the cases analyzed in this document involve the active recharge of a groundwater bank with water generated from reservoir reoperation simply because no such conjunctive use project has yet been implemented in California.[5] Therefore, to learn how to design such a program, we must extrapolate from the lessons distilled from the types of cases that have occurred. In fact, the system-wide proposal has a number of distinct advantages over historic projects from the standpoint of protecting local interests. These are described below.

Favorable Design Features of the System-Wide Approach

The system-wide approach accepts as a design constraints that water must be recharged and recovered in a manner that avoids any injury to legal users of water and in a manner that would provide a net improvement to aquatic environments. Some of the ways these constraints would be observed include:

- The program would bank water imported from reservoirs rather than exploiting native groundwater for export. This greatly simplifies the requirement of avoiding injury to legal users of groundwater because the water that is extracted and exported is not subject to the correlative rights that attach to native groundwater. The importer enjoys a paramount right to extract the banked water because it would not have been available to the groundwater basin at all but for the act of importation. Indeed, the recharge of the aquifer will benefit all groundwater users in the basin because the water table will be elevated and, therefore, pumping costs will be reduced. The major hydrologic issues associated with avoiding injury go to the rate, timing, location and volume of extractions. To be sure, these issues are somewhat more complicated where some native groundwater must first be extracted to create aquifer storage space and then

replenished with imported water. The hypothetical arrangements set forth at the end of this report propose ways that these types of projects can operate to avoid any significant likelihood of injury to legal users of groundwater.

- The recharge and recovery operations would be controlled by the local groundwater management authority. This might be a local water district, a local groundwater authority established through a county ordinance, a joint powers authority, or an entity created by special act of the legislature. The banking and extraction facilities would either be operated by that local authority or under voluntary contractual arrangements with it, specifying the terms and conditions and the compensation. Local control is therefore taken as axiomatic.

- Water tables would not be allowed to rise to the point where groundwater could invade root zones or surface structures or reduce the natural infiltration capacity of the aquifer. Conversely, water tables would not be allowed to fall below the levels that would occur in the absence of a conjunctive use program. The program would only counteract, not contribute to, subsidence. Phreatophytic habitats would only be enhanced, not degraded, by an elevated water table in the banking region.

- The program would utilize Sierra snowmelt, captured in foothill reservoirs, as the source of recharge water. This is the highest quality water available within the system. Water quality issues would arise only to the extent that this water is commingled with lower quality water, such as delta waters, en route to the recharge facilities.

Thus, actively recharged groundwater banks would avoid many of the problems and issues associated with the development of native groundwater or with groundwater substitution projects. However, the mitigation devices and institutional arrangements illustrated by the cases examined in this paper are instructive in designing all types of conjunctive use projects.

Types of Groundwater Storage Projects Studied

Of the eleven possible permutations of conjunctive use, the cases represent the following groundwater storage typologies:

- Native groundwater export projects utilizing full aquifers and natural recharge. These are a type of groundwater substitution project where existing surface water users are paid to forego those deliveries and pump groundwater instead. This allows their surface water entitlement to be delivered to a user in a different basin. The DWR Drought Water Bank and the DWR Supplemental Water Purchase Program are the only two examples of this type of project of which we are aware, and they are included as case studies. In the future, such projects can be envisioned at the Stony Creek fan, the Butte Basin and the Conaway Ranch area—all sites in the Sacramento Valley.

- Local benefit projects where recharge from imported water sources occurs before recovery. Projects of this type include the Kern Water Bank, SNAGMA, Semitropic's groundwater banking program, Berenda-Mesa's groundwater banking program, and the project of the Mojave Water Agency.

- Groundwater export projects where recharge from imported water sources occurs before recovery. Projects of this type include Madera Ranch, EBMUD-San Joaquin County, Arvin-Edison-MWD, and the Semitropic project.

We did not investigate local benefit projects where recharge is accomplished with recycled or reclaimed water. The water quality issues dominate in these projects. We also did not investigate local benefit projects utilizing full aquifers where storage space has to be created by extracting groundwater first, and then replenished through natural recharge. There are no currently operating projects of this type outside of adjudicated basins (such as the Raymond basin, the San Gabriel basin and the Orange County Water District). However, we may see examples of this type in the future, such as the project that the Glen Colusa Irrigation District is investigating. Finally, we did not study local benefit projects where recharge from native water sources occurs before recovery. The Merced Irrigation District/City of Merced project, the Clovis/Fresno project, and the Bakersfield emergency banking project are all of this type. While these projects are worthwhile, they do not offer a wealth of lessons from the standpoint of transferable institutional design features.

Risk Factors Analyzed

Each of the case studies evaluates how the project has succeeded or failed in dealing with the hydrologic, water quality, financial, legal and political risks associated with groundwater banking. Where pertinent, we specifically looked at how each project dealt with the following factors:

1 HYDROGEOLOGIC RISKS:

A) The risk of losing stored water because it "leaks" out of the aquifer and cannot be recovered without adverse impacts on other groundwater users in that aquifer.

B) The risk of losing stored water because it is not possible to increase the pumping rate at times of extraction without adversely affecting other groundwater pumpers in that aquifer.

C) The risk that raising the groundwater table will reduce natural infiltration and thereby deprive other groundwater users of natural recharge water.

D) The risk that raising the groundwater table will invade the root zone of permanent crops or create phreatophytic vegetation that is subject to regulation as a wetland.

2) WATER QUALITY RISKS:

A) The risk of degrading the receiving aquifer with lower quality recharge water (such as water that is routed through the delta).

B) The risk of leaching soil contaminants into the stored water.

3) FINANCIAL RISKS:

A) The risk that delivery of banked water through exchange arrangements will not be accomplished due to delta pumping restrictions.

B) The risk that energy requirements for pumping will be increased.

4) LEGAL RISKS:

A) The risk that groundwater storage or extraction would cause injury to other legal users of groundwater.

B) The risk that groundwater storage would limit the rights of current or future users of groundwater in the same basin.

C) The risk that the conjunctive use project would take legal action against other groundwater users to protect its rights to extract groundwater.

5) POLITICAL RISKS associated with adverse community reactions in light of real or perceived injuries to local groundwater interests.

For all of these considerations, each case study assesses how successful the project has been, as well as how it could have been designed to deal with these factors more successfully.

Study Plan

The study team progressed through the following sequence of steps:

1) SELECT THE CASES:
We screened the historical attempts at groundwater storage and selected a subset of seven cases that are representative of the various possible configurations and variables. The selected cases are regionally significant, illustrate a variety of stakeholder interactions, and are particularly rich in design lessons. The projects illustrate both successful and unsuccessful factors and strategies. All are located within the Sacramento and San Joaquin basins. Projects outside of the Central Valley or in adjudicated groundwater basins were eliminated because they present different and generally easier challenges. Projects were also selected because they provide interesting and lesson-rich contrasts. For example, the Sacramento North Area Groundwater Management Agency/American River Basin Cooperating Agencies Conjunctive Use Program (SNAGMA/ARBCA) and the Kern Water Bank were selected because they both represent successful large-scale programs but have significant differences in the end-uses of water and the types of participating stakeholder groups. Conversely, sometimes successful and unsuccessful cases share similar physical features and socio-economic settings. These cases provide further insight into the variables that can affect the success of conjunctive use programs.

2) REVIEW THE LITERATURE:
For each selected case, the study team members gathered and reviewed the literature and documents generated by the project and by external commentators, reviewers and critics.

3) DESCRIBE THE PHYSICAL FEATURES AND DESIGN CHARACTERISTICS OF EACH PROJECT:
The researchers abstracted from this literature the information on the project that is responsive to the issues and questions posed in this report. For easy comparison, the project characteristics are displayed in matrix format in Apendicies A-G.

4) CONDUCT INTERVIEWS:
For each project, the researchers interviewed project proponents and opponents, informed community and political leaders, affected water district managers and personnel, and local spokespersons for agriculture and the groundwater users.

5) WRITE NARRATIVE CASE STUDIES:
The case studies can be found in Section Five of this report.

6) DERIVE FINDINGS AND CONCLUSION:
Findings and conclusions are set forth in Section Three of this report.

7) Formulate hypothetical project design recommendations:
The hypothetical arrangements are outlined in Section Six of this report.

8) Test the hypotheses in focus group sessions:
Focus group sessions will be convened after this report has been circulated for review. They will be conducted in the groundwater basins that have been identified as promising locations for groundwater banking, based on hydrogeologic investigations that are reported in a separate document. The purpose of the focus group sessions is to confirm, adjust and refine the hypothetical design recommendations.

FINDINGS AND CONCLUSIONS

Measures of Success

As we have noted previously, conjunctive use projects must provide sufficient local benefits to prompt the local groundwater management entity or individual landowners to enter the deal. Thus, the success of the project depends upon financial or water supply rewards at the local level. The program must also insulate the local groundwater users and managers from perceptible risks. These risk factors are of three types: (1) hydrologic (the risk that either the quantity or quality of groundwater currently available for local use will be diminished); (2) financial (the risk that the energy costs of lifting groundwater will be increased); and (3) legal (the risk that existing rights and entitlements will be clouded or will have to be defended). Perceived risks must be taken at face value in the groundwater arena. Thus, risk management is more important than risk assessment in the design of conjunctive management institutions.

The design features summarized below provide a template for successful projects in settings throughout the Central Valley. Successful programs:

- Are financially rewarding for the water district, management authority or local landowners that operate the bank.[6]
- Are financially and/or hydrologically rewarding for local groundwater users.
- Pose no unacceptable hydrologic or legal risk to local groundwater users, the banking district or the local groundwater management authority.
- Involve local communities and stakeholders throughout the process of developing and implementing the groundwater banking plan.

Factors in Successful Programs

Projects that the case studies reveal to be successful under the above criteria include the Semitropic, Arvin-Edison, Kern Water Bank and SNAGMA projects. There are many common features to these projects that account for their success. We have organized analysis of these features under topical headings below.

Character of Banked Water

In all successful cases, the banked water is imported from a hydrologically disconnected source. Thus, the banked water would not otherwise be available to the groundwater basin. None of the successful projects involved the development of native groundwater either alone or as part of a groundwater substitution scheme. In the case of the Semitropic groundwater bank, the source water is state or federal project water belonging to Metropolitan Water District (MWD) and Santa Clara Valley Water District (SCVWD) or supplies imported by Vidler Water Company or Alameda County Water District. In the case of Arvin-Edison, the source water is MWD's State Water Project (SWP) entitlement or flood releases from Friant Dam. By contrast, DWR's unsuccessful 1994 Emergency Drought Water Bank in the Sacramento Valley failed in part because it did involve the substitution of native groundwater for State Water Project deliveries.

Also, in the majority of successful cases, the recharge water is of better quality than the *in situ* groundwater at the banking site.

Site the Bank Within the Boundaries of a Local Water Management Agency

One of the factors most determinative of the success of a groundwater bank is locating it within a water district, joint powers authority or other local groundwater management authority that genuinely represents the interests of affected landowners.

Avoiding Hydrologic Risks

Successful programs such as Semitropic and Arvin-Edison used a number of devices to ensure that neighboring groundwater users will not be adversely affected during the recovery operations. These fall into three categories: (1) limits on operations to avoid adverse impacts on other groundwater users; (2) arrangements to compensate for impacts or absorb the costs of measures to avoid impacts; and (3) information systems sufficient to avoid adverse impacts. Examples of measures to minimize hydrologic risks are detailed below.

Volumetric limits: In these successful projects, the volume of extractions is limited to a fixed percentage of the water percolated into the groundwater bank to account for presumed losses due to evaporation from spreading basins and migration out of the aquifer. The percentage, fixed at 90% in the Semitropic and Arvin-Edison examples, is subject to adjustment based on monitoring data.

Water table limits: For example, under its "fifteen-foot/three-year" rule, Semitropic will not make groundwater withdrawals that cause the average groundwater level in an area to decline by over fifteen feet compared to what would have occurred without the project over a three-year period.

Limits on the placement of extraction wells: The extraction wells are located so as to avoid significant impacts on the pump lifts of neighboring groundwater users.[7] The groundwater bank should also be located to avoid interaction with surface stream systems (unless a purpose of the bank is to increase base flows).

Limits on the timing of pumping: It may be advisable to restrict operation of recovery wells to the off-season or to off-days for irrigation pumping. Recovery can also be restricted until a specified period after recharge to allow sufficient time for the water to percolate into the aquifer.

Curtail pumping: If its pumping interferes with neighboring wells, the project may be required to either stop pumping or compensate for the interference.

Compensation: The project can guarantee neighboring groundwater users that it will compensate them for any costs occasioned by increased power requirements for pumping compared to the historic baseline, with an easy and fast claims processing procedure.

Provide alternative water supplies: An alternative to monetary compensation is a guarantee of a substitute water supply to impacted overlying users. For instance, a groundwater bank could agree to supply neighbors with water out of the bank in exchange for their forbearance from pumping, perhaps including the right to use the neighbors' wells as extraction facilities.

Assume responsibility for deepening wells to avoid impacts or restrict recovery wells to those shallower than the neighbors'.

Develop good baseline information: Designing a project that can avoid hydrologic impacts may depend crucially on improving the understanding of pre-project groundwater conditions including the drawdown tolerances (pumping thresholds) of existing wells.

Monitoring Program

The successful conjunctive use projects have established monitoring programs run by a committee that includes potentially affected landowners. The monitoring committee has the right to hire its own expert consultants to assist in data collection and analysis. In the case of the Kern Water Bank, the committee oversees a comprehensive monitoring program to determine groundwater levels and water quality under project and non-project conditions and has the power to modify operations if they are found to be inconsistent with local groundwater management plans.[8] In the case of Semitropic, the monitoring program has the right to curtail extractions if certain benchmarks are hit in the monitoring results.

Avoidance of Legal Risks: Dispute Resolution Procedures

One technique that emerges from the case studies is entrusting dispute resolution to the monitoring committee, which includes local groundwater users. Another option, exemplified by the Semitropic bank, is to submit factual disputes to binding arbitration before a registered civil engineer with a background in groundwater hydrology.

Local Benefits

As stated previously, sufficient local benefits are an integral part of successful conjunctive use projects. These can be in the form of cash payments or a share of the banked water. However, the case studies show that first priority to the banked water does not have to be allocated to the banking district, provided that the benefits to that district and its members are otherwise sufficient to induce its voluntary participation. In fact, successful case studies show a myriad of arrangements that are the product of negotiated agreements among the parties.

In the Kern Water Bank, local water supply agencies are accorded a "right of first refusal" on extractions from the bank and a first call on its recharge capacity. By contrast, in the Semitropic example, the agreements do not reserve to Semitropic a first right to extract water or to use the extraction facilities or other facilities of the program. Instead, the first right to extract is given to the Banking Partners. In the Arvin-Edison program, the district has the first right to use extraction facilities to meet its own needs while MWD has a priority over others who enter the banking arrangement later.

Financial Arrangements

The contractual arrangements must assure the water district or groundwater management authority that all foreseeable costs of operating the program (conveyance, recharge, extraction, reintegration) will be defrayed by the beneficiaries or some other party. Thus, Semitropic Water District, for instance, receives payments when water is stored and when water is extracted, including its energy costs and its operation and maintenance costs. Semitropic's banking partners have made the project essentially cost and risk free for Semitropic, while giving the district numerous facilities and other benefits. From a financial perspective, the program has been very successful. Revenue generated from Semitropic’s banking program has in part allowed the district to reduce water charges to its landowners from almost $60 per acre-foot in 1995 to less than $50 per acre-foot in 1998.

The Arvin-Edison program illustrates another device for managing financial risks. The agreement insulates the district from the risk that it will be unable to deliver the stored water to the intended beneficiary due to constraints beyond its control, such as pumping constraints in the delta which may prevent it from exchanging banked water for project deliveries. In the Arvin-Edison example, the district is entitled to buy back the banked water at its marginal cost of alternative supplies in the event that delivery cannot be accomplished. As in its arrangement

with Semitropic, the Metropolitan Water District of Southern California (MWD) was willing to make the project essentially cost and risk free for Arvin-Edison while providing the district with substantial benefits.

Local Control

In all successful cases analyzed, the overlying water district is in charge of the recharge and recovery operations. For agricultural water district bankers, this construct seems to work because landowners who rely on groundwater are represented in the governance of the water district. This provides a measure of local control that lends comfort and confidence to the groundwater users. It is notable also that, in most cases, the active outreach of the district's president and/or general manager was a key to overcoming the landowners' initial apprehension regarding a banking program. For instance, in the examples of the Kern Water Bank, Semitropic, and SNAGMA, local officials understood and supported the program and did a good job of explaining it to the members of the district and surrounding landowners.

Institutional Cohesion

Cohesiveness among water agencies and a common planning framework are helpful in creating successful groundwater banking projects. In the SNAGMA case, the General Plan for the region provided that common framework. In addition, the water agencies within the Sacramento area have multiple forums for communication and cooperation. In the Kern Water Bank example as well, the water agencies work together in the Kern County Water Agency, which serves as an umbrella organization and represents local interests at the state level. It is notable that Paramount Farms' involvement in the Kern Water Bank negotiation process was beneficial, as private sector organizations often have more flexibility than do public agencies.

Local Support and Public Involvement

The consistent and meaningful involvement of the range of local stakeholders is a common element of successful programs. While it is to be expected that landowners will have some concerns, the more supportive and cooperative they become, the greater the likelihood that the project will succeed. Efforts to involve landowners and other stakeholders in project development, implementation and monitoring help to garner their support. Leadership by local officials also plays an important role.

Involvement of local stakeholders in the process of building consensus and forming collaborative organizations is an important element of the SNAGMA project. This case demonstrates that, while the process may not be simple or quick, interest-based negotiation is an effective method to address these complex issues. Taking the time to train and educate the participating stakeholders, as well as using professional facilitation, increases the likelihood of success. In the Kern Water Bank example, the monitoring committee offers a structure and a forum for the involvement of overlying users adjacent to the project and an opportunity for their concerns to be addressed.

Ease in garnering local support is often due to a region's history with water banking projects and water management efforts in general. For example, internal opposition to Arvin-Edison's conjunctive use program has been non-existent. While some opposition has come from outside the district, the landowners inside the district were already familiar with conjunctive use and have seen it operate successfully in their district for almost fifty years. Notably, Arvin-Edison is a district that was originally formed to conduct conjunctive use operations for the benefit of its own landowners. Thus, the concept of conjunctive use and/or groundwater banking was never

new or foreign to landowners in the district. In the example of the Kern Water Bank, water banking projects are common in the area and tend to be accepted as necessary to preserve and enhance the local economy. Also, the Bank has done an effective job of creating habitat and enhancing the natural environment, thus winning over environmental stakeholders.

Environmental Documentation

The Semitropic case proved to be fairly easy to implement environmentally, and the Arvin-Edison project only had to comply with CEQA, not NEPA, and was implemented with an Initial Study and Negative Declaration instead of an EIR or EIS. These more streamlined processes for environmental documentation probably increased the likelihood of success for these projects.

Factors in Unsuccessful Programs

By the criteria set forth at the beginning of this chapter, the 1994 DWR Drought Water Bank in Butte County, the Madera Ranch case, and the initial EBMUD-San Joaquin County negotiations must be regarded as unsuccessful efforts, at least so far. We can learn important design lessons from these cases as well. The most salient findings are summarized below.

Character of Banked Water

According to the case studies, projects that rely on passive recharge (natural infiltration), such as the 1994 Emergency Drought Water Bank, are perilous. These groundwater substitution programs are particularly likely to be unacceptable when the water exporter does not have the power to curtail pumping in the event of injury to others, as in the Butte County example. However, this does not mean that projects that feature active recharge with imported water are always successful, as the San Joaquin County example shows. In those cases, the failure results from factors other than the source of the banked water. Banking water of inferior quality compared to the native groundwater, as was the case in the Madera Ranch project, is problematic and more likely to suffer local opposition.

Technical Analyses

Thorough technical analysis and comprehensive environmental impact reporting are important parts of a successful groundwater banking program and also crucial components in winning public support. In addition, the perception that implementation steps are being taken before technical studies are completed can undermine public confidence in the project before it even starts.

Technical analyses were a major point of contention in the Madera Ranch groundwater banking project. The technical analyses performed by the U.S. Bureau of Reclamation were preliminary in nature and designed to assist the USBR in making decisions regarding the feasibility of the project. However, project opponents considered the studies to be superficial and flawed. They believed that the feasibility of the proposed project was not demonstrated sufficiently for policymakers to commit public funds to the project and characterized the USBR's decision to proceed as "getting the cart before the horse." Particularly, they were concerned that the banked water would interact with surface streams and migrate from the site, creating root zone flooding problems for neighboring orchards and other sensitive crops,[9] and that extractions from the bank would come at the expense of neighboring wells due to the failure to account for the lost water. Although the quality of the technical analyses was not necessarily the primary problem with the State Drought Water Bank project, the programmatic environmental impact report (PEIR) prepared by DWR in 1993 was not convincing to local stakeholders. A common view in Butte County is that the PEIR was not very useful. It offered only general predictions of the nature and magnitude of potential impacts of the program. As is typical of programmatic reviews, site- or project-specific impacts were not addressed. Mitigation

measures for groundwater overdraft or impacts on surface water flows were neither identified nor adopted.

In contrast, the EBMUD project is considered to be technically strong, illustrating that technical merit, while important, is not the only factor necessary to garner local support or ensure project success.

Time Constraints

While not always controllable, compressed timeframes for project development can impair a project. When the development is rushed, it is less likely that local stakeholders will be involved adequately to "buy into" the project, which is especially important in regions without a strong history of support for conjunctive management. Shortened timeframes also can lead to inadequate technical analysis. For instance, had the Madera Ranch project continued into a second phase of investigation, the technical analysis would have addressed several outstanding issues in more detail. It appears that the landowner-imposed deadline for USBR action to commit to the project, or acquire the project site, lent impetus to move ahead without the benefit of more definitive technical studies or significant local involvement. Some feel that the property owner's deadline for USBR action forced a premature commitment by USBR that would have been avoided given a longer timeline.

Planning and Response to Drought

Drought conditions can provide the impetus for local agencies to engage in groundwater banking. In the case of the Kern Water Bank, the formation of the Future Water Supply Committee, an important first step that led to the establishment of the Bank, was spurred on by the prolonged drought from 1987 to 1992, which resulted in significant impacts to water users in Kern County. However, projects primarily created as emergency responses to drought conditions rather than deliberately designed water resource projects can encounter significant problems if they are extended. For example, the State Drought Water Bank in Butte County functioned well from 1991 to 1992, when it was created in response to drought conditions. However, in 1994 it foundered, at least partly due to the increased pumping associated with the extraction phase of groundwater banking. In Butte County, many wells were too shallow to operate in the drawdown conditions caused by the drought and the combined pumping of the water bank on top of the agricultural extractions. These wells went dry, causing financial impacts on local users and fostering local opposition to the project.

A lesson from this experience is that counties and their local groundwater management entities would do well to set up "stand by" drought water banking arrangements well in advance of the next period of extended drought. Prior to a drought or other emergency, these authorities could design a program with a specified range of extraction rates, tied to various hydrologic conditions, that would avoid well interference. With adequate lead time, the technical analyses needed to set these rate could proceed deliberately with ample public review. After the required EIR and related analyses have undergone adequate review, the local agency could approve the terms for the operation of the groundwater bank in advance of the need to actually implement the program. Then, when a drought condition or other circumstance arises that requires a relatively quick response, the "stand by" plan will have received all necessary approvals and permits. Two key ingredients for the success of such an anticipatory plan would be adequate hydrogeologic understanding of the aquifer and an appropriate monitoring system already in place. This approach would require significant initial investment from the water sellers. However, given the value of a reliable supplemental source of groundwater in times of statewide need, some form of funding to subsidize establishment of such a system would seem an investment worth evaluating.

Monitoring Programs

Monitoring programs are important to winning local support. Accurate and extensive monitoring programs can ease landowners' concerns over the potential that the groundwater bank will extract native groundwater in addition to the banked water (more "take" than "put") and thus diminish their supply. Monitoring programs can also lead to improved understanding of basin stratigraphy and recharge mechanisms and may therefore help prevent groundwater bank operation problems such as those that occurred in the 1994 State Drought Water Bank. One area of strong consensus within Butte County and DWR is that the monitoring network in Butte County should be expanded prior to future conjunctive use projects. They believe that additional dedicated monitoring wells are needed in locations currently being identified through hydrogeologic investigations. A related need is to improve public access to the monitoring data. One proposal is to make continuously recorded water levels and pumping rates available in real-time over the Internet.

Institutional Arrangements and Local Control

The cases teach that local interests view groundwater projects more favorably when they are locally controlled. And, it is common for local groundwater users to worry that a proposed groundwater export project could present a means for outside interests to gain access to native groundwater and, potentially, surface water entitlements. This fear seems to persist irrespective of the actual or proposed terms of the contract, probably as a result of the "water grab" from the Owens Valley in the 1920s. There is also fear that reliance on aquifer storage by a municipal water agency might eventually be codified by the legislature. These are fears that may not be well founded, but they are genuine. In general, local interests must be assured that the potential third party impacts are mitigated before a project can move forward.

In both the EBMUD and Madera Ranch projects, fear of losing local control over groundwater supplies presented a considerable obstacle to the successful implementation of the project. In the EBMUD example, while the pilot project was technically sound, fear of an outside entity gaining control of San Joaquin County groundwater supplies enmeshed the project in political controversy. Overlying landowners were concerned that the project represented a means for a municipal water supply agency to "stick a straw" into the local aquifer and to become reliant on the water supplied by the banking operation, eventually leading to the loss of their water rights. Even with the protections provided by the amended County ordinance in place, local interests still feared the encroachment of outside agencies into the Eastern San Joaquin Groundwater Basin.

The EBMUD example is not unique in that the issues of local control of groundwater and the protection of overlying landowner rights are a common theme in the San Joaquin Valley as well as other areas. In the Madera Ranch project as well, issues of local control were a major factor in local opposition to the project.

There are several potential antidotes to the fear that local control will be lost. As on this writing, some nineteen counties have passed groundwater export ordinances that generally prohibit exports in the absence of a permit of limited duration, issued by a local groundwater management authority. Water Code Section 1016, added in 1999 to address the specific concern that groundwater transfers can exceed contractual term limits, now removes any legal basis for that concern. However, contractual limitations on the duration of a water supply may be more appealing than statutory limitations because a breach of contract would give rise to

a right to compensation for damages. Concerns over local control can also be addressed through contracts that cede control over project operations to local authorities. In the Madera Ranch case, for example, an agreement could have been negotiated with the county to establish a stakeholder monitoring committee and set up enforceable operational rules for the project. This, coupled with an agreement to provide a quantity of banked water to alleviate conditions of overdraft, might have decreased concerns over loss of local control. Notably, such measures were successful in garnering local support in the Kern Water Bank.

Local Support and Public Involvement

As one commentator noted: "a public interaction program, or the lack thereof, is often the sole or major reason for the failure to implement a water program."[10] Establishing and maintaining early, continuous, and two-way communications between the public, stakeholders and the water agency, preferably starting on "day one" of the project, is an essential element for a successful program and for building consensus. [11, 12] Local opposition was the factor that had perhaps the most significant impact on all three of the unsuccessful projects. These projects show that local support is crucial to the success of groundwater banking projects and that substantial opposition at the local level can "sink" a project even when its technical merits are strong. In the 1994 State Drought Water Bank example, there is a general consensus within Butte County that the DWR Bank "managers" were not well connected with the local communities that the project impacted. Based on earlier success in 1991 and 1992, the 1994 bank clearly did not anticipate the problems that arose, nor did it effectively address the complaints of third parties who were, or perceived they were, adversely affected. While the local DWR office in Red Bluff dealt with citizen complaints about increasing impacts of pumping on third parties, the bank managers were not in regular communication with the staff of that office. The 1994 experience demonstrated to DWR staff the need for public education and involvement in the process of developing and implementing groundwater banking projects. Following the problems experienced in the summer of 1994, a few workshops and public meetings were conducted by local DWR staff in Butte County.

In the example of Madera Ranch, local opposition is cited as the major factor in the USBR's decision to abandon the project. [13, 14] The USBR undertook what it saw as a logical response to the landowner's proposal by performing a preliminary analysis of potential "fatal flaws." However, local stakeholders felt that USBR should have consulted with them about the project at the conceptual stage and utilized local knowledge of geography, aquifer response, and historic water levels during the preliminary investigation. Local concerns that the project was "top-down" and driven by political rather than technical considerations were reinforced when the project was prematurely championed in several political arenas before technical studies were completed. In the EBMUD project, local opposition was very strong and centered around the fear of an outside entity gaining control of groundwater in San Joaquin County.

Making the process open and transparent by keeping all information "on the table" to the extent possible (outside of privileged negotiations) is also important for gaining public trust. One complaint of the local opponents of the Madera Ranch groundwater banking project was that this did not occur in that case.

OUTSTANDING ISSUES

The case studies illuminate many of the institutional design factors that produce successful results. However, several design issues remain due to uncertainties in the state of the law governing groundwater rights in California. These uncertainties translate into risks to the operation of conjunctive use projects that could be ameliorated by legislative clarifications. The legislative recommendations at the end of this section are specifically intended to facilitate actively recharged groundwater banking projects as described earlier in this document, but would be beneficial to conjunctive use projects in general.

Among the needlessly problematic legal uncertainties is the demarcation of regulatory authority over the recharge and extraction of water banked in aquifers. At present, several types of entities with different procedural and regulatory requirements may assert jurisdiction and vie for control. In cases where the legislature has unambiguously vested management authority over specific groundwater resources in a special district, the competing jurisdictional claims are probably quieted.[15] However, this circumstance is rare. Typically, the jurisdictional boundaries are unsettled and unsettling.

Unless the banked surface water is held under a pre-1914 appropriative right, the project likely must obtain a "change order" from the State Water Resources Control Board (State Board), authorizing the transfer from a surface source to the groundwater bank.[16] To obtain such an order, the proponent of a conjunctive management project bears the burden of establishing, before commencing the project, that the recharge and withdrawal of water will not adversely affect other legal users of water.[17] Commonly, impacts that would otherwise constitute legally cognizable injury may be mitigated or avoided through implementation of a "physical solution," which may be incorporated into the project design or imposed by the State Water Resources Control Board or a court.[18] Such change orders generally must comply with the California Environmental Quality Act, which requires that changes in groundwater tables and their effects be disclosed, assessed and mitigated. Yet, the project may also have to comply with regulatory requirements imposed by a local groundwater management authority or a permitting authority created by county ordinance. The local bodies may assert jurisdiction at both the importation and storage stage and at the extraction stage and generally impose their own version of a "no injury" rule. The potential for conflicting or overlapping standards, procedures and requirements is obvious.

Uncertainty as to the division of regulatory jurisdiction is compounded by a degree of uncertainty as to proprietary rights among: (1) the importer of the recharge water; (2) the overlying landowner(s); and (3) the overlying water district. Additionally, the application of area of origin protections to the re-export of imported recharge water has not been decided.[19] Lastly, whatever the rights and remedies, enforcement problems haunt groundwater banking to the same extent as other groundwater entitlements.

In the discussion below, we approach the legal issues from two vantage points: (1) who has proprietary rights and (2) who has regulatory authority over the exercise of those rights.

Proprietary Rights to Imported Water

With respect to proprietary rights, it is important to clarify that, in the case of actively recharged groundwater banks, we are not concerned with native or *in situ* groundwater, to which the overlying landowners presumptively enjoy correlative possessory rights. In the case of imported water,[20] the case law seems clear that the recharged water belongs to the

importer, less whatever losses may occur.[21] A water right holder who imports the water with the purpose of later extracting it has the paramount right to extract that water for use either on the overlying lands or on remote locations,[22] subject of course to the requirement of avoiding injury to legal users of the native groundwater with which the imported groundwater may commingle. Injury could arise, for instance, where extraction wells are located proximate to those of pre-existing groundwater users and where the rate of extraction creates a cone of depression that increases the neighbor's pumping power requirements compared to pre-existing conditions. Calculating the amount of water to which the importer is entitled to withdraw, however, is challenging. Equally difficult is enforcing one's rights to imported water against unauthorized withdrawals by other users of the aquifer.

Another complication arises around who has the paramount claim to augmented groundwater recharge as a consequence of reoperation of upstream reservoirs. Stated another way, the question is: when the operations of a reservoir are changed to release additional amounts of water to the stream channel, some of which percolates into the downstream aquifer system, is this recharge water to be considered "imported" water that would not have been available but for the act of reoperating the reservoir? In that event, it would seem to belong to the reservoir operator. Or is this water natural recharge that would have been available to the overlying groundwater users but for the pre-existing operations of that reservoir, and therefore belongs to those groundwater users?[23]

In the main, however, the critical uncertainties are not over who owns the imported water, but over how that ownership right can be enforced where there are numerous overlying groundwater rights holders whose respective rights to pump from the aquifer have not been determined.

Property Interests in Aquifer Storage Space

As a practical necessity, groundwater banking must be developed with the cooperation and consent of overlying landowners, water districts or groundwater management authorities. As we have noted previously, there is no realistic prospect of some outside entity imposing a groundwater bank on unwilling local interests. However, where there is local opposition to a locally initiated project, the issue arises as to who owns and controls the dewatered storage space in an aquifer and who has the right to utilize that space or to exclude others from doing so.[24] It is likely that the courts would regard the storage space in an aquifer as a shared asset that all overlying landowners have a correlative right to use but that such rights holders may neither exclude other overlying landowners from using the aquifer storage space nor exact a "rental fee" for such use.[25]

Rather than characterizing the issue as one of trespass on a property interest, it may be more workable to regard it as just another application of the "no injury" rule. Thus, the correlative rights holders might well be legally entitled to prevent a water banking project from reducing the natural infiltration capacity of the aquifer. These results seem likely because the California Supreme Court has already held that public agencies can store water in aquifers.[26] The Court, analogizing groundwater banking to a surface water reservoir, deems this an economical and efficient method of "natural storage," only subject to the limitation that storage and withdrawal does not harm other legal users by, for instance, interfering with natural recharge. In the case of such interference, imported water is deemed to "spill first" after the aquifer becomes fully recharged.[27]

Under this view, the real issue is not "who owns the storage space" but how does one calculate

the amount of water that the importer is entitled to withdraw. The basic theory behind the importer's exclusive right is that the water would not be there at all but for the act of importation. But where the importation supplants natural recharge or increases leakage from the aquifer, the basic theory does not justify giving the importer any right at all, let alone an exclusive right. However, it would obviously be helpful for the legislature to make clear that groundwater users do not have an ownership interest in unoccupied aquifer storage space beneath their property.

