

Technical Appendices

California's Water Market, By the Numbers: Update 2012

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Appendix A:

Data Sources and Caveats

This appendix describes the main water transfer and water banking datasets used in the body of the report, including their construction and associated caveats.

Water Market Data

Although there is no comprehensive official data source documenting California’s water market, monitoring trends is facilitated by the fact that many transactions involve state or federal authorities either as direct purchasers (as in the drought water bank and the environmental programs) or as regulators of transactions among other users. The SWRCB must approve transfers that involve a change in purpose or place of use for all water rights established since 1914. Transfers among contractors of the federal and state 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 in most of the state.

For this project, we drew upon the full range of available sources. SWRCB approvals, records of SWP-related transfers from DWR, records of transfers within the CVP and the Colorado River project make up the bulk of the records in the transfer database. Records of environmental transfers are from DWR, USBR’s Water Acquisitions Program, CALFED’s Environmental Water Account program, and the SWRCB’s online database on §1707 permits for instream flow dedications. As noted in the main report, we did not include those §1707 permits that were part of regulatory or quasi-regulatory proceedings. For instance, we excluded the 35-year permit for instream flows of up to 4,400 taf/year from South Sutter Irrigation District and Camp Far West Irrigation District down the Feather River. This change in use was made to meet requirements of the 1995 Bay-Delta Plan’s water quality objectives and is therefore not a strictly voluntary water transfer. Similarly, we excluded the flows to be released as part of the recent San Joaquin River settlement. The database also excludes water marketing within USBR’s Klamath River project, involving irrigators straddling the California-Oregon border; in some years USBR has operated a water trading operation within this project.

For transactions that do not fall within the state and federal jurisdictions, several other catch-all sources provided useful information. Lund et al. (1992) was a source for early years in the database. Until the end of its publication in 2010, *The Water Strategist*, formerly the *Water Intelligence Monthly*, which tracked water markets in 14 western states, provided useful leads on “open market” transfers involving entities other than those in the CVP, SWP, or Colorado River project. We verified these transactions wherever possible through Internet searches and phone contacts with participating agencies. Potential and finalized water deals were also culled from a variety of local news sources throughout the state, as reported in DWR’s California Water News service.

Because there are often discrepancies between intended transactions and what is finally achieved, we conducted an intensive cross-checking exercise on the data, comparing sources and contacting the relevant water districts in the event of questions. For some periods, we also had access to the transfer records of a number of large water districts in the state: the Metropolitan Water District of Southern California,

Westlands Water District, Kern County Water Agency, Yuba County Water Agency, and the Glenn Colusa Irrigation District. We attempted to retain only transfers that were actually approved and carried out, in the amounts transferred from the point of origin, on a calendar year basis. It bears noting that the purchasing entities often receive smaller volumes of water than the volumes they purchase because of spillage, carriage water required for transfers through the Delta, and treatment losses (Lund et al., 1992).

The data presented in this report focus on annual flows from four types of transactions: temporary or short-term transfers (leases of one year or less), long-term transfers (leases of two years or more), permanent transfers or sales of water rights or contract entitlements, and what we have termed “deferred exchanges” (when water is returned after a period of one year or longer). Whereas transfers typically involve a one-way movement of water for monetary compensation, deferred exchanges refer to a promise that the buyer will return water to the seller at a later date, often in exchange for compensation as well. These agreements often contain some flexibility regarding the year of repayment to allow for uncertain future water conditions. Deferred exchanges are most commonly used among State Water Project contractors, as project operating rules make these preferable to outright transfers in many instances. As described in the main report (footnote 36), in several years there has been a market for short-term “options” trades, where potential sellers commit to transfer water in exchange for a small up-front payment and additional installments at successive call dates. The short-term data here include volumes actually sold, not the additional amounts for which the options were not exercised.

For long-term and permanent transfers, we provide estimates both of total commitments (the maximum contractual obligation) and actual flows in any given year. For long-term transfers, we made every effort to confirm actual historical amounts transferred (which are often below the contractual maximum depending on availability and hydrology). In some cases, contracts also foresee raising the amount of water transferred over time to allow for the completion of investments such as canal lining or other factors. This is the case for several of the transfers under the Quantitative Settlement Agreement on the Colorado River; we treat the full contract amount as the volume committed in all years, and we include actual delivery amounts in the estimates of annual flows. In general, actual delivery amounts were obtained from the contracting parties or the agency overseeing conveyance.

For permanent transfers of contract entitlements from the SWP and the CVP, we estimated annual flows by calculating project deliveries for a given region and use, based on annual SWP allocations from the SWP Analysis Office and CVP allocations from USBR news releases. For example, our annual flows for a permanent transfer from Mercy Springs Water District (a CVP contractor in Fresno County) might range from 100 percent of the contract amount in a relatively wet year like 2006 (when CVP contractors received their full contract amounts) to 10 percent in a dry year like 2009 (when CVP contractors south of the Delta received only 10 percent of their contract amounts). We assumed that flows under permanent transfers of non-project related water rights corresponded to the full amount of the water right. These transfers tend to involve very senior water rights that have high reliability. A transfer from the City of Petaluma to the California Department of Fish and Game for environmental purposes is an example of this kind of transfer, where the transaction is based on a pre-1914 water right that is available in all years. Nevertheless, this assumption may overstate annual flows under permanent transfers in very dry years.

In the interest 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-year exchanges of water among users, generally done for purposes of timing or technical convenience.

These include, for example, frequent exchanges between the San Benito Water District and the Santa Clara Valley Water District, which temporarily use some 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 also facilitate transfers between districts that are 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 opted not to count such 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 result in double- or triple-counting the volumes being traded.

The other category of transactions that are not picked up systematically by any of our data sources and are therefore not included in our database, are transactions within localized user groups. These include transfers among users within the same irrigation district, often done to lend flexibility to water management at different times of the year. Given the difficulties of tracking these transfers, for which many districts do not maintain records, we opted to exclude them from this study and focus on activity across parties with separate water rights or contract entitlements. However, it should be noted that the volumes involved in intra-district transfers can be substantial. For example, in the Westlands Water District, one of the nation's largest irrigation districts, U.C. Berkeley researchers estimated that internal transactions amounted to 300,000 to 400,000 af/year in the mid-1990s, or about one-third of the district's total water supplies (Sunding, 2000). Many of these transfers resemble temporary exchanges, where water is returned in the same year it is taken, leaving the total amount of water available in a given year constant. There are also some transactions across districts within a management association or wholesale network 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.¹ There is also a substantial amount of transfer and exchange activity—as much as 100,000 af/year—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. Similarly, there have been transfers among cities and special districts that hold subcontracts within the Napa County Flood Control and Water Conservation District, an SWP contractor.

