

California's Water Market, By the Numbers

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1. Introduction

The development of a water market has become a key component of California's water policy. A market permits the temporary, long-term, or permanent transfer of water from the existing rights-holders to other water users. These rights generally have been appropriated for many decades under the state's "first in time, first in right" legal system. In an era when pricing has been advocated as a solution to a wide range of resource allocation issues, water transfers are seen as a way of adding flexibility to the state's water supply—both to address temporary drought conditions and to accommodate longer term changes in the pattern of demand.

The first policy document to advocate transfers as a part of California's water future was the 1978 report of the Governor's Commission to Review California's Water Rights Law. The commission also advocated a number of changes in the Water Code to facilitate transfers, notably provisions to ensure the security of water rights for transferring parties and access to the use of conveyance facilities owned by third parties. Although many of the recommendations were accomplished in the years that followed, the 1980s saw little uptake in market activity.

In the early 1990s, several events significantly changed the trading climate. First, natural conditions provided the occasion for a large-scale experiment in water trading when a multi-year drought prompted the state to initiate an emergency water bank in 1991. The following year, in response to findings that the federally run Central Valley Project (CVP) was having deleterious effects on the indigenous wildlife of the San Francisco Bay-Delta water system, the U.S. Congress passed the Central Valley Project Improvement Act (CVPIA). The CVPIA mandated that 800,000 acre-feet of project water (of a total of 7 million) be returned to instream uses to regenerate salmon runs. The CVPIA also contained provisions to facilitate water marketing and introduced a mechanism for the project to purchase additional water, if needed, for environmental purposes. In 1994, contractors of the State Water Project (SWP) concluded negotiations for the "Monterey Agreement," which included a number of measures to make it easier for contractors to transfer water to one another. In 2000, state and federal authorities launched the Environmental Water Account (EWA), a program of water purchases for the environment under CALFED, a multi-agency state and federal program to restore health to the fisheries of the Bay-Delta system while securing water supplies to agricultural and urban users.

The purpose of this paper is to document the evolution of the water market in response to the new trading environment. It draws on a new set of data developed by the author from a variety of state, federal and local sources

on individual water transfers from the early 1980s to 2001. The data allow an analysis of volumes transferred by duration, region of origin and destination, initial and final use, type of transacting party, and affiliation (if any) with the large state and federal water projects.

2. Tracking the Water Market: Data Sources and Caveats

Monitoring the statewide water market is made easier by the fact that many transactions involve state or federal authorities in at least one of two ways: as direct purchasers (as in the drought water bank and the environmental programs) or as approvers of transactions among other water users. The State Water Resources Control Board (SWRCB) must approve transfers (changes in purpose or place of use) involving water rights established from 1914 onwards, the year the state’s “modern” Water Code was passed by the legislature. Transfers among contractors of the federal and state water projects, while generally not requiring SWRCB approval, must be authorized by the projects themselves, as the ultimate rights-holders. Finally, two other types of water which can be transferred without SWRCB approval—water held under “pre-1914” appropriative rights and groundwater—come under state or federal jurisdiction if either party’s conveyance facilities are involved, which is likely to be the case in most parts of the state.

Although these agencies only recently developed a policy to pool data and monitor transactions collectively,¹ it was generally possible to reconstruct past transfer activity.² The full range of federal and state sources was tapped: the SWRCB, the California Department of Water Resources (DWR), the U.S. Bureau of Reclamation offices for the Central Valley Project and the Colorado River Project. For transactions falling outside of state or federal jurisdiction, the primary source used was the private publication, *Water Strategist*, and its forerunner, *Water Intelligence Monthly*, which track water markets in 14 western states. For the early years, an additional source was Lund, Israel, and Kanazawa (1992).

Because there are often discrepancies between intended transactions and what is finally achieved, an intensive crosschecking exercise was conducted on the data, comparing sources and contacting the relevant water districts in the event of questions. We also had access to the transfer records of some large water districts in the state: Metropolitan Water District of

¹ In 2001, the CALFED website posted a preliminary database of water transfers compiled from various sources. Known as “On-Tap,” this database provides considerable information but still contains many inaccuracies. The participating agencies intend to improve the quality of transfer monitoring for future years.

² The one project area with incomplete records was the Friant Unit of the Central Valley Project, a group of contractors in the east side of the San Joaquin Valley, for which internal transactions were either incomplete or missing in some years. For these years (indicated by an asterisk in the appendix tables), we have adjusted the totals, setting internal Friant trades to their average share of the total market (7 percent) in years when data were complete.

Southern California, Westlands Water District, Kern County Water Agency, and Yuba County Water Agency. We attempted to retain only transfers that were actually carried out, in the amounts transferred from the point of origin, on a calendar year basis.³

The data presented below focus on annual flows of water resulting from three types of transactions: temporary transfers (under one year), long-term transfers (two years or more), and what we have termed “deferred exchanges.” Whereas transfers typically involve a one-way movement of water for monetary compensation, deferred exchanges refer to a promise that the buyer return water (in addition, in some cases, to a cash payment) to the seller at a later date. These exchanges often contain some flexibility regarding the year of repayment to allow for conditions of the water year. We have considered an exchange agreement to fall into this category as long as it does not require same or next year repayment. Like transfers, the agreements on deferred exchanges can be temporary or multi-year. State Water Project contractors make the most use of deferred exchanges, as project operating rules make these preferable to outright transfers in many instances.