Tort-based decisional rules may serve well to protect landowners from physical injuries or water supply impacts associated with groundwater banking, but the courts may need to revert to property based rules to apportion unsaturated aquifer storage space among overlying landowners competing to bank imported surface water. In the usual case, these overliers will be seeking to operate recharge and recovery facilities under contract with a non-overlying end-user such as a municipality. Several potential allocation formulas could be applied: (1) correlative rights to storage under which, like the right to exploit native groundwater, each overlying landowner has an equal right to access and utilize the aquifer storage space subject to mutual avoidance of harm and subject to the paramount right of other overliers to the natural recharge of that aquifer; (2) equitable apportionment of aquifer storage considering populations served by the banked water, investments in effecting it, etc.; (3) "first in time is first in right", analogizing to the appropriative rights doctrine to encourage and reward initiative to create groundwater banks. There are no known precedents to suggest how, ultimately, these aquifer apportionment issues will be resolved.

Restricting Groundwater Users to Historic Usage

Whether pre-existing groundwater users can be restricted to historic levels of usage to assure that they are not taking imported water that has been banked in the same aquifer is a contentious issue.[28] The general rule is that, subject to the avoidance of mutual harm, groundwater users are entitled to as much groundwater as they can beneficially use as long as the "safe yield" of the aquifer is not exceeded. This is true irrespective of their historic usage. If their historic use is less than their correlative share of the safe yield or the amount available for appropriation under their priority of right, restricting these users to their historic usage arguably diminishes their legal entitlement.

However, the problem may be more apparent than real. Groundwater banking programs are most likely to be established in two circumstances: (1) where there is a pronounced pre-existing cone of depression that can be filled (i.e. the San Joaquin Valley) or (2) where aquifers are already full such that groundwater will have to be extracted first in order to create storage space (i.e. the Sacramento Valley). In the first instance, the aquifer is already in overdraft. Current users are not entitled to increase their pumping because that would necessarily injure other rights holders.[29] In the second case, increased pumping by historic users is unlikely to adversely affect other users, including the groundwater banking project, because the aquifer has plenty of water in it.

The problem is also less likely to arise in areas of groundwater use that are incorporated within a water district, even those that do not regulate groundwater. Where a water district operates a groundwater bank within its service area, such as the Semitropic Water Storage District, Kern Water Bank or Arvin-Edison Water Storage District projects, it does so with the consent and support of those members who rely on groundwater.[30]

In the intermediate case—where the basin is close to balance and the groundwater bank is in an unincorporated area—the appropriate principle would seem to be that existing uses

can be allowed to increase only to the level that would represent safe yield, absent the groundwater bank, but no further. The problem in applying that principle is the difficulty in establishing the safe yield level short of adjudicating the basin. Even in the relatively rare circumstances where these conditions prevail, groundwater banking may be practical without adjudication if the bank can tolerate some increase in groundwater pumping or can purchase forbearance from pumping increases from existing groundwater users.

Who Has Regulatory Authority Over Groundwater Banks?

State Water Resources Control Board

The issue here is whether the State Water Resources Control Board enjoys continuing jurisdiction over imported surface water stored in groundwater basins, and if so, the extent of its regulatory authority.[31] The State Board clearly has jurisdiction over the source water if it is subject to an appropriative permit, i.e., if the appropriation occurred after 1914. If the State Board receives a petition to change the place and manner of use of that water so that it can be banked in an aquifer and then extracted for ultimate use on non-overlying lands, does the State Board retain jurisdiction over each link in this chain, including the process of recharge and recovery? Or does the imported water lose its character as surface water when it becomes commingled with the native groundwater, thereby precluding further regulatory supervision by the State Board?

Though no state board opinions are directly on point, continuing limited State Board jurisdiction over surface water placed into underground storage can be inferred from various permits issued over the last fifty years. Initial research shows that, in a limited number of cases, the State Board has issued permits and change orders to store surface water underground. These permits and change orders specify both the place of underground storage as well as the beneficial use to which the water will ultimately be put when it is subsequently diverted out of storage.[32] And, once the Board approves underground storage of surface water, several State Board decisions and water rights orders[33] make clear that the State Board retains jurisdiction to ensure that the water is ultimately used beneficially and reasonably.[34] The State Board's jurisdiction stems from its permitting authority over the original diversion from a natural watercourse, and its control extends to not only the diversion but also to the subsequent use.[35] The State Board decisions seem to treat surface water placed into groundwater storage as if it were still surface water, subject to the reasonableness and public trust limitations which the Board places on all permitted water rights.

While the State Board does have jurisdiction, the important issue is how that authority interfaces with the powers asserted by local groundwater management entities. That issue is treated on the next page.

Local Groundwater Agencies

Assembly Bill 3030[36] permits existing water agencies to create groundwater management districts. However, the authority that AB 3030 confers on districts is limited to determining safe yield, imposing modest restrictions on withdrawals, replenishing supplies, and imposing fees and assessments on extractions. The districts are not authorized to make binding determinations on matters related to water rights. Nor are AB 3030 districts authorized to prevent the exportation of groundwater. The authority to limit or suspend extractions may only be exercised if the district determines that replenishment programs or alternative water supplies are infeasible or inadequate.[37]

There are ten specially enacted groundwater management districts[38] and several other local

agencies with groundwater management authority.[39] The powers of these districts and agencies are varied, and a few require a permit for withdrawal or export of groundwater.

City and County Regulation

Cities and counties possess the power to regulate groundwater[40] except to the extent that such ordinances conflict with specific state legislation.[41] There has been a great increase in the number of counties passing groundwater management ordinances, especially in the last few years.[42] The ordinances vary greatly in terms of purpose (e.g., monitoring, replenishment, export restriction) and type of restriction (e.g., permit compliance, impact analysis, fees). Most of the ordinances require a permit to export groundwater outside of the county or to extract groundwater *in lieu* of surface water use. Few of them distinguish between native groundwater and imported water.[43] Some do explicitly recognize the value of conjunctive management and provide an exception to the permit requirement where it is demonstrated that the activity will result in net annual recharge.[44]

The Potential for Conflict Between State and Local Jurisdictions

As noted above, the State Water Resources Control Board asserts jurisdiction over permitted surface water that is temporarily stored underground, essentially treating it like surface storage. Counties also assert jurisdiction over water that is temporarily banked in their local aquifers, generally through ordinances creating groundwater planning and permitting authorities. Demarcating the division of regulatory labor between these levels of government in advance would help demystify groundwater banking and reduce the regulatory risk factors.

Jurisdiction could be shared sequentially or concurrently. In a groundwater banking operation, the water moves through a series of discrete steps: from a surface water source, through a conveyance channel (which may be a natural channel), to a recharge facility, to an aquifer, through a recovery well, through a conveyance facility (which, again, may be a natural channel), and finally to a point of ultimate beneficial use. Through each link in this chain, the banking operation has the potential to affect other water rights or cause injury to other legal uses of water, including instream beneficial uses. If the source water is subject to permit, clearly the State Board has jurisdiction over its appropriation and use. Is there then some point in the "life history" of that water at which the State Board loses its jurisdiction, or does the it retain jurisdiction to the point of ultimate consumptive use or outflow from the system? Some water lawyers believe that, when the imported water is commingled with native groundwater, State Board jurisdiction ceases. However, we have not been able to find any precedent or other legal support for this view. Moreover, it is not apparent why surface water stored underground should be treated any differently than water stored in a surface reservoir for purposes of the State's administration of water rights.

There is, however, a compelling practical limit to the State Board's ability to regulate groundwater recharge and recovery operations. While it may well be that the State Board could act to protect native groundwater users from the effects of a groundwater banking operation, it could not apparently act to protect the banker from the other groundwater users. This is because it does not have jurisdiction over the latter. This asymmetry may render its nominal authority in the aquifer ineffectual in a practical sense.[45]

If, not withstanding this asymmetry, jurisdiction is to be shared concurrently, then it would seem that the State Board pre-empts or supplants local regulation of the stored groundwater only to the extent of actual conflict. This raises the question whether the local authorities are able to go

beyond the State Board's extent of jurisdiction or only beyond its scope of jurisdiction. In other words, may the local jurisdiction prescribe measures that are more protective of the other "legal uses of water" or is it restricted to protecting against types of injury not covered by State Board regulation, such as impacts to structures or crops from rising water tables? Under the latter approach, county regulation that substantially affects the definition or exercise of water rights, especially post-1914 appropriative rights, is likely to be preempted. For instance, the State Board's determination as to the volume or rate of banked water that can be extracted without adverse consequence to users of native groundwater would preclude contrary determinations by the local jurisdiction.

Area of Origin Statutes

The application of area of origin protections to the re-export of imported recharge water has not been decided but likely does not pose an impediment to groundwater banking.[46] California Water Code Section 1220[47] prohibits the export of groundwater from the "combined Sacramento and Delta-Central Sierra basin" unless the pumping is in compliance with a groundwater management plan approved by the county board of supervisors and subsequently approved by popular vote. The statute does not distinguish native groundwater from imported, foreign water, notwithstanding that imported water transferred into groundwater storage under a permit issued by the State Board can readily be distinguished from native groundwater. Since the statute's apparent intent is to apply area of origin protections to groundwater, the courts will probably limit its application to exports of native groundwater, not imported recharge water.

Recovering Water Banked Through "In Lieu" Arrangements

Under an *in lieu* arrangement, the groundwater banking authority would enter into arrangements with overlying landowners who already use groundwater for all or a portion of their supply and also have access to surface water deliveries. During periods when the banker desires to recharge groundwater, the overlying landowners would forego pumping and accept a substitute surface delivery instead. The aquifer recharges passively from natural infiltration and percolation of the applied surface water. When the program desires to extract groundwater, the landowner would curtail its surface water use and substitute groundwater pumping. The mass balance in the groundwater basin is the same whether the water is actively recharged or delivered *in lieu* of groundwater pumping. In both cases, during years of storage, more water is contained within the basin than would have been stored absent the program. Ideally, arrangements should also be made with other groundwater users not participating in the *in lieu* recharge, such as appropriators, to minimize the risk that non-participants will take "banked" water and to provide relief in the event the banking operation injures a non-participant's water rights.[48]

In lieu banking projects differ from active recharge projects in that the groundwater that they extract is not water that the project has physically put into the aquifer. Instead, *in lieu* projects require groundwater rights holders in some years to forego pumping water that they are otherwise legally entitled to extract and to offset that forbearance by drawing more heavily on the aquifer in other years. Notwithstanding this operational difference, California Water Code sections 1005.2 and 1005.4 treat *in lieu* projects as equivalent to actively recharged projects with respect to the right to extract the groundwater that becomes available as a result of the program.[49] As is the case with active recharge, there are problems of enforcement and accounting. In years of forbearance, the other pumpers might extract the water that the program intended to store. In years of extraction, the contracting landowner's rates of withdrawal may harm correlative pumpers.

Of course, the problem associated with *in lieu* recharge may be avoided where groundwater basins have been adjudicated and the particular extraction rights have been quantified. This is

the situation with a number of groundwater basins in Southern California. The great drawback of adjudication is the time and cost associated with the process. In non-adjudicated basins where rights have not been quantified, contractual arrangements among all or most basin users may provide sufficient reliability to assure that a banking entity can recover the banked water.

Recommended Resolution of Issues

Improved hydrogeologic baseline information, including information on the depths of existing wells, would greatly assist in devising successful conjunctive use projects and in ameliorating local concerns. DWR's update of its groundwater report, Bulletin 118, now mandated by the legislature, is not detailed enough to serve as the vehicle. Use of Proposition 204 and Proposition 13 funds should be investigated for this purpose. If this is not an eligible use of funds, the Legislature should consider substantial additional appropriations for this specific purpose.

The State Board should convene a process involving its staff and outside experts to develop principles and guidelines for such key terms as "injury," "safe yield," "baseline conditions," "basin," "imported water," etc.

The following clarifications in California groundwater law would markedly facilitate groundwater banking while increasing the protection for other groundwater users. The legislature should consider codifying these clarifications:

- Overlying landowners have correlative rights to the groundwater but do not have a right to exclude other overliers from utilizing the unsaturated aquifer storage space, although such overlying landowners are entitled to compensation for any injury to crops, lands or structures resulting from the recharge of the aquifer by others.

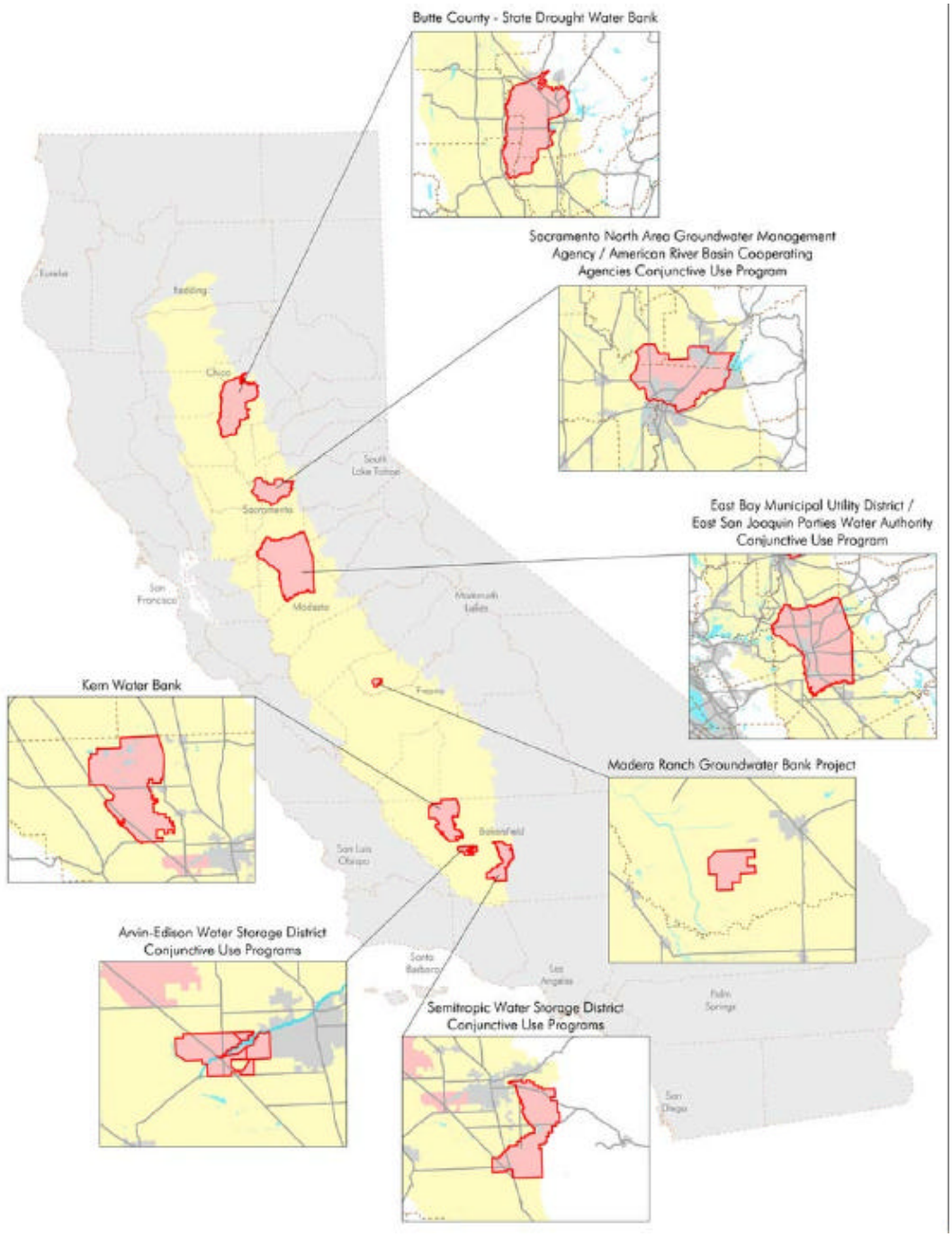
- Unless it initiates an action to adjudicate the entire groundwater basin, a banker of imported water may not enjoin historic levels of use of groundwater on overlying lands. However, the banker retains the right to protect banked water from net increases in extractions by the pre-existing groundwater users, beyond that historic baseline, in aquifers that are in an overdrafted condition. The groundwater banker would have to first proceed against groundwater appropriators, if any.

- A legal user of water may not enjoin a groundwater banking project that offers to provide a "physical solution" to such legal user, whether or not that offer is accepted, provided that the appropriate regulatory authority or court finds that the physical solution would have constituted adequate mitigation.

- The State Water Resources Control Board retains jurisdiction over surface water (subject to post-1914 appropriative rights) that is stored in groundwater basins and pre-empts conflicting requirements imposed by county ordinance that significantly affect or redefine water rights or legally cognizable injury.

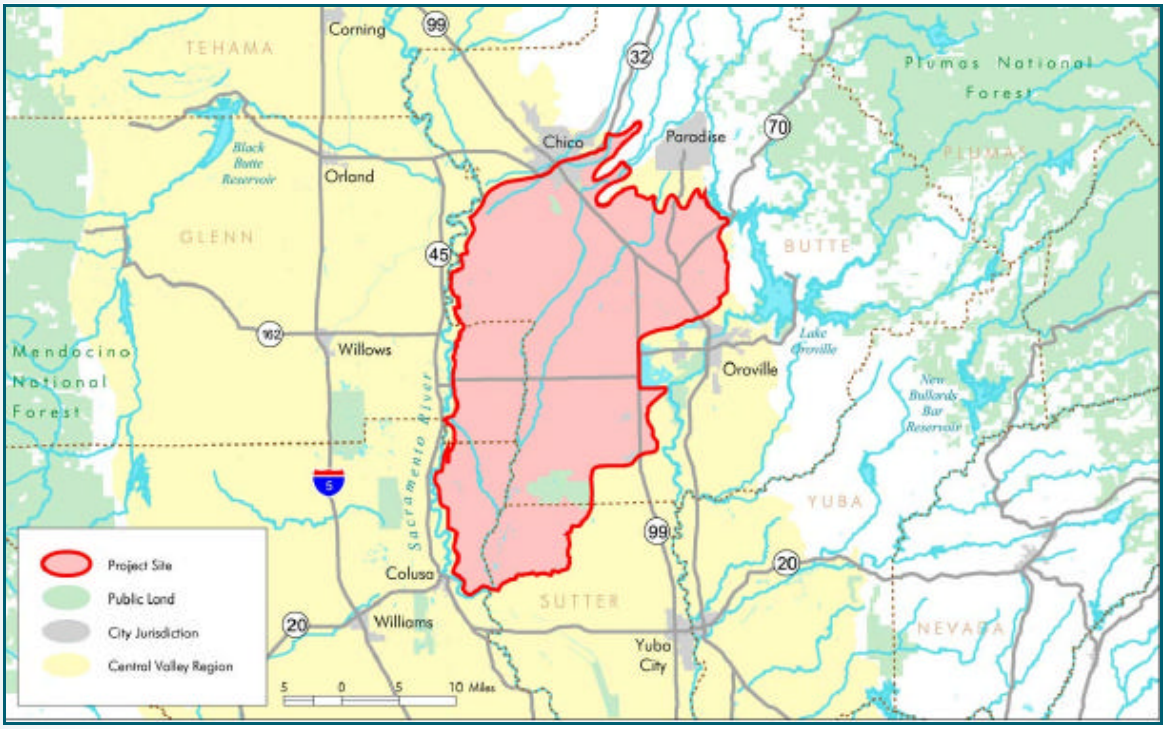
- County ordinances and local groundwater management authorities may not restrict recovery and re-export of "foreign" water imported into the groundwater basins, except to the extent necessary to prevent injury to other legal users of the groundwater basin, as that principle is understood under existing law.

The Case Studies



Map above shows the locations of the seven conjunctive use projects studied in this report

BUTTE COUNTY — STATE DROUGHT WATER BANK



Introduction

On February 1, 1991, after four years of drought in California, and facing a fifth year of below-average precipitation, Governor Wilson initiated the State Drought Water Bank (SDWB) to meet anticipated critical water needs. This case study reviews the 1991, 1992, and 1994 State Drought Water Bank programs in the Butte Basin, in which local water districts were paid to relinquish deliveries out of Oroville Reservoir and substitute groundwater instead. The relinquished surface water was then available for delivery to drought victims south of Sutter County (primarily State Water Project [SWP] contractors south of the delta and in the San Francisco Bay Area). Therefore, within the Butte Basin, the SDWB operated as a groundwater substitution project. While the 1991 and 1992 SDWB programs are generally considered successes, the 1994 SDWB generated considerable controversy within Butte County. Coupled with an additional year of intense drought, elevated SDWB pumping was perceived as having adversely affected local wells. Details of specific program years are discussed below.

Physical Characteristics

Physical and Environmental Setting

The geopolitical area of study is Butte County, located in the northeastern Sacramento Valley. Butte Basin, the primary groundwater basin, lies within western Butte County, the southern portion of Tehama County, the northern portions of Sutter and Colusa Counties, and the eastern portion of Glenn County. The Butte Basin has traditionally been defined as bounded on the west by the Sacramento River, on the east by the foothills of the Sierra Nevada, to the north by Pine and Singer Creeks, and to the south by the Sutter Buttes and the Yuba River.[50] Land use in the region is predominantly agricultural, and large volumes of surface and groundwater are

dedicated to producing rice, walnuts, almonds, prunes, wheat, and row crops. Urban water demand is approximately 10% of the total water use.[51] A list of the major water delivery systems, both agricultural and municipal, is presented in Table 5.1 below.

Table 1

WATER SERVICE DISTRICTS AND AREAS IN BUTTE COUNTY/BUTTE BASIN
Note: Districts shown in italics participated in sales to the 1994 SDWB.

AGRICULTURAL WATER SERVICE DISTRICT	CITY / MUNICIPAL WATER SERVICE AREAS
M&T Ranch Inc.	Chico
Durham Municipal Water Company	Durham
Parrott Investment Company (Llano Seco)	Oroville
Western Canal Water District	Biggs
Richvale Irrigation District	Gridley
Reclamation District 1004	Live Oak
Biggs-West Gridley Water District	Yuba City
Butte Water District	Marysville
Sutter-Extension Water District	
Thermalito Irrigation District	
Oroville-Wyandotte Irrigation District	
Browns Valley Irrigation District	
Rameriz Water District	
Cordua Irrigation District	
Hallwood Irrigation Company	

HYDROLOGY

The climate of the region is Mediterranean with cool, wet winters and hot, dry summers and little to no rainfall. Unpublished precipitation records suggest that, in three out of ten years, the Butte Basin area experiences precipitation that is significantly less than the long-term average rainfall. Precipitation shows strong orographic patterns with the foothills receiving over twice the precipitation of the Sacramento Valley floor (greater than 50 inches versus approximately 25 inches, respectively).

Surface water runoff entering the Butte Basin is dominated by the spring snowmelt period. High magnitude rainfall in the late fall and early winter, or during infrequent rain-on-snow events, can also generate peak flows in regional creeks and rivers.[52] At present, the Butte Basin aquifer system is described as being full or nearly full during years of normal or above normal precipitation (i.e., the average annual recharge appears to be sufficient to replenish local groundwater use). Drought conditions, especially over multiple years, cause water levels to decline until normal or above-normal precipitation years resume. Overdraft within the basin does not appear to be occurring based on long-term groundwater well hydrographs maintained by the Department of Water Resources (DWR). There is a perception among individuals interviewed for this study that overdraft may be occurring in the Chico area due to increasing urban demand. The DWR staff with the Groundwater Section at the Northern District Office in Red Bluff has recently re-evaluated Chico area groundwater level data. They found an average water level decline of approximately 12 feet for the period

1978–2000, accounting for periods of drought and subsequent recovery. Water levels appear to have stabilized since the end of the 1994 drought. Rather than evidence of overdraft, these data have been interpreted as evidence that the groundwater system has responded to increased pumping stresses with declining water levels but appears to be reaching a new equilibrium.

Project History

The State Drought Water Bank was initiated in early 1991 after four years of drought. Water was made available to the 1991 Bank by curtailing surface water deliveries to water districts in Butte County so that this water could be delivered to SWP contracting districts south of the delta. In 1991 and 1992, irrigation districts within the Butte Basin had their surface water allocations reduced by 375,000 acre-feet each year to meet emergency statewide needs, as permitted by delivery contracts. Butte County farmers were paid for water they made available by improving irrigation efficiency, reusing tailwater, fallowing agricultural fields, or substituting groundwater for relinquished surface water. During the 1991 program period, approximately 10,000 acre-feet of groundwater was pumped directly for export. Groundwater substitution pumping in 1991 totaled 62,000 acre-feet, with approximately 33,000 acre-feet produced by the Western Canal Water District and approximately 29,000 acre-feet produced by the four districts of the Joint Water Districts Board. Pumping rates, timing and locations were such that parties relying on groundwater for domestic, agricultural or municipal uses noticed no significant adverse impacts. Most of the public in Butte County apparently was unaware that the SDWB program was underway.

The Butte County/Basin districts that increased groundwater pumping during the 1991 State Drought Water Bank included: Western Canal Water District, the Joint Water Districts Board (Richvale Irrigation District, Biggs-West Gridley Water District, Butte Water District, and Sutter Extension Water District) Ramirez Water District, Cordua Irrigation District, Hallwood Irrigation Company, and Browns Valley Irrigation District. Participants in the 1994 State Drought Water Bank were Richvale Irrigation District, Western Canal Water District, Browns Valley Irrigation District, Cordua Irrigation District, and Ramirez Water District.

Below-average precipitation continued during 1992, prompting DWR to establish a second SDWB program. The 1992 Bank generally followed the model of the 1991 Bank, except that fallowing was discontinued (as was also the case in 1994) because it was perceived to have undesirable economic and social impacts. Drought conditions in 1992 were less severe, and thus the SDWB transactions were the smallest of the three years of SDWB operation. The consensus within Butte County appears to be that the 1991 and 1992 SDWB programs were successful statewide responses to real emergencies.

After an average precipitation year in 1993, severe drought conditions returned in 1994, leading to the most recent and controversial SDWB program. Based on the apparent success of the 1991 and 1992 SDWB programs, five local water districts (Western Canal, Richvale, Browns Valley, Ramirez, and Cordua) elected to participate in water sales to the 1994 SDWB. Three of the districts (Browns Valley, Ramirez, and Cordua) are quite small and third party groundwater users did not experience adverse impacts from SDWB pumping by these districts. The other two Butte Basin water sellers (Western Canal Water District and Richvale Irrigation District) increased their groundwater substitution pumping to approximately 100,000 acre-feet in 1994 to help meet statewide needs.

Western Canal Water District and Richvale Irrigation District entered into contracts with

DWR on behalf of individual district members intending to act as willing sellers to the Bank. These contracts prescribed the volume of groundwater that could be substituted for relinquished surface water deliveries. For example, the Western Canal Water District contract set pricing of substituted groundwater at $50 per acre-foot up to a maximum of 90,000 acre-feet. Water was sold to DWR, which in turn entered into water sales contracts with willing buyers. The contracts between the districts and DWR specified that SDWB activities would not invalidate any existing water rights. CEQA responsibilities were assigned to DWR but were addressed through a Programmatic Environmental Impact Report (PEIR) as described below. Liability for damages arising from pumping was retained by DWR. The sellers, not DWR, retained control of the timing and rate of pumping itself. This proved to be problematic during the 1994 SDWB because, although DWR retained liability for pumping and water level related impacts, the Department could not readily suspend pumping if problems arose.

Several factors contributed to the problems encountered in 1994. First, very low precipitation during the spring forced farmers to initiate irrigation earlier than normal to flood rice fields and support orchard demands, thus significantly increasing groundwater pumping. Second, spring surface runoff reduced recharge to the local aquifer system, which had already been depleted by the previous multi-year drought.

The magnitude and location of pumping by Western Canal and Richvale near the eastern boundary of the Butte Basin, combined with higher than average pumping by others, reduced groundwater levels to the point that, by July 1994, some nearby domestic and agricultural wells were adversely affected. During the summer of 1994, water levels in wells not participating in the SDWB declined such that several domestic wells failed to produce water. Some wells reportedly sustained pump damage, while others had to be deepened. A complicating factor is that many agricultural groundwater users primarily pump on weekends, when electrical rates are the lowest. This tended to temporally concentrate pumping stresses and may have contributed to depressed water levels in some areas.

In July 1994, third party complaints prompted a temporary cessation in pumping by the SDWB at selected wells. It is important to stress, however, that the problems that occurred in 1994 likely resulted from the combination of drought history, SDWB pumping, and agricultural pumping practices. Groundwater level monitoring data did not conclusively point to SDWB pumping as a unique source of the problems, and thus pumping was resumed in some wells. However, the majority of the SDWB wells adjacent to the Cherokee Strip were turned off until the second week in August. Individuals who experienced pumping-related problems began to coalesce in ad hoc groups and later in organized forums such as the Valley Water Protection Association.

Subsequent to the 1994 SDWB program, the State of California began development of a Supplemental Water Purchase Program. The intent of the program was to develop a more systematic approach to future groundwater management in relation to droughts and water transfers. Initial groundwater substitution production targets were approximately 400,000 acre-feet. A draft EIR was issued by DWR in 1996, but opposition by local interests in the Sacramento Valley was sufficient to cause DWR to reduce the groundwater substitution goals to 200,000 acre-feet. The CEQA process has never been completed, and the original Supplemental Water Purchase Program is viewed as having been superseded by the CALFED process. Opposition continues to statewide or regional groundwater pumping targets developed in the absence of local planning.

SDWB Participants

The 1991 SDWB, like subsequent programs in 1992 and 1994, relied on willing surface water users to forego portions of their entitlements so that the project could deliver that water to buyers south of the delta and in the San Francisco Bay Area whose normal supplies were constrained by the drought. DWR operated the SDWB, including identifying willing buyers and sellers and serving as the "broker" for the water transfers. DWR entered into contracts for both the purchase of water from the selling water districts and for the resale of that water to the buyers. The selling water districts obtained the water through contracts with willing sellers (district members) and then managed the pumping regime.

DWR identified potential sellers to the 1991 Bank through the State Water Contractors. In 1994, the SDWB was well established and likely sellers were already known. Buyers for the 1994 SDWB were primarily agricultural users (93% of sales). In Butte County, local water users sold but did not buy water from the Bank. Individual users within the water districts elected to pump groundwater as a substitute for surface water that was transferred through the Feather River or other surface water conveyances.

Beneficiaries

From a financial perspective, the individuals who sold water to the Banks and those who purchased water from it were the primary beneficiaries. Sellers who benefited may be presumed, in most instances, to have used proceeds from water sales to invest in their farm operations or buy goods and services in the local communities. However, the benefits to the local water users in Butte County were uneven. Some water districts were better equipped with production wells than others, and, thus, the ability of districts to participate in the program was highly variable. Likewise, within districts that did participate, some individuals had the wells and/or financial resources to increase pumping capacity, while others did not. Groundwater users not participating in the SDWB programs received no benefits from the program.

As a result of the SDWB programs, buyers in urban areas were able to minimize impacts on landscaping and reduce the need for emergency water conservation measures. Agricultural buyers were able to protect orchards and other permanent crops and minimize potential layoffs of farm employees. Environmental benefits also accrued from the increased instream flows to maintain fisheries and to protect water quality in the Delta. One environmental benefit that is not widely recognized within Butte County was a significant contribution of SDWB proceeds to fund a $9 million siphon project on Butte Creek aimed at improving local salmon populations. In addition, the County received 2% of the gross proceeds from groundwater sales to help fund development of a Butte Basin Groundwater Model.

Stakeholder Participation

Throughout all three SDWB programs, DWR viewed the water sellers and the districts that represented them as the stakeholders of concern. These water sellers organized the Butte Basin Water Users Association (BBWUA) in 1992. This group became the point of contact with DWR technical staff and Butte County staff who had little direct involvement in the Bank activities beyond monitoring the SDWB process itself.

Public Participation

While the public was not excluded from the SDWB process, little evidence exists of efforts to actively involve local communities or third parties who rely on groundwater but were not involved in groundwater substitution pumping. During 1991 and 1992, such public participation was viewed as unnecessary, but the 1994 experience demonstrated a need for the pub-

lic to be educated and involved. Following the problems experienced in the summer of 1994, local DWR staff from the Red Bluff office conducted a few workshops and public meetings in Butte County.

Environmental Review

The 1991 and 1992 banks were one-year emergency programs, and as such were exempted from CEQA compliance. Environmental reviews were conducted when preparing the individual water sale contracts, but no formal CEQA documents were prepared for the overall SDWB program prior to 1993.

A programmatic environmental impact report (PEIR) was prepared by DWR in 1993 to address potential impacts of the SDWB. However, a common view in Butte County is that the PEIR was not very useful. It offered only general predictions of the nature and magnitude of potential impacts of the program. As is typical of programmatic reviews, site or project-specific impacts were not addressed. Mitigation measures for groundwater overdraft or impacts on surface water flows were neither identified nor adopted. With the data collected since 1993 and better predictive methodology, it seems likely that creating new EIRs for conjunctive use projects would be more useful than attempting to update the 1993 document.

Technical Studies

To date, the only comprehensive technical study of groundwater use in the county has been through the development of a groundwater management computer model for the Butte Basin. In 1992, the BBWUA retained a private consultant, Hydrologic Consultants, Inc., to develop the model in order to aid future water management. Hydrologic data from a variety of agency and water district sources was compiled for use in the simulations. Grid-scales employed in the model are on the scale of miles, and thus the model cannot simulate third-party impacts at individual well locations. Rather, the model is intended to aid in basin-scale analyses and planning. The Red Bluff office of DWR conducts studies of countywide land and water use every five years. Additionally, there have been a variety of geologic, hydrologic, and soils investigations conducted by various agencies and universities.

Monitoring Program

Since the inception of the SDWB programs, DWR, Butte County, and the Western Canal Water District have monitored groundwater conditions systematically. Approximately eighty to ninety wells have been monitored for groundwater levels on a quarterly basis. However, only about ten of the wells are solely for monitoring and not also used for production. Some additional monitoring wells have been added through investigations at the M&T Ranch towards the northern end of the Butte Basin. There is a strong consensus within Butte County and DWR that more monitoring is needed to prevent recurrence of the problems experienced in 1994. All believe that additional dedicated monitoring wells are needed in locations currently being identified through hydrogeologic investigations. A related need is to improve public access to the monitoring data. One proposal is to make continuously recorded water levels and pumping rates available in real-time over the Internet.