Within some adjudicated basins there are also active markets among rights-holders, including both private parties and water districts. For example, we were able to collect data on water transfers within the Mojave Basin and the Chino Basin from their respective watermasters. Within the Mojave Basin there is an active market for both permanent and temporary transfers. Since 1995, there have been an average of over 200 transfers per year, with total volumes traded ranging from 30,000 to 70,000 af/year.² The parties include many small, private landholders in addition to several municipal water districts; in general the trend is toward agricultural activities ramping down and urban districts acquiring their water. In the Chino Basin, there are an average of 16 transfers per year, solely among water agencies. Although the total volumes traded are in a similar range of 15,000 to 70,000 af/year, the share of permanent trades is much lower than in the Mojave Basin.³ In the Mojave Basin, average prices for temporary transfers rose steadily from \$30–\$40/af

¹ Personal communication with Tim O'Halloran, Kings River Water Association, October 2002.

² A total of 202,350 af of permanent transfers and 536,724 af of temporary transfers occurred from 1995 through 2011.

³ A total of 2,444 af of permanent transfers and 531,482 af of temporary transfers occurred from 1996 through 2011.

in the mid-1990s to \$180/af in 2011. In the Chino Basin, average prices for temporary trades have fluctuated between \$150 and \$250/af throughout the 2000s, increasing to \$300 in 2010 and \$400 in 2011.

The database includes transactions involving water banks and pools, such as DWR's drought water banks, the SWP "turnback" pool (a trading pool among SWP contractors established by the Monterey Agreement which allows partial compensation for unused contract amounts that are made available to other SWP contractors), and pools among Sacramento River Water Contractors. Banks and pools make both water purchases and water sales each year, purchasing water from those with extra capacity and selling that water to those entities that need water above their existing allocations. To avoid double counting in the totals, our calculations include *either* bank/pool purchases *or* sales, depending on the purpose of the calculation. When looking at the end use of water transfers, as in Technical Appendix Table B3, we include bank/pool sales, which provide information on the water's final destination. Similarly, when interested in total volumes sold or the source region of water we include bank/pool purchases (e.g., sales by water users in Technical Appendix Table B4). In some years, the volumes acquired by the banks or pools are higher than the volumes sold. This discrepancy is particularly large for the 1991 state-run drought water bank, which could not sell close to half of the 821,000 af acquired because of substantial rains late in the 1991 rainy season (see footnote 32 in the main report).

In our earlier report on water market trends (Hanak, 2002), we made adjustments for missing or very low trades between contractors within the Friant Water Users Authority in some years in the 1980s and early 1990s. Here, we have opted not to make those adjustments. Years with no trading activity recorded for this group include 1982–86, 1988–90, and 1993. Friant area trades are unusually high relative to trends (220,000 af) in 1999.

Groundwater Banking Data

We have also attempted to capture a cross-section of the water banking activity that goes on in the state. Storing or "banking" water in underground aquifers has been increasing in California since the early 1990s, with the majority of third-party water banking taking place in Kern County due to its geography and unique basin characteristics. Of the 11 agencies with groundwater banking operations in Kern County, nine store water for third parties. Eight of these agencies were able to share information on annual 'put' and 'take' amounts for their program participants: Arvin Edison Water Storage District (WSD), Cawelo Water District (WD), Kern Delta WD, Kern Water Bank Authority, North Kern WSD, Rosedale-Rio Bravo WSD, Semitropic WSD, and West Kern WD. Buena Vista WSD also stores water for third-party entities, but we were not able to include data on their banking program in this report. Besides these agencies, Berrenda Mesa WD and the City of Bakersfield also operate groundwater storage projects for their own in-district use. Outside of Kern County, similar third-party water banking activity takes place in Southern California in the form of Metropolitan Water District of Southern California's Conjunctive Use Program with groundwater basins within their service area, the Mojave Basin, and the Coachella Valley. These data, obtained directly from MWDSC, along with the Kern County data, cover the full range of third-party groundwater banking activity in California at present. A recently established groundwater bank in Madera County is in discussions with USBR about conducting third-party banking for the CVP.

Appendix B: Detailed Water Transfer Tables

TABLE B1
Water Transfers in California by Transfer Duration (acre-feet)

Year	Total Commitments (1)	Total Volume Traded (2)	Short-term Flows (3)	Long-term Flows (4)	Permanent Flows (5)	Additional Committed under Long-term Transfers (6)	Additional Committed under Permanent Transfers (7)	Sacramento Valley 40-30-30 Index	Year Type
1982	129,851	142,314	117,157	25,157	0	-12,463*	0	12.76	Wet
1983	141,604	128,830	128,225	605	0	12,774	0	15.29	Wet
1984	68,442	63,848	55,063	8,785	0	4,594	0	10	Wet
1985	74,045	71,238	61,351	9,887	0	2,807	0	6.47	Dry
1986	135,851	131,526	125,279	6,247	0	4,325	0	9.96	Wet
1987	282,544	278,143	161,972	116,171	0	4,401	0	5.86	Dry
1988	320,872	320,872	210,872	110,000	0	0	0	4.65	Critical
1989	519,122	519,122	409,122	110,000	0	0	0	6.13	Dry
1990	529,564	529,564	419,564	110,000	0	0	0	4.81	Critical
1991	1,106,213	1,106,213	996,213	110,000	0	0	0	4.21	Critical
1992	596,351	531,652	393,351	138,301	0	64,699	0	4.06	Critical
1993	509,607	509,596	306,607	202,989	0	11	0	8.54	Above Normal
1994	755,595	727,283	552,595	174,688	0	28,312	0	5.02	Critical
1995	568,654	520,121	389,454	130,667	0	48,533	0	12.89	Wet
1996	877,058	828,525	697,858	130,667	0	48,533	0	10.26	Wet
1997	1,050,665	994,132	860,596	132,667	869	56,533	0	10.82	Wet
1998	779,725	724,525	533,356	159,000	32,169	55,200	0	13.31	Wet
1999	1,422,162	1,326,200	997,033	296,998	32,169	95,962	0	9.8	Wet
2000	1,423,515	1,292,512	893,386	309,157	89,969	121,803	9,200	8.94	Above Normal
2001	1,689,258	1,451,608	1,054,375	296,270	100,963	162,690	74,960	5.76	Dry
2002	1,377,956	1,123,903	662,502	318,955	142,446	217,505	36,548	6.35	Dry
2003	2,075,631	1,311,641	813,851	305,510	192,280	748,257	15,733	8.21	Above Normal
2004	2,005,480	1,268,152	719,875	385,976	162,301	681,716	55,612	7.51	Below Normal
2005	2,037,878	1,375,813	723,746	425,156	226,911	642,663	19,402	8.49	Above Normal
2006	1,905,903	1,282,195	483,865	524,111	274,219	623,708	0	13.2	Wet
2007	1,995,490	1,348,992	581,202	582,907	184,882	556,987	89,512	6.19	Dry
2008	2,086,382	1,292,347	426,128	720,898	145,321	639,809	154,226	5.16	Critical
2009	2,221,663	1,500,154	547,292	805,126	147,735	555,581	165,929	5.75	Dry
2010	2,223,907	1,711,877	564,000	958,431	189,446	385,499	126,531	7.08	Below Normal
2011	2,107,580	1,429,139	465,635	696,379	26,7125	628,688	49,753	10.52	Wet
Total	33,018,568	25,842,037	15,351,525	8,301,705	2,188,805	6,379,127	797,406		

SOURCES: Calculations based on author-collected data. For details see Technical Appendix A.