The annual flow data do not contain a fourth category, the permanent transfer of water rights or contract entitlements. Such transfers amount to an outright sale of the rights to use the specified amount of water in perpetuity or for the remaining duration of the contract in question. Because the actual amount accessible to the buyer under these rights or entitlements can vary with the conditions of the water year, it is not strictly appropriate to consider an annual flow of water transferred. We have therefore opted to present the data on permanent transfers separately.

In the interests of consistency, two other types of transaction have been intentionally excluded from the database: short-term exchanges and transfers within certain localized user groups. Short-term exchanges are same- or next-year exchanges of water among users, generally done for purposes of timing or technical convenience. These include, for example, the annual exchanges between the San Benito Water District and the Santa Clara Valley Water District, which temporarily use a certain amount of each other’s water to gain flexibility. This practice is also common among the members of the Friant Unit of the Central Valley Project. In the San Joaquin Valley, short-term exchanges are also used to facilitate transfers between

³ Some inaccuracies in volumes transacted may nevertheless remain. It was not always possible to resolve discrepancies because of differences in record keeping among agencies and inconsistencies in accounting for carriage losses—the amount of water lost during conveyance. Some inaccuracies in the year of transfer also may remain, especially if a transfer arrangement was initiated late in the calendar year and some of the water actually was moved after December.

districts not hydraulically connected. An intermediate district (or districts) will use the water from the transferor in exchange for letting the transferee use its water. We have opted not to count these types of exchanges for several reasons. First, they are not tracked as well as transfers: frequently, only one of several possible sides of the exchange appears in the records. Second, unlike deferred exchanges, short-term exchanges do not alter the amount of water available to the buyer and seller over the season. Finally, in cases where exchanges are used to facilitate a transfer, counting them would amount to double- (or triple-) counting the volumes being traded.

In several parts of the state, a considerable number of local transactions are not picked up systematically by any of our data sources. These include transfers among users within the same water districts, which some argue have long been a part of farmers' water management practices. Given the difficulties of tracking these transfers, for which many districts do not maintain records, we have opted to exclude intra-district transactions from the database and to focus on the activity across parties with separate water rights or contract entitlements. It should be noted that the volumes involved in intra-district transfers can be substantial. In the Westlands Water District, one of the nation's largest irrigation districts, U.C. Berkeley researchers have estimated that internal transactions amounted to 300,000—400,000 acre-feet annually in the mid 1990s, or about one-third of the district's total water supplies (Sunding, 2000). Many intra-district transactions are what might be called "convenience" transfers, in which participants sell water at certain times of the year and purchase it later, in a manner reminiscent of the temporary exchanges noted above.

There are also some local transactions across districts that we have not been able to track systematically. Within the Kings River Water Association, a 28-member group that shares water rights on the Kings River, transfers can amount to as much as 20,000 acre-feet in some water years, depending on river conditions.⁴ There is also a substantial amount of transfer and exchange activity—as much as 100,000 acre-feet annually—among the 13 member agencies of the Kern County Water Agency who share a contract entitlement with the State Water Project. According to agency management, these transfers are essentially for convenience, facilitating the joint management of water from different sources (project, river, and groundwater) in different locations within the county. Within the Mojave Basin, where groundwater rights have been adjudicated, there is an active annual market among rights-holders that enables buyers to use more than their allotment. In 2002, these trades were estimated at over 30,000 acre-feet (*Water Strategist*, July/August 2002). Permanent transfers of drawing rights also occur within the basin. It

⁴ Personal communication, Tim O'Halloran, Kings River Water Association.

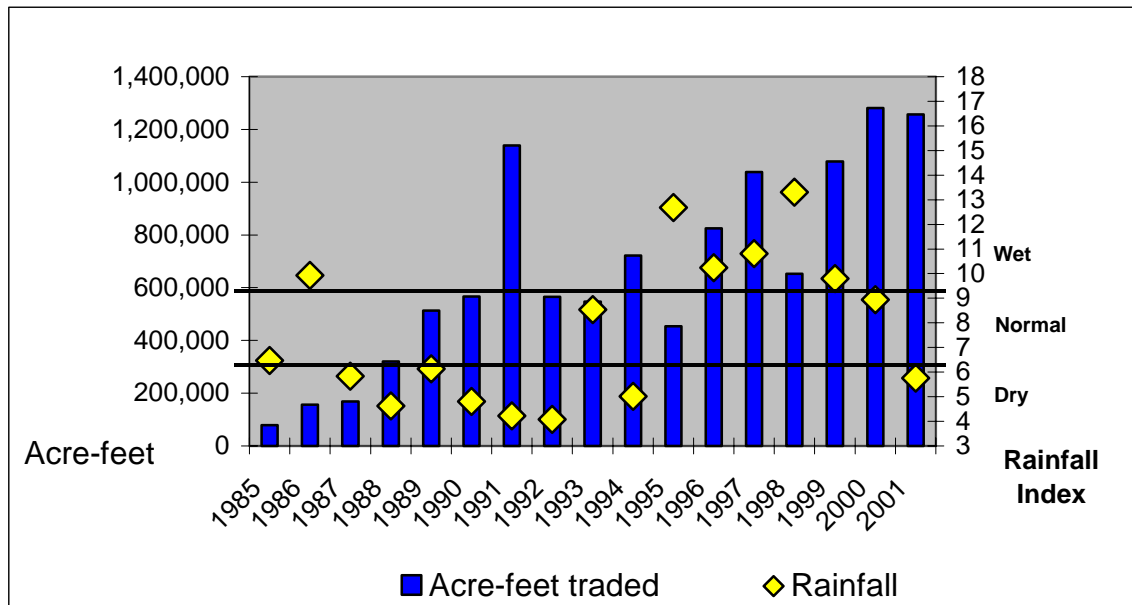
is likely that such local markets also are active in other adjudicated basins in Southern California.