Financial Characteristics

Costs of the SDWB Program

The costs of operating the SDWB programs were recovered through the difference between the buying and selling prices. In 1991, water was purchased at $125 per acre-foot and was sold at $175 per acre-foot. Approximately 37 percent of the water purchased in 1991 was

surplus to the demand that year and was carried over to the following year.[53] During the 1992 and 1994 Banks, water was purchased for $50 per acre-foot and sold for $72.50 per acre-foot. Reductions in the price offered by DWR to sellers and adjustments in the timing of commitments to sell and buy allowed the 1992 and 1994 banks to be more efficient so that they accumulated less surplus water.

Issues and Risks

Hydrogeologic Risks

One of the significant challenges to future conjunctive use projects in Butte County and elsewhere in the Sacramento Valley stems from the fact that a significant number of wells are relatively shallow. DWR estimates that there are approximately 5500 domestic wells with 50% reaching depths less than 135 feet.[54] It is unlikely that these wells can function reliably with large drawdowns during drought conditions. Thus, it may be difficult to conduct groundwater substitution projects without substantial investments in deepening a large number of wells. Given the ad hoc nature of the SDWB programs compared with other strategic conjunctive use projects, there have been no systematic analyses of pumping thresholds required to prevent or avoid third-party impacts similar to the ones experienced in 1994. Pumping volumes were specified in contracts as a range, but the upper and lower limits were not based on detailed knowledge of local groundwater systems or the potential for third party impacts.

Environmental Risks

Currently, a wide variety of efforts are underway to protect and restore riparian ecosystems. One of the recent concerns raised about future groundwater substitution projects is the potential for adverse impacts on riparian vegetation and certain oak species that are reliant on adequate deep soil moisture associated with ambient water table levels. Very little is known about the potential impacts of lowering regional groundwater levels on sensitive vegetation communities. If managed groundwater level fluctuations occurring in future conjunctive use projects were shown to be adversely affecting local riparian systems, it is likely that some form of administrative or legal intervention could occur.

Legal Risks

Based on its success in 1991 and 1992, the 1994 Bank clearly did not anticipate the problems that arose, nor did it effectively address the complaints of third parties who were, or perceived that they were, adversely affected by its operations. Third parties interviewed for this case study cite a period following the end of the 1994 SDWB program when neither DWR nor participants in the SDWB pumping would acknowledge that impacts occurred. This seems to have been due to the fact that the possibility of damage occurring to third parties was not seriously considered during development of the SDWB. Affected third-parties contracted with a consulting firm to identify SDWB pumping impacts. Following that study, dialogue between DWR staff and the consultant failed to resolve different interpretations as to whether SDWB pumping caused adverse impacts to third party wells. At that point, a group of affected third parties retained a law firm to explore the prospects of successful litigation for SDWB-related damages. Estimates of legal fees reached approximately $500,000, which was beyond the financial resources of the parties involved. However, given the increase in community involvement since the last SDWB, several organizations and individuals have threatened litigation if the problems of 1994 recur.

Subsequently, DWR established a process to evaluate claims of damages resulting from Bank-related pumping. DWR, and in many instances the water district where SDWB pumping occurred, reviewed claims and groundwater data for evidence of third-party impacts.

Where claims were substantiated, DWR offered monetary settlements, most of which covered the increased power costs for pumping from greater depths. These compensation efforts were generally viewed as insufficient to compensate third parties, and the entire claims process remains a source of dissatisfaction and distrust among some of the interviewees. The countywide consensus is that every effort should be made to avoid a repeat of the 1994 conflicts.

Other Third Party Impacts and Community Relations

Following the 1994 SDWB, Butte County placed a short-term moratorium on new wells in mid-1994. Opposition from the water districts coupled with potential impacts on agriculture and new residential development caused the moratorium to be lifted by late 1994. Seeking another solution, the County developed and circulated a concept paper that explored local controls on groundwater management. Local water districts reportedly opposed the language—if not the concept—and this effort was also discontinued.

A group of individuals that experienced third party impacts formed in 1996 to seek local legislation via a ballot initiative (Measure F) to protect groundwater resources and users. Several weeks later, local water users and participants in the SDWB programs placed an alternative groundwater management initiative (Measure G) on the ballot. It was apparently difficult for many voters to distinguish differences between the competing measures. Supported by significantly greater campaign funding, Measure G was approved by the voters in November 1996. Prior to Measure G, there was no program to manage water issues at the County level. The most significant elements of Measure G, codified as Chapter 33 of the County Codes, include establishment of a permit process for approving water sales in future SDWB or related programs; a County Water Commission with support from a Technical Advisory Committee; and administrative staff to follow water issues. The Commission and staff are in place, but no individual or district has applied for a water sale permit to date. Details of the application process are still being refined.

Local stakeholders hold divergent views regarding progress in implementing Chapter 33 {Measure G}. One person contacted in this study commented, "this Measure was born in crisis and remains in crisis." Some perceive implementation as a slow but steady process. In July 1999, the County formed a Department of Water and Resource Conservation. The Water Commission and the new Department are working to implement Chapter 33, mainly through the development of small workgroups representing various interests. More recently, Butte County has entered into a Memorandum of Understanding with DWR to examine local options under the Integrated Storage Investigation (ISI) program. The ISI program is designed to support locally initiated and controlled conjunctive use programs that will contribute to statewide water supplies under both drought and non-drought conditions. A local ISI stakeholders group has been formed with representatives from all sectors of the community actively participating in local water issues.

In general, the current process is viewed as a significant improvement over the situation prior to 1996. Policy questions are being debated in a more open manner and with substantial public participation. Virtually all of the individuals contacted who are involved in water sales feel the Water Commission adequately represents the County's interests. In contrast, individuals who rely solely on groundwater sources see the need for greater representation of third parties on the Commission.

Several potential problems in the water permitting process have been identified. For exam-

ple, the time frame to complete a permit under optimal conditions (no legal challenges) is estimated to be about nine months. This may conflict with the time period between a drought declaration on February 15 and the onset of peak water demands in the spring (approximately 4 months). However, if the permit processing time is reduced, the time available for citizens concerned about potential third-party impacts to comment would also be reduced. Observers agree that the Measure G permit process cannot be accurately evaluated until the first permit application creates a test case.

Conclusions

Comparing the activities of the SDWB programs in 1991, 1992 and 1994 to other conjunctive use programs in California is very difficult in that the three programs were primarily emergency responses rather than deliberately designed water resource projects. When problems arose in 1994, the SDWB program was unable to respond in an effective manner. Accordingly, the current implementation of Chapter 33 (Measure G) may be viewed as the first process in Butte County for designing conjunctive use projects.

The problems experienced during the 1994 SDWB program exposed several core issues that must be addressed in future groundwater management and conjunctive use projects. These issues may be grouped into two general areas: (1) monitoring of basin surface and subsurface hydrology and (2) planning and decision-making processes.

Efforts to evaluate 1994 pumping impacts were seriously impeded by insufficient knowledge of local groundwater systems and an inadequate network or monitoring wells. There is a consensus among interviewees that the monitoring network in Butte County should be expanded prior to future conjunctive use projects. Despite the existence of substantial groundwater level data in the Butte Basin, there is general agreement that a detailed understanding of the structure of the aquifer system is still lacking. The local U.S. Geological Survey Hydrologic Atlas[55] describes the Sacramento Valley as a single undifferentiated groundwater basin unit. Current investigations by the Northern District of DWR suggest that a much more complex pattern of distinct aquifers and recharge areas may exist. The type and spatial distribution of recharge mechanisms needs to be thoroughly investigated as future conjunctive use planning proceeds. Improved understanding of Butte Basin stratigraphy and recharge mechanisms may significantly contribute to preventing a recurrence of the problems encountered in the 1994 SDWB.

Changes in the planning and decision-making processes seem to be of equal or greater importance. As previously noted, the planning that occurred in the SDWB programs was essentially an emergency response. Subsequent attempts to develop groundwater management and water transfer programs[56,57] have been unsuccessful due to intense local opposition in the Sacramento Valley in general and Butte County in particular. Local acceptance and control appears to be critical to any stable conjunctive use planning program.

From the interviews, it seems that third parties (non-SDWB pumpers) carried and still seem to carry the burden of proving that pumping impacts occurred in 1994. Unfortunately, given the passage of time and the limitations on knowledge of the aquifer system described above, the magnitude and spatial distribution of SDWB impacts on third-party groundwater levels may never be known definitively. One possible resolution of this issue is to shift the responsibility for identifying pumping-related impacts from third parties to future conjunctive use projects themselves. Prospects for such a change in Butte County appear promising.

Significant efforts have been made to create a more open framework for future conjunctive use planning and decision-making in the region. Virtually all interest groups in Butte County recognize that the state government is likely to impose measures on the County in response to future emergencies if a local planning framework does not evolve soon. While there is general interest in finding an acceptable approach, much work remains to be done to fully implement Chapter 33. To create an optimal project planning and review process, local and state interests will need to commit adequate funding and other forms of support this implementation work. Some specific changes that have been recommended for the current planning and decision making processes are listed below. The first water sale permit application under Chapter 33 will be a vital test of the durability of the willingness of local stakeholders to work together.

The County should consider adopting a template for evaluating future conjunctive use projects and/or water sales. This might allow an individual or water district to obtain pre-approval of a proposed groundwater pumping rate prior to actually implementing a drought banking scheme. After any required environmental review and related analyses, the County could then approve the proposal which would be implemented when and if the need were to arise. Approval might require that the proponent present an adequate characterization of the aquifer system and have appropriate monitoring program already in place. This approach would require significant initial investment from the water sellers. Given the value of a reliable supplemental source of water in times of statewide need, some form of funding to subsidize establishment of such a system would seem an investment worth evaluating.

Summary of recommendations proposed by interviewees to improve planning for future conjunctive use projects

Legal assurances

- Liability for damages resulting from conjunctive use projects should be clearly defined.
- A trust fund or escrow account should be established to ensure timely compensation in the event of third party impacts on groundwater pumpers not involved in the water sale.

Hydrologic assurances

- Specific thresholds of impacts that would trigger a cessation of pumping need to be set in more definitive terms than those specified in Measure G.
- Water sale permits should require that drawdowns created by groundwater substitution pumping be confined to within the project or water district boundaries.
- An emergency pumping shutoff procedure is a critical need and must be established.
- Initial conjunctive use projects should emphasize locations where delineation of sub-basins or specific aquifer zones that are sufficiently characterized to determine acceptable drawdown limits.

Improvements in the planning process

- Mitigation measures necessitated by conjunctive use projects or related water transfers should be reviewed in the planning process.

- The County should review the composition of the Water Commission to improve its representation of diverse interest groups.
- The basin management objectives approach being pursued in Glenn County should be employed in Butte County.

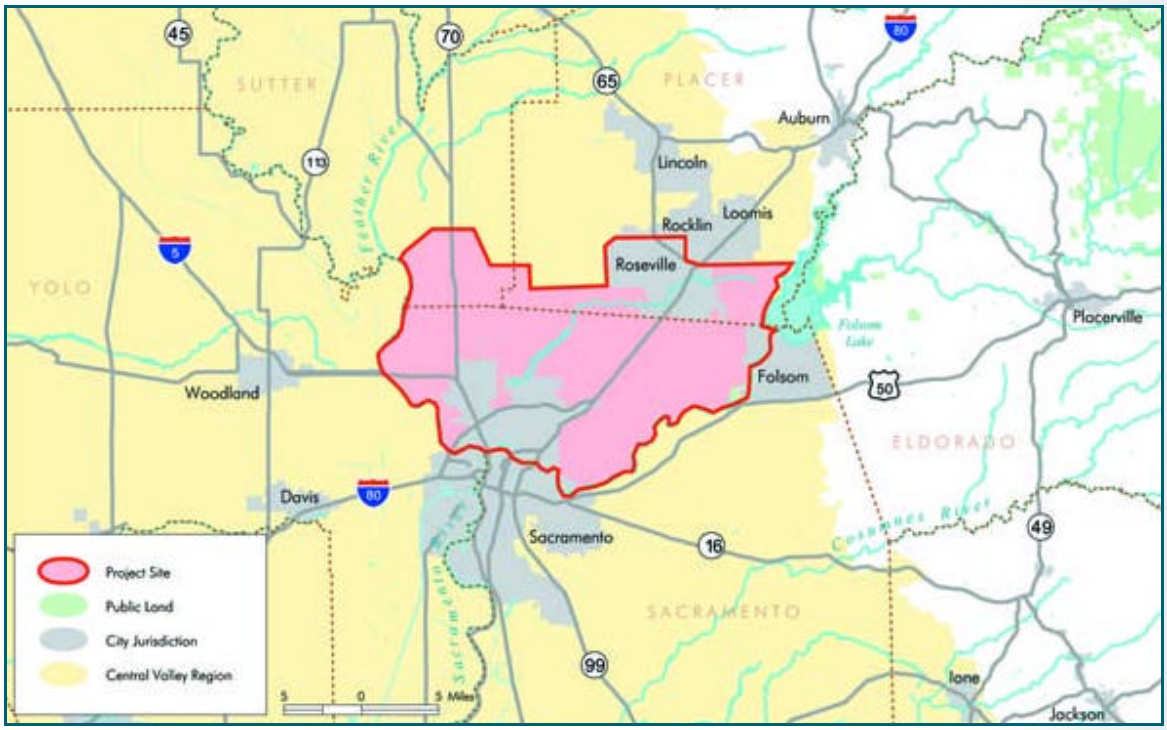
Improvements in the permitting process

- The time frame for water sale permits must be streamlined, but adequate time for EIR review must also be provided.
- Water sales approved by the Water Commission should require five "aye" votes out of the nine members rather than a majority of a quorum present.
- The overall permit process needs to be made more understandable to the public.

Improvements in the monitoring process

- Monitoring data must be made available to all interested public and private parties in an expedited manner.
- Cumulative effects of multiple water sale permits must be evaluated and monitored.

SACRAMENTO NORTH AREA GROUNDWATER MANAGEMENT AGENCY
AMERICAN RIVER BASIN COOPERATING AGENCIES
CONJUNCTIVE USE PROGRAM



SNAGMA

Introduction

This case study reviews the conjunctive use program proposed by the Sacramento North Area Groundwater Management Authority (SNAGMA) and the American River Basin Cooperating Agencies (ARBCA). The Sacramento North Area Conjunctive Use Program illustrates how interest-based negotiations can lead to consensus on regional water issues and formulation of regional water plans. While a full-scale conjunctive use project for the north area of Sacramento has not yet been implemented, a regional conjunctive use program is currently being planned in collaboration with a broad range of stakeholders. SNAGMA and ARBCA, as well as other collaborators, have expended significant time and effort in order to build consensus for a regional water plan. Their efforts have been based largely on the Sacramento Water Forum process and the resultant Water Forum Agreement.

Physical Characteristics

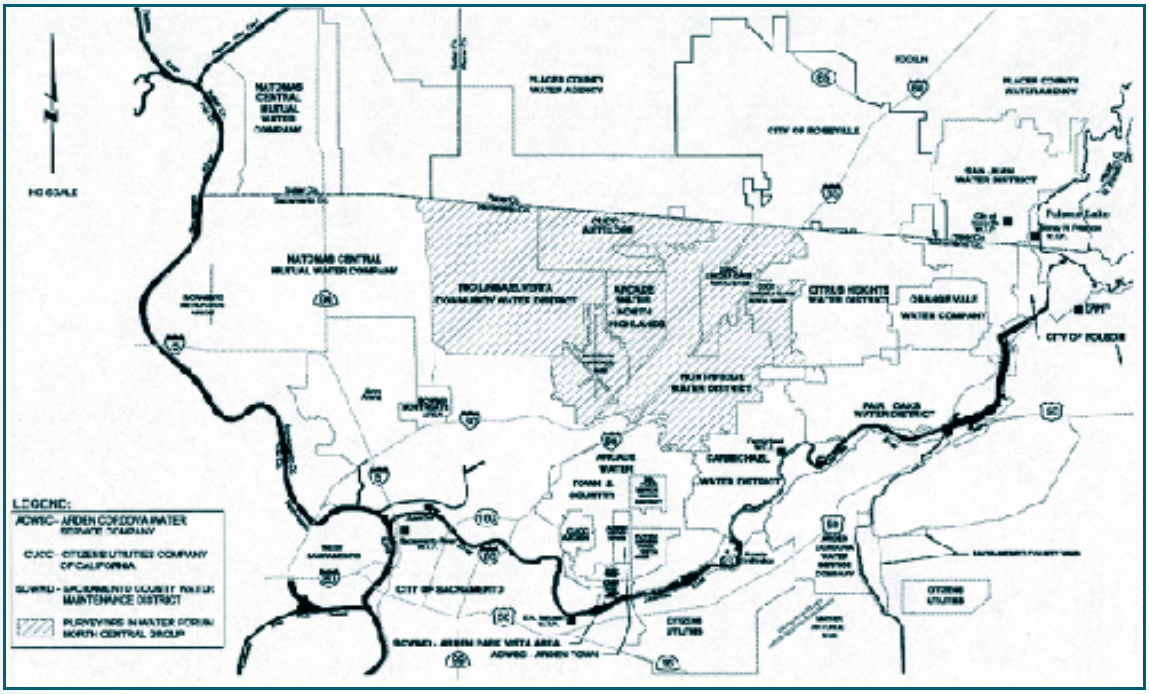
Setting

The proposed Sacramento North Area Conjunctive Use Program falls inside the northern portion of the Sacramento Groundwater Basin, which is located within the southern portion of the Sacramento River Hydrologic Region. Northern Sacramento County and southern Placer County overlie the potential project area, which is bounded on the north by the Placer County Water Agency, on the south by the American River, on the west by the Sacramento River, and on the east by the Sierra Foothills, (see figure 1 on the following page). While much of the overlying area is urbanized, significant agricultural activ-

ities still exist in western areas of Sacramento and Placer counties. The political jurisdictions and water purveyors within the proposed project boundaries include the following:[58]

- Arcade Water District
- Carmichael Water District
- Citizens Water Resources
- Citrus Heights Water District
- City of Folsom
- City of Roseville
- City of Sacramento
- County of Sacramento
- Del Paso Manor Water District
- Fair Oaks Water District
- Natomas Mutual Water Company
- Northridge Water District
- Orange Vale Water Company
- Placer County Water Agency
- Rio Linda/Elverta Community Water District
- Southern California Water Company
- San Juan Water District

AMERICAN RIVER BASIN COOPERATING AGENCIES / REGIONAL WATER MASTER PLAN
Figure 1



HYDROLOGY

Current water demand in the proposed project area is approximately 320,000 acre-feet per year. Approximately sixty percent of water demand is met with surface water, while forty percent is met with groundwater. Water usage can be characterized as approximately eighty percent municipal and industrial, fifteen percent agricultural, and five percent "self-supplied" via groundwater.[59] Groundwater pumping in the area, mostly for municipal and industrial uses, averages 125,000–130,000 acre-feet per year. Overdraft is estimated to have created 1 .5 million acre-feet of available storage (i.e., de-watered aquifer capacity), with a cone of depression

centered in the vicinity of McClellan Air Force Base.[60,61,62] Approximately 400,000 to 600,000 acre-feet of the de-watered aquifer space is assumed to be useable for recharge.

Primary sources of surface water in the area include Folsom Lake, the American River, and Sacramento River. Nearly 900,000 acre-feet of surface water is available to agencies in the proposed project area pursuant to pre-1914 water rights, other appropriative water rights, Central Valley Project (CVP) contract entitlements, and settlement agreements.[63] The Sacramento metropolitan area is the largest urban area within the Sacramento River Hydrologic Region and is the largest urban user of surface water. The largest city within the Sacramento metropolitan area, the City of Sacramento, meets the water needs of its 400,000 residents with a mix of eighty percent surface water and twenty percent groundwater (approximately 100,000 acre-feet per year surface water and 22,000 acre-feet per year groundwater).

Available aquifer storage space, the potential for making use of excess surface water flows, and the combination of public agencies and investor-owned water purveyors that use both surface and groundwater create the necessary pre-conditions for a regional conjunctive use program in the Sacramento area.

Project History

Over its eight year history, the Sacramento Water Forum has evolved from a city-county effort into a program with buy-in from a broad range of regional stakeholders. Using a process of interest-based negotiations, the Water Forum has had several successes including the development of: SNAGMA, a regional water master plan, a water action plan agreement, an EIR, a joint-powers authority for the management of groundwater, a cooperative organization for the implementation of conjunctive use projects and the analysis of potential conjunctive use projects.

The following brief history of the Sacramento North Area Conjunctive Use Program outlines several of the most important processes that have led the Program to where it is today.

The Sacramento Water Forum

The Sacramento City-County Office of Metropolitan Water Planning (CCOMWP) was formed in October 1991 for the purpose of conducting regional water planning for the Sacramento area. The mission of the CCOMWP was to develop a regional water plan to address development and environmental needs in Sacramento through the year 2030. Initially, the CCOMWP conducted water demand analyses and groundwater modeling. Efforts expanded to include input from twenty-two Sacramento area water purveyors and the community at large. A stakeholder-driven process to develop a water action plan was initiated when the CCOMWP convened meetings with a variety of stakeholders including water purveyors, representatives of the business community and representatives from development, environmental, and agricultural interest groups.[64]

Out of this stakeholder-driven process, the Sacramento Water Forum (Water Forum) was formed in 1993. The Water Forum is an ongoing water planning effort that has been cited as an outstanding example of how a collaborative process can be used to develop a regional water plan and cooperative projects. Its mission is to develop and implement a plan to meet two coequal objectives: (1) to provide a safe and reliable water supply for the region's economic health and planned development through the year 2030 and (2) to preserve the fishery, wildlife, recreational, and aesthetic values of the lower American River.[65] After six years of research and negotiation among the stakeholder groups, the members of the Water Forum signed an agreement and action plan to meet the coequal

objectives. The agreement and action plan seek to avoid future water shortages, environmental degradation, groundwater contamination, threats to groundwater reliability, and limits to economic prosperity.

For the purposes of this study, the key element of the Water Forum Agreement is the one dealing with groundwater management. This element provides the basis for the formulation of the Sacramento North Area Groundwater Management Authority (SNAGMA, adopted in August 1998), the American River Basin Cooperating Agencies (ARBCA), and the Sacramento North Area Conjunctive Use Program.

SNAGMA

The Sacramento groundwater basin consists of three sub-basins—the North Area, South Area, and Galt Area—each with its own unique conditions and problems.[66] The Water Forum Groundwater Management Element recommends an annual sustainable yield for each sub-basin. In the case of the North Area, the recommended sustainable yield is 131,000 acre-feet per year, a figure based on the volume extracted in 1990.[67]

The North Area is bounded by the American River on the south, the Sacramento County line on the north, the Sacramento River on the west, and the City of Folsom on the east. The Water Forum Groundwater Management Element recommended that the North Area move ahead with groundwater management under a Joint Powers Authority (JPA) form of governance structure. This decision was based on the following four factors:[68]

- The North Area is closer to build-out than the other two areas;
- Delivery systems for surface water are already being expanded and utilized to a greater extent in the North Area;
- Organized purveyors serve almost all of the North Area, including agriculture. Thus, the institutional infrastructure necessary to implement groundwater management is further developed in the North Area; and
- The Sacramento Metropolitan Water Authority, which includes eight of the twelve water purveyors in the North Area, wishes to implement a groundwater management plan as soon as possible and has already taken action to do so.

Pursuant to the Water Forum recommendation, a Joint Powers Agreement that uses the existing authority of the Cities of Citrus Heights, Folsom, Sacramento, and County of Sacramento established the Sacramento North Area Groundwater Management Authority (SNAGMA).[69] SNAGMA boundaries are coincident with those of the North Area Basin. The JPA requires the participation, through its Governing Board, of representatives of the County of Sacramento, the cities, private and public water purveyors, investor-held utilities, and groundwater rights holders in the North Area. Additionally, the SNAGMA Governing Board includes representatives of agriculture and commercial/industrial self-supplied (groundwater) users within the JPA boundaries.[70] The membership of the SNAGMA Governing Board consists of representatives from the boards or councils of the following North Area agencies, water purveyors, and stakeholders:

- Arcade Water District
- Carmichael Water District
- Citrus Heights Water District

- Del Paso Manor Water District
- Fair Oaks Water District
- Northridge Water District
- Rio Linda/Elverta Community Water District
- San Juan Water District
- City of Folsom
- City of Sacramento
- Sacramento County Water Maintenance District
- Southern California Water Company
- Citizens Water Resources
- Natomas Mutual Water Company
- Orange Vale Water Company
- Agricultural representative
- Self-supplied representative

SNAGMA is responsible for a wide variety of groundwater management functions in the North Area, including: collection and monitoring of groundwater data; maintenance of the recommended sustainable yield; and development and administration of a conjunctive use program. Additionally, SNAGMA is authorized to do the following:[71] (See next page).

Buy and sell water on other than a retail basis;

Exchange water, distribute water for ceasing, or reducing, groundwater extractions;

Spread, sink, and inject water into the North Area Basin;

Store, transport, recapture, recycle, purify, treat, or otherwise manage and control water for the beneficial use of persons and property within the authority;

Implement any conjunctive use program the Authority deems necessary to maintain sustainable yields in the North Area;

Study and plan ways to implement any or all of the foregoing powers;

Store water in underground basins or reservoirs within or outside of the Authority;

Exercise the right of eminent domain to take property necessary to supply the Authority with replenishment water;

Levy taxes, fees, or charges to accomplish the purposes of the Authority;

Require permitting of groundwater extraction facilities within the boundaries of the authority and meters for groundwater extraction facilities;

Carry out technical investigations to further the purposes of the Authority;

Set rates at which water acquired by the Authority can be sold for replenishment purposes;

Participate in *in lieu* contracts; and

Apply for and accept state, federal, or local licenses, permits, grants, loans, or aid.

Cited as one of the first authorities of its kind in California, SNAGMA provides an example of how collaborative negotiation processes can supply a structure for local control of groundwater resources. As seen from the list of SNAGMA's responsibilities and the number of participants, the Authority is a consolidation of local interests that have delegated their powers to it for the purposes of collectively managing groundwater resources.

ARBCA and the Regional Water Master Plan

While SNAGMA's role is primarily one of groundwater management, American River Basin Cooperating Agencies (ARBCA) was formed for the broader purpose of creating a regional partnership for water resources planning and conjunctive use project implementation.[72] ARBCA is funding the development of a Regional Water Master Plan (Regional Plan), estimating the cost of infrastructure needed for implementing a regional conjunctive use program, and developing operating agreements and institutional arrangements for conjunctive use, water banking and exchange.[73] The objectives of the Regional Plan are to enhance water supply reliability, provide high quality water and protect economic interests, while allowing each water purveyor to make its own business and policy decisions.[74]

ARBCA consists of water purveyors from Sacramento County, the City of Roseville, and Placer County Water Agency.[75] The total membership of Cooperating Agencies consists of the following:[76]

- Arcade Water District
- Carmichael Water District
- Citizens Water Resources
- Citrus Heights Water District
- City of Folsom
- City of Roseville
- County of Sacramento
- Del Paso Manor Water District
- Fair Oaks Water District
- Northridge Water District
- Placer County Water District
- Rio Linda/Elverta Community Water District
- San Juan Water District
- Southern California Water Company

In addition to the Cooperating Agencies, there are six Collaborating Agencies participating in the ARBCA regional water master planning and conjunctive use effort. These are:

- California Department of Water Resources (DWR)
- Natomas Mutual Water Company
- Orange Vale Water Company
- Sacramento Metropolitan Water Authority
- SNAGMA
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation

In particular, the Bureau of Reclamation and DWR have provided assistance in the form of grant funding and in-kind services. ARBCA and SNAGMA have formed a partnership for the purposes of developing and coordinating the Regional Plan and implementing a conjunctive use program. The goals and objectives of ARBCA and SNAGMA are fully compatible and the

significant membership overlap simplifies facilitation of the partnership. SNAGMA's role in the partnership is to establish the contractual arrangements needed to implement the conjunctive use program per the Regional Plan, exercise its authority to manage the groundwater basin, and provide the legal and political certainty for entering into long-term water banking and water exchange agreements.[77]

The ARBCA Cooperating Agencies are bound together by a series of Memorandums of Understanding (MOUs) that commit each agency to fund their share of the Regional Plan.[78] ARBCA has also established an organizational structure to oversee the development of the plan. An executive committee, consisting of technical experts and policy makers representing each member agency, provides direction and guidance. A coordinating committee, composed of a subset of the executive committee, oversees consultant team activities and develops meeting agendas. Finally, an implementation options committee evaluates institutional and policy issues that could impact the implementation of the Regional Plan. The San Juan Water District acts as the financial agent of ARBCA, as directed by the executive committee.

The development of the Regional Plan is proceeding in the following three phases:[79]

> Phase I — develop common goals and objectives for the implementation of conjunctive use, establish the current setting (supplies, demands, existing facilities), identify potential conjunctive use opportunities, and prepare a Phase II scope of work for evaluating water management and conjunctive use opportunities. Phase I was completed in June 1999.
>
> Phase II — configure the opportunities identified in Phase I into a Regional Plan institutional framework with specific projects identified and studied. Phase II includes the development of Integrated Groundwater and Surfacewater Model and economic and financial models and a communications strategy. Phase II is anticipated to be complete by April 2001.
>
> Phase III — develop draft agreements, conduct an environmental review of the Regional Plan and implement the conjunctive use program.

Groundwater Banking Opportunities

The ARBCA/SNAGMA partnership is exploring ways to establish a North Area Conjunctive Use Program to satisfy the Groundwater Element of the Water Forum Agreement. The partnership is developing a groundwater banking and exchange program that will take advantage of the regional cone of depression in the Sacramento area and integrate the operation of Folsom Lake with the recharge of the groundwater basin. Several options that have been proposed are described below.

The concept holds that, during a banking cycle, or "put" operation, surface water diversions from the American and/or Sacramento Rivers would be stored in the groundwater aquifer underlying the North Area and southern Placer County. The banking could occur either as *in lieu* recharge or direct recharge via spreading or injection. During the exchange cycle, or "take" operations, the banked groundwater would be extracted for local use *in lieu* of surface water diversions. Thus, surface water could be left in reservoirs for temperature control for fisheries, recreational uses or for releases to satisfy a variety of other purposes.[80]

To test the potential of the concept and the strength of institutional arrangements, the ARBCA/SNAGMA partnership conducted a pilot program to use conjunctive water manage-

ment for water supplies to the Sacramento Area Flood Control Agency (SAFCA) on an on-call basis. Implemented with the participation of ARBCA/SNAGMA, SAFCA, and the U.S. Bureau of Reclamation (USBR), the program allows SAFCA to divert and bank water in the basin during wet months. Exchange water is available for SAFCA to satisfy its refill obligation associated with flood pool reservation in Folsom Lake.

Under the pilot program, banking is accomplished by diversion of raw water from Folsom Reservoir and treatment at San Juan Water District Water Treatment Plant. Treated water is wheeled through the Cooperative Transmission Pipeline and the Northridge Water District Transmission Pipeline for banking via *in lieu* groundwater recharge. In the exchange cycle, Citrus Heights Water District extracts groundwater in an amount equal to the banked water, foregoing a portion of the treated water normally supplied to the city by San Juan Water District. This frees an equal amount of water that San Juan Water District can then make available to SAFCA. San Juan Water District then foregoes portions of its diversions from Folsom Reservoir to make water available to SAFCA.[81]

The ARBCA/SNAGMA pilot program has been successfully implemented, and the partnership is now pursuing an expanded banking and exchange program with the CALFED Environmental Water Account (EWA). The pilot program serves as a good test of the institutional capabilities to bank and exchange water and is indicative of the willingness of the regional partners to move forward with the full-scale Sacramento North Area Conjunctive Use Program.

Institutional Arrangements

Project Time Frame

The proposed Sacramento North Area Conjunctive Use Program is on a four to five year schedule, based on the Regional Water Master Plan timeline (1998 to beyond 2000). However, as stated previously, the Program actually has it roots in the 1991 CCOMWP formation, progressed through six years of Water Forum negotiations, and is now in the ARBCA/SNAGMA regional planning phase. Thus, the timeframe for development of the Sacramento North Area Conjunctive Use Program could be viewed as extending over ten years or more.

Participants

See list of Cooperating and Collaborating Agencies involved in the ARBCA Regional Water Master Plan formulation above.

Beneficiaries

Project beneficiaries include the participating agencies listed above as well as the environmental and business interests represented by SNAGMA. Essentially, a variety of stakeholders across the entire region benefits from the conjunctive use program.

Project Opposition

At the Water Forum stage, there was some opposition by regional environmental interests because of recommendations for increased diversions. These issues were resolved through the interest-based negotiation process.[82] San Joaquin County interests were somewhat opposed because they were not included in the Water Forum process, which was specific to the American River Basin. There is now overall stakeholder support for the ARBCA/SNAGMA stage, most likely due to the collaborative structure of the initial Water Forum.

Stakeholder Participation

A CEQA document was prepared for the Water Forum action plan. The EIR was certified with

no public comment in December 1999. This success was largely attributed to the focused outreach program and the consensus-based negotiations that resulted in development of the action plan in advance of EIR preparation.

Environmental Review

The environmental documentation for the Regional Plan and Sacramento North Area Conjunctive Use Program will start sometime in 2001, after the completion of Phase II of the Regional Plan.

Technical Studies

Phase I technical studies for the Regional Plan were completed by Montgomery Watson, in association with CH2M Hill and Bookman-Edmonson. A "Blue Ribbon" panel of experts was assembled to review the approach taken by the project consultant team and to comment on the technical studies. The approach and studies were well received by the panel.[83]

Monitoring Program

Once it has been fully implemented, the monitoring program will be administered by SNAGMA.

Financial Characteristics

Costs for the Groundwater Management Element of the Water Forum Agreement were not tracked separately from the other six elements of the agreement. Overall costs for the eight year Water Forum effort totaled nearly $13 million.[84] The Water Forum Successor Effort has an initial annual budget of $720,000 per year. Until 1998, CCOMWP bore Water Forum costs. Since then, the participants have shared the cost of the work: the City of Sacramento funds approximately thirty-five percent, the County funds approximately fifty percent, and other cities and districts fund fifteen percent of the effort.

The cost of the Regional Plan Phase I Study was $267,000. The Phase II Study will cost approximately $1,000,000.[85,86] Participants share these costs, and the finances are managed by San Juan Water District. In addition, SNAGMA has funded about $350,000 of studies in support of the conjunctive use program. Costs of the conjunctive use program will be identified in the Regional Plan Phase II Study.