NOTES: "Total volumes traded" (column 2) is the sum of actual and estimated flows under short-term transfers (column 3), long-term transfers (column 4), and permanent transfers (column 5). "Total commitments" (column 1) equals the sum of total volumes traded (column 2) plus additional commitments under long-term (column 6) and permanent (column 7) contracts that were committed but not sold in that year. The table includes purchases by state-run water banks and by various CVP and SWP user pools. *The negative amount under "Additional committed under long-term transfers" in 1982 occurs because committed flows under a 1979 long-term agreement between the MWDSC and Kern County Water Agency were carried over from 1980 and 1981 and delivered all at once in 1982.

TABLE B2a
Water Transfers in California by Type of Market, Volume Traded (acre-feet)

Year	Total Transfers	Direct Government Purchases		Within Colorado River Project		"Open Market"
		Within CVP	Within SWP	Within CVP	Within SWP	
1982	142,314	0	117,157	25,157	0	0
1983	128,830	0	65,405	605	0	62,820
1984	63,848	4,771	50,292	8,785	0	685
1985	71,238	3,308	51,673	15,489	0	768
1986	131,526	0	123,576	7,950	0	0
1987	278,143	83,100	70,872	6,171	110,000	8,000
1988	320,872	119,031	89,491	300	110,000	2,050
1989	519,122	278,000	118,975	2,691	110,000	9,456
1990	529,564	229,409	140,226	561	110,000	49,368
1991	1,106,213	865,365	72,506	3,902	110,000	54,440
1992	531,652	232,837	122,010	4,919	138,301	33,585
1993	509,596	0	245,491	197	202,989	60,919
1994	727,283	327,736	209,111	1,726	174,688	14,022
1995	520,121	88,009	267,529	4,500	110,000	50,083
1996	828,525	52,556	394,509	207,496	110,000	63,964
1997	994,132	225,783	435,439	66,144	110,000	156,766
1998	724,525	86,300	240,511	226,810	110,000	60,904
1999	1,326,200	274,416	587,470	269,095	110,000	85,219
2000	1,292,512	182,928	518,866	371,005	110,000	109,713
2001	1,451,608	584,145	550,848	69,228	106,880	140,507
2002	1,123,903	423,604	239,832	175,506	104,940	180,022
2003	1,311,641	395,985	304,832	211,602	148,834	250,388
2004	1,268,152	328,841	453,366	162,344	136,900	186,701
2005	1,375,813	223,241	524,471	195,337	255,606	177,158
2006	1,282,195	197,373	410,659	227,889	264,058	182,216
2007	1,348,992	384,469	339,697	155,102	272,956	196,768
2008	1,292,347	205,386	348,258	134,610	315,983	288,109
2009	1,500,154	212,656	322,128	112,759	454,464	398,146
2010	1,711,877	198,449	468,448	198,641	475,613	370,725
2011	1,429,139	206,116	437,981	205,003	435,399	144,639
Total	25,842,037	6,413,814	8,321,629	3,071,524	4,697,611	3,337,456

SOURCES: Calculations based on author-collected data. For details see Technical Appendix A.

NOTES: The table includes estimated market flows under short-term, long-term, and permanent contracts. The table includes purchases by state-run water banks and by various CVP and SWP user pools. "Direct government purchases" are purchases by federal or state agencies; "Within CVP", "Within SWP", and "Within Colorado River Project" are trades between local entities that both operate within those projects. "Open market" includes all other trades.

TABLE B2b
Water Transfers in California by Type of Market, Volume Committed (acre-feet)

Year	Total Transfers	Direct Government Purchases		Within Colorado River Project		"Open Market"
		Within CVP	Within SWP	Within CVP	Within SWP	
1982	129,851	0	117,157	12,694	0	0
1983	141,604	0	65,405	13,379	0	62,820
1984	68,442	4,771	50,292	13,379	0	685
1985	74,045	3,308	51,673	18,296	0	768
1986	135,851	0	123,576	12,275	0	0
1987	282,544	83,100	70,872	10,572	110,000	8,000
1988	320,872	119,031	89,491	300	110,000	2,050
1989	519,122	278,000	118,975	2,691	110,000	9,456
1990	529,564	229,409	140,226	561	110,000	49,368
1991	1,106,213	865,365	72,506	3,902	110,000	54,440
1992	596,351	232,837	122,010	4,919	203,000	33,585
1993	509,607	0	245,491	197	203,000	60,919
1994	755,595	327,736	209,111	1,726	203,000	14,022
1995	568,654	88,009	267,529	4,500	110,000	98,616
1996	877,058	52,556	394,509	207,496	110,000	112,497
1997	1,050,665	225,783	435,439	74,144	110,000	205,299
1998	779,725	86,300	240,511	234,810	110,000	108,104
1999	1,422,162	274,918	593,730	276,095	110,000	167,419
2000	1,423,515	222,548	525,126	386,205	110,000	179,636
2001	1,689,258	625,380	574,608	169,668	110,000	209,602
2002	1,377,956	504,300	260,013	204,132	110,000	299,511
2003	2,075,631	453,584	326,038	247,889	660,290	387,830
2004	2,005,480	384,928	476,517	198,565	619,700	325,770
2005	2,037,878	338,389	546,252	219,406	619,700	314,131
2006	1,905,903	260,733	479,629	240,598	619,700	305,243
2007	1,995,490	426,431	410,529	213,833	619,700	324,997
2008	2,086,382	379,163	459,084	265,850	619,700	362,585
2009	2,221,663	453,272	445,118	244,407	664,195	414,671
2010	2,223,907	399,099	543,793	292,504	625,622	362,890
2011	2,107,580	398,476	529,471	265,138	619,700	294,796
Total	33,018,568	7,717,426	8,984,681	3,840,131	7,707,307	4,769,025

SOURCES: Calculations based on author-collected data. For details see Technical Appendix A.