Finally, the paper will not report in any detail on groundwater banking, which, while not technically a transfer, frequently involves the movement of water among parties in manners akin to transfers. Storing, or “banking,” water in underground aquifers has been on the rise in California since the early 1990s. A number of water users have embarked on projects in which water is stored on behalf of the rights-holder by another party, at another more suitable location. These projects are by nature long-term arrangements that allow the rights-holder to respond to dry years by drawing down on stored reserves. Our records, limited mainly to the operations of the State Water Project contractors, show that close to 750,000 acre-feet were stored in such projects since the mid-1990s in various locations in Kern County. The first drawdowns occurred in 2001, a dry year. In some of the banking projects, a market exists for the permanent sale of storage rights—in effect, for ownership of a share of the bank facilities. Because banked water can be used in transfers, there are also direct links between banking projects and the annual water market. Transfers can involve not only water users with their own on-site banking projects, but also those banking at a distant location. A case in point was Santa Clara Valley Water District’s transfer of water banked in Kern County to the Environmental Water Account in 2001.

3. Overall Market Trends

A comparison of the annual volumes of water traded and rainfall trends since the mid-1980s makes it clear that the statewide water market got a “jumpstart” during the last multi-year drought (Figure 1). Market growth was largely driven by direct interventions of the Department of Water Resources. DWR began making dry-year purchases to offset lower deliveries to State Water Project contractors and wildlife refuges in 1988, the first year of the drought. These early operations, which involved only a handful of Sacramento Valley water districts (most notably the Yuba County Water Agency), quickly brought the total volume traded to over 500,000 acre-feet, three times the pre-drought levels. In 1991, when the dry-year market was opened up to any willing buyers and sellers, DWR purchased 820,000 acre-feet of water for resale, bringing the overall market volume to over 1.1 million acre-feet. Water banks and other dry-year purchases were also operated in 1992 and 1994. From 1988 to the end of the drought in 1994, state and federal dry-year purchases for resale and environmental uses

Figure 1. Short and Long Term Water Transfers in California Since 1985



Source: PPIC water transfers database. For details see Appendix Table 1. Rainfall is measured by the Sacramento River 40-30-30 index.

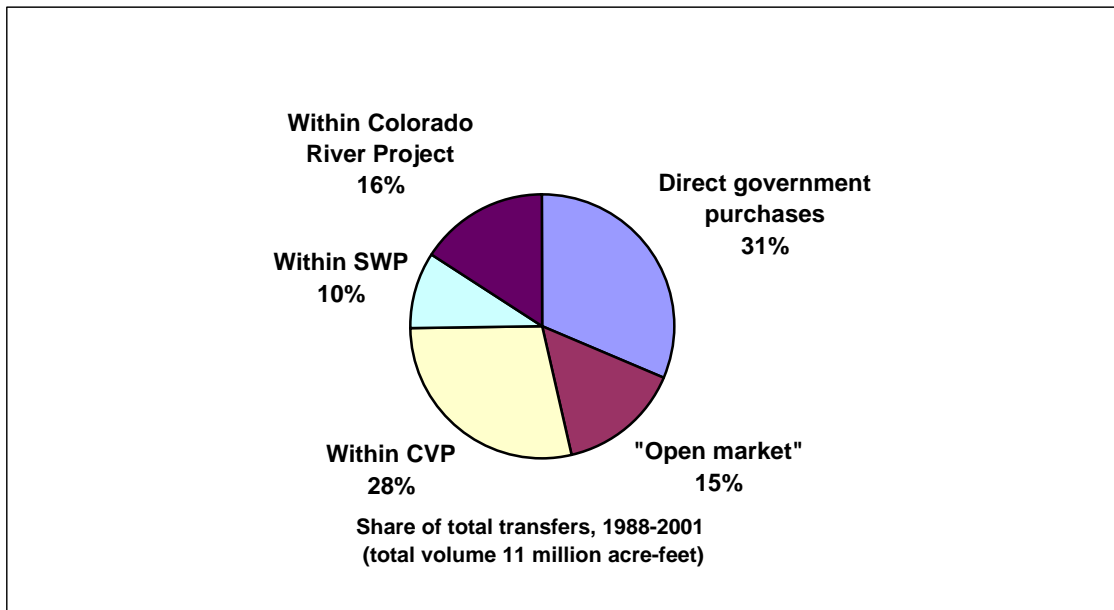
accounted for over 40 percent of a market that had jumped from an average of 150,000 acre-feet to over 600,000 acre-feet per year.⁵

Although the second half of the 1990s saw a succession of wet years, market activity remained strong, with volumes typically exceeding the drought year levels, especially by the end of the decade. The only dips in a generally upward trend occurred in the exceptionally wet years of 1995 and 1997, when many areas of the state experienced flooding. With annual trades now exceeding 1.2 million acre-feet—eight to ten times the levels of the mid-1980s—the market appears firmly established as a component of California’s water allocation process.