Issues and Risks

Many of the issues, risks (e,g., hydrologic, economic, legal), operational details, and environmental impacts of the program will be determined in the Regional Plan Phase II Study and supporting CEQA documentation, which will be completed in 2001. Funding for project planning and implementation will be provided by the participating agencies. Water rate increases were estimated at four percent per agency in the Water Forum, but this estimate will be refined based on the Phase II Regional Plan work.

SNAGMA will manage the groundwater resources and administer program rules in the North Area. The risk to crops is expected to be minimal as most of the project area is urbanized.

Because the ARBCA/SNAGMA conjunctive use project is an outgrowth of the Water Forum process, political risks and risks of substantial opposition are expected to be minimal. All stakeholders, including potential project opponents, were identified at the outset and included in the process of interest-based negotiations. The principal role of the Water Forum Successor Effort is to review implementation of the conjunctive use program. As noted above, the Water Forum is cited as an example of an outstanding stakeholder effort to develop a cooperative water action plan, and political opposition is unlikely.

Conclusions

The Water Forum, and the subsequent formation of SNAGMA and ARBCA for the purposes of groundwater management and conjunctive use, is an example of the effectiveness of interest-based negotiation in addressing water resources issues in California. This case demonstrates that the process is not simple or quick. Rather, it shows that, in order to be successful, the process of building consensus and forming collaborative organizations requires planning, organization, education, negotiation, and implementation, as well as ongoing follow-up. Some of the factors that most likely contributed to the success of the Water Forum and subsequent efforts include:

GENERAL PLAN — having a clear General Plan for the region that demonstrates the need for securing water resources over the next thirty years provides a focus for generating discussion and planning.

FORUMS — SMWA provides a forum for communication and interaction among local water purveyors and was instrumental in carrying out the American River Water Resources Investigation and helping to initiate the formation of SNAGMA. Also, the Sacramento Area Water Works Association (SAWWA), founded in 1958, is a volunteer organization representing thirty-five Sacramento area water purveyors. SAWWA promotes communication, cooperation, and the integration of resources among its members.[87]

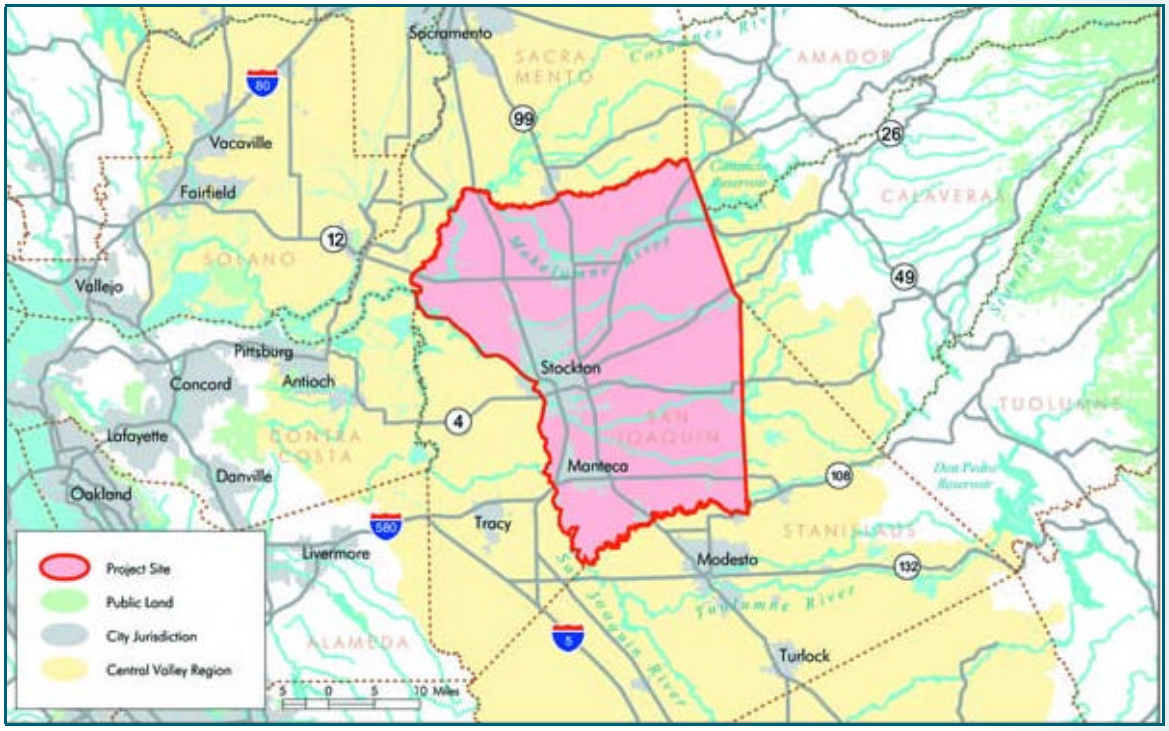
LEADERSHIP — having good leadership within the local water interests that recognized the need to reach out and include stakeholders in the Water Forum process is essential for success.

FACILITATION — recognizing the need for and retaining professional facilitation and mediation is a key element for success. Likewise, using interest-based negotiation and taking the time to train and educate the participating stakeholders is also crucial.

UNIFORM LAND USE — for the most part, the North Area has been extensively urbanized, and the remainder will most likely be urbanized over the next thirty years. Uniform land use contributes to the focus of the participants.

The Sacramento North Area Conjunctive Use Program is a good demonstration of how interest-based negotiations can lead to consensus on regional water issues and the formation of water plans. The Water Forum process led to an effective means of collective action for managing groundwater resources at the local level. As stated in the Water Forum Groundwater Management Element, this collective action is intended to avoid the "train wreck" that can occur when all overlying users exercise their right to pump groundwater beyond the sustainable yield of the basin. The Water Forum, and now SNAGMA and ARBCA, seek to prevent overdraft and the resultant disaster of divisive, protracted litigation and adjudication. Thus far, the effort has proven successful.

EAST BAY MUNICIPAL UTILITY DISTRICT/EAST SAN JOAQUIN PARTIES WATER AUTHORITY CONJUNCTIVE USE PROGRAM



Introduction

This case study reviews the efforts by the East Bay Municipal Utility District (EBMUD) and the East San Joaquin Parties Water Authority (ESJWPA) to jointly bank groundwater in Eastern San Joaquin County.

Physical Characteristics

Setting

San Joaquin County is located at the northern end of the San Joaquin Valley, between the Sacramento-San Joaquin River Delta and the Sierra Nevada foothills. Eastern San Joaquin County is bounded by Sacramento County in the north; Amador, Calaveras and Stanislaus counties in the east; the Stanislaus River in the south; and the San Joaquin River and the San Joaquin River Delta in the west.[88]

San Joaquin County encompasses a total of 912,599 acres with about 600,000 acres of this area considered "Eastern San Joaquin County."[89] The majority of the land use in Eastern San Joaquin County is agricultural, and about six percent of the area is urban.[90] The major urban areas of Eastern San Joaquin County include the City of Stockton, City of Lodi, City of Manteca, Lathrop, Escalon and some unincorporated towns such as Lockeford, Clements and Thornton.

Water suppliers in Eastern San Joaquin County include the Woodbridge Irrigation District, the Stockton East Water District (SEWD), the North San Joaquin Water Conservation District, the Central San Joaquin Water Conservation District, the South San Joaquin Irrigation District, and

the Oakdale Irrigation District. Additionally, San Joaquin County's Flood Control & Water Conservation District overlies the area.

Eastern San Joaquin County is traversed by the Mokelumne River in the north, the Calaveras River in the middle, and the Stanislaus River in the south at the San Joaquin/Stanislaus County line. Additionally, several small creeks cross the area. These include Dry Creek, Little Johns Creek, Lone Tree Creek, Duck Creek, Bear Creek, Mormon Slough, and Mosher Creek. Finally, six surface water reservoirs are operated within close proximity to the area: Camanche, Pardee, New Melones, New Hogan, Farmington, and Woodward Reservoirs.[91]

Hydrology

San Joaquin County is within the northern portion of the San Joaquin River Hydrologic Region, as defined by the USGS, and overlies two groundwater basins—the Eastern San Joaquin County Groundwater Basin and the Tracy Groundwater Basin. The Eastern San Joaquin County Groundwater Basin is located east of the San Joaquin River and the delta and the Tracy Basin is west of the San Joaquin River. Sediments in the area are highly permeable.

Total agricultural consumption of water in San Joaquin County averages approximately 1,120,000 acre-feet per year. The municipal and industrial (urban) water demand is about 111,000 acre-feet per year.[92] Due to the relative lack of sufficient dry-year surface water rights in the San Joaquin County, the county has relied heavily on groundwater throughout its history. As a result, groundwater supplies approximately seventy percent of San Joaquin County's water needs.[93] The total groundwater usage in the county is estimated to be approximately 731,000 acre-feet per year, which exceeds the estimated safe yield of 618,000 acre-feet per year.[94] This mining of groundwater results in an estimated groundwater overdraft of 113,000 acre-feet per year.

Technical studies demonstrate that the groundwater overdraft problem has existed in Eastern San Joaquin County for several decades.[95] Two pronounced groundwater pumping depressions were observed in the region during the late 1940s and early 1950s. The largest of the two depressions is located in northeastern San Joaquin County between the Mokelumne and Stanislaus Rivers and is centered in the Stockton area. Here, groundwater levels are greater than seventy feet below sea level and as much as one hundred and fifty feet below pre-development levels.[96,97] One study indicates that the rate of groundwater withdrawal has exceeded recharge for at least fifty years. The overdraft has resulted in the intrusion of saline water into the aquifer below Stockton, with. some studies indicating that the saline water front is advancing at a rate of 140 to 150 lateral feet per year.[98,99] If the groundwater overdraft continues in the Stockton area, the saline migration will expand, resulting in a significant loss of Eastern San Joaquin County's groundwater resources.

The estimated overdraft for the northeastern part of the county is about 70,000 acre-feet per year, and a recent study shows that approximately 183,000 acre-feet per year is needed to overcome the impacts of the groundwater overdraft.[100,101] As a result, the ongoing overdraft has dewatered an estimated three million acre-feet and created considerable storage capacity in the Eastern San Joaquin County groundwater basin.[102]

The East Bay Municipal Utility District's 1993 Water Supply Management Program describes groundwater use as a key element of EBMUD's water supply reliability strategy. The District's engineering and environmental work clearly demonstrates the technical feasibility of recharg-

ing and extracting surface water in the Eastern San Joaquin County Groundwater Basin. The EBMUD literature also points out that, while it is technically feasible to bank water in the area, institutional issues need to be resolved before a project can move forward.[103] The following discussion provides a brief history of EBMUD's involvement in water banking in Eastern San Joaquin County.

Project History

Water officials and the public have been aware of the groundwater overdraft problem in Eastern San Joaquin for many years. In 1971, the serious nature of the situation prompted the California State Legislature to take special action. In recognizing the problem, the Legislature stated:

> *"The water supplies in the underground basin in the area of Stockton East Water District are insufficient to meet the water demands of the area, and, because of the geologic conditions peculiar to the area and because excessive pumping has seriously depleted the underground water storage, there has been an intrusion of saline waters into the underground water basin causing serious water quality deterioration and the destruction of the usefulness of a portion of the underground water basin. Further excessive pumping, without proper management of the underground water basin is certain to destroy the usefulness of a major portion of the underground water basin and endanger the health of and welfare of the district."*[104]

The Legislature found that the overdraft problem was broad and complex and that neither the urban nor the agricultural interests could solve the problem by themselves but instead must make a joint effort to reach a solution. Policymakers have recognized the overdraft problem in other forums as well. For example, Section 1011.5 of the Water Code mandates that the overdraft in the Eastern San Joaquin County Groundwater Basin be halted by 2007 as a condition for exportation of groundwater. And, the California Department of Water Resources (DWR) in Bulletin 118-80 identified the groundwater underlying Eastern San Joaquin County as subject to critical conditions of overdraft.

The recognition of the overdraft problem in Eastern San Joaquin County led to a number of proposals for dealing with the situation. Several options have been explored, including the reoperation of Farmington Reservoir to provide recharge water and a regional canal connecting the Folsom South Canal to the lower Farmington Canal to make use of water from the Calaveras and Stanislaus Rivers. One of the proposals involves participating in a conjunctive use project with EBMUD, where, during certain years, a portion of EBMUD's Mokelumne River Water or its CVP water would be banked in the Eastern San Joaquin County Groundwater Basin prior to being diverted into the Mokelumne Aqueduct.[105] This proposal was discussed in the EBMUD 1993 Water Supply Management Program (WSMP) and is the focus of this case study.[106,107]

EBMUD's involvement in Eastern San Joaquin County groundwater issues can be traced back to 1937 when concerns were raised about Mokelumne River diversions and groundwater in the Lodi area. EBMUD currently monitors groundwater levels as a part of an agreement with the City of Lodi. In 1981, the San Joaquin County Flood Control and Water Conservation District retained the firm of Brown and Caldwell to study groundwater conditions in Eastern San Joaquin County (Brown and Caldwell Study). The Eastern San Joaquin Water Users Association—composed of the North San Joaquin Water Conservation District, the Woodbridge Irrigation District, the Stockton East Water District, the Central San Joaquin Water Conservation District, the County Flood Control and Water Conservation District, and the Woodbridge Water Users Conservation District—supported the need for this study. Participants in the study Policy Advisory Committee included the City of Stockton, City of

Lodi, California Water Service Company, and EBMUD. The members of the Eastern San Joaquin Water Users Association, with the Cities of Lodi and Stockton (and the California Water Service Company as a non-voting member), eventually formed the East San Joaquin Parties Water Authority (ESJPWA) for the purpose of negotiating a groundwater recharge project with EBMUD.

The goal of the Brown and Caldwell Study was to determine the relative effects of various water supply alternatives on the Eastern San Joaquin County groundwater basin. Completed in 1985, the study found that development of a plan to optimize the use of surface water and groundwater supplies was technically feasible and economically attractive. However, the study notes that much technical, legal, economic, and institutional work would need to be completed before a conjunctive use program could be considered.[108]

The prolonged drought of 1987–1992 caused the groundwater levels in San Joaquin County to decline sharply.[109] This allowed the saline waterfront to encroach further eastward, degrading the quality of the groundwater in the eastern part of the county (Fall 1993 Groundwater Report). The drought also induced landowners to install wells in the southwest area of San Joaquin County for groundwater export via the adjacent CVP aqueduct facilities (the Delta Mendota Canal). These events, plus growth in the county, underscored the need to move forward with some form of supplemental water program.

The idea to actively pursue a recharge project for Eastern San Joaquin County originated with Stockton East Water District.[110] As a major water agency within Eastern San Joaquin County responsible for providing supplemental surface water supplies, SEWD recognized the seriousness of the overdraft problem and the need to explore regional solutions. The district's initiative, coupled with some active leadership within San Joaquin County and the development of EBMUD's Water Supply Management Program, led to negotiations between Eastern San Joaquin County water interests and EBMUD in 1994.[111,112]

In 1995–96, the Eastern San Joaquin County water interests, consisting of the San Joaquin County Flood Control and Water Conservation District, the Cities of Stockton and Lodi, SEWD, Central San Joaquin Water Conservation District, Woodbridge Irrigation District, North San Joaquin Water Conservation District, and the California Water Service Company (as an associate member), formed the East San Joaquin Parties Water Authority (ESJPWA), a joint powers authority.[113] The stated purpose of the ESJPWA is to plan a project or projects to meet the water deficiencies of Eastern San Joaquin County, either alone or in conjunction with EBMUD and/or other public entities.[114]

The ESJPWA negotiations with EBMUD resulted in a 1995 agreement to pursue jointly funded technical studies.[115] The technical studies were completed in 1996 and found that a mutually beneficial program would entail recharging 40,000 acre-feet per year in about half of all years into the basin, while extracting about 50,000 acre-feet of water in one out of four years.[116] The study looked at *in lieu* conjunctive use and injection/extraction as options. It concluded that the least expensive option would be to use dual-purpose aquifer storage and recovery wells located near EBMUD's Mokelumne River Aqueduct (MRA). Capital facilities for this option were estimated to cost $25 million, as opposed to $90 million for *in lieu* recharge facilities.[117] The MRA injection/extraction option would allow EBMUD to take advantage of normal weather and wet weather flows from the Mokelumne River.

The findings of the 1996 technical studies led to the execution of a 1997 Memorandum of Agreement (MOA) between ESJPWA and EBMUD to demonstrate the feasibility of the injection and extraction of surface water into the Eastern San Joaquin County Groundwater Basin.[118] The purpose of the proposed project was to test the reaction of the aquifer to injection and extraction, the water quality impacts and optimal rates of injection and extraction. The data generated by this pilot project would provide the necessary information for the design of full-scale injection/extraction facilities.

The proposed project, which became the Beckman Test Injection/Extraction Project (Beckman Test Project), was designed to inject 3,000 acre-feet of Mokelumne River Water from the MRA into a site adjacent to the MRA. Per the MOA, EBMUD would sell the water to ESJPWA; EBMUD would have the ability to recover up to fifty percent of the injected water (1500 acre-feet). The project was operated for a nine month period during 1997–1998 and demonstrated the feasibility of injecting up to 500 gallons per minute.[119] While the project performed as expected, the Beckman Test Project created an institutional controversy within San Joaquin County as a result of EBMUD filing an application for the export of water extracted from the project.

In 1996, in partial response to the groundwater overdraft in the southwest portion of the County that occurred during the drought, San Joaquin County adopted an ordinance establishing a permit process for exportation of groundwater. In 1997, EBMUD became the first entity to apply for a permit when it requested a permit for export of water from the Beckman Test Project site via the MRA.[120] Per the requirements of the County ordinance, the Advisory Water Commission of the San Joaquin County Flood Control and Water Conservation District reviewed the permit. The permit process includes the opportunity for public comment at the Commission review. Significant opposition to the permit application was voiced by the overlying farmer/landowners, including the San Joaquin Farm Bureau Federation, which was concerned about granting EBMUD access to the Eastern San Joaquin Groundwater Basin.[121] As a result, only three of the nineteen Commission members present (out of a total twenty-two members) voted to support the permit.[122,123] Thus, the permit was denied and no water was exported from the Beckman Test Project.

The application triggered nearly two of years of review of the protections afforded by the 1996 Ordinance. The ordinance was amended in June 2000 to incorporate measures to ensure that local groundwater users have enough water. The amendments adopted portions of the Kern Water Bank operating rules, modified to meet the needs of San Joaquin County. The amendment requires the submission of more detailed project information, the installation of at least three monitoring wells, a limit on the amount of water that can be exported to assure a net gain in usable water underlying the project, requirements for the spacing of extraction wells and buffer zones, limits on extraction times and periods, the formation of a monitoring committee, and a provision that the project shall not create conditions that are worse than conditions in the absence of the project (the so-called "Golden Rule"). The permit approval is made by the County Board of Supervisors. However, before approving any permit application, the Board of Supervisors must find that the proposed project will not operate to the injury of the reasonable and beneficial uses of the overlying groundwater users.[124]

With the adoption of the amended ordinance and the completion of the Beckman Test Project, ESJPWA and EBMUD proposed to move ahead with the Eastern San Joaquin Groundwater Bank #1 Project. This project would use both *in lieu* pumping and groundwater

injection methods to bank Mokelumne River water. Injection/extraction wells would be constructed near the MRA in the North San Joaquin Water Conservation District area. The Eastern San Joaquin Groundwater Bank #1 Project proposed to recharge an average of 7,000 acre-feet per year and extract an annual average of 3,500 acre-feet of water per year. The estimated cost for this project was $25 million.[125]

ESJPWA began soliciting partners to provide water and/or funds to assist in advancing the project. This triggered the opposition of local interests who feared the encroachment of outside agencies into the Eastern San Joaquin Groundwater Basin, even with the protections provided by the amended County ordinance in place.

As of September 2000, the ESJPWA intended to move forward with the Eastern San Joaquin Groundwater Project, utilizing the lessons learned from the Beckman Test Project. The ESJPWA representatives believed, based on the ordinance revision process, that they understood what level of information is required to satisfy the Advisory Water Commission needs, and ESJPWA planned to develop the project along these lines. Also, ESJPWA intended to incorporate an ongoing public outreach effort regarding the project.[126] ESJPWA and EBMUD stated that they could work within the requirements of the amended County Groundwater Extraction and Exportation Ordinance. Eastern San Joaquin Parties Water Authority disbanded on June 30, 2000. The future of this project is therefore uncertain.

Table 2

EASTERN SAN JOAQUIN COUNTY/EAST BAY MUNICIPAL UTILITY DISTRICT GROUNDWATER BANKING PROJECT CHRONOLOGY	
EVENT	DATE
Brown and Caldwell are retained by San Joaquin County Flood Control & Water Conservation District to study groundwater conditions in Eastern San Joaquin County—EBMUD is a study participant.	1981
Brown and Caldwell study is completed. Study finds 200,000 af per year of surface water needed to stabilize groundwater basin, recommends Folsom South Canal option and/or New Melones be used as water source.	1985
Prolonged drought—farmers in Tracy area install wells for groundwater export.	1987–1992
San Joaquin County Flood Control & Water Conservation District groundwater monitoring demonstrates that saline front has encroached farther east towards Stockton (drought impact).	1993
Active negotiations begin between Eastern San Joaquin County water producers and EBMUD regarding a joint conjunctive use project.	1994
East San Joaquin Parties enter into an agreement with EBMUD to evaluate a joint groundwater storage conjunctive use program. Montgomery Watson, in conjunction with CH2M Hill, is selected to perform the study.	1995
East San Joaquin Parties Joint Exercise of Powers Agreement is executed. ESJWPA's stated purpose is to plan projects to meet water deficiencies of Eastern San Joaquin County.	1996
San Joaquin County adopts a groundwater extraction and export ordinance.	1996
Montgomery Watson issues Mokelumne Aquifer Recharge and Storage Project Final Report. Stanislaus & American River injection and *in lieu* options are presented. Folsom Canal South option plus Mokelumne River options are also presented.	1996
EBMUD and ESJWPA enter into a Memorandum of Agreement to demonstrate the feasibility of injection and extraction of surface water into the Eastern San Joaquin County Groundwater Basin. EBMUD will provide 3000 af of water to ESJWPA for $1/af. EBMUD can extract up 50% of the stored water.	1997
EBMUD files for an export permit pursuant to Division 7 of Title 5 of the Groundwater Extraction and Exportation Ordinance of San Joaquin County. Local interests strongly oppose issuing the permit. The Advisory Water Commission (AWC) approves environmental documentation, but the permit application subsequently fails.	1998
Beckman Test Injection/Extraction Project constructed and operated. Boyle Engineering Corp. is project consultant. Mokelumne River Aqueduct is used to supply water.	1997–1998
Boyle Engineering releases final report on Beckman Project. Report concludes that injection rates of 500 gallons per minute, or more, per well are feasible. Extraction rates were as projected.	1999
After a series of extensive reviews, the San Joaquin County Board of Supervisors approves an amendment to the Groundwater Extraction and Exportation Ordinance that limits groundwater exports, creates a monitoring committee for projects and requires groundwater banking projects to provide a net increase in groundwater in the basin.	May 2000
ESJWPA presents proposed Groundwater Bank No. 1 Project ("10 Well Project"). Information from the Beckman Project will be used for design. EBMUD will participate and Mokelumne River water is the proposed supply source. ESJWPA solicits partners for project.	August 2000
San Joaquin Farm Bureau Federation (SJFB) publicly opposes participation by outside interests in any groundwater banking/extraction project within San Joaquin County. The Farm Bureau states opposition to ESJWPA soliciting outside partners.	August 2000
ESJWPA charter formally expired June 2000—this is not recognized until November 2000.	November 2000
Members of former ESJWPA form northeastern San Joaquin County Groundwater Banking Authority.	February 2001

Institutional Arrangements

The proposed source of the banked water is the Mokelumne River and, potentially, water diverted from the Sacramento River. EBMUD has rights to 360,000 acre-feet per year of Mokelumne River water, but the district has inadequate storage and the Mokelumne River flows are highly variable, ranging from 80,000 to 1.8 million acre-feet per year.[127]

The Beckman Test Injection/Extraction Project was sited on land owned by Mr. Charles Beckman, near the Mokelumne River Aqueduct (MRA) to minimize conveyance costs. Similarly, the proposed Eastern San Joaquin County Groundwater Bank No.1 will be located near the MRA within the North San Joaquin Water Conservation District, in order to minimize costs of pipes for distribution and extraction. The proposal is for an aquifer storage and recovery (ASR) project, where banking would be accomplished by approximately ten injection/extraction wells. Water would then be conveyed to end-users via the Mokelumne River Aqueduct. Water remaining in the basin would be used for overdraft correction.

Beneficiaries

The project includes two groups of intended beneficiaries—EBMUD and the ESJPWA members. EBMUD will benefit by the addition of water storage to improve the reliability of its Mokelumne River supply. EBMUD is a participant due to its Mokelumne River rights and the proximity of its facilities (MRA) to Eastern San Joaquin County. The ESJWPA represents agencies in the Eastern San Joaquin County area that are most affected by the groundwater overdraft. Incidental beneficiaries will consist of overlying landowners who are groundwater users; groundwater users in Eastern San Joaquin County would benefit from the improved groundwater levels. The stored water would help to correct the overdraft created by agricultural pumping and municipal and industrial demands in Eastern San Joaquin County.

Project Opposition

For the most part, project opposition consisted of the San Joaquin Farm Bureau and Central Delta Water Agency. Their major concern was that it was too risky to bring in an outside agency and give that agency access to the local groundwater basin. Outside agencies were viewed as predatory organizations that would take the water when they needed it, without considering San Joaquin County's needs.[128] They also feared a loss of water rights if these agencies put a "straw in the aquifer." Paul Sanguinetti, past San Joaquin Farm Bureau President, member of the SEWD board and Stockton area farmer, expressed the essence of the local fears by stating that dealing with EBMUD was like "playing with a loaded gun" and that once the area experienced several dry years in a row, "there's no way we're going to stop them from exporting that water out of the county. No way. We'll have to stop pumping here."[129] The San Joaquin Farm Bureau Federation, representing the local farming interests, elaborated these concerns in public forums. The Executive Director, Russ Matthews, stated "everyone is in favor of recharging groundwater—as long as that water remains in the area and is not exported out of the county."[130]

In response to the ESJPWA call for partners, the San Joaquin Farm Bureau Federation interviewed local political leaders and Farm Bureau officers and members regarding the proposal. The Farm Bureau elicited responses to the effect that: solicitation of partners was premature until an export permit was obtained; banking by a local agency was preferable because "they'd have a stake in the groundwater situation and would work for both themselves and the area," overlooking the fact that the ESJPWA was comprised wholly of local agencies; San Joaquin county's needs should come first; "our" water rights might be lost; and the county should undertake groundwater banking itself for local control and benefit. It was also believed that, once involved, it would be expensive to get outside municipal water agencies out of the aquifer (invoking the Owens

Valley episode where MWD purchased overlying lands in order to appropriate the groundwater). In an earlier article, the San Joaquin Farm Bureau Federation discussed the SEWD technical study of recharging the Eastern San Joaquin County Groundwater Basin with winter run-off through percolation ponds. The article showed that local interests were supportive of the project due to the fact that a local San Joaquin County agency would be in charge, rather than an outside agency. The two articles, plus the statements of individuals interviewed for this study, indicated that the major issue was the fear of an outside entity gaining control of groundwater in San Joaquin County. However, the Farm Bureau did support an amended export ordinance that provided greater protections for overlying landowners.

Stakeholder and Public Participation

For the most part, public participation took place at the Advisory Water Commission level and at the ESJPWA Board meetings. ESJPWA members reported project information back to their respective Boards and Councils. The ESJWPA Board was composed of the majority of the agency stakeholders in the northern portion of Eastern San Joaquin County (the southern agencies, such as the cities of Manteca, Lathrop, Escalon and the South San Joaquin Irrigation District are participating in a regional plan to use the District's surface water). Overlying landowners and other agencies could voice their concerns regarding the project through the San Joaquin County Water Advisory Commission and the Board of Supervisors. San Joaquin County is currently conducting a stakeholder/consensus building effort for the development of a county-wide Water Master Plan. This effort includes all of the stakeholders that are affected by the proposed groundwater banking project.

Environmental Review

If this project continues, the Beckman Test Project site and proposed project site will be located on farmland near the MRA. There are no environmental or water related issues that have been currently identified. The Beckman Test Project was carefully monitored to check for impacts to adjacent wells and the groundwater table. No detrimental impacts to adjacent wells occurred during the test project, and the ground surface was not impacted by injection.

A specific site for the proposed Eastern San Joaquin Groundwater Bank No. 1 has not been selected. The proposal calls for a site south of the Mokelumne River, adjacent to the MRA and within the North San Joaquin Water Conservation District area.

A Negative Declaration was approved by ESJWPA for the Beckman Test Project. Environmental compliance documentation has not been completed on the San Joaquin County Groundwater Bank No. 1 Project.

Technical Studies

There was no dispute regarding the various technical studies describing the overdraft problem in Eastern San Joaquin County. The Beckman Test Injection/Extraction Project Final Report prepared by Boyle Engineering Corporation was a very thorough and well-documented study. According to ESJWPA participants and published reports, the issue was not the thoroughness or validity of the technical studies—it was the distrust of an outside agency. The concern was that an outside agency could become overly reliant on the Eastern San Joaquin County groundwater basin, draining the region of its groundwater resources.[131] The issue is not a technical one; it is an institutional and political issue, and local interests must be assured that the potential third party impacts are mitigated before a project can move forward.[132]

Monitoring Program

The Beckman Test Project incorporated a thorough monitoring program to check groundwa-

ter levels and water quality impacts. Staff members of the ESJPWA performed daily monitoring of the Beckman Test Project. The Beckman Test Project also incorporated careful monitoring to determine if water quality problems might be encountered by injecting MRA water. The Technical Advisory Committee for the Beckman Test Project adopted a turbidity limit of 2.0 NTU to avoid well plugging. The project Final Report showed no water quality issues and recommended that the injection of surface water be suspended when MRA turbidities exceeded 2.0 NTUs.

The 2000 amendment to the San Joaquin County Groundwater Extraction and Export Ordinance required the establishment of a five-member monitoring committee for any permitted groundwater banking project within San Joaquin County. This requirement for a monitoring committee was modeled after the Kern Water Bank monitoring committee requirements and applies to any permitted project in San Joaquin County. Thus, the proposed San Joaquin County Groundwater Bank No. 1 will require the establishment of such a monitoring committee.

Per the ordinance, the monitoring committee will consist of representatives from the following agencies and stakeholder interests: the County Public Works; the County Public Health Services; the permittee; the local agency providing water within the project service area; and owners of land within two miles of the project location. The monitoring committee will set criteria to determine if there is well interference caused by the project and can engage the services of a professional groundwater specialist to provide assistance. The committee will also maintain records of the recharge and recovery activities related to the project and make recommendations to the San Joaquin County Advisory Water Commission for project modifications based on evaluation of monitoring data.[133]

Financial Characteristics

Costs for the design and construction of facilities—outside of the EBMUD right-of-way, permitting, right-of-way acquisition and environmental documentation for the Beckman Test Project—were borne by the ESJPWA. The design and construction of facilities within the EBMUD right-of-way were borne by EBMUD.[134]

The proposed San Joaquin County Groundwater Bank No. 1 will cost an estimated $25 million.[135] The cost shares are yet to be determined. The value of the water produced is estimated at $400 per acre-foot.

Issues and Risks

There is no full-scale project on line at present; therefore, hydrologic risks (e.g., aquifer leakage, pumping limitations, reduced infiltration) cannot be completely addressed. However, it should be noted that the San Joaquin County Groundwater Extraction and Exportation Ordinance does address these risks as follows:

- Extraction for export is limited to an amount that ensures that the project will result in a net addition to the usable groundwater underlying the project.
- Extraction wells may be spaced to limit impacts and an appropriate number of wells required to allow rotation.
- Buffer areas may be required between extraction wells and neighboring users.
- Annual, seasonal, or monthly limits and time restrictions can be placed on extraction rates.

- Pumping rates can be adjusted or terminated to reduce impacts.
- Exportation cannot result in lowering the average static water level in the project area by more than fifteen feet.
- A monitoring committee is required for each project.
- The project cannot create conditions that are worse than conditions absent the project.
- Lowering neighboring pump bowls to accommodate lower groundwater levels may be required to mitigate unavoidable adverse impacts.
- The cost of providing alternative water supplies to an impacted overlying user may be required of the project owner/operator.
- Financial compensation may be provided to an impacted overlying user by the project owner/operator.

The conditions and mitigation measures listed above are to be imposed by the County Board of Supervisors per the amended ordinance.

The ESPJWA and EBMUD 1997 Memorandum of Agreement provides that each party will indemnify the other. Both agencies agreed to equally share the costs of any permit challenges. It is assumed that similar contract provisions will be incorporated in future agreements.[136]

The Beckman Test Project and subsequent permit application did bring to the foreground the issues and concerns of the community regarding the EBMUD/ESJPWA partnership. This will allow the project participants to design the Eastern San Joaquin Groundwater Bank No. 1 Project in a way that responds to the concerns of the local community.

Conclusions

The ESJPWA/EBMUD experience in San Joaquin County is not unique in that the issues of local control of groundwater and the protection of overlying landowner rights to groundwater are a common theme in the San Joaquin Valley. As an example of this commonality, parallels can be drawn between this case and the Madera Ranch/USBR experience. Similarities between the two cases include:

- A groundwater basin in a state of overdraft, with potential capacity for recharge.
- Proximity to surface water conveyance features, providing for convenient put and take operations.
- An outside agency willing to consider banking within the county.
- Significant overlying landowner opposition to the proposed project.