NOTES: The table includes actual short-term transfers and total commitments under long-term and permanent contracts. The table includes purchases by state-run water banks and by various CVP and SWP user pools. "Direct government purchases" are purchases by federal or state agencies; "Within CVP", "Within SWP", and "Within Colorado River Project" are trades between local entities that both operate within those projects. "Open market" includes all other trades.

TABLE B3a
Water Purchases by Type of End User, Volume Traded (acre-feet)

Year	Total Purchases	Environment	Municipal and Industrial	San Joaquin Valley Farmers	Sacramento Valley Farmers	Other Farmers	Mixed Purpose
1982	142,141	0	0	41,144	0	0	100,997
1983	125,466	0	62,820	3,954	0	0	58,692
1984	61,306	4,771	0	25,855	0	0	30,680
1985	75,781	3,308	5,000	44,518	0	768	22,187
1986	156,669	0	5,000	69,589	13,740	0	68,340
1987	278,143	0	110,044	49,912	10,350	0	107,837
1988	320,872	0	110,500	38,878	12,366	0	159,128
1989	362,674	78,000	131,043	123,412	30,219	0	0
1990	416,507	1,500	145,535	126,057	34,415	0	109,000
1991	669,889	64,612	477,292	121,770	5,365	850	0
1992	493,306	49,201	197,473	166,090	12,763	400	67,379
1993	508,772	0	233,208	263,697	11,867	0	0
1994	620,764	105,984	203,997	286,724	24,029	30	0
1995	520,121	88,009	132,667	291,438	8,007	0	0
1996	828,525	52,556	201,189	506,548	29,113	0	39,119
1997	992,960	226,652	176,402	440,822	14,084	0	135,000
1998	625,882	87,169	205,956	212,079	65,678	0	55,000
1999	1,326,280	275,285	196,254	754,769	72,582	10	27,380
2000	1,292,512	183,797	260,002	742,943	72,057	0	33,713
2001	1,460,250	446,208	338,098	514,715	121,304	0	39,925
2002	1,120,401	402,423	322,786	306,339	43,374	6	45,474
2003	1,311,525	385,499	449,075	338,661	47,412	94	90,784
2004	1,242,463	343,180	321,110	445,328	73,941	2,233	56,671
2005	1,355,815	238,230	462,252	535,649	44,367	1,476	73,841
2006	1,281,956	213,742	478,006	450,776	59,111	1,123	79,198
2007	1,356,372	403,359	448,103	370,578	59,336	1,068	73,928
2008	1,292,347	239,942	534,117	351,002	102,942	298	64,046
2009	1,500,153	178,354	737,542	405,383	110,283	684	67,907
2010	1,711,877	243,935	846,090	510,866	64,138	0	46,848
2011	1,429,139	243,687	606,401	489,133	49,172	26	40,720
Total	24,880,868	4,559,403	8,397,962	9,028,629	1,192,015	9,066	1,693,794

SOURCES: Calculations based on author-collected data. For details see Technical Appendix A.

NOTES: The table includes estimated market flows under short-term, long-term, and permanent contracts. The table includes sales by state-run water banks and by various CVP and SWP user pools. In some years, these volumes are lower than totals including purchases by banks and pools (e.g., Technical Appendix Table B1 and B2) because the banks and pools did not sell the entire volume purchased. In 1991, there is a particularly large discrepancy because DWR did not sell roughly 400,000 af of water it acquired through the drought water bank (see discussion in report).

TABLE B3b
Water Purchases by Type of End User, Volume Committed (acre-feet)

Year	Total Purchases	Environment	Municipal and Industrial	San Joaquin Valley Farmers	Sacramento Valley Farmers	Other Farmers	Mixed Purpose
1982	129,678	0	0	28,681	0	0	100,997
1983	138,240	0	62,820	16,728	0	0	58,692
1984	65,900	4,771	0	30,449	0	0	30,680
1985	78,588	3,308	5,000	47,325	0	768	22,187
1986	160,994	0	5,000	73,914	13,740	0	68,340
1987	282,544	0	110,044	54,313	10,350	0	107,837
1988	320,872	0	110,500	38,878	12,366	0	159,128
1989	362,674	78,000	131,043	123,412	30,219	0	0
1990	416,507	1,500	145,535	126,057	34,415	0	109,000
1991	669,889	64,612	477,292	121,770	5,365	850	0
1992	558,005	49,201	262,172	166,090	12,763	400	67,379
1993	508,783	0	233,219	263,697	11,867	0	0
1994	649,076	105,984	232,309	286,724	24,029	30	0
1995	568,654	8,8009	181,200	291,438	8,007	0	0
1996	877,058	52,556	249,722	506,548	29,113	0	39,119
1997	1,049,493	226,652	232,935	440,822	14,084	0	135,000
1998	681,082	87,169	261,156	212,079	65,678	0	55,000
1999	1,422,242	275,787	255,454	754,769	72,582	10	63,640
2000	1,423,515	223,417	345,125	742,943	72,057	0	39,973
2001	1,697,900	487,443	508,329	517,139	138,804	0	46,185
2002	1,374,454	483,119	490,369	307,852	56,374	6	36,734
2003	2,075,515	543,098	951,288	340,579	60,412	94	180,044
2004	1,979,791	484,267	805,841	451,260	86,941	2,233	149,249
2005	2,017,880	438,378	816,912	538,046	57,494	1,476	165,574
2006	1,905,664	360,102	806,039	501,002	72,238	1,123	165,160
2007	2,002,870	527,300	813,327	423,019	72,428	1,068	165,728
2008	2,086,382	301,753	877,199	414,751	127,146	266	365,267
2009	2,221,662	301,870	966,713	456,471	130,371	642	365,596
2010	2,223,907	321,683	941,674	548,300	77,090	0	335,160
2011	2,107,580	310,390	850,863	549,014	62,127	26	335,160
Total	32,057,399	5,820,369	12,129,080	9,374,070	1,358,060	8,992	3,366,82

SOURCES: Calculations based on author-collected data. For details see Technical Appendix A.

NOTES: The table includes actual short-term transfers and total commitments under long-term and permanent contracts. The table includes sales by state-run water banks and by various CVP and SWP user pools. In some years, these volumes are lower than totals including purchases by banks and pools (e.g., Technical Appendix Table B1 and B2) because the banks and pools did not sell the entire volume purchased. In 1991, there is a particularly large discrepancy because DWR did not sell roughly 400,000 of water it acquired through the drought water bank (see discussion in report).

