

CALIFORNIA WATER: 2004

I. Introduction

California, with its population of 36 million, is the top-ranked state in the value of agricultural production, contributing over half of the nation's fruit, nut, and vegetable production. And with its unique milieu of industry and business developments, many of which are characterized as "high-tech", its recreational attractions, its geographic location, and its rich natural resource endowment California has become the fifth largest economy in the world (\$1.4 trillion).

Developing and managing a sufficient and reliable water supply has been essential to achieving these ends and providing an ever-expanding population with a superior quality of life. Precipitation varies widely from place to place, season to season, and year to year. Most of the precipitation and runoff occur in the northern and mountainous parts of the state and most of the people live in the southern part of the state. Interbasin storage and transfer projects have allowed for redistribution of water to where it has been needed for crops, people, and industry. And extensive groundwater supplies have provided additional water that has been put to beneficial uses.

As extensive, intensive and diversified as the development has been over the past 150 years, meeting the associated water requirements has induced reductions in river flows, changes in timing of flows for flood management, overdrafting of several groundwater aquifers, and has contributed to species losses, impacted commercial fisheries, and degraded water quality. Awareness of these and related problems has increased in recent times. Signs of a growing private and public commitment to act to protect and enhance the state's water resources are widespread.

Local water agencies have developed most of the groundwater and surface water supplies in the state. Nearly 600 cities and local agencies provide water through locally developed projects and imported supplies. More than 300 water districts, some private and some cooperatively owned and managed, serve the water needs within their geographic areas of operation. The Central Valley Project (federal) and the State Water Project

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transport captured river water generally from the northern part of the state to central and southern areas for agricultural and urban and commercial purposes. These two projects also provide hydropower, flood management, and recreation.

California has had sufficient water resources to meet most, but not all, of the demands of its present population and, until the past two decades, most of the demands associated with its agricultural and manufacturing industries producing both for in-state and export consumption. But, in periods of multi-year drought such as the late 1980's and early 1990's this has not been the case. Furthermore, the water supply has been inadequate to meet the known environmental needs let alone those that are only now being identified in wet, normal, and dry years. A comparison of California's water balance (water entering, water leaving, and changes in storage) for a wet, average and dry year highlight the precarious nature of California's current water balance (Exhibit 1).

II. The Situation

Major Issues

The current and upcoming issues concerning California's water can be summarized as follows:

1. The water available in a normal year is no longer sufficient to meet all the demands. Underground aquifers are being overdrafted and farmlands are being fallowed or retired as agriculture, the largest consumer, relinquishes water to other users in increasing amounts. Furthermore, estimates of reservoir capacities, and therefore captured water, are believed to be overstated. These capacities were established many years ago at the time of construction and unknown but significant silting has taken place in several of these facilities.
2. An unknown, but substantial amount of water will be required even to partially restore the major ecosystems and repair the environmental degradation that has occurred over the years by the diversion of water from one locality to another. Where this water will come from in the future and who will pay is not entirely clear, but agriculture has been the major provider to date.
3. The ability to capture, store and transport water from one part of the state to another is limited by an antiquated and inadequate infrastructure and, in drought years particularly, it is evident that this inadequate infrastructure is not only adding to the unreliability of supply, but limits the possibility of transporting additional supplies that water markets can generate.
4. Since the system is already inadequate, the expected population growth in the state over the next 25 years requires that planning and actions must move

ahead now if the added water needs are to be met and other shorter term needs are to be addressed.

5. There are many partial remedies known and in use that can play a role in alleviating a portion of the imbalance between water available and the perceived needs, but a combination of institutional barriers, political forces and lack of incentives appear to be blocking more widespread adoption.
6. In the absence of market price-setting mechanisms and full-costing of developed water to establish economic values of water in various uses, and the presence of numerous governmental and quasi-governmental agencies fixing prices, the necessary signals to allocate water efficiently and induce capital investment that can add to the supply are lacking.

Achieving solutions to the many controversial facets of the “water problem” in California has proven to be a difficult, time consuming and challenging process. Changing provider and user group perspectives and behaviors with respect to water supply and use requires education, demonstration and functional economic incentives. Political processes are involved at all levels in the water decision milieu and such processes take time to develop the consensus required before changes can be made. Infrastructure revisions and additions take years to plan, gain approvals, finance, and construct. Physicists refer to such variables when they are found in the physical world as “slow variables”, a term which describes accurately the nature of many of the variables in the world of water development, transportation and utilization. If there were true economic indicators of the value of water in various uses would these variables be quite so “slow”?

Water Management, Politics, and Pricing

Those who manage this resource are challenged with the need to balance the limited, and variable, water supplies for various uses. Looking ahead, some of the specific challenges requiring astute management of water in California are population growth, reduced allocations of water from the Colorado River, groundwater overdraft, contamination of surface and ground water, ecosystem degradation, constraints on inter-regional deliveries, providing a reliable supply for food production, and the mandate to provide the people of California with an adequate supply of clean and safe water for domestic and industrial use.

Until the mid-1900’s, construction of new water supply infrastructure was the primary approach to securing more water to meet the variety of demands. As opportunities for additional storage construction became fewer (and increasingly expensive per acre foot of water captured) and public opposition to interrupting natural flows intensified for a variety of reasons, attention turned to other management strategies. Water conservation, water recycling, water transfers, groundwater/surface water conjunctive use and storage programs, increased efficiency and productivity in use of existing infrastructure elements, and desalinization have been relied on by managers to meet their needs with some, but

not total, success. And, the debate over providing additional infrastructure, intense and emotional, continues.

Water quality has generally been good but specific areas are, or soon will be, facing serious water quality problems. Water treatment and distribution can provide for those uses demanding the highest quality. But, all uses do not demand the same high quality. Once this has been more widely understood and accepted, current available supplies of water of various qualities can be used to serve an increasingly broad spectrum of needs. For example, reclaimed water from modern treatment facilities is adequate for a range of purposes such as maintaining landscaping, washing automobiles, supplying wetlands and other ecosystems requiring water. Investing in distribution facilities has been the primary barrier to expanded use of reclaimed water.