While the two cases appear to be essentially similar, there are significant differences. The differences can be summarized as follows:

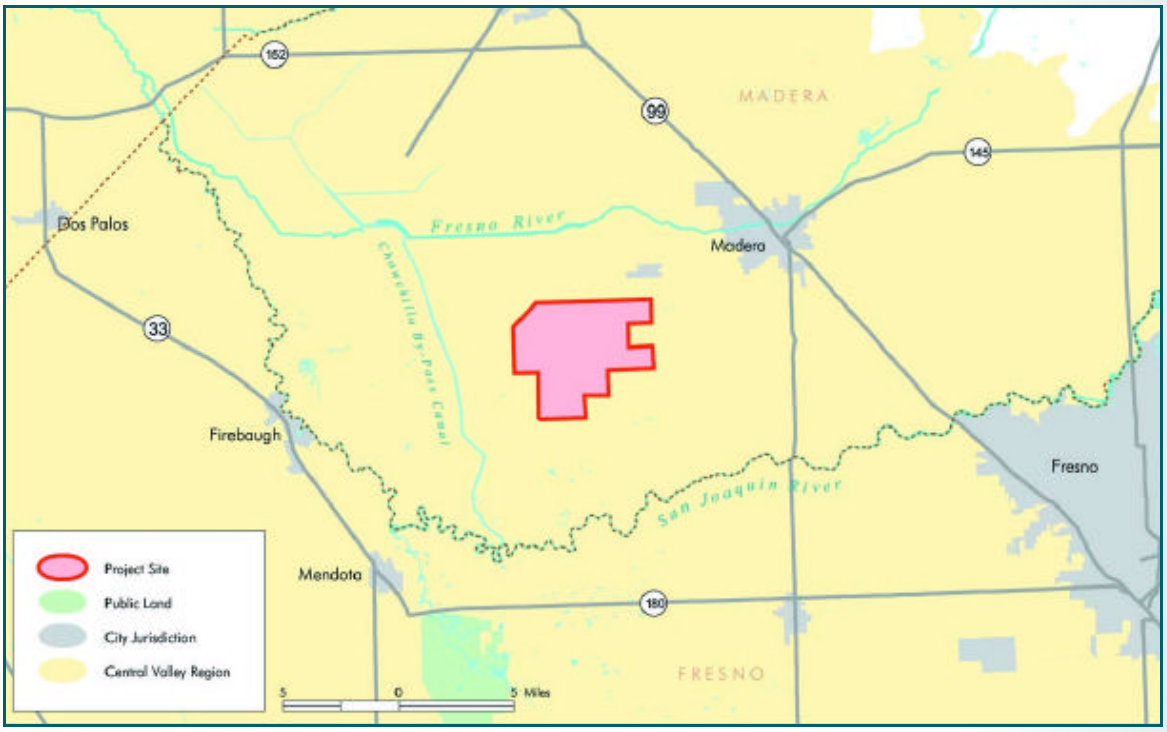
- The presence in San Joaquin County of a groundwater extraction and exportation ordinance developed concurrent with, and in response to, the initial project proposal.
- The presence in San Joaquin County of a water advisory commission with authority to condition/approve/disapprove permits to extract and export groundwater.

This commission also provides a forum for the multiple water interests within San Joaquin County, including agencies outside of the groundwater basin (this did not exist in Madera County).

- The presence in San Joaquin of a joint powers authority made up of agencies in the area of overdraft, serving as project proponents.
- The lack, in San Joaquin County, of a property transaction and time limit for pur chase (pending land sale) to make the project workable.
- Multiple local water agencies investigating significant local groundwater banking projects within San Joaquin County (SEWD, San Luis Delta Mendota Water Users Authority, City of Tracy).

These differences create a different dynamic in San Joaquin County than the Madera case. The test of the ESJPWA/EBMUD will be the permit application for the proposed Eastern San Joaquin Groundwater Bank No. 1. The permitting process and decision will indicate how successful the ordinance amendment process was and whether or not local landowners are satisfied with its protections.

MADERA RANCH GROUNDWATER BANK PROJECT



Introduction

This case study reviews the Madera Ranch Groundwater Bank Project as proposed by Mr. Heber Perrett and the U.S. Bureau of Reclamation (USBR) prior to the purchase of the Madera Ranch property by the Azurix Madera Corporation in 1999.

Physical Characteristics

Setting

Madera Ranch is a 13,600-acre property in Madera County, approximately eight to ten miles southwest of the City of Madera. Approximately 1,000 acres of the Madera Ranch property are irrigated, and the balance (12,600 acres) is used either for dryland farming or grasslands. The project site is located on the lower alluvial floodplain of the San Joaquin and Fresno Rivers in the southernmost portion of the San Joaquin River Hydrologic Region, (see Figure 2 on the following page). The Madera Ranch property overlies what is commonly referred to as the Madera Groundwater Basin.

The project site is situated in an unincorporated portion of Madera County. Madera Irrigation District overlies two sections (1,497 acres) on the eastern edge of the Madera Ranch property and is also directly north of and adjacent to the project site. Gravelly Ford Water District overlies two sections (1,282 acres) along the southeastern edge of the property.

Hydrology

Ongoing monitoring and studies demonstrate that the Madera Groundwater Basin, including the groundwater table underlying the ranch, is in a state of overdraft that has been exacerbated by the drought periods of 1976–1977 and 1987–1992.[137] Groundwater levels in the Madera Basin dropped from 10 to 120 feet from 1960 to 1990[138] and the approximate average annual

decline in static groundwater levels within the Madera Irrigation District is 1.25 feet per year.[139] Currently, the depth of groundwater in the Madera Basin is, on the average, 40 feet below pre-drought levels; thus, there should be space in the basin for groundwater recharge.[140]

Groundwater pumping in the Madera Basin is estimated to supply about one half of Madera County's irrigation needs. The Madera Irrigation District provides surface water deliveries to a 128,294 acre service area adjacent to the Madera Ranch site. The ten year average of surface water deliveries to the Madera Irrigation District Service area is 95,557 acre-feet per year.[141]

The Madera Ranch Groundwater Bank Project site is ideally located to take advantage of existing water project facilities for the conveyance of recharge water to the site. The Madera Ranch site is situated near the southern portion of the Delta-Mendota Canal and Mendota Pool, potentially enabling surplus Central Valley Project (CVP) water to be conveyed to the project site—with the construction of minimal facilities—for percolation into the basin. Additionally, the project site location could also allow for the conveyance of water from the San Joaquin River via an improved Gravelly Ford, a canal facility that currently can deliver water from the San Joaquin River to lands adjacent to the Madera Ranch site.

The location of the Madera Ranch property above the Madera Groundwater Basin, its proximity to existing water project conveyance features, and the fact that the property is one of the last large unfarmed pieces of privately held land in the San Joaquin Valley make it a logical site to investigate for a potential groundwater banking project.

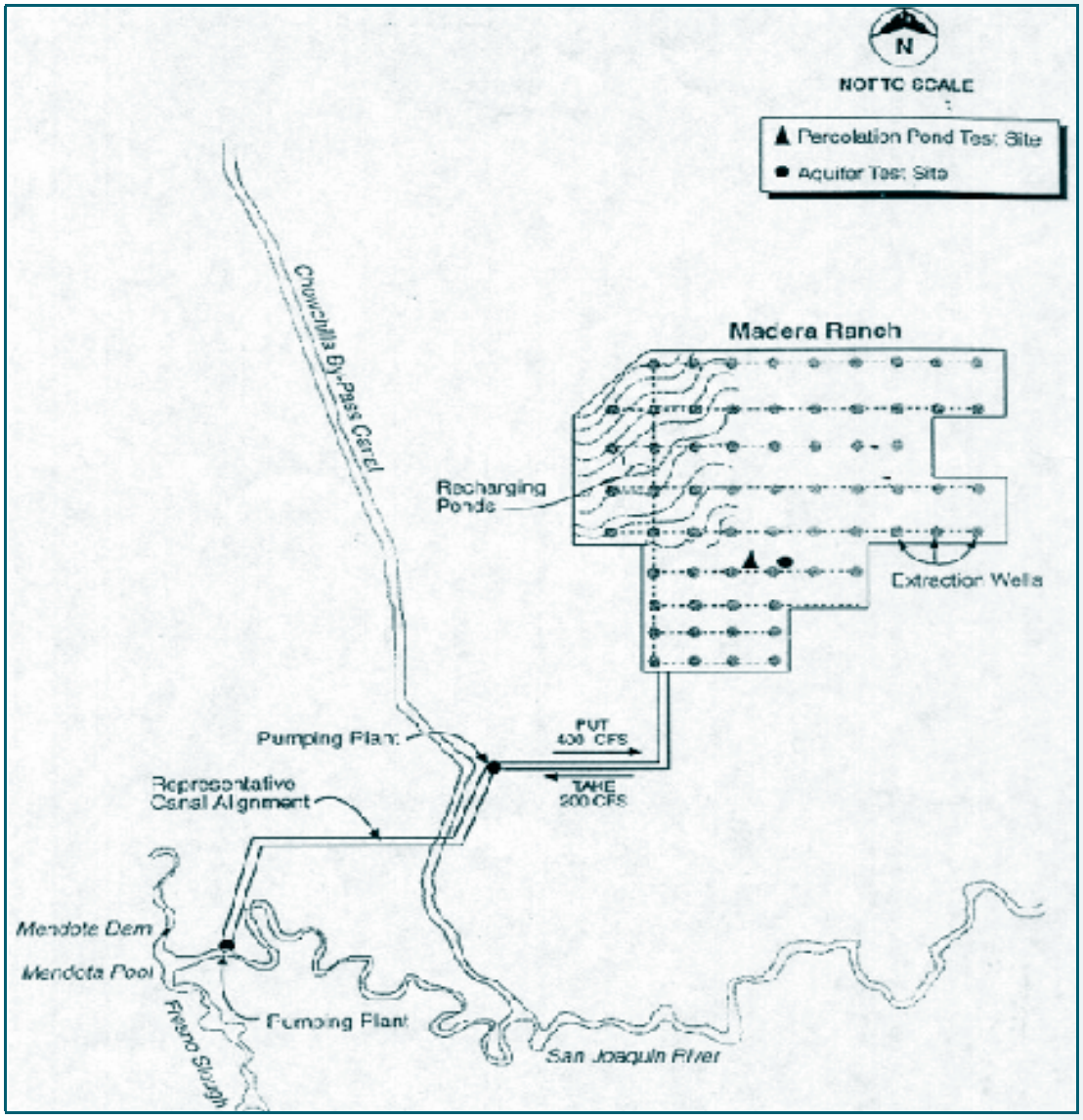
MADERA RANCH GROUNDWATER BANK
Figure 2

The original Madera Ranch project concept involved conveying surplus CVP water from the Delta to the Mendota Pool and then diverting this water to the Madera Ranch Project site. This could be augmented by additional water pumped under the joint point of diversion as part of a water

reserve account proposed by USBR.[142] The CVP can only pump 4,200 cubic feet per second (cfs) from the San Joaquin River Delta due to conveyance capacity constraints downstream from the Tracy Pumping Plant. By utilizing the joint point of diversion, the 400 cfs not pumped by the CVP due to the constraints can be pumped by the State Water Project (SWP) at the Banks Pumping Plant and delivered for CVP uses, such as groundwater banking. Additional sources might include water purchased by the USBR as part of its Land Retirement Program and water from non-federal water users. Flood flows diverted from the Chowchilla Bypass flood channel were also considered but rejected because the operation would produce an average annual increase in yield of less than 3,000 acre-feet and the cost of the requisite additional facilities could not be justified.[143]

A gravity turnout and a two-way canal with pumping plants would be used to convey the water from the Mendota Pool to the Madera Ranch Project site and then percolated using recharge wetland ponds. Water extracted from the bank would be reconveyed to the Mendota Pool for delivery to end-users. Figure 3 shows a conceptual schematic of the conveyance, recharge and extraction facilities originally proposed for the project.

MADERA RANCH GROUNDWATER BANK / CONCEPTUAL DRAWING
Figure 3



Project History

On August 13, 1996, Mr. Heber Perrett, the owner of the Madera Ranch site at that time, presented the original Madera Ranch Groundwater Bank Project proposal to the USBR. The Bureau was interested in the Project to store water reserve account water. This reserve account is designed to assist the USBR in meeting the requirements of the Central Valley Project Improvement Act (CVPIA), improving CVP operations, and for drought year water supplies. An estimated maximum of 390,000 acre-feet of surface water was proposed for storage in the Madera Ranch Groundwater Bank Project, with 100,000 acre-feet reserved for critically dry years.[144]

The property owner's offer prompted the USBR to undertake a preliminary investigation to determine if fatal flaws existed in the Madera Ranch project proposal. The San Luis-Delta Mendota Water Authority (SLDMWA) and the Santa Clara Valley Water District (SCVWD), as potential groundwater bank partners, provided the information needed to model delivery and extraction operations at the project site. This preliminary investigation was also designed to evaluate the physical suitability of the Madera Ranch site for banking water.

The preliminary investigation, completed in July 1997, found no obvious fatal flaws and recommended a phased evaluation of the proposed banking project.[145] The first phase was initiated in July 1997 and completed in April 1998. The Phase 1 Investigation included the results of a geologic and hydrologic study by Bookman-Edmonson that was completed for Heber Perrett (February 1998). The investigation also provided a brief review of local issues, environmental concerns, operational concerns and financial issues. This preliminary investigation culminated in a Phase 1 Report that found that the Madera Ranch site has potential for groundwater banking development and is worth further investigation. However, it also pledged that further pursuit of the project would be halted if any fatal flaw, with no remedy, was revealed at any time by the Phase 2 Investigation.[146] The Phase 1 Report recommended proceeding with a more detailed Phase 2 Investigation of two project alternatives: a multi-year commitment by USBR to lease facilities and services developed by Mr. Perrett or an option for USBR to purchase the Madera Ranch Property for development of the project by USBR.[147] The Phase 2 Investigation also intended to also make recommendations on permit applications, public involvement, environmental compliance development under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), necessary negotiated agreements and congressional authorizations.[148]

After the completion of the Phase 1 Report, opposition by the Madera County Board of Supervisors, the Madera City Council, the Madera Ranch Oversight Committee, area farmers, regional water districts and local stakeholders caused USBR to reconsider the project planning process.[149] The project timeline was extended an additional 18 to 24 months to give the Bureau time to address local stakeholder concerns.[150] A request by USBR to CALFED for $14.5 million in funding for the purchase of the property was rejected because of the local opposition, and CALFED indicated it would not reconsider the project until local concerns had been adequately addressed.[151]

Subsequently, USBR abandoned the project and the Madera Ranch property was sold to Azurix Madera Corporation (a Texas-based water development corporation owned in part by the Enron Corporation) in October of 1999 for a reported $31 million.[152] Azurix is currently pursuing the development of the Madera Ranch Groundwater Bank Project with the objective of providing banking participants with storage space for their water.[153]

A summary chronology of major project events is illustrated by Table 3 of this report.

Table 3

MADERA RANCH GROUNDWATER BANKING PROJECT CHRONOLOGY 1996–1999	
EVENT	DATE
Mr. Heber Perrett purchases the Madera Ranch property	May 1991
USBR receives Madera Ranch Groundwater Banking Project Proposal	August 1996
Preliminary evaluation is completed (fatal flaws analysis, capacity analysis)	July 1997
Agreement for two-phase investigation is made	November 1997
Phase 1 Investigation starts	December 1997
USBR issues press release and holds two public briefings	January 1998
Bookman-Edmonston provides study results to Perrett and USBR	February 1998
Phase 1 Report completed (field tests, technical issues identified)	April 1998
Perrett conducts on-site tour of Madera Ranch for local landowners	May 1998
Area farmers and representatives of local water districts form grassroots Madera Ranch Oversight Committee to monitor project	August 1998
Oversight Committee gathers information and makes presentations opposing the project	September1998–March 1999
USBR releases Bookman-Edmonston study to the general public	September 1998
Emergency congressional appropriation attempts to fund land acquisition of Madera Ranch	September 1998
Various local agencies voice concerns and opposition to land acquisition prior to the completion of comprehensive studies	September/Oct 1998
CALFED rejects $14.5 million funding request by USBR due to local opposition	October 1998
USBR extends project timeline by 18 to 24 months due to local opposition	October 1998
USBR meets with Friant Users Authority and Oversight Committee	October 1998
Freedom of Information Act request is filed	December 1998
Madera County Supervisors pass groundwater ordinance and resolution opposing project	March 1999
Landowner sets deadline for USBR action	1999
Azurix purchases Madera Ranch site from landowner	October 1999

Institutional Arrangements

Participants

The proposed Madera Ranch Groundwater Bank Project sponsors and participants included Mr. Heber Perrett (owner), the USBR, SLDMWA, and SCVWD. Stakeholders included: local farmers and adjacent property owners; adjacent water and irrigation districts (Aliso WD, Gravelly Ford WD, Madera ID, Chowchilla WD); Madera County; City of Madera; California State Farm Bureau; Nisei Farmers League; Families Protecting the Valley; Tehipiti Chapter of the Sierra Club; Friant Water Users Authority; and the Regional Council of Rural Communities.[154]

The Phase 1 Report recommended that the choice between the two options that were under consideration—a multi-year lease of services and facilities or the purchase of the land and development of the facilities by USBR—be based on stakeholder consensus, partnership agreements, costs, contract negotiations and other factors.[155] However, no contractual arrangements for the use of the project were ever developed because the proposed Madera Groundwater Bank Project was not implemented beyond the Phase 1 Report recommendations.

Beneficiaries

As originally proposed, the water would be used to meet Central Valley Project (CVP) con-

tract deliveries to agricultural water districts, as well as requirements to reduce pumping demands on the Delta to benefit wildlife refuges. USBR also proposed using the bank to implement a 100,000 acre-foot reserve account for drought relief in critically dry years. The non-federal project partners, the SLDMWA and SCVWD, participated in the project investigation to determine if possible banking opportunities existed for their agencies. Other potential uses included meeting unforeseen environmental needs and meeting general storage needs south of the Delta during certain critical periods.

Stakeholder and Public Participation

According to stakeholder interviews, the Phase 1 Report, and other documentation, stakeholder participation during the preliminary investigation stage and the Phase 1 Investigation was limited to USBR, the property owner and the participating agencies (SLDMWA and SCVWD).

USBR issued a press release at the start of the Phase 1 Investigation to inform the public and identify interested stakeholders.[156] The press release was followed by the distribution of an information package to interested parties. Two public briefings were held and a list of interested parties compiled based on the telephone response to the press release and attendance at the public briefings.

Project Opposition

The Madera Ranch Groundwater Bank Project drew opposition from a variety of sources, most notably area farmers, local irrigation and water districts, Madera County and the City of Madera. The issues that triggered local concerns are summarized below:

1) Incomplete Information — opponents of the project characterize it as an example of USBR "getting the cart before the horse." Local stakeholders felt that the technical studies were very preliminary and incomplete, and thus the feasibility of the proposed project was not demonstrated sufficiently for policymakers to commit public funds to the project.[157,158,159] Some feel that the property owner's deadline for USBR action forced a premature commitment by the agency to move forward on the purchase of the property.[160] A Freedom of Information Act request for project information was filed by project opponents and Representative George Radanovich in 1998.[161,162] This request produced USBR internal documents and documents from other federal agencies that indicate potential flaws in the project as proposed.

2) Lack of Effective Public Involvement — due to the nature of the proposal, it was felt that USBR's public outreach came too late in the process and that local experts should have been consulted before, or at least during, the preliminary investigation. Utilizing local knowledge of the geography, aquifer response and historic water levels could have been beneficial to the evaluation. Additionally, CALFED officials and DWR Bulletin 160-98 characterized the project as feasible and beneficial before the technical studies were completed. As a result, the project was championed in several political arenas prematurely. This reinforced local concerns that the proposed project was political rather than technical in nature and a "top-down" driven project.[163] Community relations for the proposed Madera Ranch Groundwater Banking Project were a significant problem and local opposition is cited as the major factor in USBR's decision to abandon the project.[164,165]

3) Location near surface waters — the Madera Ranch Groundwater Bank Project site is in close proximity to the San Joaquin River, and adjacent property owners have observed immediate impacts to the unconfined aquifer based on fluctuations in the river levels. A 31.9-foot rise in water levels was observed over a twelve-month

period that included flooding and continuous river flows.[166] Based on these observations, local opponents to the project questioned the estimated storage capacity of the aquifer in the Madera Ranch area. Finally, the gradient and proximity to the river also raised concerns about a "topped off" aquifer and the outflow of stored water to the river.

4) Root Zone Flooding — local farmers adjacent to the Madera Ranch site have calculated that the area directly under the project site could only store a maximum of 130,000 acre-feet of water based on their observations of the variation of water levels in adjacent wells. Based on this calculation, the projects proposed storage of a maximum of 390,000 acre-feet would require about 10 square miles of surface area. Thus, local opponents believe stored water could move off of the project site, creating root zone flooding problems for neighboring orchards and other sensitive crops.[167]

5) Water Quality — Water quality consequences of groundwater banking were a concern for local farmers and adjacent landowners and were identified in the Phase 1 Report as an issue to be studied in the Phase 2 Investigation.[168] Local farmers state that the salinity of the Mendota Pool is approximately six times that of area groundwater; thus the introduction of Mendota Pool water might degrade water quality in the aquifer. This, coupled with the potential for stored water to move off-site, is a concern for farmers with wells and crops adjacent to the Madera Ranch site.[169] These concerns were echoed in comments by other agencies reviewing the preliminary studies, as evidenced in documents that were obtained by the Madera Ranch Oversight Committee through the Freedom of Information Act request referenced previously.[170]

6) Risk of Hydrologic Impacts on Groundwater Users — Proposed project well sites were upgradient of the infiltration ponds and close enough to the City of Madera wells that there was significant likelihood that water extracted may not be the water that was placed in storage. There was concern that the project could "exchange" lower quality banked water for higher quality native groundwater through the extraction process.[171] Additionally, area landowners were concerned about the accurate monitoring of the proposed project and its potential for extracting native groundwater in addition to the banked water (more "take" than "put). It should be noted that these hydrologic issues were expressed in communications by USBR staff, as evidenced in the Freedom of Information Act documents.[172]

7) Potential Loss of Local Control — the proposed project could present a means for outside interests to gain access to native groundwater and potentially other surface water entitlements (for example Friant water). In essence, local interests were concerned that the project represented a means for an outside entity to establish a foothold, or "pipeline," into the local water supply.[173,174,175]

Environmental Review

The CEQA process was not initiated for the proposed Madera Ranch Groundwater Banking Project. CEQA/NEPA compliance was to have been addressed in late 1998, according to the original project schedule. The Phase 2 Investigation would have identified whether or not a single CEQA/NEPA document would suffice for environmental compliance (as opposed to separate CEQA and NEPA documents).

The USBR Phase 1 Report indicates that the unfarmed area of Madera Ranch is "Priority 1" habitat "where actions must be taken to prevent the extinction or to prevent a species from declining irreversibly in the foreseeable future."[176] A reconnaissance survey of the site

revealed the presence of vernal pools and the presence of sensitive terrestrial plant communities. Several species of halophytic (salt-tolerant) plants were found, and the presence or potential presence of several special status wildlife species was also noted.[177] Based on the reconnaissance survey, any groundwater banking facilities and operations at the Madera Ranch site would be required to minimize impacts on sensitive species and habitats. It should be noted that the reconnaissance survey in Phase I did not fully address the biological issues presented by the proposed Madera Ranch project and that additional site investigations would have been needed.[178]

Financial Characteristics

The options of leasing or purchasing the Madera Ranch were considered by USBR. The estimated cost of the proposed lease arrangement with Mr. Perrett was $14.8 million per year for a twenty year term. The option of purchasing the land was purported to cost from $43 million to $53 million.[179]

USBR estimated the annual cost for operations and maintenance of the facilities at $400,000. While the financing options were not fully developed, USBR did approach CALFED for $14.5 million to supplement the cost of purchasing the Madera Ranch site.[180] The Phase 1 Report identifies costs, cost allocations and repayment as items to be analyzed in the Phase 2 Investigation. Based on the term of the lease, the estimated value of the water produced was $226 per acre-foot at an annual yield of 70,000 acre-feet. The estimated value of the water under the scenario in which USBR would own and operate the facility is not available.

Issues and Risks

The proposed Madera Ranch Groundwater Banking Project did not proceed much beyond the Phase 1 Report phase, and thus the operational and administrative mechanisms for dealing with areas of risk were not fully developed.

The operational rules for dealing with the hydrogeologic risks of losing stored water were not developed. However, this was a significant issue that would have needed to be thoroughly addressed, both technically and institutionally, before the project could have been implemented.

As stated in the Phase 1 Report, landowners in the area were concerned about the location of the put and take conveyance features and the acquisition process for rights-of-way. They were especially concerned about the potential for parcels being split by infrastructure and land takes.[181] This issue was deferred to the Phase 2 Investigation. It was too early in the process to consider precise alignments and design of the conveyance features.

Potential crop damage associated with manipulating groundwater levels was a major concern of adjacent landowners, especially those with crops that are sensitive to high groundwater levels. This is an issue that would require significant study and the development of operational rules to avoid potential problems.

Summary of Issues

News articles and interviews with participants identify the lack of early stakeholder involvement and a clear public participation process, failure to incorporate the critiques of other federal agencies into the public process, the lack of sufficient technical analyses, the issue of local control, and the landowner-imposed deadline for USBR action as the key factors in galvanizing local opposition to the Perrett/USBR Madera Ranch Groundwater Banking Project.

Public and Stakeholder Involvement

The Madera Ranch Groundwater Banking Project chronology above indicates that the USBR took a logical approach to responding to the landowner's proposal by performing a preliminary analysis for potential fatal flaws. This step provided the Bureau with an indication of whether or not the project concept was worth pursuing further. The Phase 1 Investigation and Report were the next logical "due diligence" steps for the USBR.

The Phase 1 Report states that it is the USBR's policy to include public participation in decision processes that lead to federal actions, and it outlines a basic public involvement plan that includes identifying USBR and stakeholder roles, defining decision processes, holding briefing events, issuing a call for project partners and producing project status reports.[182] This process appears to comply with the USBR's Directives and Standards for public involvement in Reclamation activities.[183] If this is correct, then why is public/stakeholder involvement identified as a significant problem for the Madera Ranch Groundwater Banking Project?

As one commentator has noted: "a public interaction program, or the lack thereof, is often the sole or major reason for the failure to implement a water program."[184] Establishing and maintaining early, continuous—and most importantly, two-way—communications between the public, stakeholders and the water agency, preferably starting on "Day 1" of the project, is an essential element for building consensus and a successful program.[185,186] Based on comments by the local stakeholders that they would have preferred that USBR had consulted with them about the project at the conceptual stage, it appears that defining and communicating with potential stakeholders during the preliminary evaluation period would have been helpful to the overall process.

Keeping the process open and transparent by keeping all information "on the table" to the extent possible (outside of privileged negotiations) is another important element for gaining public trust and for effective communications. This appears to have been a problem for the Madera Ranch Groundwater Banking Project, based on the documented concerns of other federal agencies obtained through the Freedom of Information Act request by stakeholders.

Technical Analyses

The technical analyses of the Madera Ranch Groundwater Banking Project performed by USBR were preliminary in nature and designed to assist the agency in making decisions regarding the feasibility of the project. The Phase 2 Investigation would have addressed several outstanding technical issues, including the significant questions of compatibility of surface water from the Mendota Pool with native groundwater and the response of the aquifer under project operations. The major criticism of the preliminary and Phase 1 technical studies is that they were not sufficient to support the decision to commit public funds to the project.

It appears that the landowner-imposed deadline for USBR to commit to the project or acquire the project site may have contributed to the impetus to move ahead without the benefit of further technical studies.

Issues of Local Control

Many irrigation districts in the central, southern and eastern parts of the San Joaquin Valley have established effective conjunctive use programs in which water from wet years is stored in underground aquifers for dry year use.[187] Conjunctive use programs are widely viewed as an effective means for extending water storage in California, and Madera County stakeholders have stated that they support groundwater banking.[188,189] This poses the question of why the Madera Ranch Groundwater Banking Project met with significant local opposition.

In addition to the issues of insufficient public and stakeholder involvement and the need for more technical studies, the issue of local control, or the lack of local control, appears to be a major factor in the opposition to the Madera Ranch Groundwater Banking Project. The issue of local control can be exacerbated by the California water rights system. California's system of water rights does not require filing and licensing or quantification to establish rights to groundwater. A user only needs to begin use by drilling a well and making sure that the groundwater use is continuous.[190] Therefore, the concept of connecting the local groundwater basin to the rest of the California water system through extraction wells and a canal greatly enhances the fears of local stakeholders that local control could be taken away in the future. This, combined with the question of monitoring the quantities of banked water, makes it evident that a new, major non-local user of groundwater (in this case, USBR) would be viewed with suspicion, especially if that user were proposing a major extraction well field. Finally, no local benefits were identified by the project proponents, giving local stakeholders no incentives to support the project. Based on this situation, it can also be assumed that local interests would view local groundwater projects, controlled by local district boards and providing benefits to the community, more favorably.

In March 1999, a groundwater export and banking ordinance was passed in Madera County, along with a resolution opposing the Madera Ranch Groundwater Banking Project. This ordinance put in effect a permitting process for any groundwater project within the county and states that no groundwater extracted in the county can be exported without a permit. The groundwater exportation and banking ordinance was a direct response to the proposed Madera Ranch Groundwater Banking Project.[191] Also, Madera County officially appointed a Groundwater Oversight Committee in this time period.

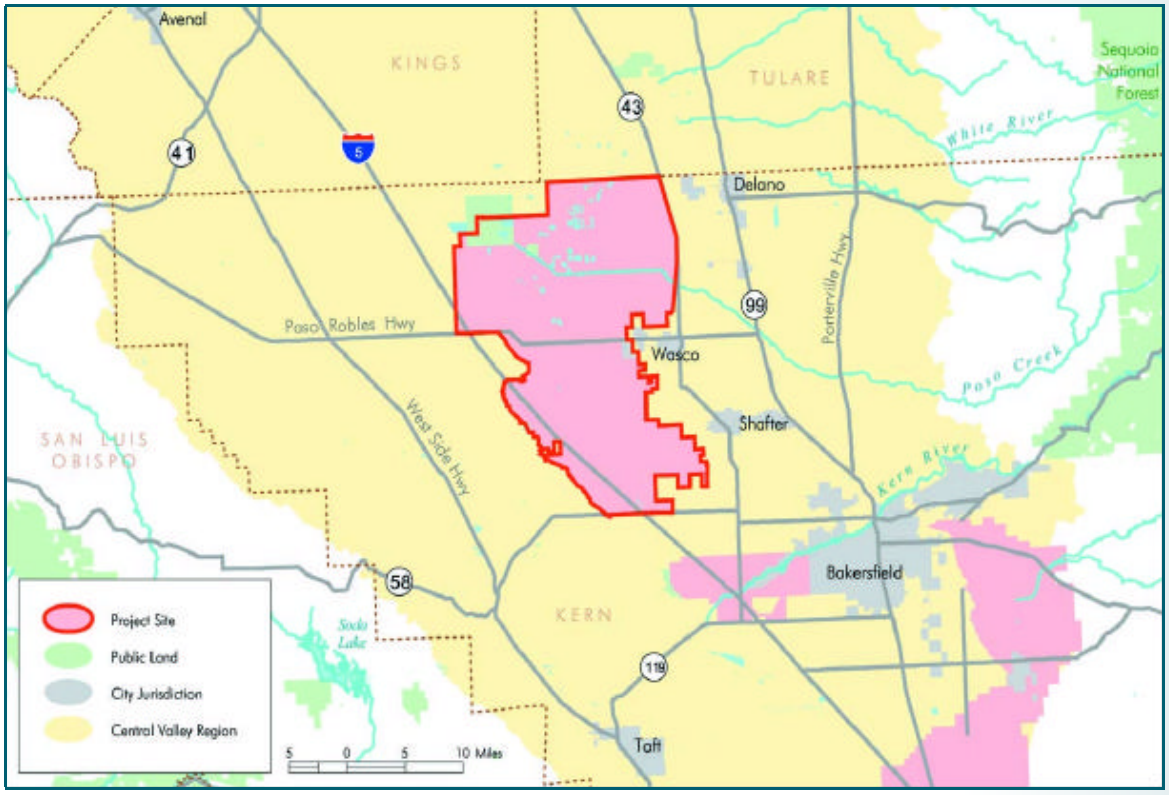
The concern over local control might have been effectively addressed through a public involvement process that established institutional and operational mechanisms to ensure local input and a measure of local control. As an example, an agreement could have been negotiated with Madera County to establish a stakeholder monitoring committee and set up enforceable operational rules for the project. This, coupled with an agreed-upon obligation to provide a quantity of banked water to alleviate conditions of overdraft, might have aided local support of the project proposal.

The Importance of Local Site-Specific Knowledge

The subject of local site-specific knowledge is closely aligned with the issue of local control. Recent water policy research points out the need to integrate local site-specific knowledge with more generalized scientific understanding of hydrology in order to successfully address what one commentator called the "wicked water problems."[192] The assistance of people who work with and know the important site-specific factors that can impact a project must be effectively utilized when reviewing a project proposal. This need is clearly highlighted by the Madera Ranch Case.

In the Madera County setting, local farmers and water users with years of experience in using area groundwater and surface water are an excellent resource for evaluating the potential for a successful groundwater banking project. As cited in the section on local control, it is essential to involve these local experts in the initial project evaluation. It is recommended that local water organizations, in this case the irrigation districts, be used as a resource for engaging water users. These organizations often play a similar role interfacing between citizens, water users, and State and Federal agencies.

SEMITROPIC WATER STORAGE DISTRICT
CONJUNCTIVE USE PROGRAMS



Introduction

This case study outlines the conjunctive use programs of the Semitropic Water Storage District.

Physical Characteristics

Setting

Semitropic Water Storage District (Semitropic) contains 221,000 acres in the northern part of Kern County. Semitropic is surrounded on all sides by other water and irrigation districts including Lost Hills Water District, Buena Vista Water Storage District, Rosedale-Rio Bravo Water Storage District, Shafter-Wasco Irrigation District, North-Kern Water Storage District and the Southern San Joaquin Municipal Utility District.