It is also useful to consider the size and scope of the market from three other perspectives. First, at current levels, the statewide market represents only 3 percent of all water used by Californians for municipal, industrial, and agricultural purposes (DWR, 1998). Second, although there has been an increase in the number of long-term transfer agreements, the market continues to be dominated by short-term transactions, negotiated on an annual basis, which account for about 80 percent of the total volume transferred. Finally, the size and scope of the market are strongly influenced by the intervention of state and federal authorities. This influence stems not only from an important direct role in purchases, but also from the relative ease water users have in gaining approval for transfers within the confines of the state and federal projects. Since 1988, direct government purchases have accounted for nearly one-third of the total volume traded. Transfers among contractors within the same projects (SWP, CVP and the Colorado River Project) account for more than half of all water sold (Figure 2). Transfers within the CVP and the SWP have generally increased in response to the more flexible trading rules adopted by those projects in the early 1990s. The growth has been most pronounced within the SWP, for which internal transfers were rare prior to the Monterey Agreement. By contrast, the “open market,” a residual category defined broadly to include any transfers between water users not associated with the same project, accounts for only 15 percent of the water transfers recorded over the 14-year period. This share initially increased immediately after the drought, but it has been on the decline again recently, as direct government purchases for environmental programs have been on the rise.

⁵ The average market volume as measured by end user purchases is just over 500,000 acre-feet for the 1988-94 period. This discrepancy arises mainly because DWR’s purchases were higher than its resales to other users in some years. The gap was most notable in 1991, the first year of the water bank, when purchases exceeded resale volume by over 400,000 acre-feet. In several years in the 1990s, there were also smaller discrepancies between purchases and sales of water user pools, notably the SWP turn-back pool, described in the text, and the Sacramento River Water Contractors’ Association, a pool run by some CVP contractors.

Figure 2. Share of Water Transfers by Type of Market



Source: PPIC water transfers database. For details, see Appendix Table 1.

4. Water for the Environment: A Key Factor in Market Growth

The composition of final demand for water sold reveals that market growth in the aftermath of the drought has been largely driven by environmental concerns. The influence of environmental policy is most readily seen by comparing the patterns of water purchases during the multi-year drought (1988-94) and in the more recent period (1995-2001), when rainfall has generally been above normal (Figures 3a and 3b).

The most obvious element of the new role for the environment is the rise in direct purchases for instream uses and wildlife refuges, through federal and state programs and most recently the CALFED Environmental Water Account (EWA). As one of the targeted beneficiaries of DWR's drought purchases, the environment already accounted for 12 percent of demand during the 1988-94 drought. Since 1995, this share has doubled on average; it reached a third of total demand in 2001, the first full-fledged year of the EWA. On an average yearly basis, environmental purchases have increased by 155,000 acre-feet, out of a total market gain of 430,000 acre-feet.

The less obvious component of environmentally related demand is the rise in purchases by San Joaquin Valley farmers. Although this group's change in market share is less dramatic (moving from 37 percent to 44 percent over the two periods), its increase in volume (228,000 acre-feet per year) accounts for over half of total market growth. Much of this growth can be linked to the changes introduced under the CVPIA in 1992, which mandated that a portion of project water be returned to instream uses. Since then, the CVP's agricultural service contractors located south of the Delta received full project deliveries in only the two very wet years, 1995 and 1997. One outcome has been the development of an active water market, as certain contractors (most notably Westlands Water District) seek to offset reductions in deliveries via purchases. Within the San Joaquin Valley, CVP service contractors' market share of purchases has risen from 63 percent to 87 percent across the two time periods.

The corollary of this growth has been a decline in the relative importance of municipal and industrial water users. Whereas cities were the main recipients of traded water during the 1988-94 drought with 42 percent of all purchases, their share since 1995 has been halved. With the exception of 1991, when purchases nearly reached 500,000 acre-feet, volumes have remained relatively flat, at around 200,000 acre-feet per year. The modest role of urban demand contrasts with the frequently voiced assumption that a water market would develop primarily as a response to population growth and the ability of urban dwellers to pay more than agricultural users for

water.⁶ As we will see below, cities are more significant players in defining the market for long-term and permanent transfers of water. This pattern suggests that their role may increase as this part of the market develops.