In considering reasons for, and possible solutions to, nearly every aspect of the “water problem”, it is striking that so little attention has been given to the real value of water in all uses and the role of market prices as signals of value. Since the country was founded, water management in the U.S. has been dominated by government decisions concerning agriculture, water rights, transportation, hydroelectric power, manufacturing and drinking needs. Where water has been abundant, it has most often been considered a “free” good in spite of the fact that it is vital to plant and animal survival. Most, but certainly not all, of the infrastructure has been government financed (state and/or federal) and controlled and designed to move water from where it is abundant to where it is needed to support agriculture and urban needs. At the time of these developments, water was considered to be abundant and the supply was renewed on a regular basis. Furthermore, it was public policy to establish prices for such water to users (or their agents) that did not reflect the full cost of developing, storing, transporting and distributing the water. As a result, water has been historically under-priced and under-valued. Over time this has created significant differences in what water is worth in its various uses and what is paid by those who benefit from its use. In recent years as supplies have fallen further behind demands and new claimants have come on the scene, the lack of meaningful market prices reflective of relative values has rendered prices less effective than they could be in allocating this valuable resource among a wide range of uses.

California, as other states, governs water within its boundaries, through a complex array of agencies (Exhibit 2). A number of federal agencies are also deeply involved in management of water in California (Exhibit 3). State laws and regulations define the rights of private parties and government entities to use the water. “Appropriative” and “riparian” rights govern allocations and, while the water must be beneficially used, *allowable withdrawals are generally not priced*. The California Water Code and a substantial body of state and federal law related to water use and protection outlines the rights and some of the responsibilities of users. Publicly owned systems are subject to the oversight and competing interests of county, city, or regional governing boards, water authorities or commissions.

Considerable dissatisfaction, if not distrust, prevails among all parties to the many rulings and decisions that are promulgated in the bureaucracies that govern water issues. As a consequence, those outside the processes, but who are directly affected, have developed

mechanisms to exchange views, work out ways of minimizing adverse impacts and possible long term damages, and coming to informal, but powerful agreements on how they will conduct their affairs in response to decisions of the agencies. One such organization has for several years been a strong force in focusing very divergent views toward rational responsive behavior in the face of difficult governmental edicts and actions.

The institutional character of the water management sector and the influence of governments have given the water sector deep political roots and few economic norms. Prices have often been set on the basis of some estimate of “ability to pay” or partial cost of developing and delivering water to the customer. Some changes in prices have resulted from trying to meet the needs for more water to correct identifiable ecological damages. Increasing recognition of externalities associated with water use and movement has further complicated pricing in a market context. These practices have impeded the development of a market pricing mechanism capable of imparting the type of information that can lead to value-driven allocations and guide future investments toward augmenting supplies. In short, water is not widely viewed as yet another commodity to be traded in a market sense.

In the short run, it is unrealistic to anticipate the emergence of a true market for water that yields prices for water used in different ways that approximate the value that water imparts to each end-product. It is equally unrealistic to expect general acceptance of the practice of “full-cost” pricing of water in all uses. Many believe that until both are approximated, a near optimum solution to California’s “water problem” can never be attained. However, it is possible that some water pricing at the margin in agricultural uses could foster the development of regional markets, particularly where there are many transactions during a season. This is most likely to occur in a location such as Westlands Water District.

In preparing this paper, several participants in this group were asked what they considered to be major issues in the current water situation in the state. While expressed in a number of different ways, several spoke of the need to have market derived prices before we can identify the misallocations among present uses, determine the amounts that can be expected to be traded among competing uses, and provide signals concerning what levels of investment might be required to facilitate a functioning water market.

III. Increasing Water Supplies

Over the past several years we have all seen a number of efforts to improve California water supply conditions. When it seemed unlikely that additional storage would be forthcoming, the focus shifted toward making existing supplies go further by instituting a variety of conservation and technological practices and communication and education programs to induce changes in water use. There has been little evidence of considering water pricing to achieve changes in usage and reallocation. Concurrently, demands increased for additional water to improve ecosystems damaged by earlier alterations of natural flows and to allocate water to meet a range of new needs. The environmental

movement was a significant force in (1) slowing or shutting down any new attempts to develop new dams or other means of adding to supply, while (2) promoting diversion of water already committed to other uses, primarily agricultural, to improving ecological conditions on many of the waterways considered previously damaged.

Water Conservation

It has long been reported that the agricultural sector used from 75 to 80% of the state's developed water supply. "Developed water" includes surface sources (CVP, SWP, other federal projects, Colorado River and local projects) and groundwater sources (excluding overdraft). It does not include required environmental flow and reapplied water. In terms of total supply, agriculture uses about 43%, the environment 46% and urban 11%. Great strides in irrigation technology, including greater sophistication in monitoring plant needs for water, have reduced the input of water per irrigated acre on a wide variety of crops, primarily tree and vine crops and, to a lesser extent, row crops. Drip irrigation and low-flow sprinkler systems have been installed extensively. There are still a large number of farms in the state that flood and furrow irrigate indicating that the water is available and priced sufficiently low that investment in conservation technology is not attractive.

Improving the efficiency of delivery of irrigation water to districts and farms and on-farm distribution has resulted in substantial conservation by reducing seepage and evaporation. It is estimated that for every \$1 spent on maintaining an existing canal lining, a return of up to \$10 in conserved water can be achieved. And a \$1 spent on modernizing a distribution system can be expected to return \$3 to \$5 in conserved water. Concreting ditches, stopping leaks at transfer points, and avoiding overflows and flooding are the primary methods of achieving this type of conservation. Opportunities for additional applications of these techniques are numerous and several more are in the planning stages.

California farmers have been reducing irrigation runoff and recovering and using tailwater for well over three decades. Given the fact that irrigation drainage water accumulates naturally occurring and added chemicals, its reapplication on crops is often limited until it undergoes some type of reclamation. Historically, this water was typically allowed to enter some type of natural or constructed drainage system either to find its way into the major waterways or seep into the ground. Concerted efforts have been made to stop contaminated drain water from entering the ecosystem and either finding ways to use it productively or improve its quality. The Kesterson drain, a key element in the Central Valley Project designed to transport drain water from much of the Westside to the Bay-Delta, was only partially completed because, while under construction, it was discovered that the drainage water contained dangerously high levels of selenium leached from the soils when irrigated with traditional flood and furrow practices. Irrigation practices were modified and a number of projects were quickly initiated to find ways of removing this toxic element (when concentrated) from the drain water. While some isolated improvements were achieved, retiring land high in selenium from irrigated

agriculture became the primary remedy. It took many years to arrive at this conclusion. Undervaluing of water, crop subsidies, federal control, failure to complete the drainage project, engaging in a long series of political and legal processes, and failure to fulfill commitments to supply water to agriculture in some years were all factors that delayed this solution. To date, about 300,000 acres are reported purchased. Federal agencies with some assistance from Westlands Water District made the purchases. The water allocation to the District was not reduced as a result of this acreage removal.