Hydrology

Semitropic is a primarily agricultural district that was originally developed with groundwater. The district has over 1,200 private wells. Continued use of these wells has caused significant overdraft in the basin underlying the district. To help alleviate this overdraft, the district started receiving surface water supplies in 1973 from the State Water Project. From 1973 to 1998 the district imported a total of 3,952,000 acre-feet of water. Other than its 155,000 acre-feet of State Water Project (SWP) entitlement (contracted through Kern County Water Agency) the district has no other significant surface water source. Rainfall is the district is also meager, averaging less than four inches per year.[193,194]

Of Semitropic's 221,000 acres, about 142,553 were irrigated before the district's groundwater banking program began. The "firm" contract surface water service area in the district compris-

es 42,343.65 acres and the groundwater service area in the district comprises 70,828.51 acres. An additional 29,381.99 acres has received temporary contract surface water service.[195] Semitropic's total irrigation water demand exceeds 480,000 acre-feet per year, an amount greater than the district's SWP entitlement and other surface water supplies. Thus, the district still relies heavily on groundwater and the basin underlying the district is still in overdraft. In times of drought and/or minimal deliveries under its SWP contract (such as 1987–1992), the overdraft conditions in the district are severe and groundwater levels drop rapidly.[196,197,198]

Semitropic's Groundwater Banking Program began as a means of addressing several challenges that the district was facing in the late 1980s including an increasing groundwater overdraft, rising energy and water costs, and increasing unreliability of SWP contract water deliveries. The district sought a banking partner who was willing to finance such a program, with the goal that the additional money and facilities of the program would allow Semitropic to increase its own ability to take surplus waters when available, increase groundwater levels in the district, correct overdraft and reduce water costs to district landowners.[199]

Project History

Negotiations for Semitropic's banking program started in 1986 with Metropolitan Water District of Southern California (MWD). The Semitropic Groundwater Banking Program began as a Demonstration Project between the Department of Water Resources and the District. In 1990, the district and DWR entered into a contract, and DWR delivered 92,000 acre-feet of SWP water to Semitropic for underground storage via *in lieu* deliveries. The contract provided that the water would be returned to DWR via an exchange of the district's SWP entitlement wherein the district's landowners who would normally receive this SWP water would utilize groundwater substitution.[200]

In 1991, DWR wanted to recover its banked water by exchange of the district's SWP entitlement. Due to a very dry year and Delta pumping restrictions, no SWP water was available to the district that year, making the exchange impossible. These circumstances showed the District and others that a more successful groundwater banking program would include facilities to allow the district to directly deliver stored water back to the California Aqueduct, rather than having to rely on an exchange.[201,202]

MWD had been watching the DWR demonstration project in Semitropic with great interest and had been discussing a similar project with the district. However, in order for the project to be worthwhile from MWD's perspective, it had to include a pumpback component. While landowners in the district were originally apprehensive about this idea,[203] MWD and Semitropic started serious discussions and entered into a final banking agreement in 1994. Four additional Banking Partners have also contracted with Semitropic to participate in the banking program: Alameda County Water District, Zone 7 Water Agency, Vidler Water Company and Santa Clara Valley Water Agency.[204,205,206]

The basic concept of Semitropic's Groundwater Banking Program is that Banking Partners can purchase a proportionate share of the available space in the aquifer underlying the district by paying the district and delivering water to the district for storage. Banking Partners also pay to establish rights to use a proportionate share of the new facilities constructed to "put" water in storage and "take" it out at a later date.[207]

Engineering studies estimate that the basin beneath the district has at least 2,000,000 acre-feet of storage space.[208,209] To date, 1,000,000 acre-feet of space has been allocated between Semitropic's Banking Partners as follows: Metropolitan Water District of Southern California (MWD) 350,000 acre-feet; Santa Clara Valley Water District (SCVWD) 350,000 acre-feet; Vidler Water Company, Inc. 185,000 acre-feet; Zone 7 Water Agency 65,000 acre-feet; and Alameda County Water District 50,000 acre-feet.[210,211] These Partners have also allocated among themselves through contract the 91,000 to 315,000 acre-feet/year "put" capacity of the Program, the 90,000 acre-feet/year maximum pumpback capacity of the Program and the zero to 133,000 acre-feet/year maximum SWP Entitlement Exchange capabilities (for a total maximum "take" capacity of 233,000 acre-feet) of the Program. The source of water for the banking program consists primarily of SWP contract supplies of the Banking Partners.[212,213]

The percolation rates in the district are not high. Thus, water is banked via *in lieu* delivery arrangements with individual landowners. Banking Partners have financed the additional facilities necessary to expand this "put" capacity through fees paid when water is "put" in or "taken" out of the basin. The district has entered into individual contracts with landowners who receive *in lieu* water that specify how payment and operations will occur. Generally these contracts provide that the landowner will take *in lieu* surface water deliveries when made available from the district instead of pumping groundwater. These same agreements provide that the district may utilize the landowner's well (if it is not needed for irrigation of the landowner's property) to extract stored water for return to a Banking Partner, with full compensation.[214]

In 1999, the Banking Partners and Semitropic began studying an expansion of the original Semitropic Groundwater Banking Program that would increase the put and take capacity of the system so that full capacity of storage could be returned within a three-year period. This expansion plan was analyzed in a Draft and Final Supplement Environmental Impact Statement in 1999 and 2000 but has yet to be implemented.[215,216,217]

Institutional Arrangements

No new institutions were created to implement Semitropic's water banking program. Rather, the program operates through contractual arrangements between the banking partners, with surrounding landowners and with necessary agencies. These agreements are explained in detail below.

Financial Characteristics

Semitropic's Groundwater Banking Program is designed so that the district is fully compensated for the costs of construction and operation of the program by its Banking Partners. The Banking Partners' payments to Semitropic include the following kinds of payments: when water is stored; when water is returned from storage; with respect to energy used to recover water from the basin and deliver it to the Aqueduct; and for operation and maintenance expenses. The total cost to Banking Partners to store their supplies is approximately $175.00 per acre-foot (in 1994 dollars). Semitropic has structured the payments for Banking Partners so that there is an incentive to make larger payments upfront in order to achieve a permanent allocation of capacity in the system. These options are outlined in Table 4 on the following page.[218,219]

Table 4

*** All costs are in 1994 dollars, which began to escalate in 1995.*

	Option 1	Option 2	Option 3	Option 4	
Put	$110.00	$90.00			Per af in year water stored
Take	$20.00	$40.00	$10.00	$10.00	Per af plus actual power in year water is recovered
Annual O&M	$3.98	$3.98	$3.98	$3.98	Per af of vested storage capacity
Cycling Incentive	$20.00				Per af per year for water in storage longer than 5 years if capacity not vested
Capital Contribution			$12.40		Per af of storage capacity per year for the first 10 years
Capital Contribution				$120.60	Per af of storage capacity

Banking partners who use Option 1 have their capacity rights vested as water is put into storage. For those that use Option 2, storage and withdrawal capacity is specified at the outset and reserved during a ten-year vesting period. Only ten percent of total project capital is due within sixty days of signature. For those that want their storage and withdrawal capacity fixed at the outset, regardless of the amount of water stored in the initial years, Options 3 and 4 provide this benefit.[220]

The options outlined above apply to "first tier" water, or the amount of water required to establish capacity rights in the project. Recharge and withdrawal capacity rights are proportional to storage capacity rights. Once a banking partner has stored the amount of water represented by its specified storage capacity, any additional water put into storage is considered "second tier" and subject to a standard payment scheme.[221]

Interestingly, the banking agreements between Semitropic and its partners do not require that the district have the first right to use the new facilities constructed for the program. Rather, this first right is given to the Banking Partners for the duration of their banking agreements with the district. The district can use these facilities for its own operational flexibility, and to take surplus waters, when the facilities are not in use by the banking partners. The facilities will remain the property of the district.[222,223]

MWD advanced $1.35 million in early 1995 to Semitropic to begin design and construction of the banking facilities. In return, after the first five years of the Agreement, MWD is accorded a first priority to a certain storage capacity in the project. The "front-end" investment by MWD has been repaid through reductions in storage payments required under its banking agreement with the district.[224]

Issues and Risks

Political Issues

The district's President, Vido G. Fabbri, converted some of the landowners' original apprehension to a banking program with MWD into support through landowner meetings and a lot of "legwork". The district's General Manager, Will Boschman, was also instrumental in helping the district's board of directors and landowners visualize how the program would work. Before becoming the district's general manager, Mr. Boschman spent numerous years work-

ing for the Bookman-Edmonston engineering firm. The firm designed and constructed most of the water-related facilities in Kern County, including the recharge ponds and delivery system already in place in Arvin-Edison Water Storage District.[225]

In 1992, a temporary banking agreement was reached between MWD and Semitropic, which was converted into a long-term agreement in 1994. The agreement triggered CEQA, and an EIR was prepared in July of 1994. Surrounding landowners used the EIR process to address their concerns about potential third party impacts that a Semitropic Groundwater Storage Program might cause. Attorneys for Semitropic and the surrounding districts immediately started working together to resolve these concerns to gain the necessary support for the project. At the same time, districts adjacent to other new groundwater banking programs in Kern County were addressing the same concerns.[226,227,228]

Representatives of many of the affected parties had previously participated in a process to delineate the technical issues associated with the Kern Water Bank's groundwater monitoring program.[229] This process resulted in recommendations on rules to be incorporated in a Memorandum of Understanding between the project participants of the Kern Water Bank Authority and the Adjoining Entities, entered into in October of 1995, and for the MOU between Semitropic Water Storage District and the Adjoining Entities on September 14, 1994 (MOU).[230]

When the district and its Banking Partners proposed the expansion of the put and take capacity of the program in 1999, surrounding landowners again expressed their concerns through the Supplemental EIR process. Semitropic addressed these concerns by completing additional studies and maps as requested by the surrounding districts and by adding additional elements to its Mitigation Monitoring Plan as part of the Final Supplement EIR completed in January 2000.[231,232,233]

Hydrological Concerns

The MOU for the Semitropic Groundwater Banking Project focused primarily on the hydrological concerns of surrounding landowners. The landowners were concerned about the following issues:

- Banked water would have recharge, evaporation and migration losses that needed to be accounted for to avoid withdrawal of more water than was actually banked.
- Groundwater migration could cause adverse impacts on groundwater quality or make it impossible to recover stored water, creating the risk that recovery of banked water would increase the pump lift for surrounding landowners.
- The placement and number of the extraction wells had to be planned so that the cone of depression around these wells would not adversely affect surrounding landowners dependent on groundwater.
- The program had to be closely monitored to prevent obstruction of natural recharge to the basin or an increase in basin overdraft.[234]

With these concerns in mind, Semitropic and the surrounding landowner districts hired Kenneth D. Schmidt, a groundwater quality consultant, to prepare a monitoring plan and detailed maps of "Well Location, Water Quality Network" and "Well Location, Water Level Network" that could be used as benchmarks for the monitoring program. In the meantime, the attorneys for the district worked on drafting the MOU. The primary elements of the MOU include the following:

- The MOU is based on the maximum project design as of 1994. Major changes or additions to this design are subject to additional environmental review.
- A monitoring committee, consisting of representatives from Semitropic and each of the surrounding districts and one ex officio non-voting representative of each of the Banking Partners, was created.
- A monitoring well network was established that would be modified as needed based on the committee's recommendations. Semitropic bore the cost of the installation of the original monitoring wells.
- Other costs of the monitoring program are borne 50% by Semitropic and 50% by the adjoining districts.
- "Fifteen-Foot/Three-Year Rule:" Semitropic will not make groundwater withdrawals that cause the average groundwater levels in an area to decline more than fifteen feet over a three-year period compared to the average groundwater levels that would have occurred without the project.
- If Project pumping causes well interference, Semitropic must stop pumping or compensate for the interference. The Monitoring Committee must establish criteria to determine if well interference is due to Project pumping.
- The MOU provides a dispute resolution procedure via the Monitoring Committee. If this procedure is not successful, any party may still pursue any remedy for injunctive relief or damages, with one exception. If all parties to the dispute agree that a factual dispute exists regarding any recommendation of the Monitoring Committee, the dispute shall be submitted to binding arbitration before a registered civil engineer with a background in groundwater hydrology. The MOU specifically states that nothing in the agreement prevents any landowners within the boundaries of any party from pursuing any legal remedy in the event the landowner is damaged as a result of the project.

Interestingly, the Semitropic MOU was the first finalized in Kern County between a banking district and surrounding districts. The Semitropic MOU was used as a model for the first draft of the more comprehensive MOU developed in 1995 for the Kern Water Bank, on direction by the Kern Water Bank Authority, and later to other Kern River Fan Projects.[235]

In addition to the MOU, The Final EIR approved by Semitropic and MWD under CEQA contains a Mitigation Monitoring Plan that addresses many of these same hydrological concerns and provides monitoring criteria for the project. The banking agreements between Semitropic and each Banking Partner also contain criteria to address hydrological concerns such as:

- Evaporation, migration and other losses for banked water are collectively assumed to be 10% of the amount of water furnished for storage. This loss percentage may be increased or decreased with evidence gained from monitoring.
- When water is returned via direct pumpback, it must be returned during Semitropic's off-peak irrigation season.
- Semitropic will seriously consider reducing or terminating groundwater pumping to return stored water to a Banking Partner if required by the MOU.[236,237]

To date, the Monitoring Committee has not had to resolve any disputes and no one has brought suit under the MOU or the Mitigation Monitoring Plans for either the original or Supplement EIRs for the project.[238,239]

Environmental Concerns

From an environmental standpoint, implementation of Semitropic's Groundwater Banking Program has been relatively easy. The program does not utilize any natural stream systems or involve use of a significant amount of critical habitat. Environmental impacts identified in the 1994 EIR were mitigated pursuant to the Mitigation Monitoring Plan that was part of the Final EIR. In addition, the district was able to certify a Negative Declaration in May of 1996 that addressed the additional environmental impacts relating to the program that were not addressed in the 1994 EIR.[240] The district did not have to comply with NEPA because no federal agency approval is required to implement the program.[241]

Water Quality Issues

The groundwater that is extracted for Banking Partners is delivered to them via the California Aqueduct. This required that Semitropic enter into an agreement with DWR for "Introduction of Local Water into the California Aqueduct." This agreement imposes strict quality criteria on the water that is introduced into the Aqueduct.[242] To date, the water withdrawn from Semitropic has met these criteria. If the criteria become more stringent, the water may have to be treated before it is pumped into the Aqueduct or returned via an exchange instead.[243] Any additional costs imposed due a change in water quality standards for the California Aqueduct must be borne by the Banking Partners pursuant to the Agreements between Semitropic and each Partner.[244,245]

Groundwater quality was one of the concerns addressed by surrounding landowners at the inception of Semitropic's program. To date, the program appears to have actually prevented the migration of lesser quality groundwater from west to east.[246]

Conclusions

To date, Semitropic's Banking Partners have stored over 675,000 acre-feet of water in the district. However, the only water recovered under Semitropic's program has been by DWR in 1992 and 1997.[247] Thus, the withdrawal capabilities of the program—and its potential third-party impacts—have yet to be tested.

From a financial perspective, however, the program has been very successful for Semitropic. The program will allow the district to finance $134 million worth of new facilities to increase its own operational flexibility. To date, over $70 million in new facilities have been constructed. In addition, revenue generated from Semitropic's banking program has, in part, allowed the district to reduce water charges to its landowners from almost $60 per acre-feet in 1995 to less than $50 per acre-feet in 1998. Pump lifts in the district have also decreased since the inception of the program by about 33 feet, representing additional savings in energy costs for landowners who utilize groundwater wells.[248]

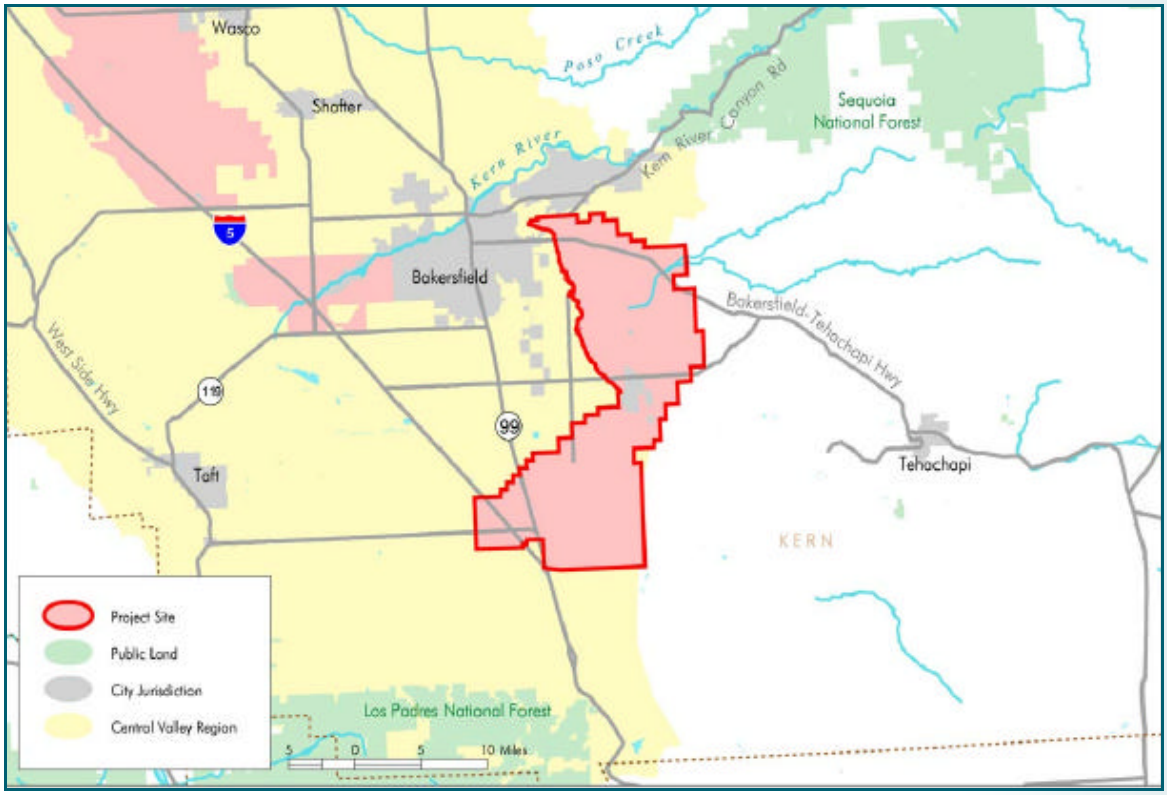
To date, the Semitropic Groundwater Banking Program has been successful due to the following factors:

- The program is not anticipated to affect the hydrogeologic conditions of a significant number of surrounding landowners.
- The landowners in Semitropic and surrounding districts that could be affected by

the program were generally cooperative in working with the district to resolve their concerns via a monitoring agreement and committee.

- The program was environmentally easy to implement.
- The district itself is a landowner-voting district where the larger landowners in the district are either represented on the board or trust those landowners who are board members. The banking Project was approved by a 97% favorable landowner election in November of 1991.
- The landowners in the district all have a common interest, as the district is primarily agricultural.
- The district has been in charge of the project since its inception and controls the operations in a manner that makes the landowners within and adjoining the district comfortable.
- Semitropic's Banking Partners have made the project essentially cost and risk free for Semitropic, while providing the district with numerous benefits and facilities.
- The district's general manager and president understood and supported the program and did a good job of explaining it to the members of the district and surrounding landowners.

ARVIN-EDISON WATER STORAGE DISTRICT
CONJUNCTIVE USE PROGRAMS



Physical Characteristics

Setting

Arvin-Edison Water Storage District (Arvin) consists of 132,000 acres in the southeastern corner of the San Joaquin Valley, entirely within Kern County. Arvin is bordered by the foothills of the Sierra Nevada on the east and the Tehachapi Mountains on the southeast. Farming began in the area now included in the district in the early 1900s. Today, the district is known for its high quality soils and high value crops such as grapes, citrus, potatoes, carrots, cotton, orchard fruit and truck crops.[249] The area is almost entirely agricultural, with only small areas of urban development.

Hydrology

No significant streams or rivers are located within the district and the region receives only 8.3 inches of rain in an average year. Historically, farmers in Arvin relied primarily on groundwater to cultivate the region. Evidence of groundwater overdraft appeared as early as the 1930s. Prior to the importation of surface water to the area, depth to groundwater exceeded 600 feet in some areas of the district. In addition, the receding water table had induced the subsurface movement of water with high boron concentrations from the east into the aquifers underlying the district.

The district's groundwater basin can be divided into three distinct areas—a large central area and two smaller areas to the northeast and southeast. Two faults running through the district affect the movement of groundwater and create the three areas. However, in practice, the district is regarded as one groundwater management area.[250]

Project History

In 1942, the Arvin-Edison Water Storage District was formed to obtain a supplemental surface water supply in order to alleviate groundwater overdraft. The district secured Federal water contracts from the Central Valley Project (CVP) in the 1960s. In the meantime, agricultural operations expanded in the district, with approximately 100,000 acres in irrigated agriculture by the mid-1960s.

In 1966, the district began importing surface water from the Friant-Kern Canal under its CVP contract. A federal loan enabled the district to construct the Arvin-Edison Canal (which conveys water from the terminus of the Friant-Kern Canal into the district), 1,000 acres of spreading works, and 55 recovery wells. Thus, the district was able to store surface water underground via recharge ponds or by delivering surface water to landowners in lieu of their customary use of groundwater. To achieve economies of scale with the infrastructure, the district concentrated its surface water delivery facilities to serve 52,000 acres of the district with the poorest quality groundwater at the greatest depths. Thus, much of the district (about 80,000 acres) is still totally dependent on groundwater but has benefited from the district's programs in the form of reduced depth to groundwater (and associated reductions in pumping costs) and higher quality groundwater.[251]

The district's CVP contract includes 40,000 acre-feet of Class 1 priority water and 311,675 acre-feet of Class 2 priority water.[252] However, water deliveries under the contract are highly variable. Average demand for surface water in the district (exclusive of demand for groundwater) is 160,000 acre-feet. Deliveries under the contract have ranged from a low of 10,000 acre-feet in 1977 to a high of 351,675 acre-feet in 1978.[253,254]

The district has attempted to realize maximum benefit from its highly variable surface water supply, in part, through its conjunctive use system. The district deep percolates supply in excess of coincident irrigation demand when it can. The district has banked over 1.5 million acre-feet in this manner since 1966. The results are evident: in the 1950s, average overdraft in the district was 200,000 acre-feet per year; today overdraft averages only 5,000 to 10,000 acre-feet per year.[255,256,257]

Beginning in the 1970s, the district entered into exchange programs with other CVP contractors on the Friant-Kern Canal in an effort to further regulate its surface water supply. Through an exchange agreement, six exchange agencies located along the Friant-Kern Canal on the east side of the San Joaquin Valley receive up to 70,984 acre-feet per year of the district's highly variable Class 1 Friant water. In exchange, the district receives up to 66,096 acre-feet of non-Friant CVP water from the California Aqueduct (west of the district) on an irrigation demand schedule. The water that Arvin receives via this exchange is available almost every year, as opposed to the district's much less reliable Class 1 Friant water. Delivery of water to the district via the California Aqueduct is made possible by the Cross Valley Canal, which connects the Arvin-Edison Canal to the Aqueduct.[258,259]

In the mid-1980s, the district sought financing for additional water banking facilities that would allow further regulation of its erratic surface water supply and increased water availability to district landowners. These additional facilities would allow Arvin to take more of its Class 2 CVP water, when available, and store the supply in the underground aquifer for subsequent recovery during high demand/low supply periods. Thus, the district sought a partner that would provide financial assistance for these additional facilities in exchange for temporary storage of water in

the groundwater basin underlying the district. By the late 1980s, a tentative agreement had been reached with Metropolitan Water District of Southern California (MWD). Although that initial agreement was never implemented, the concept resurfaced again in 1995, and a final agreement for a Water Management Program between Arvin and MWD was signed in 1997.[260,261]

In this original proposal, the Arvin/MWD program required approval by the United States Bureau of Reclamation (USBR) for the transfer/exchange of the Delta-CVP water to MWD; by the California Department of Water Resources (DWR) for use of the California Aqueduct to wheel CVP water to MWD under MWD's SWP contract and by the State Water Resources Control Board (SWRCB) for amendment to USBR's Delta-CVP water rights permits to include portions of MWD's service area as a permitted place of use and for changed points of diversion. Originally, the CVP Water Users Association opposed the concept of amending the Delta-CVP water rights permits. However, Arvin and MWD were able to resolve issues through negotiation with other Delta-CVP users and by agreeing to seek a very limited permit amendment that would facilitate only the proposed project.[262,263]

Federal and State approvals required environmental compliance pursuant to the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA), and a joint EIR/EIS was prepared in 1992. Public and agency comments on the Draft EIR/EIS reflected concerns that the project would result in increased deliveries from the delta that would damage the estuary and adversely affect fisheries. Pumping restrictions in place at the time rendered delta deliveries to the west side of the valley extremely unreliable. Because of the increasing uncertainty of delta deliveries, MWD determined that it was only interested in pursuing a banking program that included the option of direct pumpback of banked water. Thus, the program as planned was abandoned for the time being, and the SWRCB change petition that would have amended the Delta-CVP water right permits was never filed.[264]

After shelving the original banking program concept with Arvin, MWD negotiated and entered into a banking agreement with Semitropic Water Storage District that included a direct pumpback component. The Semitropic/MWD program addressed the concerns of neighboring landowners through an agreement that placed operational criteria on the project to limit third party impacts and required a formal groundwater monitoring committee.[265]

In light of the success of the Semitropic/MWD project, Arvin and MWD reinitiated discussions and developed a project that included a pumpback component. Under this arrangement, MWD would deliver its SWP water to Arvin for subsurface storage. At some future date, Arvin would recover the water and deliver it to MWD via a new 4.5-mile pipeline intertie between the Arvin-Edison Canal and the California Aqueduct.[266]

Under the twenty-five year agreement with MWD, substantial new groundwater banking facilities were constructed in the district including 500 additional acres of spreading ponds, 15 new groundwater wells, and a 4.5-mile bi-directional intertie pipeline connecting the terminus of the district's canal with the California Aqueduct. Facilities are expected to cost approximately $25 million. It is anticipated that MWD will store a minimum of 250,000 acre-feet of water in Arvin within the first seven years. Maximum storage levels over the life of the program are not specified, but MWD cannot store more than 350,000 acre-feet of water in the district at any one time without amendment of the agreement by both parties. The new spreading grounds constructed for the project have the capacity to recharge 45,000 acre-feet per year. The recovery capacity of the project ranges from 40,000 to 75,000 acre-feet per

year.[267,268] To date, MWD has banked water in the district but has not yet withdrawn water from the district.[269,270] The agreement characterizes Arvin as holding MWD's water in "trust" while the water is stored in the district.[271]

The restructuring of the project obviated the need for USBR to approve the transfer, as Arvin's CVP water was no longer involved. Without USBR involvement, NEPA compliance was not required, and the project had only to comply with CEQA. After the Monterey Agreement, the water rights held by the State of California for the State Water Project allowed off-stream storage. Thus, the proposed project was already an approved use under project partners' SWP contracts and only required ministerial approval by DWR for changes in points of diversion. The parties adopted a Mitigated Negative Declaration in July of 1996, and the project was approved without substantial public or agency controversy. The agreement between Arvin and MWD for a Water Management Program was signed December 19, 1997.[272,273]

Currently, source water for the banking program includes only MWD water from its SWP contract and other sources. However, the Arvin/MWD agreement also contemplates acquisition and banking of 150,000 acre-feet (over twenty five years) of Friant flood flows as an additional source of water for MWD.[274] This aspect of the Arvin/MWD program was sought by MWD as an incentive to invest the many millions needed to construct the additional conjunctive use facilities in Arvin. It was also the most controversial part of the program.[275]

Friant flood flows are currently available to all Friant contractors. However, because they are available in times of very low demand and most districts do not have the facilities to capture and store the water, flood flows are not often utilized. The Arvin/MWD Agreement provides for flood flow purchase by Arvin for storage and transfer to MWD.[276] Theoretically, this transfer would have required that the Friant CVP water right permits be amended to add portions of MWD to the permitted service area. Other Friant water users and districts adamantly opposed the idea of expanding the permitted place of use to include MWD, fearing that MWD's domestic water uses would take priority over the needs of east side farms in times of shortage in the Friant system.[277]

This opposition led to negotiations between the Friant Water Users Authority, the Central Valley Water Coalition, MWD and Arvin.[278,279] The result of these negotiations was a Principals Agreement between the four groups that allows MWD to capture 150,000 acre-feet of additional water supply without the need to amend the Friant CVP permits. The Principals Agreement allows Arvin to purchase flood flows in the form of "Conservation Credits." Arvin can transfer these flood flows to Kern County Water Agency (KCWA) in exchange for a like amount of KCWA's SWP water which, in turn, can be sold to MWD and stored in Arvin's underground aquifer. MWD can request return of its stored water and the SWP water would be pumped back to MWD via the California Aqueduct.[280]

The concerns of the Friant Water Users and Central Valley Water Coalition were addressed by imposing specific operational criteria on when "Conservation Credits" may accrue and when water may subsequently be delivered to MWD. Under the Principals Agreement, Conservation Credits accrue to the extent that Arvin's new water banking facilities can conserve additional water supplies at times and under conditions that do not adversely affect other Friant Water Users. Thus, if Arvin shows that its new facilities can conserve up to 45,000 acre-feet of water per year, Arvin accrues 45,000 acre-feet of Conservation Credits and may transfer up to 45,000 acre-feet of non-CVP water to MWD.[281]

The Principals Agreement also explains that Conservation Credits can only be accrued if the following conditions are met:

- Water is being released from Friant Dam for flood control and can be diverted without unreasonably affecting downstream water quality requirements;
- Capacity exists in the Friant-Kern Canal, above all other demands for water delivery which will be used in the San Joaquin Valley, to deliver the water to Arvin; and
- The new water banking facilities in Arvin are recharging water.[282]

The Principals Agreement also requires that no land be fallowed for the purpose of transferring water outside of the San Joaquin Valley. These requirements provide protection to other Friant water users.[283]

The agreement expressly prohibits Arvin from delivering CVP water directly to MWD, which would have necessitated adding MWD as a place of use under the CVP water right permits. Thus, to put this component of the program into place, the additional exchange described above is required. MWD has also agreed that it will not pursue any future program involving Friant Division contract supplies that is inconsistent with the Principals Agreement without the prior written approval of the Friant Water Users Authority.[284]

Although Arvin and MWD made great strides in negotiating a solution to the opposition of the Friant Water Users Authority to this portion of their banking program, it is still not operational. This component of the program has been stalled by the USBR's interpretation that the contemplated transaction involving the conservation credits and subsequent transfer of non-CVP water to MWD would require the $25 per acre-foot M&I surcharge provisions of the CVPIA.[285] The negotiated Principals Agreement conditions the transfer to MWD on USBR approval of the long-term exchange/transfer, and on the exchange/transfer not being subject to the CVPIA. To date, USBR has stated that the transfer is subject to the CVPIA (notwithstanding that CVP water would be delivered to KCWA, which is not a CVPIA transfer), and that the $25 per acre-foot surcharge would apply. Because of this additional cost, the parties have not yet pursued this component of the project.[286]

Arvin intends to expand its banking program to third parties in the future, but no final agreements have been reached to date.[287] The MWD/Arvin Agreement contemplates such program expansion, however, and grants MWD certain rights of priority to banking and conveyance capacity in the new facilities.[288]

Institutional Arrangements

No new institutions have been formed to implement Arvin's banking program with MWD. Rather, the districts have formed the program through contractual arrangements between the districts themselves and between the districts and the Department of Water Resources. Negotiated principles with local interest groups have been used to overcome initial apprehension about controversial aspects of the program. For example, the contract between MWD and Arvin incorporates the Principles of Agreement between the district, MWD, the Friant Water Users Authority and the Central Valley Water Coalition. The contract between MWD and the district also requires certain monitoring activities and rules that are designed to protect local groundwater users.

Financial Characteristics

As noted above, the district's original facilities were constructed with a federal loan, which has since been repaid. The Arvin/MWD agreement provides that the $25 million to construct the facilities for the project will come from fees charged by Arvin to MWD for banking its water. Arvin will also recoup all of its costs through operation and maintenance fees, energy cost fees and

conveyance facility use fees. The bottom line cost to MWD is about $250 per acre-foot.[289,290]

To finance construction of the necessary facilities, MWD advanced the district $12 million in fees. To recoup this investment, MWD will pay proportionately reduced rates per acre-foot when it stores and extracts water—in effect creating a $12 million interest-free loan from MWD to Arvin.[291,292]

Arvin is further protected financially because the agreement with MWD requires a minimum of 277,778 acre-feet of water to be stored by MWD in the district within seven years. This minimum level is tied to the estimated cost of facilities to be constructed so that the fees paid at this level will generate sufficient funds to pay for the cost of the necessary facilities. The Agreement contemplates that additional water may be stored by MWD, up to 350,000 acre-feet at any one time, upon mutual agreement of the parties. The parties may also amend the agreement to exceed this limit.[293,294]

Arvin's cash flow position in constructing the project is further protected in that MWD has agreed to advance additional funds to Arvin under certain conditions. Specifically, if at any time Arvin has expended $3 million more in constructing the necessary facilities than it has earned in water management fees, MWD will advance additional funds so that Arvin is never more than $3 million "upside down."[295,296,297]

The facilities constructed for the project are owned and operated by Arvin and allow the district the benefit of being able to increase its dry year supplies, expand its surface water delivery capabilities to additional acreage and increase its overall operational flexibility. Notably, the additional facilities that Arvin will own as a result of its banking program with MWD will allow the district to conserve about 8,000 to 10,000 acre-feet of its own contract entitlement per year. However, at an estimated cost of $25 million, it never would have been cost effective for Arvin to build these same facilities without the financing of a banking partner such as MWD.[298] MWD's use of the facilities will always be subject to Arvin's superior right to use the facilities for its own benefit. However, MWD will have a first priority to use a certain capacity of the new facilities in front of other bankers that enter the program in the future.[299]

MWD is responsible for dealing with DWR to schedule deliveries of returned water from Arvin to MWD via the California Aqueduct. Thus, MWD must incur the costs of these arrangements and meet the water quality standards necessary to put the returned water into the aqueduct.[300]

The financial risk that the project will not succeed has been primarily placed on MWD. There are several reasons why it could become impossible for Arvin to return stored water to MWD, including changes in water quality or water quality standards or other reasons beyond its control. If this were to happen, Arvin could buy the water that MWD has stored. The purchase would be arranged so that Arvin would buy the water from MWD for an amount equal to the costs that Arvin would have incurred to purchase the same amount of water as Class 2 supplies from the Friant-Kern Canal, under its contract with USBR in the year that the water was delivered to storage by MWD.[301]

Issues and Risks

Political Issues

Arvin's local benefit program Political opposition to Arvin's internal conjunctive use program has been non-existent. Notably, Arvin is a district that was originally formed to conduct con-

junctive use operations for the benefit of its own landowners. Thus, the concept of conjunctive use and/or groundwater banking was never new or foreign to landowners in the district. Rather, those landowners surrounding the district's original spreading ponds and collection wells historically have experienced fluctuating pump lifts due to the district's operations.[302,303] Political opposition to Arvin's new banking program with MWD has come primarily from outside of the district and has not prevented implementation of the program.[304,305,306]

When MWD and Arvin first began negotiating a banking program in the 1980s, the district's consultants, attorneys and board members anticipated political opposition to any program that included pumping groundwater from the valley and conveying it to MWD.[307,308] Therefore, the program was structured so that MWD would receive its banked water only via exchanges on the California Aqueduct and never through a direct pumpback from the district. As originally envisioned, the proposal would have worked as follows:

- MWD would bank water in Arvin by delivering surplus water under its State Water Project (SWP) contract to Arvin for either direct recharge or delivery to farmers *in lieu* of groundwater pumping. MWD would accrue a like amount of groundwater credits.