TABLE B4a
Water Transfers by Region of Origin and Region of Destination, Volume Traded (acre-feet)

Sales by Water Users							Purchases by Non-Environmental Water Users					
Year	Sacramento Valley	San Joaquin Valley	Southern California	San Francisco Bay Area	Central Coast	Other	Sacramento Valley	San Joaquin Valley	Southern California	San Francisco Bay Area	Central Coast	Other
1982	12,480	104,677	25,157	0	0	0	12,480	129,661	0	0	0	0
1983	3,845	124,380	605	0	0	0	122	62,524	62,820	0	0	0
1984	11,035	44,028	8,785	0	0	0	4,282	52,253	0	0	0	0
1985	4,823	51,510	9,887	5,018	0	0	4,943	61,762	750	5,018	0	0
1986	13,740	106,539	6,247	5,000	0	0	13,740	137,929	0	5,000	0	0
1987	93,450	68,478	116,171	44	0	0	10,350	74,649	110,000	44	0	83,100
1988	131,397	78,975	110,500	0	0	0	12,366	78,975	110,500	0	0	119,031
1989	301,023	69,099	110,000	39,000	0	0	30,219	123,412	110,000	21,043	0	0
1990	252,328	155,456	110,000	11,700	0	80	34,415	126,057	110,000	35,535	0	109,000
1991	900,720	40,132	111,206	53,905	0	250	5,365	121,770	325,736	152,156	0	250
1992	221,621	156,660	142,364	11,007	0	0	12,763	166,090	152,364	45,509	0	67,379
1993	17,910	252,952	208,084	30,650	0	0	11,867	263,697	202,989	30,219	0	0
1994	303,038	226,638	176,788	4,933	0	15,886	26,298	287,124	175,568	25,760	0	30
1995	67,816	341,638	110,000	667	0	0	10,007	311,438	110,000	667	0	0
1996	41,113	559,282	144,500	20,267	63,363	0	33,113	526,548	215,641	667	0	0
1997	148,658	710,161	118,108	10,860	6,345	0	114,084	460,827	190,730	667	0	0
1998	74,901	410,315	220,898	4,869	13,542	0	68,378	232,179	232,156	6,000	0	0
1999	91,992	941,451	247,096	10,519	35,132	10	75,582	775,377	198,026	2,000	0	10
2000	102,076	827,063	330,551	5,869	26,953	0	82,334	793,243	187,926	45,212	0	0
2001	494,978	783,129	125,120	48,366	0	15	139,150	585,536	234,823	49,384	5,149	0
2002	247,989	669,221	192,277	13,554	845	17	60,312	386,620	228,614	42,109	324	0
2003	281,118	824,030	182,609	23,869	0	15	63,213	422,706	371,536	68,434	43	94
2004	247,928	815,680	198,792	5,739	0	13	89,129	537,400	238,874	33,758	122	0
2005	99,353	925,330	301,763	49,250	105	12	58,731	628,655	376,300	53,619	260	20
2006	147,578	799,221	324,080	10,769	528	19	74,135	555,395	381,743	53,413	528	3,000
2007	135,939	871,792	330,590	10,540	111	20	63,539	476,724	367,187	38,452	111	7,000
2008	349,149	576,552	330,381	28,771	411	7,083	122,019	452,588	437,980	39,367	451	0
2009	439,249	580,359	460,493	10,286	6,335	3,432	121,800	511,770	636,167	45,702	6,360	0
2010	316,951	841,288	499,675	48,079	251	3,432	78,257	576,442	738,450	48,183	111	26,499
2011	173,007	760,775	461,065	25,995	2,659	3,432	61,798	540,141	526,112	57,290	111	0
Total	5,727,205	13,716,811	5,713,792	489,526	156,580	33,716	1,494,791	10,459,492	7,032,992	905,207	13,570	415,413

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes estimated market flows under short-term, long-term, and permanent contracts. "Sales" include purchases by various banks and pools. "Purchases" include sales by banks and pools. "Other" includes transfers for which the region is unavailable (including the SWP turnback pool and the state-run drought water bank).

TABLE B4b
Water Transfers by Region of Origin and Region of Destination, Volume Committed (acre-feet)

Sales by Water Users							Purchases by Non-Environmental Water Users					
Year	Sacramento Valley	San Joaquin Valley	Southern California	San Francisco Bay Area	Central Coast	Other	Sacramento Valley	San Joaquin Valley	Southern California	San Francisco Bay Area	Central Coast	Other
1982	12,480	104,677	12,694	0	0	0	12,480	117,198	0	0	0	0
1983	3,845	124,380	13,379	0	0	0	122	75,298	62,820	0	0	0
1984	11,035	44,028	13,379	0	0	0	4,282	56,847	0	0	0	0
1985	4,823	51,510	12,694	5,018	0	0	4,943	64,569	750	5,018	0	0
1986	13,740	106,539	10,572	5,000	0	0	13,740	142,254	0	5,000	0	0
1987	93,450	68,478	120,572	44	0	0	10,350	79,050	110,000	44	0	83,100
1988	131,397	78,975	110,500	0	0	0	12,366	78,975	110,500	0	0	119,031
1989	301,023	69,099	110,000	39,000	0	0	30,219	123,412	110,000	21,043	0	0
1990	252,328	155,456	110,000	11,700	0	80	34,415	126,057	110,000	35,535	0	109,000
1991	900,720	40,132	113,206	53,905	0	250	5,365	121,770	325,736	152,156	0	250
1992	221,621	156,660	207,063	11,007	0	0	12,763	166,090	217,063	45,509	0	67,379
1993	17,910	252,952	208,095	30,650	0	0	11,867	263,697	203,000	30,219	0	0
1994	303,038	226,638	205,100	4,933	0	15,886	26,298	287,124	203,880	25,760	0	30
1995	67,816	388,838	110,000	2,000	0	0	10,007	358,638	110,000	2,000	0	0
1996	41,113	606,482	144,500	21,600	63,363	0	33,113	573,748	215,641	2,000	0	0
1997	148,658	757,361	118,108	20,193	6,345	0	114,084	508,027	198,730	2,000	0	0
1998	74,901	457,515	220,898	12,869	13,542	0	68,378	279,379	240,156	6,000	0	0
1999	91,992	1,025,413	247,096	22,519	35,132	10	75,582	852,577	205,026	13,260	0	10
2000	120,799	929,343	330,551	15,869	26,953	0	101,057	840,443	200,926	57,672	0	0
2001	528,528	955,106	148,240	57,369	0	15	170,180	644,352	308,643	82,133	5,149	0
2002	273,051	896,851	182,638	24,554	845	17	85,374	494,060	247,674	63,903	324	0
2003	307,777	1,022,280	709,690	35,869	0	15	89,872	546,282	812,992	83,134	43	94
2004	274,980	1,053,533	659,215	17,739	0	13	116,181	670,524	649,139	59,558	122	0
2005	127,116	1,183,065	666,330	61,250	105	12	86,494	750,825	672,984	68,919	260	20
2006	176,360	1,026,237	677,990	24,769	528	19	102,917	711,702	667,385	63,030	528	0
2007	174,234	1,148,144	660,441	12,540	111	20	101,834	639,441	667,312	66,872	111	0
2008	490,770	907,598	651,029	29,491	411	7,083	162,984	625,826	719,264	76,104	451	200,000
2009	527,759	981,931	691,420	10,786	6,335	3,432	162,676	667,747	807,880	75,130	6,360	200,000
2010	355,546	1,162,290	651,809	48,079	551	3,432	106,290	729,500	757,982	81,542	411	226,499
2011	346,682	1,054,988	666,985	30,329	2,959	3,432	91,127	730,326	684,012	91,314	411	200,000
Total	6,395,492	17,036,499	8,782,194	609,082	157,180	33,716	1,857,360	12,325,738	9,619,495	1,214,855	14,170	1,205,413