The claim is popularly made that the most environmentally sound source of water to meet California's future needs (including water for environmental restoration) is the water currently being wasted in every sector of urban use. It is estimated that approximately 20% (about 7 million acre feet) of the state's water is used to meet commercial, industrial, institutional, and residential needs each year. Those making this claim argue that California's urban water needs can be met into the foreseeable future by reducing water waste through cost-effective water-saving technologies, revised economic policies, appropriate state and local regulations, and public education.

Their estimate is that one-third of California's current urban water use – more than 2.3 million acre-feet – can be saved with existing technology. They further argue that at least 2 million acre feet (85%) can be saved at costs below what it would cost to tap into new sources of supply. Estimates of current urban water use in California and the potential to reduce this use cost-effectively by the urban sector (Exhibit 4) are of a magnitude that brings into question the barriers that would have to be overcome and the incentives that would be required to achieve these levels of saving. They claim that with no further technological improvements, almost 40% of the 2.3 million acre-feet potential saving can be achieved by replacing the remaining inefficient toilets, washing machines, showerheads, and dishwashers, and by reducing leaks.

An effective water management tool – water metering – has been in use in many communities in California for decades, but there are still a number of cities, particularly in the Central Valley, that retain an essentially communal system. This system provides users little incentive to conserve water. In fact, per capita water use in Central Valley cities with communal water systems is much higher than in cities where water is metered. There is no incentive to conserve when water has zero cost at the margin.

Several cities in the Central Valley, including Fresno and Bakersfield (the second and third largest), meter a small percentage of their service connections and many smaller cities meter all service connections. Sacramento's preference is for the communal system. Its city charter specifically forbids residential water service meters. Of a sample taken in 2000 of 59 urban districts in the Central Valley, 27 are fully metered, 10 have no residential meters, and 22 have some of their residences on meters. Where metered, water cost for residential water was about one-third higher while use was 25% less per residence on the average.

Recycling

Recycled water has been used for many years in California. There have been periodic concerns raised concerning the health risks in some uses and localities. It is estimated that recycled water use is currently about 500,000 acre-feet. It is used mostly for irrigation, landscaping, groundwater recharge, and industry. The use of recycled water has doubled in the period 1987-2000, particularly for groundwater recharge, landscape irrigation and industrial uses (Exhibit 5). Its use for agricultural irrigation has dropped from 60% to less than 30% of the total recycled water use in California.

A recent state multi-agency sponsored task force report sees an increase to 2 million acre feet as being feasible. It also sees recycling as one important part of the solution to meeting increased water needs. This would free up enough potable water to meet 30 to 50% of the domestic water needs of the population growth expected by 2030. For this to happen, more information on the public health concerns must be developed, recycling projects need to be designed and built, and standards for indoor use of recycled water and dual plumbing would be required.

Capturing New Sources

In recent years, as the search for additional water to meet growing demands intensified, the capture of water, heretofore disregarded as a possible useful source, has been rediscovered. One such source is urban runoff that has found its way into storm drains, small creeks and drainage ponds. Untreated, this water is being substituted for potable water in many local uses such as those described for recycled water. In some cases, the quality of this water may be higher because of its source and place of capture. Some localities have treated this type of water and augmented their potable water supply. Local reservoirs fed by springs or small uncontaminated watersheds often collect water fit for human or animal consumption directly or after chlorination. These supplies typically are one component in a local water supply system.

Searching for such capturable sources has been and continues to be a popular approach to augmenting local urban water supplies. While much attention has been given to this practice in the recent past, it is not expected that this will become a major contributor to meeting the growing demands of the future.

Water Transfers

Through changes in place of use, water marketing options can relocate supplies from one hydrologic region to another. Through changes in type of use, water marketing options can reallocate supplies from one water use sector to another. For a given place and type of use, water marketing options can reallocate supplies among average and drought years. That nearly 80% of the developed water supply in California is, and has been for a number of years, going to agricultural uses makes it clear why transferring water from agriculture to meet the growing demands of urban growth has received so much attention

over the past two decades. The popular perspective has been that a transfer of only a small fraction of the water from agriculture to urban and industrial uses could easily meet the needs of a growing population for many years. During the two periods of drought in this same time period the idea emerged that agriculture could serve as the reservoir when urban supplies were temporarily short. And the idea that a market-based allocation system would result in more “efficient” use of water gained strength. Many were quick to embrace the naïve idea that the state was at the point of finding a simple answer to what was widely believed to be a complex problem.

Spurred by drought in the late 1980’s and the early 1990’s, the volumes traded in California’s water market accounted for roughly 3 percent of the state’s water use by 2001 (Exhibit 6). Agricultural water districts are the main suppliers, with Central Valley farmers typically accounting for three-fourths of all sales. In the San Joaquin Valley, where environmental mitigation programs have reduced water deliveries to agriculture, farmers have turned to the market for replacement water. Their purchases accounted for over half of the water market’s expansion between 1995 and 2001. The state has also been a major buyer to support environmental programs. Direct purchases for instream uses and wildlife reserves account for over one-third of the market expansion. Municipal agencies are the major buyers of long-term and permanent contracts, which account for roughly 20 percent of all sales. Recent legislation requires that local governments demonstrate adequate water supplies for development, and this policy should increase urban demand for long-term water transfers.

The Drought Water Bank of 1991 and 1992, managed by the DWR, demonstrated that water transfers could be done. The opening offering price of \$125 per acre-foot set by the state brought forth a surprising number of willing (even eager) sellers. The selling price of \$175 did not attract as many buyers. In the decade since that early experience, DWR has been involved in more than 400 water transfers. Most early transfers were carried out between customers of a specific water supplier and were for a single season. Experience with long term contracts is very limited though interest in long term contracts is growing rapidly. The question of oversight on such contracts is not fully resolved, but recent experience underscores the critical necessity to consult widely with local and county governments with respect to the inevitable economic dislocations that are likely to occur.