- Recovery of banked water by MWD would involve transfer by Arvin of a portion of its Delta-CVP water received via the California Aqueduct (from the exchange agreement with the Cross Valley Contractors) to MWD. MWD would take delivery of water from the California Aqueduct that would otherwise be diverted at the Cross Valley Canal for use by Arvin. Farmers in Arvin would pump groundwater in place of the CVP surface water they would normally receive. MWD banking credits in Arvin would be reduced accordingly.[309,310,311]

Hydrological Concerns

The concerns of adjoining landowners were addressed rather easily in the Arvin case. The only adjoining district affected at all by Arvin's manipulation of the groundwater table is Kern-Delta Water District, located to the west of Arvin. None of Arvin's recharge ponds or wells are located near the boundary with Kern-Delta, and thus groundwater levels in the neighboring district are not affected by Arvin's operations. However, there is a slight gradient of groundwater movement west to east from Kern-Delta to Arvin, with groundwater levels higher in Kern-Delta. Over the long term, it is conceivable that Kern Delta's water levels could be affected by a concentration of pump-back operations in Arvin over a multiple year period. To alleviate this concern, Arvin worked with Kern-Delta to adopt groundwater monitoring and operational criteria that became provisions of the contract with MWD. Although these criteria do not establish a contract between Kern-Delta and Arvin and/or MWD, they do set up project operating parameters that are acceptable to Kern-Delta and that protect landowners within Arvin.[312]

The contract between Arvin and MWD also provides the following protections for the basin:

- MWD may only request return of water to the extent that there is water in its account balance.

- A 10% loss is imposed on all water banked under the program; i.e., to recover 250,000 acre-feet of banked water, MWD must deliver 277,778 acre-feet to the district.

- Return of regulated water by the district to MWD must not interfere with deliveries to the district's contract users or other "normal and customary uses"

by the district of its available supplies. Water will generally be returned to MWD "off-peak" and will not compete with Arvin's need for dry year water.

- Arvin will reduce or terminate groundwater pumping for purposes of returning water to MWD as necessary to comply with the groundwater monitoring program and operating criteria discussed above.[313]

Environmental Concerns

As originally envisioned, some parties were concerned that the Arvin/MWD project would cause increased diversions from the delta at times that would injure fish or water quality.[314] Restructuring the project to include a pumpback rather than an exchange alleviated these concerns. Endangered species concerns were raised with regard to construction of the 500 new acres of spreading ponds and ancillary facilities necessary to operate the project, however, these concerns were addressed through mitigation or otherwise resolved through the CEQA process.[315] No natural stream systems were utilized as part of the project, and the isolation of the Arvin groundwater basin makes hydrologic interaction a minor issue.[316]

The groundwater produced in the district currently meets the state standards necessary for water to be pumped into the California Aqueduct for transport to MWD.[317] The agreement also requires that water delivered to Arvin by MWD for storage meet specific quality criteria.[318] The project has raised groundwater levels, which has reduced the migration of boron concentrations from the eastern hills surrounding the district.[319] Should any water quality problem arise, the Agreement puts the burden on MWD to solve the problem with DWR.[320]

Conclusions

The Arvin/MWD project has to date only operated to bank MWD's SWP water in Arvin. The recovery aspect of the project has yet to be tested. The other components of the project, including the use of Friant water and/or exchanges with CVP water, have also yet to be finalized because of outstanding cost issues associated with implication of the CVPIA.

To date, Arvin has not experienced any adverse third party impacts as a result of its own conjunctive use programs or as a result of banking water for MWD. This is so even though Arvin resorted to significant groundwater pumping for its own use during the late 1970s and early 1990s.[321]

Arvin's own conjunctive use program appears to have been extremely successful since its implementation in 1966 for the following reasons:

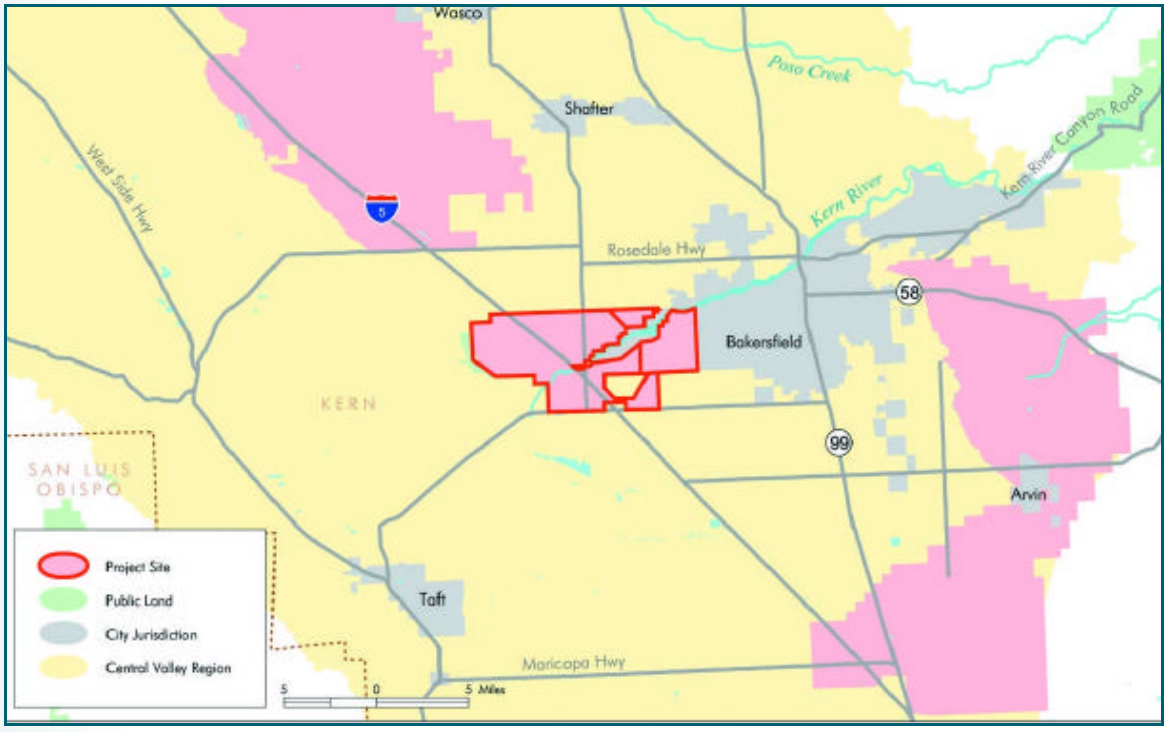
- Soils in the region are excellent for recharge ponds and have never had subsidence problems.
- Nearly half of all supplies banked in Arvin-Edison have remained to mitigate groundwater overdraft, and half has been extracted during critically dry periods.
- The program has had years of extreme pumping that greatly mitigated drought conditions without resulting in extreme impacts on pump lifts for surrounding landowners.
- The basin is relatively isolated geographically and does not interact specifically with surrounding basins or districts.

- History has shown that the program has resulted in a reduction in annual overdraft and much more plentiful and regulated supply of water for the landowners in the district.

Arvin's project to bank water for MWD also appears to have been implemented in a rather painless fashion because of the following factors:

- The program will not hydrologically affect a significant number of surrounding landowners, if any.
- The landowners in the district are already familiar with conjunctive use and have seen it operate successfully in their district for almost fifty years.
- A board elected by the members governs the district whose votes are in proportion to their land holdings. Thus, the larger landowners in the district are either represented on the board or trust those landowners who are board members.
- The landowners in the district all have a common interest, as the district is primarily agricultural.
- The district has been in charge of the project since its inception and its control makes the landowners within and adjoining the district comfortable.
- USBR did not need to be involved in the project as currently approved.
- The project only had to comply with CEQA, not NEPA, and was able to be implemented with an Initial Study and Negative Declaration instead of an EIR or EIS.
- MWD was willing to make the project essentially cost and risk free for Arvin, while providing the district with numerous benefits.

KERN WATER BANK



Introduction

This case study reviews the Kern Water Bank (KWB) and provides an overview of the project development, interest group interactions, financing and performance. The KWB's objective is to enhance the water supplies of the southern San Joaquin Valley while providing exceptional upland and wetland habitat.[322] The beneficiaries include the KWB project participants, SWP contractors and Improvement District 4, which encompasses the City of Bakersfield located immediately east of the KWB site, the Rosedale-Rio Bravo Water Storage District immediately north of the site, and the Kern Delta WD to the south. The banked water is used primarily in agriculture.

Physical Characteristics

Setting

The KWB is located on 19,883 acres of land in Kern County, California, at the extreme southern end of the San Joaquin Valley. The Kern River flows through the southeastern portion of the site from northeast to southwest. The KWB is on the lower part of the Kern River Fan.

The primary land use in the vicinity is agriculture. Approximately 835,000 acres of irrigated land exists in Kern County.[323,324] The SWP and the Friant-Kern Canal, linked by the locally-constructed Cross Valley Canal, serve the area. The City of Bakersfield is located to the east of the KWB site and is the major municipal water user in the area.

Approximately half of the 19,883 acres of the KWB project area has been set aside for habitat as part of the KWB Habitat Conservation Plan. More than forty species of birds have been sighted at the KWB, including the Caspian tern, white-faced ibis, and freshwater pelicans.[325] ESA listed species found on the KWB site include the San Joaquin kit fox (Vulpes macrotis mutica), Tipton's kangaroo rat (Dipodomys Tiptonsi), and blunt-nosed leopard lizard (Gambelia sila).[326]

HYDROLOGY

Groundwater pumping in the area serves agricultural and municipal uses. Median groundwater use for irrigation is 1.2 million acre-feet per year, while drought year use increases to 1.9 million acre-feet per year. In 1998–1999, the City of Bakersfield, with a population of over 210,000, used approximately 59,511 acre-feet of groundwater per year to meet its annual water demand of 73,500 acre-feet.[327] The balance of its demands are met by treated surface water supplied by Kern County Water Agency, KCWA.[328]

Bakersfield owns and operates a 2,800-acre groundwater recharge project that follows the path of the Kern River through the easternmost portion of the Kern Water Bank site. In addition, the Kern County Water Agency Pioneer Project recharge areas (North Pioneer, Central Pioneer and South Pioneer) are adjacent to the KWB on the east and northeast. Neighboring water districts include the Rosedale-Rio Bravo WSD immediately north of the KWB site and the Kern Delta Water District and Wheeler Ridge-Maricopa WSD located to the south of the site.

A unique combination of water supply, delivery infrastructure and geology place the KWB in an ideal location for water banking. The KWB can take advantage of water deliveries from three sources—the Kern River, the California Aqueduct (State Water Project), and the Friant-Kern Canal.[329] The Kern River and the California Aqueduct converge near the KWB, and the Kern River is the terminus of the Friant-Kern Canal, which is a facility of the federal Central Valley Project (CVP).[330]

The KWB is located in the Tulare Lake Hydrologic Region, which has an aquifer system with the capacity to store an estimated 50,000,000 acre-feet of water.[331] As a sub-section of the Tulare Hydrologic Region, the 19,883 acre KWB has the ability to store an estimated 1,000,000 acre-feet of water at an estimated annual recharge capacity of 450,000 acre-feet per year.[332] The recovery capacity is estimated to be 240,000 acre-feet per year at project completion.[333]

Approximately 7,000 to 7,200 acres of the KWB are used as active recharge basins.[334] There are 61 shallow (2 feet deep) recharge basins at the site, with approximately 63 miles of levees.[335] The areas between the recharge basins are managed as habitat. The habitat areas are approximately 6,800 acres and are used to regenerate native grasses and plants to provide habitat for local threatened and endangered species. Additionally, the water recharge process has created intermittent wetlands, with willows and tules growing at the edges of the recharge basins, thus providing habitat for a variety of waterfowl.[336]

The Kern River (winter floodwaters) and the SWP are the major sources of water banked in the KWB. The location of the KWB also allows for delivery of water from the Friant-Kern Canal. Construction of a six mile long, two-way conveyance canal connecting the SWP and the Kern River to the KWB was initiated in August 1999.[337]

The water is banked in what is known as the Kern Fan Element. This river fan consists of sandy soil created by years of alluvial deposits. KFE sediments are capable of percolating up to six inches of water per day. Recharge is accomplished utilizing 800 cubic feet per second (cfs) flow from the Kern River and 750 (cfs) from the SWP (California Aqueduct).

Banked water will be recovered by thirty new recovery wells and fifteen old wells that have been rehabilitated. These are located on the site, and an additional thirty wells are proposed as part of the KWB Master Plan Facilities. Other Master Plan Facilities include: a two-way canal connecting the KWB and the SWP; approximately 21 miles of transmission pipeline; and a 545 cubic feet per second (cfs) pump station and meter structures.[338,339] As of August 2000, the two-way canal, turn-outs, pipeline and meter structures were nearly complete.[340]

The new two-way canal will have a capacity of 800 cfs. Drilling started on thirty new extraction wells during 2000 and eighteen existing wells were slated for rehabilitation.[341] Recovery is anticipated to be 375 cfs (240,000 acre-feet per year) to the SWP.[342]

Project History

The original proposal to bank water at the KWB dates to the 1970s when Tenneco West, Inc., the owner of the land where the KWB is now located, and the Wheeler Ridge-Maricopa WSD entered into an agreement to explore banking water on the 46,000 acre Tenneco West parcel. Wheeler Ridge-Maricopa WSD recognized that the scope of the proposed project would require the participation of other entities and began to solicit potential partners in the Kern County area. However, most districts and entities in the Kern County area looked to the completion of the State Water Project (SWP) for additional water supplies and, therefore, chose not to participate in the Wheeler Ridge-Maricopa/Tenneco West project.[343] As a result, Tenneco West eventually terminated the agreement with Wheeler Ridge-Maricopa WSD. Subsequently, Tenneco West sold the future KWB land to the Department of Water Resources (DWR) in 1988, as discussed below.[344,345]

By the early 1980s it became apparent that the SWP would not be completed as anticipated. Consequently, in years of short water supplies in the SWP, water contractors in Kern County receive substantially less water from the SWP than their initial expectations.[346] As a result, a groundwater overdraft of approximately 250,000 to 300,000 acre-feet per year persisted in Kern County.

Thereafter, a series of technical studies, such as "Water Resources Management in the Southern San Joaquin Valley California (1979)" and the "Report on the Investigation of Optimization and Enhancement of the Water Supplies of Kern County (1983)," illuminated opportunities to integrate available surface water supplies into groundwater recharge operations. The reports also underscored the adverse impacts of continued groundwater overdraft in Kern County. These factors, combined with the opportunity to increase SWP water supply reliability during dry years, provided the incentive for DWR to initiate the KWB project in 1988 with the purchase of 19,883 acres of the Tenneco West property.

With that acquisition, DWR phased out farming leases on the KWB land. In 1991–1992, the California Department of Fish and Game identified endangered species on the fallow land, and it became subject to Endangered Species Act requirements.[347] Subsequently, DWR's process of developing the KWB project stalled due to high costs, habitat regulations, complicated negotiations over local use of the bank and uncertainty over the volume of water that could be diverted from the delta for storage.[348,349] The estimated cost of banked water was approximately $400 to $450 per acre-foot, which was unacceptably high for local users.[350] Over $28 million was spent on proposal studies without any project development.

In 1990, local water district managers formed the Kern County Future Water Supply Committee to evaluate future water supply options including groundwater banking in the southern Kern area.[351] The Committee was spurred along by the prolonged drought from 1987 to 1992, which resulted in significant impacts to SWP water users in Kern County. Reductions in SWP allocations and major increases in groundwater pumping for local use and export during 1990–1991 underscored the need for the KWB project. In 1992, an Issues Resolution Committee was appointed to produce a draft set of rules for the joint operation of the KWB and to resolve monitoring issues.

The existing KWB project (under the Kern Water Bank Authority) was initiated on August 4, 1994, when DWR staff, Kern County Water Agency staff, and representatives of the Westside Mutual Water Company met to discuss the potential for transferring the KWB property from DWR to Kern County interests in exchange for 40,000 acre-feet of SWP annual entitlement. Subsequently, representatives of the State Water Contractors and DWR executed the Monterey Agreement ("Statement of Principles for Potential Amendments to the State Water Supply Contracts") on December 4, 1994. The Agreement established principles for making changes in the SWP water supply contracts by modifying each contractor's SWP contract.[352] The Agreement allowed for an amendment to local SWP contracts that facilitated the exchange of the KWB lands from DWR to Kern County Water Agency and Dudley Ridge Water District in return for 45,000 acre-feet of SWP entitlement.[353] Subsequently, DWR agreed to allow the KWB project participants, under Kern County Water Agency, to use the KWB in April of 1995.

After the execution of the Monterey Agreement, Kern County Water Agency, Dudley Ridge WD, Semitropic WSD, Wheeler Ridge-Maricopa WSD and the Westside Mutual Water Company agreed to a Statement of Principles for the Development, Operation and Maintenance of the Kern Fan Element of the KWB. This group, with the addition of the Tejon-Castaic Water District, became known as the Project Participants.

By the end of 1995, the Project Participants had formed the Kern Water Bank Authority (KWBA), executed a "Memorandum of Understanding Regarding Operation and Maintenance of the Kern Water Bank Groundwater Banking Program," established a Monitoring Committee with non-participating districts adjoining the KWB to ensure avoidance or mitigation of potential adverse impacts resulting from KWB operations, and executed a transfer and exchange agreement for the transfer of the KWB from the Kern County Water Agency to the Kern Water Bank Authority. Thus, in 1995, the KWB officially became a locally operated project under a joint powers authority formed for the purposes of recharge, storage, and recovery of water to supplement State Water Project supplies to agricultural and urban communities within Kern County.[354]

Prior to the transfer of the KWB from the Kern County Water Agency to the Kern Water Bank Authority, the KWB Project Participants had received a 2081 Permit from the California Department of Fish and Game for interim operation of the KWB and a Section 7 Permit from the U.S. Fish and Wildlife Service (USFWS) for interim operations. KWB participants began recharge operations with floodwaters in 1995 under an emergency declaration to prevent flooding (Kern County Water Agency operated the KWB facilities for project participants). This declaration expedited the USFWS permit process and freed the Water Agency from California Environmental Quality Act (CEQA) compliance requirements. Environmental effects of recharge with regulated non-emergency flows were addressed in an adopted mitigated negative declaration.[355] By the end of 1995, over 222,000 acre-feet of water had been recharged into the KWB.[356]

On August 9, 1996, the KWB property was officially transferred from the Kern County Water Agency to the Kern Water Bank Authority. In 1997, the KWBA filed a CEQA Notice of Determination and completed the 75-year KWB Habitat Conservation Plan/Natural Community Conservation Plan. Construction of Master Plan Facilities, consisting of a six mile long, two-way conveyance canal connecting the SWP and the Kern River to the KWB, turnout facilities on the SWP and Kern River, 30 new recovery wells, 15 rehabilitated recovery wells, approximately 21 miles of transmission pipeline, and metering structures, commenced in 1999. During the 1995–2000 period, the KWBA recharged a total of 871,502 acre-feet of water into the KWB, nearly reaching the 1,000,000 acre-feet of estimated banking capacity.

The chronology of significant KWB project events, up to and following the Monterey

Agreement, is summarized below:[357,358]

1986 — DWR begins to explore the possibility of developing a Kern Water Bank for the purposes of augmenting the SWP.

May 1986 — DWR issues a draft program Environmental Impact Report (EIR) on the proposed KWB.

December 1986 — DWR issues the Final Program EIR.

March 1987 — DWR enters into a memorandum of understanding with the KCWA to develop and operate the KWB.

April 1987 — DWR issues a Preliminary Technical Report describing the features, facilities, costs, and operation of a direct recharge program.

August 1987 — DWR accepts a report from a consultant evaluating toxics in the area of the Kern River Fan.

September 1987 — DWR makes an offer to Tenneco West, Inc., to purchase approximately 24,000 acres of Tenneco West land for the purposes of establishing the KWB.

May 1988 — DWR contracts with the Kern County Water Agency to assist in the development of the KWB. DWR and the Water Agency solicit proposals from local districts to participate in the KWB. Seven local districts express interest in participating; DWR and the Water Agency analyze the proposals.

August 31, 1988 — escrow closes on the purchase of 19,833 acres of Tenneco West land by DWR. The land is purchased by DWR for $31,115,168.74 (approximately $1,565 per acre).

1989 — DWR installs monitoring wells and implements water level and water quality monitoring program. DWR starts the five-year phase out of 20 agricultural leases on approximately 16,000 acres of the KWB land. Planning activities for the KWB are implemented by DWR. Land management activities are started, as is the clean up of contaminated soils.

1989 through 1994 — DWR spends approximately $28–$30 million on studies. ESA issues emerge. Participants note that the cost of banked water is increasing to around $400 to $450 per acre-foot already with no physical banking project yet in place.

1990 — Kern County Future Water Supply Committee is established and provides the forum for discussion of operating criteria for banking projects in Kern County.

1991 — drought impacts begin to underscore the need to move ahead with the KWB. Agricultural allocations of water from the SWP are reduced to zero acre-feet, and municipal and industrial users are reduced to 35 percent of their allocation. Exportation of groundwater out of the Kern area basin accelerates.

1991 — due to lack of water, 101,400 acres in the entire San Joaquin portion of Kern County are fallowed; 9,700 acres are abandoned after crops (primarily, cotton and almonds) are planted; and 101,700 acres of crops suffer reduced yields.

August 1992 — Kern County Future Water Supply Committee appoints an Issues Resolution Committee for the purpose of identifying resolutions to issues surrounding the monitoring and operations of a joint water bank project.

1993 — SWP contractors and the DWR enter into negotiations to resolve dry year water allocation issues.

August 4, 1994 — DWR staff, Kern County Water Agency Staff and representatives of the Westside Mutual Water Company meet to discuss the potential for transferring the KWB property from DWR to Kern County interests in exchange for 40,000 acre-feet of SWP annual entitlement.

August 22, 1994 — the Issues Resolution Committee issues its Draft Groundwater Management Rules. Attorneys Committee begins to investigate the formation of a Joint Powers Authority to operate the KWB.

October 6, 1994 — the Issues Resolution Committee issues a memorandum describing six major areas where disagreements remain regarding the Groundwater Management Rules for banking projects.

December 1994 — the Monterey Agreement between the DWR and the SWP water contractors is executed to resolve dry year allocation issues. This agreement sets forth principles for making changes in SWP water contracts, which would be implemented by amendment. The Monterey Agreement allows for an amendment to the Project Participants contracts to allow the title to the Kern Water Bank to be transferred to local SWP contractors in exchange for 45,000 acre-feet of their annual SWP entitlements. The Kern County Water Agency is to assume operation of the bank.

March 1995 — the Kern County Water Agency, Dudley Ridge Water District, Semitropic Water Storage District, Wheeler Ridge-Maricopa Water Storage District and the Westside Mutual Water Company agree to a Statement of Principles for the Development, Operation and Maintenance of the Kern Fan Element of the Kern Water Bank.

April 13, 1995 — DWR agrees to allow KWB participants use of the Kern Water Bank for water banking, with the Kern County Water Agency managing operations until the Kern Water Bank Authority is officially chartered in October 1995.

May 16, 1995 — California Department of Fish and Game (CDFG) issues a 2081 Permit for the interim operation of the Kern Water Bank.

May 22, 1995 — U.S. Fish and Wildlife Service (USFWS) issues a Section 7 Permit for Stage 2 1995 Interim Operation of the Kern Water Bank.

May 1995 — the KWB Project Participants start recharging water at the KWB.

June 27, 1995 — USFWS and CDFG meet with KWB participants regarding the outline for the Habitat Conservation Plan and to discuss master permit and Natural Communities Conservation Program issues.

October 16, 1995 — Project Participants officially form the Kern Water Bank Authority, which incorporates prior participant agreements.

October 26, 1995 — a Memorandum of Understanding Regarding Operation and Maintenance of the Kern Water Bank Groundwater Banking Program (MOU) is entered into between the Project Participants in the KWB and the Adjoining Entities (agencies not participating in the KWB). This MOU addresses and resolves the six major issues identified by the Issues Resolution Committee. The Monitoring Committee is established.

December 13, 1995 — the Transfer and Exchange Agreement between the Kern County Water Agency and the Kern Water Bank Authority is executed. Upon close of escrow, this agreement will allow the transfer the KWB property from the Water Agency to the Kern Water Bank Authority.

December 31, 1995 — a total of 222,377 acre-feet of water is recharged into the KWB.

August 9, 1996 — the KWB property is transferred from Kern County Water Agency to the Kern Water Bank Authority.

June 4, 1997 — Kern Water Bank Authority posts CEQA Notice of Determination.

October 2, 1997 — signing ceremony takes place for the completion of the KWB Habitat Conservation Plan.

August 30, 1999 — construction is started on the KWB Master Plan Facilities, including a two-way canal, 72,000 feet of transmission pipeline, a pump station, and new recovery wells to allow an estimated recovery of 236,430 acre-feet of water per year.

April 2000 — 871,502 acre-feet of water has been recharged into the KWB.

August 2000 — most of the Master Plan Facility construction is complete. Installation of new recovery wells and distribution piping are the major facilities remaining to be completed.

Stakeholders and Beneficiaries

Participants in the KWB (referred to as Project Participants) include: Dudley Ridge Water District, KCWA, Semitropic Water Storage District, Tejon-Castaic Water District, Westside Mutual Water Company and Wheeler Ridge-Maricopa Water Storage District. Project Participants entered into a Joint Powers Agreement to form the KWBA.

Additional stakeholders include: Rosedale-Rio Bravo Water Storage District, the Buena Vista Water Storage District, the Henry Miller Water District, the West Kern Water District and the Kern Delta Water District. These agencies are not participants in the KWB, but, due to the proximity of their agency boundaries to the KWB, they are stakeholders. The special districts listed above (referred to as "Adjoining Entities") entered into a Memorandum of Understanding with the KWBA regarding the operation and maintenance of the KWB so as to prevent significant adverse impacts and to create a monitoring committee and forum for dispute resolution.

Paramount Farming Co., a major landowner and farming operation in the area, is another stakeholder. Paramount Farming Co. played a key role in working with DWR and the participants to facilitate the transfer of the KWB land from DWR to the Kern Water Bank Authority.[359] The Kern County Water Agency acted as the intermediary in the transfer of the KWB land to the Kern Water Bank Authority.

Outside agencies can purchase KWB water from Project Participants per the JPA. The JPA contains a "right of first refusal" clause, wherein a Project Participant proposing to transfer (sell) water must first notify the other Participants of the offer and allow them the opportunity to purchase before selling to a third party.[360,361] KWB recently concluded one-year sales of water to USBR for 70,000 acre-feet and the Westlands Water District for 45,000 acre-feet of water.

It should be noted that the KWB project priority is to enhance water supplies for the KWB project participants and SWP contractor needs (when possible). Kern County Water Agency member units and the Kern County Water Agency have a second priority.

Project Opposition

The Adjoining Entities had six concerns regarding the KWB that needed to be resolved before an agreement to proceed could be reached. These issues were as follows:[362]

- The level of authority of an oversight committee (Project Participants say it functions as a forum and for record keeping; Adjoining Entities propose authority power to modify programs for compliance with groundwater management plans).
- The right to reserve the recharge capacity of the basin for local water supplies (avoidance of reduction in the capability of the basin to recharge both imported and native water).
- Recognition of the possible benefits to the basin (bankers would like recognition of enhancements to the basin due to banking).
- Recognition of mitigation credit for fallowed land (adjoining entities propose no credit, Project Participants propose a credit).
- Definition of adverse impacts to prevent recovery.
- Definition of migration losses.

Local water users' fear of adjudication was an incentive to develop an agreement to resolve these six major issues. A sixty day negotiation process resulted in the execution of a "Memorandum of Understanding Regarding Operation and Monitoring of the Kern Water Bank Groundwater Banking Program" between the Project Participants and the Adjoining Entities.

Stakeholder and Public Participation

The KWB project engaged local stakeholders through the Future Water Supply Committee process and the Issues Resolution Committee process. The Kern Water County Agency represents many of the water agencies in the area, as they are member units of the Agency. This helps to provide some cohesiveness among the stakeholders. Public participation was accomplished through the environmental compliance (CEQA) process.

Environmental Review

The original Environmental Impact Report for the KWB was completed by DWR in December 1986 for the purpose of acquiring the Tenneco West land (Final Environmental Impact Report, Artificial Recharge, Storage and Overdraft Correction Program, Kern County, California—Kern Water Bank). The EIR adequately analyzed potential operations of the KWB and identified potential groundwater impacts, in this case interference with neighboring banking projects. Monitoring and rotating recharge areas to minimize impacts was recommended. It should be noted that the issue of endangered species at the site was not identified until 1992.[363] A mitigated negative declaration was issued in 1995 to address recharge operations utilizing non-emergency regulated flows.

Financial Characteristics

As mentioned earlier, the KWB was purchased from the DWR through an entitlement transfer. Major construction costs for the KWB project were obtained through a Proposition 204 loan ($5 million) and a private loan ($20 million).[364]

The expenses for the operation and maintenance of the KWB for FY 2000–2001 are budgeted at $1,645,100. These expenses include the cost of monitoring, operations and maintenance, land management and administration. Income to the Kern Water Bank Authority from banking operation assessments, mitigation credit sales, grazing, third party banking and interest earnings is estimated to balance with the budgeted expenses.[365]

Monitoring costs via the KWB Monitoring Committee are shared equally between the KWB Project Participants and the Adjoining Entities.[366] Costs for construction of monitoring wells are borne by the project participants. Each of the parties is responsible for the personnel costs of their representatives to the KWB Monitoring Committee.[367]

The costs of operations and maintenance for the KWB are recovered by the Kern Water Bank Authority through assessments levied against the Project Participants per their share of the project.[368]

The KWB project water uses the market value of water to establish the base value of the water put into storage.[369] Thus, in 2000, the value of the water was approximately $138 per acre-foot, based on recent transactions with the USBR and Westlands Water District.[370] However, it should be noted that the value of water is dependent on the hydrologic cycle, and the cost of $138 per acre-foot would be more typical of the minimum cost or "value" of KWB banked water.

The price of water to third parties outside of Kern County could be in the range of $350 to $400 per acre-foot, depending on variable costs.[371]

Issues and Risks

Hydrogeologic risks are addressed in the 1995 "Memorandum of Understanding Regarding Operation and Monitoring of the Kern Water Bank Groundwater Banking Program (MOU)." This MOU creates a Monitoring Committee made up of one representative from each of the Adjoining Entities and one representative from each of the Project Participants. The Monitoring Committee oversees a comprehensive monitoring program to determine groundwater levels and water quality under project and non-project conditions. The Monitoring Committee has the authority to retain an independent expert consultant to assist in the data collection and analysis necessary for monitoring the banking operation. The Monitoring Committee, assisted by the consultant, prepares a monitoring plan, maps well locations and specifies additional monitoring wells as needed for a monitoring network. The consultant prepares annual water balance studies, develops criteria to define excessive groundwater mounding, and develops recommended KWB Project operating criteria for the purposes of avoiding significant adverse impacts. The Monitoring Committee deals with all banking projects operating in the Kern Fan Area and is the body charged with resolving disputes regarding the KWB Project operations. Meetings of the Monitoring Committee are held monthly or at regular intervals as deemed necessary.

The MOU states that the banking project will be operated by the "golden rule," meaning that, unless acceptable mitigation is provided, the banker may not operate so as to create conditions that are worse than would have prevailed absent the banking project. Also, the MOU states, "operators of projects in the Kern Fan area will avoid operating recharge projects in such a fashion so as to significantly diminish the natural, normal and unavoidable recharge of water native to the Kern Fan Area as it existed in a pre-project condition."[372] Per the MOU, mitigation measures for hydrogeologic risks include the following:

- A spread-out recovery area and the provision of adequate well spacing.
- Buffer areas between recovery wells and neighboring overlying users.
- Limits on the monthly, seasonal, and/or annual recovery rate.
- Provision of sufficient recovery wells to allow the rotation of recovery wells.
- Adjustment to pumping rates and/or termination of pumping to reduce impacts.
- Time restrictions between recharge and recovery to allow for downward percolation of water to the aquifer.
- Provision of water that would not otherwise be available to recharge the Kern Fan Basin.
- Lowering of well pump bowls or deepening wells for impacted overlying users.
- Provision of alternative water supplies to impacted overlying users.
- Financial compensation to impacted overlying users.

The MOU assigns losses of water during the recharge process at 6% for evapotranspiration, and 4% for migration. Thus, the assigned loss rates help to dedicate water to the basin for

overdraft correction. Finally, the operation of the recharge basins is deliberately designed to create intermittent wetlands to provide habitat for waterfowl.

Conveyance Capacity

Conveyance capacity in the SWP (California Aqueduct) is conditioned through a Point-of-Delivery Agreement. Put and take conveyance is accomplished in accordance with a schedule approved by DWR. A Use-of-Facilities Charge is applied for each reach of the California Aqueduct in which the users are not participating in a repayment of charges.[373]

Groundwater Rights

Recovery has not preceded recharge due to the fact that the KWB may only recover water that it has recharged. With regard to protection of banked groundwater, the monitoring program described above provides such protection, as it is composed of the adjoining agencies that utilize groundwater in the Kern River Fan.

Water Quality

The 1995 "Memorandum of Understanding Regarding Operation and Monitoring of the Kern Water Bank Groundwater Banking Program" provides for water quality monitoring and has specific requirements for the operation of the KWB to enhance water quality. Recharge water must be of high quality and cannot degrade the groundwater basin.

Financing is allocated by the percentage of base shares of the Project Participants, and operating costs are pooled and shared in a similar fashion. Using the base share formula, the costs are allocated as follows:

Table 5

Agency	Percentage Share of Costs and Benefits Based on Entitlement Contributed
Kern County Water Agency	9.62%
Dudley Ridge	9.62%
Semitropic	6.67%
Tejon-Castaic	2.00%
Westside	48.06%
Wheeler Ridge	24.03%

Political Risks

The political risks associated with adverse community reactions for this project are minimal because:

- Water banking projects are common in the area and tend to be accepted as required to preserve and enhance the economy of the area.
- The KWB project has done an effective job of creating habitat and enhancing the natural environment.
- The Monitoring Committee structure offers a forum for addressing the concerns of overlying users adjacent to the project.