Figure 3a. Annual Volumes Purchased by Type of End User

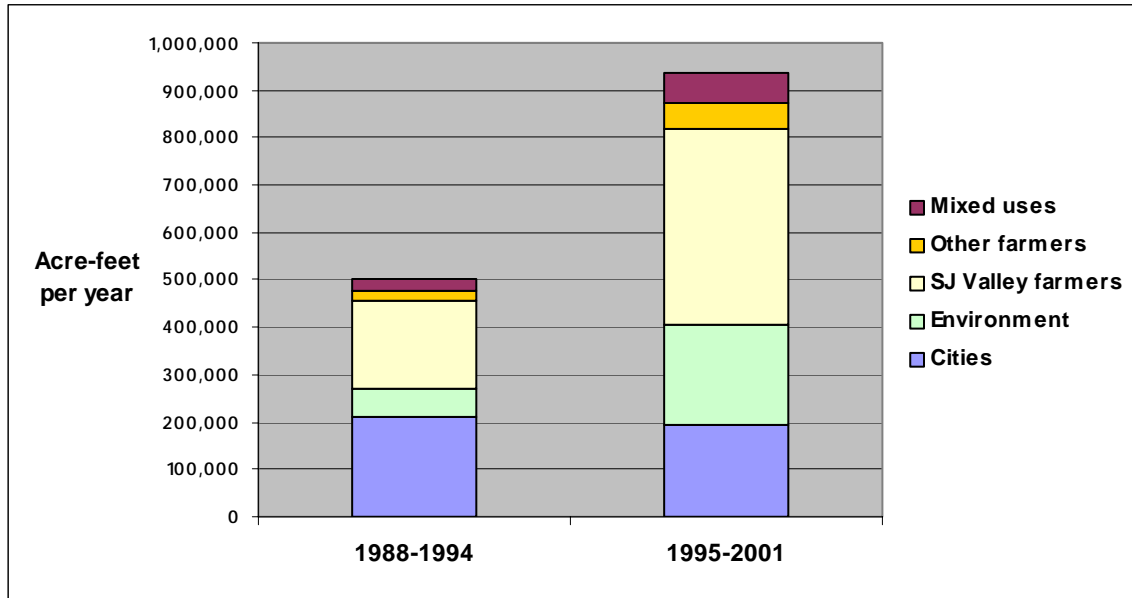
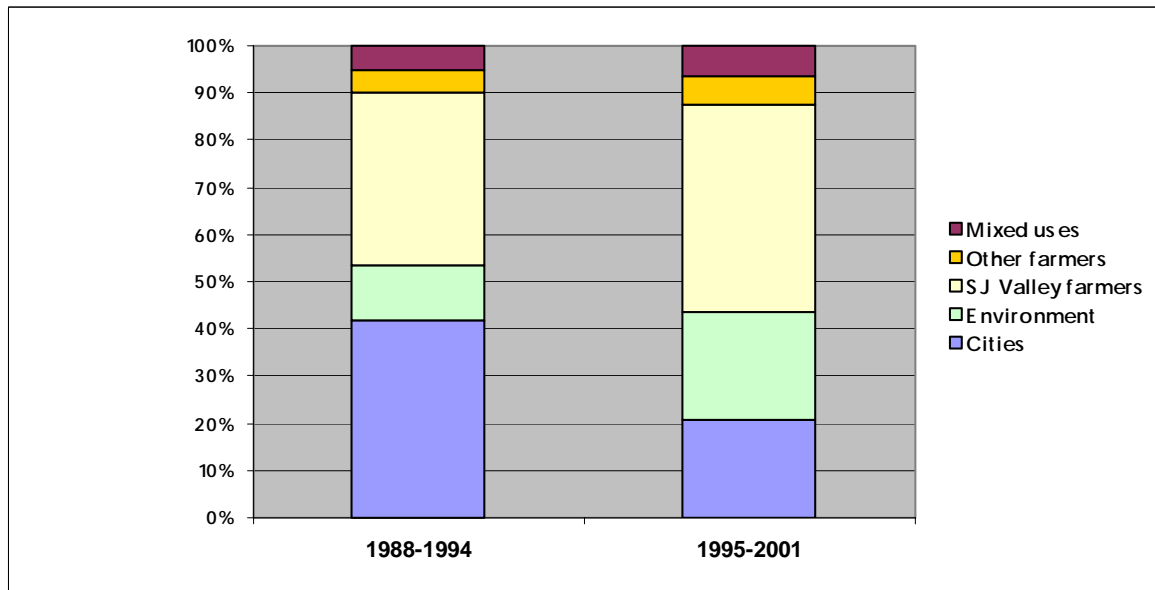


Figure 3b. Market Share of End Users



Source: PPIC water transfers database. For details, see Appendix Table 2.

⁶ See Vaux and Howitt (1984) for an early exposition of the economic arguments in favor of a water market in California.

5. Agriculture's Leading Role in Market Supply

Economists have typically assumed that agriculture would be the leading source of supply, and this assumption is confirmed by the data. In most years, agricultural water users provide at least 90 percent of supply. It is nevertheless interesting to note that the post-Monterey introduction of “turn-back” pools within the State Water Project has made a significant amount of urban agency water available to agricultural users in wet years. Under the program, SWP contractors are able to sell back amounts of project water they will not need if there are willing SWP buyers.⁷ From 1998 to 2000, the turn-back pool generated 200,000 acre-feet or more of water per year, or roughly one-fifth of total market supply.

Given the primacy of agricultural supply, it is not surprising to find that the main source regions are the Central Valley (served by the CVP, the SWP, and several large, autonomous, surface water projects) and the agricultural valleys to the south served by the Colorado River project (Table 1). In most years, the Central Valley has furnished about three-fourths of the total volume transferred. Within this region, there are pronounced shifts depending on the nature of the water year. From 1988 to 1994, Sacramento Valley farmers and districts supplied about 45 percent of all water sold. Although this share fell considerably after 1994 (in some years, to under 10 percent of the statewide market), the region again provided over 40 percent of the water in 2001, the first dry year experienced since the previous drought. In the interim, the market shifted to the San Joaquin Valley, which established a vibrant intra-regional market to supply water-short districts within the region. In every normal to wet year since 1993, the first year of CVPIA implementation, San Joaquin Valley farmers and districts have furnished at least half of the total amount transferred. It is common for agricultural districts in this region to restrict out-of-district transfers to cases where land in the recipient district is owned or leased by same farmer.