When transfers are local in nature and involve a specific water supplier, transaction costs are less, there is more certainty over keeping water rights, uses are likely to be similar (agricultural), transport of water is usually easier to achieve and third party effects are less likely. Where many trades take place within a district such as Westlands, the market can be handled inexpensively and efficiently by computer.

The criteria and procedures governing transfers were developed as transfers were being proposed and decisions being made. Based on this early experience, the conclusion was that every deal is unique and must be evaluated separately, recognizing some common principles. Water for transfer must be “new” water (water not previously available in the system). It also must be “real” water (not derived at the expense of any other lawful water user). And it cannot be “paper” water (water proposed for transfer that does not

create an increase in the water supply – water the seller is legally entitled to use under a water right or service contract, but that has not been historically used).

It also became clear that every evaluation required some degree of informed judgment about hydrologic reality and that prospective sellers and those operating the Water Bank often had differing views of hydrologic reality. It is this difference that continues to give rise to most of the unresolved issues in what seems to be an evolving workable process. Unfortunately, it is these differences that give rise to most of the controversy concerning damages to other parties.

State law prohibits transfers that would have an unreasonable impact on fish, wildlife or other instream uses. There are a number of other concerns that govern transfers. Some water transfers have potential to harm the economies of areas from which water is transferred. For example, fallowing can have an adverse effect on local farm economies. Groundwater pumping can result in ground subsidence or higher pumping costs for other local users of the basin. No public agency facilities can be used in the transfer process unless a finding is made of no unreasonable impacts on the overall economy of the county from which the water is being transferred. No transfer can be made that would deprive areas of origin of water reasonably required to meet beneficial needs. Additional constraints apply to CVP water if it is shown that the transfer would have a long-term adverse effect on groundwater conditions in the transferor's service area. And transfers that would unreasonably impact water supply, operations, or financial conditions of the transferor's contracting district or its water users are considered unacceptable.

Since water transfer activity centers in the central valleys and CVP and SWP are under strict rules with respect to withdrawals from the Delta and its tributaries, any errors that are made in water transfers are absorbed by these entities in the form of required releases from Project reservoirs as needed to maintain specified water quality and flow criteria in the Delta. For example, to the extent paper water transfers reduce the flow of water available to meet Delta criteria, the deficiencies must be made up by release of additional water from federal and state reservoirs. In a period of drought when the reservoirs are not immediately refilled, significant water supply impacts may result. Federal and State water contractors have an interest in ensuring that transfers of Sacramento-San Joaquin basin water do not simply take water from the CVP and SWP without compensation and sell it elsewhere.

Experience shows that transfer proposals generally fall into one of six categories:

1. Fallowing land previously cropped and irrigated
2. Shifting to lower water-using crops
3. Substitution of groundwater for surface irrigation supplies
4. Direct delivery of groundwater
5. Conserved water
6. Releasing water from reservoir storage

Experience further indicates that if water transfers are to play a meaningful role in California's water future, there are still critical policy issues to be resolved. Some of the more obvious are:

1. Will water marketing stimulate water use that would not otherwise take place? If people are paid to stop using water, will there be sellers who start using as much water as possible to establish a higher base level of use?
2. The problems that will arise from the failure to recognize the interrelationship of surface and groundwater are not resolved.
3. How can uncontrolled "mining" of the aquifers in many rural areas be avoided?
4. Every transfer affects a number of public entities and private parties. How can we be assured that all interests are protected?
5. Water conservation accomplishments must be evaluated realistically, from a system perspective. Transfers of water made available through conservation should be undertaken only after thorough analysis of the effects on other water users and environmental values.
6. The transfer prices have been set by an agency of the state government since the inception of the program. Looking forward, shouldn't there be serious attention given to developing a real market where prices reflect agreements between buyers and sellers? Certainly there is need for a thorough review by the appropriate governmental agency to assure that damages to others, the environment, and the water resource meet stated limits.
7. The transfer price needs to reflect the true value of the water (including full cost of transfer, any damages imposed, etc.)

The key issue that has emerged during the review and approval process for transfers is "How conclusive must the proof be that other parties' rights will be protected?"

A one-year transfer completed in February 2003 by Metropolitan Water District (MWD) in Northern California highlights a number of the issues raised above. The first action was to exercise option contracts entered into with three Northern California water districts to purchase 97,000 acre-feet of water. It then exercised options on 50,000 acre-feet with an additional ten water agencies in the Sacramento Valley. MWD paid \$100 per acre-foot for the transferred water and an additional \$5 per acre-foot to be dedicated to third party impacts. Most of the water comes from the fallowing of rice ground, which typically uses 3.3 acre-feet per year, yielding \$330 per acre of idled rice ground. This transfer will result in the idling of over 40,000 acres of rice land in the Valley.

Proponents of the one-year sale argue that with a depressed farm economy, growers will be able to earn more revenue by idling land and selling water. Some view the water transfers as a way of protecting their water rights by invoking statutory protections and asserting property rights over their resource by selling it.

Opponents to these transfers are wary that these one-year water sales are just the beginning and fear a more permanent and substantial grab for Northern California water by urban Southern California. Allied businesses and local governments and school districts fear the impact of both short term and long term sales, based on land fallowing, as leading to severe stress on their revenues and tax collections. This purchase/transfer is not complicated, but it demonstrates the impact of this process on the local communities involved.

Underground Water Storage

Groundwater accounts for about 30 percent of California's urban and agricultural water applied, and up to 40 percent in a drought year. One in three Californians rely solely on groundwater to meet their needs. The amount of water stored in California's aquifers is far greater than that stored in the state's surface water reservoirs, although only a portion of California's ground water resources can be economically and practically extracted for use with current prices and technology. In average rainfall years, Californians use more groundwater than is replaced by precipitation, stream seepage or artificial recharge programs. Annual statewide overdraft is estimated by DWR to be about 1.6 million acre-feet in a normal year. The long term impacts are lowered water tables and increased energy costs for pumping, possibly land subsidence and shrinking of the holding capacity of the aquifer, and in some basins, seawater and other contaminant invasion.

Joint or "conjunctive" use of surface and underground water supplies to reduce the overdrafting has been practiced only to a limited extent, primarily because of the widespread fear that groundwater management by a governmental or quasi-governmental body will lead to additional control over ground water use. This approach is unacceptable to those who consider groundwater a property right of overlying landowners.