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes actual short-term transfers and total commitments under long-term and permanent contracts. "Sales" include purchases by various banks and pools. "Purchases" include sales by banks and pools. "Other" includes transfers for which the region is unavailable (including the SWP turnback pool and the state-run drought water bank).

TABLE B5a
Source Regions for Environmental Water Purchases, Volume Traded (acre-feet)

Year	Sacramento Valley	San Joaquin Valley	Southern California	San Francisco Bay Area	Far North	Other
1982	0	0	0	0		0
1983	0	0	0	0		0
1984	0	4,771	0	0		0
1985	0	3,308	0	0		0
1986	0	0	0	0		0
1987	0	0	0	0		0
1988	0	0	0	0		0
1989	39,000	0	0	39,000		0
1990	1,500	0	0	0		0
1991	64,612	0	0	0		0
1992	0	20,000	0	4,736		24,465
1993	0	0	0	0		0
1994	0	90,128	0	0		15,856
1995	57,809	30,200	0	0		0
1996	0	52,556	0	0		0
1997	29,800	195,983	0	869		0
1998	6,300	80,000	0	869		0
1999	6,300	268,116	0	869		0
2000	6,300	176,628	0	869		0
2001	83,780	331,544	0	30,869		15
2002	152,958	246,380	2,199	869		17
2003	76,214	286,526	1,875	20,869		15
2004	125,000	200,921	16,377	869		13
2005	15,344	180,474	17,027	25,373		12
2006	69,300	122,322	21,232	869		19
2007	69,300	305,756	27,414	869		20
2008	73,122	133,058	32,893	869		0
2009	74,211	70,226	32,938	979		0
2010	80,164	124,718	35,760	1,092	2,201	0
2011	86,682	110,311	32,500	11,988	2,206	0
Total	1,117,696	3,033,926	220,215	142,727	4,407	40,432

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes estimated market flows under short-term, long-term, and permanent contracts. It includes sales by various banks and pools. "Other" includes transfers for which the location is unavailable.

TABLE B5b
Source Regions for Environmental Water Purchases, Volume Committed (acre-feet)

Year	Sacramento Valley	San Joaquin Valley	Southern California	San Francisco Bay Area	Far North	Other
1982	0	0	0	0	0	
1983	0	0	0	0	0	
1984	0	4,771	0	0	0	0
1985	0	3,308	0	0	0	0
1986	0	0	0	0	0	
1987	0	0	0	0	0	
1988	0	0	0	0	0	
1989	39,000	0	0	39,000	0	0
1990	1,500	0	0	0	0	0
1991	64,612	0	0	0	0	0
1992	0	20,000	0	4,736	0	24,465
1993	0	0	0	0	0	
1994	0	90,128	0	0	0	15,856
1995	57,809	30,200	0	0	0	0
1996	0	52,556	0	0	0	0
1997	29,800	195,983	0	869	0	0
1998	6,300	80,000	0	869	0	0
1999	6,300	268,618	0	869	0	0
2000	6,300	216,248	0	869	0	0
2001	86,300	370,259	0	30,869	0	15
2002	152,958	326,775	2,500	869	0	17
2003	76,214	343,500	102,500	20,869	0	15
2004	125,000	255,885	102,500	869	0	13
2005	15,344	295,149	102,500	25,373	0	12
2006	69,300	187,414	102,500	869	0	19
2007	69,300	354,611	102,500	869	0	20
2008	31,021	167,363	102,500	869	0	0
2009	31,028	167,363	102,500	979	0	0
2010	31,028	184,863	102,500	1,092	2,201	0
2011	31,028	162,669	102,500	11,988	2,206	0
Total	930,141	3,777,663	925,000	142,727	4,407	40,432

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes actual short-term transfers and total commitments under long-term and permanent contracts. It includes sales by various banks and pools. "Other" includes transfers for which the location is unavailable.

TABLE B6a
Average Annual Transfers by Region of Origin and Destination: 1987–1994 (acre-feet)

REGION OF ORIGIN (SALES)	REGION OF DESTINATION (PURCHASES)								Total Sales b/	Total Non-Environmental Exports d/
	San Francisco Bay Area	Central Coast	Sacramento Valley	Southern California	San Joaquin Valley	Region Unknown a/	Statewide Bank/Pool Purchases	Environment		
San Francisco Bay Area	4,351	-	-	-	1,459	1,000	6,629	5,467	18,905	9,088
Central Coast	-	-	-	-	-	-	-	-	-	-
Sacramento Valley	8,854	-	17,955	-	5,527	32,207	179,980	13,139	257,662	226,568
Southern California	-	-	-	133,880	1,759	-	-	-	135,639	1,759
San Joaquin Valley	636	-	-	-	94,827	14,107	7,713	13,766	131,049	22,456
Region Unknown a/	-	-	-	-	10	35	-	-	45	10
Statewide Bank/Pool Sales	24,943	-	-	28,265	51,640	-	-	3,058	107,905	
Environment	-	-	-	-	-	-	-	1,982	1,982	
Total Purchases c/	38,783	-	17,955	162,145	155,222	47,349	194,322	35,430		
Total Non-Environmental Imports d/	34,433	-	-	28,265	60,395	47,314				
Total Net Non-Environmental Imports (Exports) e/	25,345	-	(226,568)	26,506	37,939	47,304				

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes estimated market flows under short-term, long-term, and permanent contracts.

a/ The “region unknown” category includes trades outside of banks or pools for which the location could not be identified.

b/ “Total sales” correspond to regional sales in Technical Appendix Table B4a, with the exception of the Sacramento Valley, for which totals here were calculated using sales by Sacramento Valley CVP pools (which sometimes sell to out-of-region entities). (Table B4a sales include purchases by these pools.) The discrepancy arises because these pools do not operate in balance in all years (sometimes purchasing more than they sell, especially in the first period, 1987–1994). In some years, total sales by the statewide banks and pools also exceeded volumes acquired by the banks or pools. The discrepancy was particularly high for the state-run drought water bank in 1991 (see discussion in main report).

c/ “Total purchases” correspond to regional average purchases in Technical Appendix Table B4a.

d/ “Total non-environmental imports” include purchases from statewide banks and pools, which could originate in the region in which they are purchased by end-users. Likewise, “total non-environmental exports” includes sales to statewide banks and pools, which could end up being sold to end-users in the region in which they are acquired.

e/ “Total net non-environmental imports (exports)” equals “total non-environmental imports” minus “total non-environmental exports.”