The two Central Valley regions are the principal suppliers of environmental water (Table 1). There has been a major source shift from north to south of the Delta since the early 1990s drought, with the institution of restoration programs along the San Joaquin River system, supplied by area water districts. The Kern County water users have also been major suppliers of the EWA. Most environmental water is used in the region of purchase, the main exception being EWA purchases of water north of the Delta, which are used to facilitate the delivery of project water to users to the south while protecting Delta fisheries.

⁷ Because the sale price is fixed below the level of per acre-foot charges incurred by the seller for project water, the pool's attractiveness to sellers is relative, not absolute: it enables them to pay less than full price for contract amounts in excess of current needs.

Table 1. Regional Sources and Destinations (Acre-Feet)

	1988-1994	1995-2001
Sales by Water Users		
Sacramento Valley	1,924,937	1,057,064
San Joaquin Valley	1,363,037	3,715,039
Southern California	970,942	1,577,597
SF Bay Area	87,195	82,575
Other	3,055	88,694
<i>Total sales*</i>	<i>4,349,166</i>	<i>6,520,969</i>
Purchases by Water Users		
Sacramento Valley	135,079	515,509
San Joaquin Valley	1,450,917	3,253,292
Southern California	1,187,157	1,234,555
SF Bay Area	313,197	43,505
Other	6,152	14,993
Purchases of Environmental Water		
- % from Sacramento Valley	74%	17%
- % from San Joaquin Valley	25%	81%
<i>Total purchases*</i>	<i>3,501,174</i>	<i>6,546,109</i>
Exports (imports) of Non-Environmental Water		
Sacramento Valley	1,488,725	288,383
San Joaquin Valley	(190,683)	(739,455)
Southern California	(216,215)	343,042
SF Bay Area	(230,738)	9,070

Source: PPIC water transfers database. For details, see Appendix Tables 3 and 4.

Note: The bulk of the difference between total purchases and total sales in the first period is the surplus purchased by DWR and distributed through means other than resales. There were also some small discrepancies in both periods between purchases and sales of user pools. See footnote 4 in text.

The Southern California region, defined broadly to include both the desert counties and the coast, generates most of the remaining quarter of total supply. The largest single source has been the Imperial Irrigation District, which has operated a 110,000 acre-feet per year long-term transfer with the Metropolitan Water District of Southern California (MWDSC) since 1988. In the mid-1990s, there was also a large two-year transfer to the MWDSC by the Palo Verde Irrigation District, another agricultural contractor on the Colorado River Project.

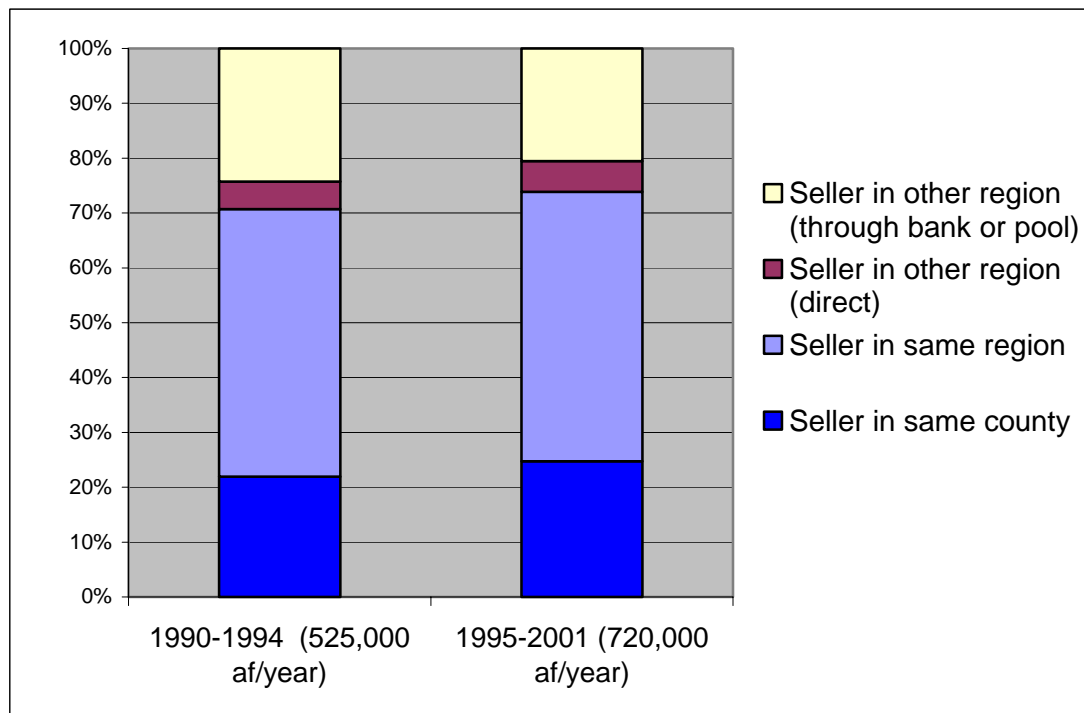
With the exception of the early 1990s drought, when several Bay Area cities made substantial purchases, no other region has played a significant role in the market on either the supply or demand side. The Bay Area's share in demand has dropped from 9 percent of the total in the drought years to only 1 percent in the more recent period. This region's share in supply is about 2 percent.