Underground storage using a recharge program represents a way of holding water in years of excess supply and drawing on the stored water in years of less than normal supplies. Kern County Water Bank is one significant groundwater recharge program in California. Department of Water Resources (DWR) managed the program in the beginning but transferred the responsibility to the local water agencies in 1996. Available surface water from the SWP, CVP, or Kern River is purchased by the six participating water agencies to recharge depleted aquifers and shallow ponds. By mid-1998, over 700,000 acre-feet of water had been recharged. Like a traditional savings account, water deposited into the water agency can be withdrawn as needed. It is estimated that there is sufficient capacity to store about 1 million acre-feet of water in the facility.

Texas and California are the only remaining Western states that do not have a comprehensive statewide groundwater management system. There are some adjudicated basins and some regulation exists in some local districts in California, but generally there are no controls in California over extraction. Yet, there are almost 70 water agencies in

the state operating groundwater recharge programs. Their success seems to turn on their ability to purchase surface water from other users.

Desalinization and Advanced Water Treatment

Desalinization has been held out as the ultimate solution to the world's water woes. More than 97% of the water on the planet is too salty to drink or grow food. In theory, therefore, desalination offers a limitless supply of freshwater, "freeing humans from the vagaries and inconsistencies of natural freshwater supplies". Yet desalinization remains a minor contributor to the water supply except in extremely water-short countries with substantial energy or economic resources. Six of the ten desalinating countries are located in the Arabian Gulf and North Africa regions.

Desalination is technologically well developed, but remains hindered by high economic costs because of the large amounts of energy required to strip salt ions from water. In addition, the high cost of moving water from one place to another further constrains desalination developments to areas with a limited distance from the coasts.

While desalination cannot yet be considered an economically viable solution to California's urban, let alone agricultural, water shortages except in very special cases, its cost has dropped from nearly \$2000 per acre foot several years ago to less than \$1,000 in recent years. An expanded federally funded research program is anticipated in the near future. Several California coastal communities, including San Diego, have looked seriously at constructing a plant. If water were to become priced nearer its value in all uses, desalination would become a competitive alternative to several other water sources for cities near seawater, brackish water, or impure industrial wastewater.

Advanced water treatment typically employs reverse osmosis water treatment technology to upgrade otherwise non-potable water for human consumption. This process employs an advanced filtering technique capable of successfully removing even microscopic impurities from all types of industrial and other wastewater. A stumbling block to wider use of such treated water, as with recycling, is the lack of public trust over science's ability to clean wastewater to the point of potability.

IV. Forging New Agreements

CALFED

This organization is the outgrowth of a long period of concern and inaction with respect to protecting and enhancing the ecological quality of the Sacramento-San Joaquin Delta. In 1995, the California Water Policy Council, speaking for the state's multiple water agencies and a similar body representing a host of U.S. agencies, known as the Federal Ecosystem Directorate, came together as CALFED. It was (politely) described at the time as a "collection of federal and state agencies with their own responsibilities and authorities trying to work together to improve efficiency". This move was essential to

stop the infighting and unproductive competitiveness that was impeding progress on dealing with the deteriorating Delta area.

Its first assignment was to devise a long-term plan for saving and restoring the estuary. The targeted issues were water quality and supply, fish and wildlife, endangered species, and levee protection. A thirty-one member Bay-Delta Advisory Committee was formed composed of representatives of all interests with a stake in the estuary's future. This addition reflected the desire not to repeat the disastrous last attempt to deal with the same problems – the divisive Peripheral Canal proposal of 1982.

Its first action was to announce the interim water-quality standards known as the Bay-Delta Accord. For the next several years, as hard as the group tried to advance plans that would meet the objectives, the historical battles between the northern and southern interests, farmers and urbanites, environmentalists and farmers never subsided and every plan that was put forth was met by both strong support and strong opposition. This group put together a carefully crafted pair of bond issues which were passed in March 2000. Much of the earlier conflict was avoided by omitting any reference to construction of large dams or reservoirs. Agricultural interests objected to this omission. The emphasis was on protection of neighborhood parks and rivers, clean air and water, conservation programs, and plans for banking water in underground aquifers that were expected to increase current supplies by a million acre-feet.

In June 2000, *California's Water Future: a Framework for Action* was released by CALFED. This was an ambitious plan that contained something that each faction wanted, including plans to increase groundwater storage, in-delta storage, and for raising Shasta Dam and Los Vaqueros Dam, and storing surface water within the levees of the delta's islands. It also called for ecosystem protection, creating an Environmental Water Account, purchasing and retiring some poor quality farmland in the San Joaquin Valley to free good quality water for other uses, moving responsibility for groundwater management from the local to the basinwide level, checking waste water discharges in communities without meters, obtaining additional money for watershed protection and restoration and money for improving and maintaining the delta levee system. The total cost for the first seven years of activity was estimated to be between \$8.7 and \$10 billion. It also called for "studies" related to a number of controversial issues such as off-stream reservoirs and a very modest substitute for the earlier defeated peripheral canal proposal.

In a few short months serious opposition coalesced and it was apparent that the conflicts and issues that had been needing resolution for years were not going to be resolved by CALFED. As a result, Congress failed to reauthorize funding for the organization leading to growing stagnation and the loss of funds to carry out environmental restoration and other features of the program. In 2003, renewed interest in jumpstarting CALFED emerged in both houses of congress as members of the California delegation were intent on "fixing" California's current and future water problems. In January 2004, California's Governor Schwarzenegger called on the federal government to support the legislation authorizing formal federal participation in the new CALFED Bay-Delta program and to provide needed funding. Supporters of CALFED consider this to be the largest program of environmental restoration in American history.

Colorado River, Imperial Irrigation District and San Diego Water Authority Agreements

The Colorado River supplies much of the water to the southwest of the United States, including California's southern coastal plain. Six other states share in Colorado River water, but California's allocation has always been the most controversial – and largest (Exhibit 7). In 1997 following federal actions reducing California's allocation, a plan was drafted by California's Colorado River Board that would lessen California's dependence on Colorado River water. This plan was never finalized, but in 2000, after nine months of hard negotiations among the seven states taking water from the Colorado and the Department of Interior, an agreement was reached that California would be required to limit its annual withdrawals to the 4.4 million acre-feet it was entitled to by earlier agreements. It was given 15 years to adjust down to this level from the 5+ million it was withdrawing regularly.