TABLE B6b
Average Annual Transfers by Region of Origin and Destination: 1995–2002 (acre-feet)

REGION OF ORIGIN (SALES)	REGION OF DESTINATION (PURCHASES)						Statewide Bank/Pool Purchases	Environment	Total Sales b/	Total Non-environmental Exports d/
	San Francisco Bay Area	Central Coast	Sacramento Valley	Southern California	San Joaquin Valley	Region Unknown a/				
San Francisco Bay Area	1,740	-	-	1,875	2,783	-	3,572	4,402	14,371	8,229
Central Coast	-	-	-	-	118	-	18,154	-	18,273	18,273
Sacramento Valley	1,052	-	72,870	1,815	16,505	-	24,069	42,906	159,218	43,442
Southern California	-	-	-	116,077	2,650	-	67,067	275	186,069	69,717
San Joaquin Valley	14,613	-	-	29,573	400,187	-	38,233	172,676	655,283	82,420
Region Unknown a/	-	-	-	-	-	1	-	-	1	-
Statewide Bank/Pool Sales	931	684	-	50,399	86,728	-	-	-	138,743	-
Environment	-	-	-	-	-	-	-	4	4	-
Total Purchases c/	18,337	684	72,870	199,740	508,971	1	151,095	220,258		
Total Non-environmental Imports d/	16,597	684	-	83,663	108,784	-				
Total Net Non-environmental Imports (Exports) e/	8,368	(17,588)	(43,442)	13,946	26,364	1				

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: See notes to Technical Appendix Table B6a.

TABLE B6c
Average Annual Transfers by Region of Origin and Destination: 2003-2011 (acre-feet)

REGION OF ORIGIN (SALES)	REGION OF DESTINATION (PURCHASES)								Total Sales b/	Total Non-environmental Exports d/
	San Francisco Bay Area	Central Coast	Sacramento Valley	Southern California	San Joaquin Valley	Region Unknown a/	Statewide Bank/Pool Purchases	Environment		
San Francisco Bay Area	3,216	-	-	5,782	7,238	-	377	7,086	23,700	13,397
Central Coast	-	857	-	-	283	-	16	-	1,156	299
Far North	-	-	-	-	-	-	-	490	490	-
Sacramento Valley	3,118	-	79,642	42,640	17,861	2,947	17,203	74,371	237,781	83,768
Southern California	-	-	-	304,289	1,118	1,111	12,350	24,224	343,287	14,774
San Joaquin Valley	39,317	-	-	83,032	483,957	-	440	170,479	777,334	122,897
Region Unknown a/	1,525	-	-	406	-	-	-	-	1,931	1,931
Statewide Bank/Pool Sales	1,514	43	1,263	16,557	11,968	10	-	-	31,355	
Environment	-	-	497	-	-	-	-	9		
Total Purchases c/	48,691	900	81,402	452,705	522,425	4,068	30,565	276,659		
Total Non-environmental Imports d/	45,475	43	1,760	148,417	38,467	4,058				
Total Net Non-environmental Imports (Exports) e/	32,078	(256)	(82,008)	133,643	(84,430)	2,127				

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: See notes to Table B6a.

TABLE B7a
Average Annual Transfers by San Joaquin Valley Sub-Region of Origin and Destination: 1987–1994 (acre-feet)

SUB-REGION OF ORIGIN (SALES)	SUB-REGION OF DESTINATION (PURCHASES)							Total Sales
	Eastside, Other	Eastside, Senior	Westside, Other	Westside, Senior	Environment	Statewide Bank/Pool Purchases	Other Region	
Eastside, Other	12,812	-	20,849	-	-	-	14,107	47,768
Eastside, Senior	-	-	424	-	11,446	7,713	611	20,195
Westside, Other	918	-	47,513	191	796	-	25	49,444
Westside, Senior	38	71	11,383	628	1,524	-	-	13,643
Environment	-	-	-	-	-	-	-	-
Statewide Bank/Pool Sales	-	-	51,421	219	-	-	-	51,640
Other Region	-	-	8,755	-	-	-	-	8,755
Total Purchases	13,768	71	140,346	1,038	13,766	7,713	14,743	
Net Imports (Exports)	(34,000)	(20,124)	90,901	(12,605)				

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes estimated market flows under short-term, long-term, and permanent contracts. "Eastside, Senior" includes pre-1914 water rights holders on San Joaquin River tributaries and some entities located on the eastern side of the valley with senior access to CVP flows under "settlement" contracts. "Westside, Senior" includes entities on the western side of the valley with senior access to CVP flows under "settlement" or "exchange" contracts. "Westside, Other" includes CVP service contractors located on the western side of the San Joaquin Valley and all SWP contractors and sub-contractors, whether located on the eastern or western side of the valley. "Eastside, Other" includes entities on the eastern side of the San Joaquin Valley not falling into the other categories. "Net imports (exports)" equal "total purchases" minus "total sales."

TABLE B7b
Average Annual Transfers by San Joaquin Valley Sub-region of Origin and Destination: 1995–2002 (acre-feet)

SUB-REGION OF DESTINATION (PURCHASES)								
SUB-REGION OF ORIGIN (SALES)	Eastside, Other	Eastside, Senior	Westside, Other	Westside, Senior	Environment	Statewide Bank/Pool Purchases	Other Region	Total Sales
Eastside, Other	97,057	-	79,257	-	916	-	6,058	183,287
Eastside, Senior	34,375	-	4,015	-	100,395	-	-	138,785
Westside, Other	1,057	-	155,055	458	33,960	38,233	38,129	266,891
Westside, Senior	138	-	28,685	91	37,406	-	-	66,320
Environment	-	-	-	-	-	-	-	-
Statewide Bank/Pool Sales	-	-	86,728	-	-	-	-	86,728
Other Region	375	-	21,681	-	-	-	-	22,056
Total Purchases	133,001	-	375,422	549	172,676	38,233	44,187	
Net Imports (Exports)	(50,286)	(138,785)	108,530	(65,771)				

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: See notes to Table B7a.