6. Most Transfers Are Local or Regional

We have already seen that the San Joaquin Valley is both a major supplier and purchaser of water. The market in Southern California is also primarily regional in nature (Table 1). The only “exports” are the transfers by municipal agencies to the SWP turn-back pool, purchased by San Joaquin Valley agricultural districts. In the Sacramento Valley, the only region in the state where water users purchase significantly less than the volume sold, exports are concentrated in dry years. In years with normal to high rainfall, two-thirds of the water is transferred to other water users within the region.

Another way of seeing the shares of local and regional markets is to look directly at the source of water obtained by users. Figure 4 shows this breakdown, for non-environmental water only, according to the location of the selling party in relation to the buyer.⁸

Figure 4. Non-Environmental Water Purchases by Location of Selling Party



Source: PPIC water transfers database.

⁸ The first period of reference in this figure is 1990-94 (instead of 1988-94) because detailed county breakdowns are more accurate from 1990 on.

Nearly one quarter of total volume is purchased from parties in the same county, and another half from parties in the same region. Interregional transfers account for the remaining 25–30 percent of the market.⁹ Of this total, a relatively small fraction (one-fifth) results from transfers negotiated directly between parties in different regions; the lion’s share moves through banks and pools run by DWR. This pattern highlights again the very important role played by the government agencies in California’s water market. When the agency acts as an intermediary, it is able to facilitate the movement of water across the Delta. Interregional transfers between districts without agency involvement face significant complexities. Agency input has been crucial in successful district-to-district transfers across regions—for instance the 2001 “forbearance program” of the CVP contractors, which moved 160,000 acre-feet from Sacramento Valley water users to the Westlands Water District.

⁹ Because this graph presents data from the standpoint of end user purchases, it only includes the water bank volumes that were actually resold in the first period, not the full amounts acquired by DWR.

7. From Farms to Cities: A Key Element of Long-Term and Permanent Transfers

From 1985 to 2001, our records show 14 approved long-term transfers, and as many permanent transfers of surface water rights or entitlements. At least ten additional transfers are currently pending approval. As noted, long-term transfers have generally accounted for about one-fifth of volumes traded since the late 1980s. Volumes traded surpassed the 250,000 acre-feet mark for the first time in 2001. Contract duration runs from a low of two years to a high of 35, with an average of 15. The permanent transfers, bunched at the end of the decade, total another 175,000 acre-feet. These mainly concern the transfer of SWP contract entitlements under the Monterey Agreement (representing close to 130,000 acre-feet), and the transfer of pre-1914 water rights among parties within Kern County.

The striking aspect of these transfers is that they almost all involve shifts of water from agricultural to urban uses. The handful of exceptions includes two long-term deferred exchanges between districts with a large municipal customer base (Solano County Water Agency and the Mojave Water Agency; Placer County Water Agency and Northridge Water District), and several long-term transfers from agricultural districts to the environment (most notably, as part of the negotiated agreement for the restoration of the San Joaquin River). Only two long-term transfers between agricultural districts appear, one in the Sacramento Valley and one in San Joaquin, and two permanent transfers of contract entitlement among agricultural users (both in the San Joaquin Valley). Thus, agricultural users remain the largest single source of demand for water in today's market, but they conduct their purchases almost entirely through temporary arrangements.

In light of the rapid population growth rates being experienced in the state, it is not surprising that municipal agencies are taking the lead in negotiating long-term and permanent arrangements for water supply. Legislation passed in 2001 requiring local governments to demonstrate adequate water supplies for development should increase urban demand for long-term water transfers.

Conclusion

Jumpstarted by a prolonged drought in the late 1980s and early 1990s, California's water market has now become a firmly established feature of the state's water allocation process. The market remains largely intra-regional in nature, with most transfers across regions directly intermediated by the state's Department of Water Resources. The market is also highly segmented, with over half of the volumes traded among contractors of the large state and federal water projects and another third involving direct purchases by state and federal agencies for drought relief and environmental mitigation.

Outside of drought years, when urban agencies have been important buyers, the main sources of demand have been directly and indirectly linked to environmental concerns. Direct purchases for the environment (for instream uses and wildlife reserves) have accounted for over one-third of the increase in purchases since 1995.

The other growth sector has been agriculture in the San Joaquin Valley (accounting for over half of market expansion), as farmers whose contractual water deliveries have been cut in the context of environmental mitigation programs have turned to the market for replacement water. Municipal agencies are the principal buyers of long-term and permanent contracts. Their role promises to increase as this part of the market—still modest—develops in the years ahead.