California had been able to withdraw an additional 1.1 million acre feet each year primarily because neither Nevada nor Arizona was using its full allocation. Urban growth in both states triggered action to protect and more fully utilize its allocation. This event forced additional serious pressure on all recipients of Colorado River water in Southern California, particularly on Metropolitan Water District, to seek out and solidify alternative sources including transfers from Imperial Irrigation District (IID).

The Coachella Valley Water District, the San Diego County Water Authority, the Imperial Irrigation District, and the Metropolitan Water District of Southern California engaged in protracted negotiations for water transfers. A prior agreement between IID and MWD delivered water to the latter in exchange for MWD paying for lining the major canals that were delivering water from the River to IID.

During the negotiations some reluctance on the part of IID surfaced over a number of issues. Potential socioeconomic impacts of fallowing land, what credit for water created by fallowing would be given, how could IID be protected from charges by the Bureau over how irrigation water was being used, and how the potential impacts of the transfers on the Salton Sea would be paid for were four of the major concerns.

Both state and federal water officials set timelines for action and offered both carrots and sticks to achieve agreement. In September 2003, after eight years of negotiations, The Quantification Settlement Agreement was signed which, over a 15 year period reduces to 4.4 million acre-feet the state's annual draw from the Colorado River and transferred some water from farms to homes and businesses.

The key element in this agreement is a water transfer between IID and the SDCWA that represents a new supply of 12.9 million acre-feet for San Diego over the 75-year term of the agreement. In exchange for idling 20,000 acres of land, Imperial Valley will get \$258 for every acre-foot of water that is transferred to San Diego. In addition, the Valley will get \$10 million from San Diego to help ease the socioeconomic impacts on the region

and another \$10 million spread out over the next twenty years. IID will not be held liable for the ultimate fate of the Salton Sea and caps Imperial Valley's liability for damage to the Salton Sea at \$30 million. It is estimated that it will take \$1 billion to save the Sea and the farmers did not want to be put on the hook for this outlay.

This agreement will likely set the tone for future water policy negotiations throughout the West. In terms of overall water policy this agreement leaves more questions than answers. Farmers and environmentalists can still hold up the transfer, perhaps indefinitely should they get into legal arguments and wind up in court. The overlying question of water rights also remains unanswered. Clarification and sharper definition of water rights will help avoid the bitter and prolonged fights over transfers that have characterized the Colorado/ IID/SDCWA negotiations.

Four California agencies, the State of California, and the Department of the Interior finally signed the Quantification Settlement Agreement and related agreements concerning use of the Colorado River water in California, including the long-term water conservation and transfer agreement between the Imperial Irrigation District and the San Diego County Water Authority. One observer notes the agreements are "not a model of market transactions, but an early prototype". Progress was made but the political and legal transaction costs were astronomical.

The California Water Plan Update: 2003

The California Water Plan, updated by law every five years, "is accepted as the master plan which guides the orderly and coordinated control, protection, conservation, development, management and efficient utilization of the water resources of the state" [Water Code 10005 (a)]. Several important substantive and procedural changes have been instituted for this revision. Data will be developed that extend well beyond the limits imposed in previous updates. These data will allow a much more comprehensive analysis of all aspects of the Plan. An open and transparent process, wide sharing of draft assumptions and estimates, and broad public review and input at all stages in the updating process are also new approaches. A fairly fundamental reformulation of the process and content of the plan by DWR reflects new legislative requirements and advice from its committees. The new process uses a 65-member public Advisory Committee, a 260-person Extended Review Forum, and an outside facilitation team. The Water Plan Update is being transformed into an ongoing strategic planning process.

In place of the past updates, which have been static prescriptions to guide water managers and those involved in making state water infrastructure decisions for each upcoming five years, the Advisory Committee has concurred on a number of key features of Update 2003:

1. Create detailed state and regional "water portfolios" to more comprehensively describe water supplies, water uses, and water management decisions, while identifying underutilized opportunities and unmet challenges for all beneficial uses.

2. Describe current conditions of water supply, use and management with actual data from a wet, a dry and an above normal precipitation year rather than only a typical year.
3. Set up multiple ranges for key factors affecting water supply and use and water management options in order to create a variety of versions of the water future (Study Plans) as a means of getting a broader perspective on the impacts of various policy choices and broaden the choices.
4. Consider alternative futures and a variety of management options for the state *and its individual regions*.
5. Consider multiple hydrologies and planning horizons when forecasting alternative futures such as 2010, 2020, 2030, and 2050.

In addition, the Advisory Committee has identified global climate change as one of the factors that DWR should consider in Update 2003. DWR has agreed to include a comprehensive discussion on the potential impacts and implications of global climate change on California's water system infrastructure and future water supply, quality, and management, including short term and long term recommendations.

DWR reports holding meetings throughout the state to receive comments from the Extended Review Forum and the public on the draft assumptions and estimates on which the revised plan will be based. These assumptions and estimates are also available on a Web site. DWR and the Advisory Committee feel they are making good progress describing "where we are now" and "where we are going". They see the challenge ahead to be exploring "where we want to be" and "how we get there". The Work Plan for the Update 2003 is elaborate and ambitious, and its success as a policy guide seems to rest heavily on forging a consensus among the same groups that have been unable to reach few agreements in the past.

WATER 2025: Preventing Crises and Conflict in the West

In May 2003, the U.S. Department of Interior (DOI) announced a proposal to concentrate federal resources to support community solutions to the conflicts over water during the next 25 years even in the absence of drought. This proposal reflects the view that chronic water supply problems in the West are one of the greatest challenges facing the nation in the coming decades. It also aims to provide a basis for a public discussion of the realities that face the West so that decisions can be made at the appropriate level in advance of water supply crises. This proposal is apparently an outgrowth of the crises management experience in the Klamath River and Middle Rio Grande River basins where farmers, urban residents, Native Americans, and fish and wildlife have been affected by water shortages without any means of addressing strategically the problem of competing demands for a finite water supply. It also recognizes that over-allocated watersheds can cause crisis and conflict.