Conclusions

KWB participants cited the following factors as having contributed to the success of the Kern Water Bank:

- Kern County has a long history of water banking programs; therefore, it is not a new concept but rather considered a "tried and true" method for water resources management.

- The water agencies within the southern Kern County area are fairly cohesive. The Kern County Water Agency serves as an umbrella organization and a forum for water agencies dealing with the DWR on SWP contracts. The Water Agency also serves as an important intermediate "linking" and resource organization for representing local interests at the state level.

- Leadership within the local water interests recognized the need to develop committees or other mechanisms to reach out and include stakeholders in the program development process. The "glass house" theory was used extensively—in other words, invite and include as many participants into the project as possible (they are less likely to "throw stones" if they are involved in the project).

HYPOTHETICAL ARRANGEMENTS

Based on the lessons learned from the case studies, we propose the following design features for successful and locally acceptable conjunctive use projects. These elements are posed for detailed discussion and reaction by focus groups comprised of knowledgeable and constructive groundwater users, water managers, local officials and opinion leaders in the communities that appear on the basis of hydrogeologic criteria to be particularly well-suited for groundwater banking. The Natural Heritage Institute intends to conduct such focus group reviews as a future phase of the "System-Wide Investigation of the Opportunities for Conjunctive Water Management in the Central Valley" project, out of which this case study report itself emanated.

OVERALL PROJECT DESIGN:

- Banked water would be imported. Thus, aquifer would be actively recharged with water not otherwise available;
- Recharge and extraction facilities would be sited within an existing water district service area or within an AB-3030 planning area;
- The banking operations (recharge and recovery) would be performed by (under the control of) the overlying water district or groundwater management authority;
- Local benefits in the form of water or cash payments would be obligated in enforceable contracts. These commitments could take the form of rights of first refusal in favor of the local water district or authority that is operating the bank (or its individual members) to utilize either the banked water or the aquifer storage capacity or both;
- For unincorporated areas (e.g., for *in lieu* projects), create a local water management authority by special act or county ordinance; and
- Issues, alternatives, and mitigations would be routinely analyzed in NEPA/CEQA documents with full public participation.

IMPROVEMENTS IN HYDROGEOLOGIC INFORMATION

- Measures to improve baseline data in the project area would be undertaken. Local groundwater users would be included in the process of collecting, interpreting, and modeling the data. Efforts would be made to prompt DWR to aggressively improve aquifer baseline information in the areas most suitable for banking.

HYDROLOGIC ASSURANCES

- "Groundwater substitution" projects would only be conducted where subsequent recharge is assured—perhaps through escrow arrangements;
- *In lieu* banking would be conducted only where substitute surface water deliveries are assured—perhaps through escrow arrangements;
- Groundwater substitution arrangements and *in lieu* arrangements should be avoided in areas with shallow wells unless the project is operated within tolerance limits or it pays for deepening the wells or it provides a substitute water supply out of the bank to neighbors with shallow wells;
- The project would commit to recharge more water than it recovers by a specified percentage to provide a buffer against hydrogeologic uncertainties, or the

project would provide some other type of hydrologic assurance;

- The project would be operated within specific water table elevation limits to avoid inundating root zones or structures;
- The recharge and extraction facilities would be located near the center of the overlying water district of groundwater management authority to avoid or minimize effects on external groundwater users;
- The project would cease pumping or provide automatic compensation whenever monitoring wells indicate interference with neighboring wells. Where this potential is significant, the project would allow neighboring groundwater users to order cessation pending investigation of the impacts;
- The project would extract water on a schedule designed to avoid impacts on irrigators. The schedule could be subject to modification by the monitoring committee. For example, the extraction schedule would be limited to seasons or days when neighboring wells are not in operation such as nights, weekdays or before or after the peak irrigation season;
- The groundwater bank should be located as far as possible from surface streams (unless interaction is desired);
- The contract terms should assure that water deliveries to beneficiaries will cease at the termination of the contract period. Enforcement mechanisms might include export permits of limited duration or substantial liquidated damages; and
- Where recharge water is routed through the delta (or otherwise degraded en route), it will be subject to water quality criteria that will assure that the recharge water is of higher quality than the *in situ* groundwater.

Financial assurances

- Costs incurred by neighboring landowners due to increases in power requirements to lift groundwater—for any reason—will be compensated out of project revenues. Such compensation arrangements will feature streamlined and simplified claims processing procedures; and
- The customers of a groundwater banking project will defray the costs incurred by the water district or groundwater management authority that is providing the banking services even if delivery constraints beyond the control of such banker prevent the delivery of water to such customers. The customers may also be required to pay those costs in advance. If the banked water cannot be delivered, banking district can purchase that water at their marginal costs of substitute supplies.

Legal assurances

- In groundwater basins that are in a condition of chronic overdraft, groundwater users' historic rates and volumes of pumping would be immune from legal action by groundwater bankers. Unless the basin is adjudicated, the formula for defining "historic use" would be specified in the contract setting up the groundwater bank;
- In groundwater basins in which current extractions are less than natural recharge, groundwater users' would also be immune from legal action to the extent of the "safe yield" surplus in the basin. Unless the basin is adjudicated,

the formula for defining "safe yield" and surplus would be specified in the contract setting up the groundwater bank;

- For *in situ* projects, either all of the local groundwater users would be brought into the project via contract (probably unrealistic), or the program will have to be operated in a manner that avoids injury—perhaps by allowing "take" only after a period of "put"; and
- A groundwater banking project will have the burden of proving that its operations will not cause injury to legal users of water, including groundwater users, where the project is required to obtain a permit or order from the State Water Resources Control Board or a local groundwater management authority.

Monitoring program

- A banking project will establish a groundwater monitoring program directed by committee representing the local groundwater users as well as project participants. The program will include perimeter monitoring wells and adequate monitoring infrastructure. The program will monitor specified quantity and quality parameters. The committee will possess the power to modify the pumping regime when specified thresholds are exceeded; and
- The committee will also be vested with authority to resolve disputes regarding project operations either directly or by referring the dispute to an arbitration panel comprised of technical experts.

Local participation

- The overlying water district or groundwater management authority that will provide the banking services will consult with the local groundwater community, involve it in the project design and operations, and solicit and use "local knowledge" of groundwater conditions;
- Where possible, the project will be located in areas where groundwater banking is already an established practice;
- The project proponents will make all technical investigations transparent and provide ample opportunities for early review and comment;
- The proponents will complete all technical investigations and public review before implementation steps are taken; and
- That will include thorough and convincing NEPA/CEQA compliance.

ENDNOTES

INTRODUCTION

[1]For the purposes of this paper, "imported water" refers both to "foreign water imported from a different watershed" or water that comes from an in-basin source that is not hydrologically connected with the banking site within a relevant period of time (e.g. flood flows of a river). City of Los Angeles v. City of San Fernando, 14 Cal. 3d 199, 261 n.51 (1975). Note that this definition would include water that originates within the same hydrologic basin as the banking site, provided that it would not be available for extraction at that site but for the physical act of bringing it to that location as recharge water.

[2]We use the term "rent" figuratively for, as we shall see in the section of this document on "Outstanding Issues", overlying landowners probably do not have a right to charge rent for the use of the subsurface aquifer. Nonetheless, the landowner or groundwater management entity that provides and operates the recharge and recovery facilities will want to participate in the benefits of the groundwater bank. When that inducement takes the form of a cash payment, it may resemble "rent", a term of art we employ with the above caveat.

[3]The potential for groundwater export and refill projects adversely affecting streamflows is a function of the transmissivity of the groundwater, the proximity to surface streams, and the interval between extraction and refill. These are parameters that are not difficult to control if the baseline information is adequate. We envision projects where extraction and refill both occur annually, and where the bank is located remotely from surface streams. Under those circumstances, uncertainties in the current understanding of the linkage between surface water and groundwater systems in the northern Sacramento Valley should not pose an unmanageable risk.

[4]The courts, using their equitable powers, and the State Board, though Cal. Wat. Code § 275, can fashion and enforce physical solutions to ensure more efficient use of water, provided that the legal rights of the parties are protected and senior rights holders are not required to incur any material expense. See generally City of Barstow v. Mojave Water District, 23 Cal. 4th 1224 (2000). (Examples of State Board enforcement of physical solutions include SWRCB Decision 1631 and Order WR 98-05, D 1600 and Order 88-20, and Orders WR 2000-13, WR 96-002, WR 94-2 & 93-8, and WR 90-16.)

SCOPE AND METHODOLOGY

[5]The storage of Friant flood releases at Arvin-Edison comes closest to the system-wide approach. However, it does not entail reoperation of Friant Reservoir to capture such flood events.

FINDINGS AND CONCLUSIONS

[6]E.g., the Semitropic and Arvin-Edison programs have allowed these districts to finance new facilities that increase their internal operational flexibility to the substantial benefit of the districts' members.

[7]The Kern Water Bank MOU includes the following provisions:

A spread out recovery area and the provision of adequate well spacing.
Buffer areas between recovery (extraction) wells and neighboring overlying users.
Limits on the monthly, seasonal, and/or annual recovery rate
Provision of sufficient recovery wells to allow the rotation of recovery wells.

[8]That monitoring committee prepares annual water balance studies, develops criteria to define excessive groundwater mounding, and develops operating criteria to avoid adverse impacts. It is also charged with resolving disputes concerning project operations.

[9]Personal communications with Madera County Groundwater Oversight Committee (Pistoresi and Prosperi) and Steve Ottemoeller, Madera Irrigation District, April 6, 2000.

[10] Stuart G. Walesh, *Dad is Out, Pop is In, 35:3* Journal of the American Water Resources Association, 537.

[11]USBR, Reclamation Manual/Directives and Standards CMP 04-01, http://www.usbr.gov/recman.

[12]Walesh, supra note 10, at 540.

[13]*Consensus Quells the Water Wars*, Sacramento Bee, April 29, 1999, Section Editorials, at B7.

[14]"Bank on it or Flush it?", Fresno Bee, July 2, 2000.

OUTSTANDING ISSUES

[15]See, e.g., Niles Sand and Gravel Co. v. Alameda County Water Dist., 37 Cal. App. 3d 924 (1974).

[16]Unless already authorized, groundwater banking usually involves both a new place of storage and a new or expanded place of use (when the water is pumped back out of the aquifer). The State Board exercises jurisdiction over both. See California Water Code § 1266, Cal. Code Regs. tit. 23, § 722.

[17]For instance, the groundwater banking authority must avoid raising the groundwater table to a level that might invade the root zones of neighboring crops or structures. It must avoid lowering the groundwater table below the level

that would exist in the absence of the project, thereby dewatering nearby wells or increasing the power requirements for pumping. The banking authority must also avoid degrading the quality of the *in situ* groundwater.

[18]For example, water users could be made whole through delivery of an alternate source of water of equal quality and quantity. Additionally, a well owner who has to deepen her well to respond to a declining water table (as occurs with a groundwater substitution project) might be reimbursed for the increased well construction and pumping costs. Depending on the nature and severity of the change, adverse impacts on groundwater quality may not be allowable even if the affected well owners accept compensation.

[19]By their terms, the county and watershed of origin statutes apply only to water that originates in the county or watershed of origin. However, if this water is banked within the county or watershed of origin and then extracted and exported, it would seem that the doctrines would apply.

[20]City of Los Angeles v. City of San Fernando, supra note 1.

[21]The importer would lo

se rights to the water only if it is abandoned, which would be contrary to the intent of a groundwater banker, or is acquired by "adverse possession", also known as prescription. Prescriptive rights cannot be obtained as against a public agency, however. City of Los Angeles v. City of San Fernando, 14 Cal. 3d 199 (1975). This is yet another reason why water districts are the preferred operators of a groundwater bank.

[22]The California Supreme Court has affirmed the paramount rights of the importer to recapture foreign water intentionally lost to groundwater basins and unintentionally lost to surface waters. See, Stevens v. Oakdale Irr. Dist., 13 Cal. 2d 343 (1939); City of Los Angeles v. City of Glendale, 23 Cal. 2d 68 (1943); City of Los Angeles v. City of San Fernando, 14 Cal. 3d 199 (1975). Some water law practitioners contend that the Stevens rule permitting recapture of unintentionally lost imported water should not be extended to deep percolation from irrigation. They are concerned that if the right to recapture percolation losses is extended to large importers like the SWP or CVP, they could effectively control every groundwater basin in the Central Valley. Others point out that groundwater users who are the incidental beneficiaries of irrigation imports contribute nothing to the capital or maintenance costs of such projects, and are not entitled to insist on the continuation of that gratuity.

[23]This issue is emerging in discussions over the reoperation of Friant Dam to restore the downstream anadromous fishery. The increased releases will increase infiltration in the Gravelly Ford reach. Groundwater pumpers in that area are likely to benefit from the increased recharge—if it is theirs to pump. Is a change in dam operations of this sort an act of importation, utilizing a natural channel to bring in water that would not otherwise be available to the aquifer but for the reoperation, if part of the intended purpose is to bank groundwater downstream? If so, shouldn't the USBR be entitled to pump that increased recharge and deliver it to, for instance, the San Joaquin exchange contractors in exchange for Mendota Pool water that could be wheeled to the Friant Water Users to make them whole? On the other hand, the Gravelly Ford groundwater users point out that that increased flow to more closely mimic the natural hydrograph is water that would have been available to them as recharge water if Friant Dam had not been built. Thus, the reoperation merely restores a degree of the natural conditions to which they are entitled. The issue of the hydrologic and temporal baselines for determining what constitutes "imported water" permeates this paper and is a matter on which we recommend clarifying legislation.

[24]Katz v. Walkinshaw overturned the rule of absolute ownership of groundwater traced back to Acton v. Blundell, 12 Mees. & W. 324 (Exchequer) (1843), and rejected the notion that a landowner owns everything from the "heavens to the center of the earth." It made groundwater a common property resource in that groundwater resources must be shared in a correlative fashion by the overlying landowners. But Katz did not consider whether an overlying landowner may restrict a water importer from using the free space in an aquifer.

[25]If overlying users own a correlative share of the aquifer storage space, they arguably would have to be compensated for use of that space, whether or not they are injured. The City of Los Angeles v. City of Glendale and City of Los Angeles v. City of San Fernando holdings make no provision for compensation for use of aquifer storage space.

[26]City of Los Angeles v. City of Glendale and City of Los Angeles v. City of San Fernando uphold Los Angeles DWP's importation and storage of water underground despite Los Angeles' status as an appropriator and lack of any statutorily authorized groundwater management authority.

[27]See Slater, California Water Law and Policy (1998); City of Los Angeles v. City of San Fernando, 14 Cal. 3d 199 (1943).

[28]Correlative rights are like riparian rights: they are neither quantified nor prioritized by historic use. The only limitation on their exercise is the mutual avoidance of harm. The problem that emerges is illustrated by the following hypothetical: Suppose a groundwater bank is recharged for two years and then water is extracted in the third year. Suppose there are three overlying groundwater users, A, B and C. In the first two years (of recharge), A and B greatly exceed their historic rates of pumping to take advantage of the new recharge, and in the third year they revert to historic levels. In that third year, the program also seeks to extract. The combined pumping increases C's lifting costs above the historic baseline. May C sue to prevent the project from extracting its water? May the project sue in the first two years to prevent A and B from increasing their rates of pumping?

[29]There is an enforcement problem, however. Water users are typically aware when pumping exceeds safe yield, but the costs of curtailing pumping and/or initiating an adjudication inhibit legal action for abatement. Also, an individual user has at least a theoretical argument that it can increase its pumping as its needs increase, even when the basin is in overdraft. The fact that total use exceeds the safe yield does not rule out the possibility that some of the overlying users are entitled to increase their pumping (i.e. their correlative share happens to be higher than their current pump-

ing, because their needs have substantially increased). See City of Barstow v. Mojave Water Agency, 23 Cal. 4th 1224 (2000). Of course, the total basin pumping cannot legally increase, but they could argue that others' correlative share must be reduced to accommodate their increased need.

[30]However, the fact that the land is within the boundaries of a district that delivers surface water doesn't necessarily mean that the district is doing anything to regulate groundwater extractions.

[31]Some water lawyers argue that the State Board has no jurisdiction over water in underground basins because it is not water flowing in "surface streams" or in "known and definite channels." The argument suggests that, once surface water is put into aquifer storage, it becomes groundwater outside of the State Board's authority to regulate. Also, county ordinances define "groundwater" subject to their jurisdiction as "all water below the surface not in known and definite channels."

[32]See, e.g., In the Matter of Application 17002, Decision No. D. 894, at 3 (Mar. 25, 1958)(approving an application for water that, after appropriation, will be placed into underground storage and later released for municipal, domestic, irrigation, and recreation purposes over 18,100 acres of land); In the Matter of Application 20621, Decision No. D. 1235, at 3, 29 (Aug. 25, 1965)(approving the Navy's application to store 4,000 afa underground from which it will be pumped for military, domestic, municipal, and agricultural purposes, both within and without the watershed.)

[33]For example, In the Matter of Application . . . to Appropriate Water from Sespe Creek In Ventura County, Decision No. D 1129 (Apr. 29, 1963), the State Board weighed competing permit applications for development of certain water resources in the Santa Clara River basin near Oxnard. The United Conservation District planned to appropriate water year-round for domestic, industrial, irrigation, and salinity control purposes, with a portion of the water first being placed in underground storage. In approving United's application, the board, as a condition of United's permit, held that it retained authority to ensure the use of the water was consistent with the permit. We note that these orders pertain to water right applications. It is not certain that the same holdings would apply to change orders.

[34]The ultimate use of the water is subject to the reasonable and beneficial use requirement of Article X, §2 of the California Constitution. Under Water Code §1242, the storage of surface water underground is considered a beneficial use if the water provided that the water so stored is thereafter applied to a beneficial purpose.

[35]The State Board retains authority over the use of water diverted from a natural watercourse even if it is first diverted to storage in an offstream reservoir. Its jurisdiction does not depend on whether the reservoir is characterized as a "natural channel" as long as the water diverted into the reservoir was diverted from a stream lake or other body of water. For purpose of State Board jurisdiction over rediversion and use of water first stored to a reservoir, the Water Code does not distinguish between surface and underground reservoirs. See California Water Code § 1201.

[36]California Water Code §§ 10750-10753.9.

[37]See California Water Code § 10753.8(c).

[38]The ten special districts are Willow Creek Groundwater Management Agency (Lassen Co.), Honey Lake Groundwater Management District (Lassen Co.), Long Valley Groundwater Management District (Lassen Co. and Sierra Co.), Sierra Valley Groundwater Management District (Sierra Co.), Mendocino City Community Services District (Mendocino Co.), Mono County Tri-Valley Groundwater Management District, Pajaro Valley Groundwater Management Agency (Santa Cruz), Ojai Groundwater Management Agency (Ventura Co.), Fox Canyon Groundwater Management Agency (Ventura Co.), and the Monterey Peninsula Water Management District (Monterey Co.). See California Department of Water Resources, Water Facts: Groundwater Management Districts or Agencies in California (1996).

[39]Such as the Orange County Water District, Santa Clara Valley Water District, and the Monterey County Water Resources Agency.

[40]See In re Mass, 219 Cal. 422, 424-25 (1933); Ex parte Elam, 6 Cal. App. 233, 237 (1907).

[41]Baldwin v. County of Tehama, 31 Cal. App. 4th 166, 173-74 (1994, 3rd Dist.); review denied, Cal. Sup.Ct., March 17, 1995. Baldwin held that state law, namely AB 3030, specially enacted local districts and California Water Code Section 1220 (about which more, later) do not preempt city and county management of groundwater resources. State law preempts local ordinances only when "the subject matter has been so fully and completely covered by general law as to clearly indicate that it has become exclusively a matter of state concern . . ." or "the subject matter has been partially covered by general law couched in such terms as to indicate clearly that a paramount state concern will not tolerate further or additional local action. . . ." .

[42]The following counties have passed groundwater management ordinances that govern the extraction and exportation of groundwater (dates of the most recent amendment are noted): Butte Co. 1996; Colusa Co. 1998; Fresno Co. 2000; Glenn Co. 2000; Imperial Co. 1998; Inyo Co. 1998; Kern Co. 1998; Lake Co. 1999; Madera Co. 2001; Modoc. Co. 2001; Napa Co. 1999; Sacramento Co. 1952 Water Act (Sec 32 on GW mgmt added 1985); San Benito Co., 1995; San Diego Co. 1991; San Joaquin Co. 1996; Shasta Co. 1998; Siskiyou Co. 2001; Tehama Co. 1994; Yolo Co. 1996. Ordinances have been proposed or are pending approval in a number of other counties.

[43]Groundwater is generally defined as "all water below the surface not in known and definite channels." Since none of the ordinances exempt imported water from this definition, the ordinances arguably apply to banked, imported water.

[44]For example, see Colusa County Code §§ 43-3, 43-4 and Shasta County Ordinance No. SCC 98-1, §§ 18.08.030, 18.08.040.

[45]The Board must make an injury determination when approving the change order to transfer water into the aquifer and likely retains jurisdiction over the subsequent rediversion of the stored water. Parties potentially affected by the banking

operation would have the opportunity to protest the project as well as seek protection from the Board if the project operation affects their rights. On the other hand, the Board's authority to protect the banker is not symmetrical; the Board does not have the power to prevent groundwater pumpers from taking the banked water. Legal counsel to the State Board suggests that the instances of actual conflict may not be frequent in that, in situations where there is a competent county regulatory regime, the Board would likely defer to the county and exercise its authority only when necessary.

[46]The County of Origin and Watershed of Origin statutes by definition only apply to water that originates in the county or watershed of origin.

[47]California Water Code § 1220: "(a) No groundwater shall be pumped for export from within the combined Sacramento and Delta-Central Sierra Basins . . . unless the pumping is in compliance with a groundwater management plan that is adopted by ordinance pursuant to subdivision (b) by the county board of supervisors, in full consultation with affected water districts, and that is subsequently approved by a vote in the counties or portions of counties that overlie the groundwater basin, except that water that has seeped into the underground from any reservoir, afterbay, or other facility of an export project may be returned to the water supply of the export project. . . ."

[48]Injury to groundwater appropriators is unlikely, however, as their rights are subordinate to the overlying parties who are participating in the *in lieu* banking project.

[49]California Water Code § 1005.2 and 1005.4 states that where a nontributary source of water (imported foreign water or conserved water otherwise unavailable to the aquifer) is used *in lieu* of groundwater pumping, a reduction or cessation of groundwater pumping to permit groundwater replenishment is deemed a beneficial use of water and will not result in loss, reduction or forfeiture of the groundwater rights.

Case Studies

[50]More recent geologic investigations by the Department of Water Resources Northern District Office suggest that the western boundary of the basin may not coincide with the Sacramento River. The southern boundary is likewise in question due to limited hydrogeologic characterization of the stratigraphy surrounding the Sutter Buttes. A further complication related to the southern boundary is that the greater reliance on groundwater south of the Sutter Buttes has created a net outflow of regional groundwater from the Butte Basin.

[51]Camp, Dresser & McKee, Inc. 2001. Butte County Water Inventory and Analysis Report 5-8 (Draft).

[52]Department of Water Resources, State of California (DWR), 1978. Evaluation of Ground Water Resources: Sacramento Valley, Bulletin 118-6, at 136.

[53] L.S. Dixson, N.Y. Moore, and S.W. Schechter, California's 1991 Drought Water Bank, Economic Impacts in the Selling Region, RAND, Santa Monica, CA (1993).

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[55]M. Planert and J.S. Williams, Groundwater Atlas of the United States, Segment 1: California and Nevada, U.S. Geological Survey, Hydrologic Atlas HA-730B (1995).

[56]Department of Water Resources, State of California (DWR), Program Environmental Impact Report: State Drought Water Bank, Sacramento, CA.(1993).

[57]Department of Water Resources, State of California (DWR), State Water Project supplemental water purchase program: Draft program environmental impact report (1996).

[58]American River Basin Cooperating Agencies and Sacramento North Area Groundwater Management Authority (ARBCA/SNAGMA), The Opportunity for Large-Scale Groundwater Banking and Exchange in Northern Sacramento and Southern Placer Counties, 1 (January 2000).

[59]*Ibid*.

[60]*Ibid*.

[61]Personal communications with Mr. Marshall Davert, Project Manager, Montgomery-Watson, 2000.

[62]DWR, *supra* note 52, at 8-6.

[63]ARBCA/SNAGMA, *supra* note 58.

[64]Personal communications with Mr. Jim McCormack, Sacramento, Office of Metropolitan Water Planning, September 18, 2000.

[65]ARBCA/SNAGMA, *supra* note 58, at 8-9.

[66]Water Forum Groundwater Management Element 2-5 (1998).

[67]*Ibid*.

[68]Water Forum Groundwater Management Element, *supra* note 66, at 8.

[69]Joint Powers Agreement Between the City of Citrus Heights, the City of Folsom, the City of Sacramento, and the County of Sacramento Creating the Sacramento North Area Groundwater Management Authority, August 11, 1998.

[70]*Ibid*., p. 6.

[71]*Ibid.*

[72]Personal communications with Mr. Jim McCormack.

[73]*Ibid*.

[74]American River Basin Cooperating Agencies, Regional Water Master Plan, Phase I Final Report, Technical Memoranda, TM 2: Regional Water Master Plan Goals and Objectives 2-3 (June 1999).

[75]ARBCA, Regional Issues Committee Report — Overview of Regional Organizations, n.d.

[76]ARBCA/SNAGMA/USBR , Sacramento North Area Conjunctive Use Program: A Partnership for Regional Water Planning (June 1999).

[77]ARBCA/SNAGMA, *supra* note 58, at 4.

[78]ARBCA, *supra* note 75.

[79]*Ibid*.

[80]ARBCA/SNAGMA, *supra* note 58, at 5-6.

[81]*Ibid*.

[82]Personal Communications with Mr. Jim McCormack.

[83]Personal communications with Mr. Marshall Davert, September 2000.

[84]Information provided by Mr. Bill Edgar, McDonough Holland & Allen, February 25, 2000.

[85]Montgomery Watson, American River Basin Cooperating Agencies, Regional Water Master Plan, Phase I Final Report, Technical Memoranda, TM 1 Regional Water Master Plan Phase I Project Management Plan 1-9 (1999).

[86]Montgomery Watson, American River Basin Cooperating Agencies, Regional Water Master Plan, Phase II , Technical Memoranda, TM 1: Project Management Plan, 1-16 - 1-27.

[87]ARBCA, *supra* note 75.

[88]Brown and Caldwell, Eastern San Joaquin County Groundwater Study Summary Report 2 (October 1985).

[89]California Department of Conservation, Farmland Conversion Report 1994 to 1996, Publication No. FM 98–01, 20–21.

[90]Brown and Caldwell, *supra* note 88.

[91]*Ibid*, p. 4.

[92]US Army Corps of Engineers, Sacramento District, Farmington Dam and Reservoir, California WRDA 1996 Section 411— Conjunctive Use Study 11-10 (December 1998).

[93]Baseline Environmental Consulting, Final Environmental Impact Report, San Joaquin County Comprehensive Planning Program, ER 91-3 (May 1992).

[94]US Army Corps of Engineers, *supra* note 92, p. II-9.

[95]Brown and Caldwell, *supra* note 88, at 1.

[96]DWR, The California Water Plan Update, Bulletin 160-98, November 1998, at 8–29.

[97]Stockton East Water District, US Army Corps of Engineers, loc. cit.

[98]US Army Corps of Engineers, *supra* note 92, p. I-1.

[99]Stockton East Water District, History, www.sewd.net/history.html.

[100]*Ibid*.

[101]Stockton East Water District, US Army Corps of Engineers, Solving the Water Shortage in Eastern San Joaquin County, Informational Brochure, 2000, at 1.

[102]ESJPWA, Groundwater Recharge & Banking in Eastern San Joaquin County, 5.

[103]East Bay Municipal Utility District, Increasing Water Supply Reliability, Technical Publication, 4 (1996).

[104]*Ibid*.

[105]DWR, *supra* note 96.

[106]East Bay Municipal Utility District, Increasing Water Supply Reliability, Technical Publication, 3-4 (1996).

[107]DWR, *supra* note 96.

[108]Brown and Caldwell, *supra* note 88, at 13.

[109]San Joaquin County Flood Control and Conservation District Groundwater Monitoring Program Evaluation, 1999.

[110]Personal communications with Ms. Jeanne Zolezzi, SEWD Counsel, May 17, 2000.

[111]Personal communications with Mr. Fran Forkas, City of Lodi, August 21, 2000.

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[113]Personal Communication with Mr. John Pulver, San Joaquin County Water Resources Coordinator, June 5, 2000.

[114]East San Joaquin Parties Joint Exercise of Powers Agreement, East San Joaquin Parties Water Authority, Article I, Section 1.02.

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[116]*Ibid*, at 75.

[117]Williamson, *supra* note 112, at 75.

[118]Amended Memorandum of Agreement Between the East Bay Municipal Utility District and the East San Joaquin Parties Water Authority, November 5, 1997.

[119]Boyle Engineering Corp., Beckman Test Project, 1–10 (1999).

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[122]Personal Communications with Mr. Richard Prima, City of Lodi, July 2000.

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[125]From a presentation to the Advisory Water Commission of SJC Flood Control and Water Conservation District by Anthony Saracino, ESJPWA Executive Director, August 9, 2000.

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[128]*What People are Saying,* San Joaquin Farm Bureau News, August, 2000.

[129]Jim Nickles, *A Special Report, Divided over Water*, The Record, May 4, 1998, at A4.

[130]Mike Treleven, *Stockton East Studies Overdraft Solutions*, San Joaquin Farm Bureau News, February 2000.

[131]Personal communications with Mr. Richard Prima, Director of Public Works, City of Lodi, July 2000.

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[133]Ordinance Amending Division 8 to Title 5 of the Ordinance Code of San Joaquin County Regarding the Extraction and Exportation of Groundwater from San Joaquin County, Chapter 3, Section 5-8345.

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[141]Madera Irrigation District, *supra* note 137, at 10.

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[153]*Ibid*, pp. 136–137.

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[156]*Ibid*, p. 21.

[157]Madera County Groundwater Oversight Committee, *supra* note 9.

[158]Fresno Bee, *supra* note 14.

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[161]*Ibid*.

[162]*Mystery in Madera, How a Water Banking Project Ran Amok,* Sacramento Bee, March 15, 1999, at B4.

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[167]Madera County Groundwater Oversight Committee, *supra* note 9.

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[204]*Ibid*.

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[212]Semitropic Water Storage District, *supra* note 205.

[213]Semitropic Water Storage District, *supra* note 206.

[214]Semitropic Water Storage District. Contract Between Semitropic Improvement District of Semitropic Water Storage District and [landowner] for Intermittent Water Deliveries In Lieu of Groundwater Pumping, December 13, 1995.

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[216]Navigant Consulting, Inc., *supra* note 198.

[217]Conant, *supra* note 202.

[218]Semitropic Water Storage District, *supra* note 205.

[219]Semitropic Water Storage District, *supra* note 206.

[220]Semitropic Water Storage District. Groundwater Banking Project, Financing Options Summary.

[221]*Ibid*.

[222]Semitropic Water Storage District, *supra* note 205.

[223]Semitropic Water Storage District, *supra* note 206.

[224]*Ibid*.

[225]Boschman, *supra* note 194.

[226]*Ibid*.

[227]Interview with Gene McMurtry, Esq., Attorney for landowner districts surrounding Semitropic Water Storage District, Bakersfield, California (June 23, 2000).

[228]Conant, *supra* note 202.

[229]Issues relating to groundwater management in Kern County were presented to Kern County's Future Water Supply Committee in July of 1992. This Committee appointed an Issues Resolution Committee to recommend possible solutions to these issues. The Issues Resolution Committee tried to develop groundwater management rules regarding banking projects. In October of 1994 the Issues Resolution Committee presented their draft rules to the Kern County Water Agency. On issues where the committee could reach resolution between groundwater districts and bankers, a specific rule was outlined. On issues where the committee could not reach resolution between groundwater districts and bankers, the Committee outlined the positions of each group.

[230]McMurtry, *supra* note 227.

[231]Navigant Consulting, Inc., *supra* note 197.

[232]Navigant Consulting, Inc., *supra* note 198.

[233]Conant, *supra* note 202.

[234]McMurtry, *supra* note 227.

[235]*Ibid*.

[236]Semitropic Water Storage District, *supra* note 205.

[237]Semitropic Water Storage District, *supra* note 206.

[238]McMurtry, *supra* note 227.

[239]Conant, *supra* note 202.

[240]Navigant Consulting, Inc., *supra* note 197.

[241]Conant, *supra* note 202.

[242]State of California, The Resources Agency, Department of Water Resource. Amendment No. 1 to the Agreement Among Department of Water Resources, State of California, Kern County Water Agency and Semitropic Water Storage District for Introduction of Local Water into the California Aqueduct, August 21, 1995.

[243]Boschman, *supra* note 194.

[244]Semitropic Water Storage District, *supra* note 205.

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[246]McMurtry, *supra* note 227.

[247]Boschman, *supra* note 194.

[248]*Ibid*.

[249]Arvin-Edison Water Storage District, The Arvin-Edison Water Storage District Water Resources Management Program, November 1999.

[250]Bookman-Edmonston Engineering, Inc., Organization of Existing Groundwater Management Activities Under California Water Code Sections 10750 et seq. (AB-3030) - DRAFT, November 1996.

[251]*Ibid*.

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[253]Arvin-Edison Water Storage District, *supra* note 249.

[254]Interview with Howard Frick, President of the Board of Directors of Arvin-Edison Water Storage District, in Arvin, California (June 23, 2000).

[255]*Ibid*.

[256]Arvin-Edison Water Storage District, *supra* note 249.

[257]Bookman-Edmonston Engineering, Inc., *supra* note 250.

[258]Frick, *supra* note 254.

[259]Conant, *supra* note 202.

[260]*Ibid*.

[261]Frick, *supra* note 254.

[262]McMurtry, *supra* note 227.

[263]Conant, *supra* note 202.

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[266]Frick, *supra* note 254.

[267]Kern County Water Agency, *supra* note 210.

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[270]Conant, *supra* note 202.

[271]Arvin-Edison Water Storage District, *supra* note 268.

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[293]*Ibid*.

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