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Appendix: Supplementary Tables

Appendix Table 1. Short and Long-Term Water Transfers in California, by Type of Market (Acre-Feet)

Year	Total Transfers	% Long-term	Direct Government Purchases	Within CVP	Within SWP	Within CO River Project	"Open Market"
1985	78,781	0	3,308	52,216	15,489	0	7,768
1986	156,669	0	0	147,447	7,950	0	1,272
1987	168,143	0	0	70,622	6,171	0	91,350
1988	320,872	34	119,031	87,141	300	110,000	4,400
1989	513,731	21	239,000	*152,584	2,691	110,000	9,456
1990	566,633	19	131,409	*177,142	3,561	110,000	144,521
1991	1,139,653	10	864,315	*102,202	2,696	110,000	60,440
1992	565,551	24	217,983	*155,786	4,919	138,301	48,562
1993	547,090	37	1,703	*213,782	197	202,989	128,419
1994	721,916	24	302,852	*218,400	1,726	174,688	24,250
1995	454,095	25	54,090	182,829	4,500	110,000	102,676
1996	825,185	13	69,216	270,282	207,496	110,000	168,191
1997	1,038,980	11	291,500	216,159	66,144	110,000	355,177
1998	653,054	21	60,748	145,026	201,810	110,000	135,470
1999	1,078,299	13	229,059	*368,348	241,390	110,000	129,502
2000	1,281,305	14	276,290	369,759	286,305	110,000	238,951
2001	1,257,118	22	584,349	440,252	18,240	110,000	104,277

Source: PPIC water transfers database.

Note: In years indicated by an asterisk, volume adjusted to account for incomplete data on the Friant Unit of the CVP (see footnote 2 in text).

Appendix Table 2. Water Purchases by Type of End User (Acre-Feet)

Year	Total Purchases	Environment	Municipal & Industrial	SJ Valley Farmers	Other Farmers	Mixed Purpose
1985	78,781	3,308	5,000	44,518	3,768	22,187
1986	156,669	0	5,000	69,589	13,740	68,340
1987	168,143	0	44	43,741	10,350	114,008
1988	320,872	119,031	110,500	38,878	12,366	40,097
1989	357,283	39,000	131,043	157,021	30,219	0
1990	453,576	1,500	146,735	260,562	33,779	11,000
1991	703,329	64,612	477,292	104,892	6,863	49,670
1992	530,305	101,726	198,473	188,592	12,163	29,351
1993	546,266	1,703	208,208	293,838	42,517	0
1994	615,397	81,100	203,997	249,215	27,830	53,255
1995	511,904	111,899	112,667	279,331	8,007	0
1996	825,185	72,216	220,308	503,548	29,113	0
1997	1,037,808	293,000	191,402	439,322	14,084	100,000
1998	554,411	61,748	215,956	211,029	65,678	0
1999	1,078,379	229,459	173,988	556,980	72,592	45,360
2000	1,281,305	276,290	169,826	507,841	94,146	233,202
2001	1,257,117	445,543	261,922	388,401	112,776	48,475

Source: PPIC water transfers database.

Note: For discrepancies between total transfers (Appendix Table 1) and total purchases by end user listed here, see footnote 4 in text.

Appendix Table 3. Transfers by Region of Origin and Region of Destination (Acre-Feet)

Year	Sales by Water Users						Purchases by Water users (Non-Environmental Water)							
	Sacramento Valley		San Joaquin Valley		San Francisco Bay Area		Sacramento Valley		San Joaquin Valley		San Francisco Bay Area		Other	
1985	8,693	55,183	9,887	5,018	0	0	7,943	61,762	0	5,018	750			
1986	13,740	131,682	6,247	5,000	0	0	13,740	137,929	0	5,000	0			
1987	93,450	68,478	6,171	44	0	0	10,350	74,649	0	44	0			
1988	131,397	78,975	110,500	0	0	0	12,366	78,975	110,500	0	0			
1989	301,023	102,708	110,000	0	0	0	30,219	157,021	110,000	21,043	0			
1990	252,328	191,525	110,000	11,700	1,080	1,080	34,879	260,562	110,000	35,535	100			
1991	700,720	271,572	113,206	53,905	250	250	6,013	154,562	325,736	152,156	250			
1992	218,521	193,659	142,364	11,007	0	0	12,641	203,089	152,364	45,509	122			
1993	17,910	290,446	208,084	5,650	25,000	25,000	11,867	293,838	202,989	30,219	5,650			
1994	303,038	234,152	176,788	4,933	3,005	3,005	27,094	302,870	175,568	28,735	30			
1995	22,097	321,331	110,000	667	0	0	10,007	279,331	110,000	667	0			
1996	57,773	459,704	224,078	20,267	63,363	63,363	33,113	506,548	215,641	667	0			
1997	164,375	721,311	136,958	9,991	6,345	6,345	114,084	440,827	190,730	667	0			
1998	79,349	257,385	294,778	4,000	17,542	17,542	68,378	212,129	207,156	6,000	0			
1999	107,251	620,324	305,932	9,650	35,142	35,142	75,582	603,348	168,380	2,000	10			
2000	105,571	760,142	377,611	6,000	31,981	31,981	82,334	771,343	124,926	26,412	0			
2001	520,648	574,842	128,240	32,000	1,388	1,388	132,011	439,766	217,722	7,092	14,983			

Source: PPIC water transfers database.

Appendix Table 4. Source Regions for Environmental Water Purchases (Acre-Feet)

Year	Sacramento Valley	San Joaquin Valley	San Francisco Bay Area
1988	119,031	0	0
1989	39,000	0	0
1990	1,500	0	0
1991	64,612	0	0
1992	52,525	20,000	4,736
1993	0	1,703	0
1994	0	81,100	0
1995	69,899	42,000	0
1996	16,660	55,556	0
1997	45,517	247,483	0
1998	10,748	51,000	0
1999	21,559	207,900	0
2000	9,795	266,495	0
2001	80,000	335,543	30,000

Source: PPIC water transfers database.

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