The DOI believes it should focus its attention and resources on areas where scarce federal dollars can provide the greatest benefits to the West and the nation. It sees the "new reality" as explosive population growth in western urban areas, increasing need for water

for environmental and recreational users, and the continuing national importance of food and fiber production from western farms and ranches.

This proposal addresses a number of issues in the water debate:

1. State, tribal, and federal water rights, contracts, and interstate compacts or Supreme Court decrees that allocate the right to use water must be recognized.
2. Existing water facilities are aging and need to be maintained and modernized in order to continue to provide water and power.
3. Water supplies need to be used more effectively by enhancing water conservation, use efficiency, and resource monitoring.
4. Collaborative approaches and market-based transfers need to be used to minimize conflicts.
5. Water treatment technology, such as desalination, needs to be improved to help increase water supply.
6. Existing water supply infrastructure can provide additional benefits for existing and emerging needs for water.

This proposal appears to have been developed quite independently of the update of the California Water Plan: 2003. Yet, it reflects most of the same concerns and recognizes the need for a revised approach. Timely planning and decisions and a broader base of discussion are essential in order to understand and meet the broader array of needs for water over the next several years. At the same time it is crucial to minimize excessive conflict leading to short term crises resolution or stalemate.

The proposal does not pretend to provide a complete solution to the complex water needs of the West and recognizes that the principles of federalism and fiscal realities make it clear these decisions cannot and should not be driven from the federal level.

V. WHERE ARE WE AND WHERE ARE WE GOING?

As one observer noted, “Since the days of Mark Twain -- who is said to have coined the phrase ‘Whiskey’s for drinking; water’s for fighting over’ -- cities, farmers and environmentalists have battled over who will control California’s water. The three powerful political factions have effectively turned the water issue into a stalemate by blocking one another’s agenda”.

A mix of large and small scale engineering projects and political compromises worked for many years to stretch a limited water supply to meet growing needs. But, as the distribution controversies intensify in the face of a growing population and intensified pressure to find water to meet a wide range of more clearly defined environmental needs, old approaches are not going to provide workable answers. Mark Twain’s famous phrase has been upstaged by a newer one -- “Decisions about water in California are too important to leave to governments and politicians”.

We have looked at the issues, the problems, the approaches and several available partial remedies that have surfaced. We have observed the emerging experiments with extensive communication and participation aimed at producing compromise among competing interests in California water. And, we have looked at selected current agreements for clues as to what the future may hold for California agriculture.

What we have not done is outline a strategy to satisfy the many competing demands for an essential commodity for which every person and organization has multiple uses but rarely has the opportunity to convey the value of that commodity in each of its uses. Therefore, those who supply water to various users seldom, if ever, have the opportunity to discover what customers are willing to pay for water for different uses. And some of the strongest current voices for more water are representing uses for which no real markets even exist.

The people of California, and particularly those directly involved in activities where water is a crucial component of their activity, whether a business or not, are living in a challenging time. All must search seriously for the answers to a number of questions related to water availability and use.

1. Is there a problem(s)?
2. What is the problem(s)?
3. Is there a single workable decision framework (e.g., economic, political, or legal) to guide public and private choices of action in the future?
4. Is there a workable mechanism(s) to reach a solution to a problem(s) identified even if we can agree on a framework(s)?
5. What is the solution(s)?

Exhibit 1

**STATE OF CALIFORNIA
STATEWIDE WATER BALANCE SUMMARY - MAF**

(See Volume 3 for Details)	1998 (wet)	2000 (average)	2001 (dry)
Water Entering the State			
Precipitation	329.6	187.7	139.2
Inflow from Oregon/Mexico	2.2	1.7	1.2
Inflow from Colorado River	5.0	5.3	5.1
Imports from Other Regions	N/A	N/A	N/A
Total	336.8	194.7	145.5
Water Leaving the State			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	19.7	24.9	25.2
Outflow to Oregon/Nevada/Mexico	1.5	0.9	0.7
Exports to Other Regions	N/A	N/A	N/A
Statutory Required Outflow to Salt Sink	61.4	38.6	21.8
Additional Outflow to Salt Sink	40.1	18.0	9.5
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	208.5	118.1	102.7
Total	331.4	200.5	159.9
Storage Changes in State			
[+] Water added to storage			
[-] Water removed from storage			
Change in Surface Reservoir Storage	7.1	-1.4	-4.6
Change in Groundwater Storage **	-1.7	-4.4	-9.8
Total	5.4	-5.8	-14.4
Applied Water * (compare with Consumptive Use)	33.8	41.2	41.2
* Definition - Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.			

Water Entering the State – Water Leaving the State = Storage Changes in State

****Footnote for change in Groundwater Storage**

Change in Groundwater Storage is based upon best available information. Basins in the north part of the State (North Coast, San Francisco, Sacramento River and North Lahontan Regions and parts of Central Coast and San Joaquin River Regions) have been modeled – spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and year 2001 were calculated using the following equation:

$$\text{GW change in storage} = \text{intentional recharge} + \text{deep percolation of applied water} + \text{conveyance deep percolation} - \text{withdrawals}$$

Source: “California Water Plan Update 2003”, California Water Today, January 2004

Exhibit 2

State Government Agencies Roles in Water Management
<ul style="list-style-type: none"> ▪ State Water Resources Control Board – Regulates California’s water rights and water quality ▪ Regional Water Quality Control Boards – Protects surface, ground and coastal water quality ▪ Department of Water Resources – Operates the State Water Project and is responsible for overall water planning ▪ Department of Health Services – Oversees state program – Oversees programs to protect and improve the health of all Californians– Regulate and permit drinking water ▪ Department of Fish and Game – Regulates and conserves the state’s wildlife ▪ Reclamation Board – Plans and controls flooding along the Sacramento and San Joaquin Rivers and their tributaries in cooperation with the U.S. Army Corps of Engineers ▪ Department of Food and Agriculture – Supports California’s agricultural economy ▪ California Environmental Protection Agency – Restores, protects and enhances the environment, to ensure public health, environmental quality and economic vitality ▪ Delta Protection Commission – Responsible for preparation of a regional plan for the “heart” of the Delta ▪ Colorado River Board - Protects California’s rights and interests in the resources provided by the Colorado River ▪ California Bay-Delta Authority – Develops and implements a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the in the Bay-Delta ▪ Department of Pesticide Regulation ▪ Department of Toxic Substances Control ▪ California Integrated Waste Management Board

Exhibit 3

Federal Government Agencies Roles in Water Management
<ul style="list-style-type: none"> ▪ Bureau of Reclamation – Federal water supply projects, Secretary of Interior is watermaster on Colorado River ▪ USEPA – Protecting human health, safeguarding the natural environment ▪ Fish and Wildlife Service – conserve, protect and enhance fish, wildlife, and plants and their habitats ▪ U.S. Geological Survey – Water measurement and water quality research, biological surveys ▪ NOAA Fisheries – Protects and preserves living marine resources, including anadromous fish ▪ Bureau of Land Management – Manages federal lands ▪ National Park Service – Manages national parks, including their watersheds ▪ Department of Agriculture – Manages forests, watersheds, and other natural resources ▪ U.S. Army Corps of Engineers – Flood management and wetlands permits ▪ Western Area Power Administration – Manage power generated by the Central Valley Project

Source: “California Water Plan Update 2003”, California Water Today, January 2004

Exhibit 4

California Urban Water Use by Sector	Current (2000) Water Use (AF/year)	Best Estimate of Conservation (AF/year)	Potential to Reduce Use (%)	Minimum Cost-Effective Conservation (AF/year)
Residential Indoor	2,300,000	893,000	39	893,000
Residential Outdoor	983,000 to 1,900,000 (b)	360,000 to 580,000 (c)	25 to 40	470,000
Commercial/ Institutional	1,850,000	714,000	39	Combined CII: 658,000
Industrial	665,000	260,000	39	(e)
Unaccounted-for Water	695,000	(d)	(d)	(d)
Total	6,960,000 (+/- 10%)	2,337,000	34	2,020,000

Source: Glick, "Waste Not Want Not: The Potential for Urban Water Conservation in California", Environmental Center, 2003

Exhibit 5

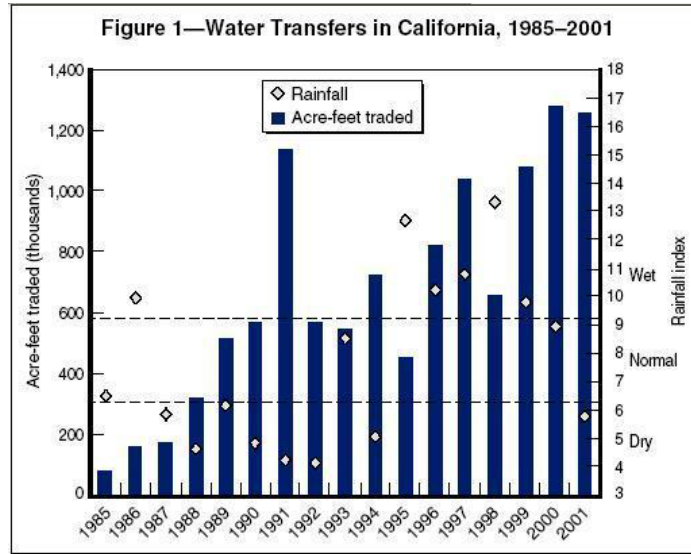
Table 1. Use of Recycled Water in California by Category

	1987	1989	1993	1995	2000*
Agricultural Irrigation	207	213	99	179	201
Groundwater Recharge	48	86	228	150	167
Landscape Irrigation	49	67	58	94	141
Industrial Uses	7	7	9	36	40
Environmental Uses	12	22	36	19	20
Other	5	5	44	76	77
Total	328	400	474	554	646

*Estimated. Amounts in million cubic meters. Source: Wong, 1999.

Source: Changing Water Paradigm", Water International, Vol. 25, No.1, March 2000

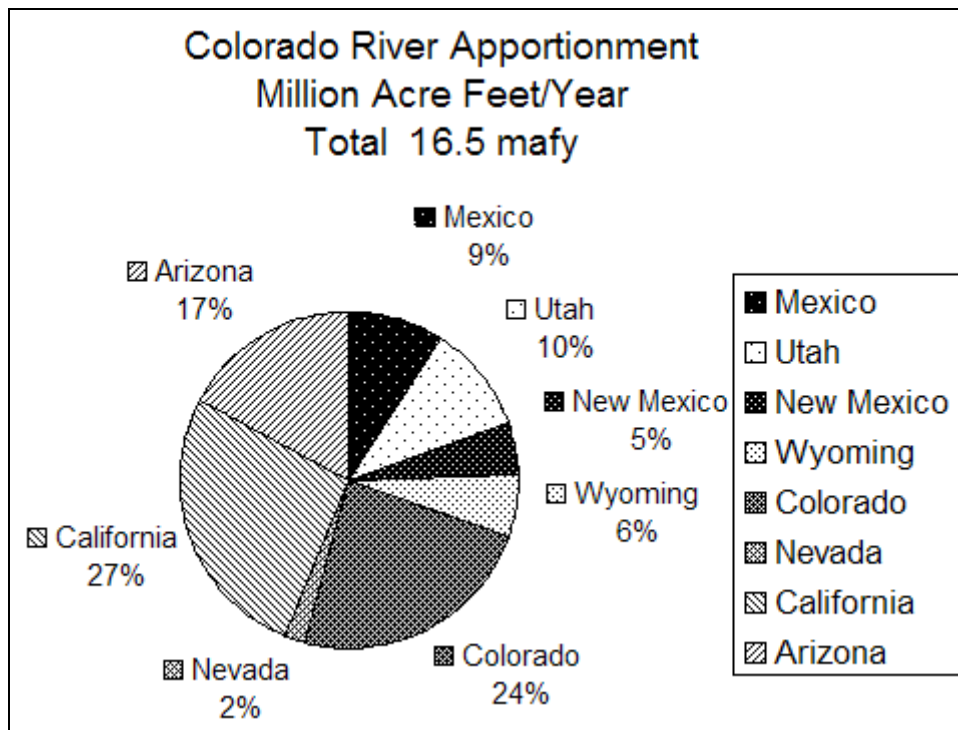
Exhibit 6



Aided by several dry years, California’s water market was established when the state began purchasing water and launching water banks in the late 1980s and early 1990s.

Source: “Managing California’s Water Market: Issues and Prospects”, Institute of California, July 2003

Exhibit 7



Source: CALFED Website