TABLE B7c
Average Annual Transfers by San Joaquin Valley Sub-region of Origin and Destination: 2003-2011 (acre-feet)

SUB-REGION OF DESTINATION (PURCHASES)								
SUB-REGION OF ORIGIN (SALES)	Eastside, Other	Eastside, Senior	Westside, Other	Westside, Senior	Environment	Statewide Bank/Pool Purchases	Other Region	Total Sales
Eastside, Other	138,717	-	96,369	5	5,149	-	5,095	245,336
Eastside, Senior	70,979	-	16,571	-	72,304	-	-	159,854
Westside, Other	1,367	267	107,125	4,724	53,605	440	113,663	281,192
Westside, Senior	1,471	-	46,676	31	39,420	-	3,591	91,189
Environment	-	-	-	-	-	-	-	-
Statewide Bank/Pool Sales	-	-	11,968	-	-	-	-	11,968
Other Region	-	-	26,301	199	-	-	-	26,499
Total Purchases	212,534	267	305,010	4,959	170,479	440	122,349	
Net Imports (Exports)	(32,801)	(159,587)	23,819	(86,339)				

SOURCES: Calculations based on author-collected data. See Technical Appendix A for details.

NOTES: See notes to Table B7a.

TABLE B8
Permanent Transfers

Year	Seller	Buyer	Maximum Delivery (af/year)	Purpose	Region of Origin	Region of Destination	Within Project?
1997	City of Petaluma	CDF&G	869	M&I to Env	Bay Area	Bay Area	No
1998	Berrenda Mesa WD	Mojave WA	25,000	Agr to M&I	SJ Valley	So Cal	SWP
1998	Corning WD	USF&WS	2,300	Agr to Env	Sac Valley	Sac Valley	No
1998	Proberta WD	USF&WS	2,000	Agr to Env	Sac Valley	Sac Valley	No
1998	Thomes Creek WD	USF&WS	2,000	Agr to Env	Sac Valley	Sac Valley	No
2000	Belridge WSD	Palmdale WD	4,000	Agr to M&I	SJ Valley	So Cal	SWP
2000	Berrenda Mesa WD	Alameda Cty FCWCD	7,000	Agr to M&I	SJ Valley	Bay Area	SWP
2000	Lost Hills WD	Alameda Cty FCWCD	15,000	Agr to M&I	SJ Valley	Bay Area	SWP
2000	Wheeler Ridge-Maricopa WSD	Castaic Lake WA	41,000	Agr to M&I	SJ Valley	So Cal	SWP
2001	Belridge WSD	Alameda Cty FCWCD	10,000	Agr to M&I	SJ Valley	Bay Area	SWP
2001	Belridge WSD	Napa Cty FCWCD	4,025	Agr to M&I	SJ Valley	Bay Area	SWP
2001	Belridge WSD	Solano Cty WA	5,756	Agr to M&I	SJ Valley	Bay Area	SWP
2001	Tulare Lake Basin WSD	Dudley Ridge WD	3,973	Agr to Agr	SJ Valley	SJ Valley	SWP
2001	Olcese WD	Kern Cty WA	50,000	Agr to Agr	SJ Valley	SJ Valley	No
2001	Tulare Lake Basin WSD	Antelope Valley-East Kern WA	3,000	Agr to M&I	SJ Valley	SJ Valley	SWP
2002	Lower Tule River ID	City of Orange Cove	2,000	Agr to M&I	SJ Valley	SJ Valley	CVP
2002	Mercy Springs WD	Westlands WD	1,071	Agr to Agr	SJ Valley	SJ Valley	CVP
2003	Angiola WD	Westlands WD	5,000	Agr to Agr	SJ Valley	SJ Valley	No
2003	Banta-Carbona ID	City of Tracy	3,750	Agr to M&I	SJ Valley	SJ Valley	CVP
2003	Belridge WSD	Alameda Cty FCWCD	2,219	Agr to M&I	SJ Valley	Bay Area	SWP
2003	Berrenda Mesa WD	West Kern WD	6,500	Agr to M&I	SJ Valley	SJ Valley	SWP
2003	Centinella WD	Westlands WD	2,400	Agr to Agr	SJ Valley	SJ Valley	CVP
2003	Tulare Lake Basin WSD	Kings County	5,000	Agr to Agr	SJ Valley	SJ Valley	SWP
2003	Tulare Lake Basin WSD	Alameda Cty FCWCD	400	Agr to M&I	SJ Valley	Bay Area	SWP
2003	Westside ID	City of Tracy	3,750	Agr to M&I	SJ Valley	SJ Valley	CVP
2004	Tulare Lake Basin WSD	Coachella Valley WD	9,900	Agr to All	SJ Valley	So Cal	SWP
2005	Berrenda Mesa WD	Coachella Valley WD	16,000	Agr to All	SJ Valley	So Cal	SWP
2005	Berrenda Mesa WD	Dublin San Ramon SD	6,000	Agr to M&I	SJ Valley	Bay Area	SWP
2005	Pebble Beach Company	Del Monte Forest residential property owners	105	M&I to M&I	Central Coast	Central Coast	No
2005	Tulare Lake Basin WSD	Kings County	305	Agr to Agr	SJ Valley	SJ Valley	SWP
2005	Widren WD	Westlands WD	2,990	Agr to Agr	SJ Valley	SJ Valley	CVP
2005	Anderson-Cottonwood ID	USF&WS	3,000	Agr to Env	Sac Valley	Sac Valley	CVP

TABLE B8 (continued)
Permanent Transfers

Year	Seller	Buyer	Maximum Delivery (af/year)	Purpose	Region of Origin	Region of Destination	Within Project?
2006	Broadview WD	Westlands WD	27,000	Agr to Agr	SJ Valley	SJ Valley	CVP
2006	Pebble Beach Company	Del Monte Forest residential property owners	2	M&I to M&I	Central Coast	Central Coast	No
2006	Pebble Beach Company	Del Monte Forest residential property owners	4	M&I to M&I	Central Coast	Central Coast	No
2006	City of Santa Monica	Golden State Water Company	900	M&I to M&I	So Cal	So Cal	No
2007	Santa Monica Real Estate Holdings	Borrego WD	150	Agr to Env	Unknown	So Cal	No
2007	Santa Monica Real Estate Holdings	Developer	25	Agr to M&I	Unknown	Unknown	No
2008	Shell Oil	Tesoro Refining & Marketing Company	3,432	M&I to M&I	Unknown	Bay Area	No
2008	M&T Inc. & Parrot Investment Company	CDF&G, NMFS	21,721	Agr to Env	Sac Valley	Sac Valley	No
2009	Dudley Ridge WD	Mojave WA	14,000	Agr to M&I	SJ Valley	So Cal	SWP
2009	PG&E	CDF&G	6.6	Agr to Env	Sac Valley	Sac Valley	No
2009	Warren T. Weber	CDF&G, NMFS, Marin RCD	110	Agr to Env	Bay Area	Bay Area	No
2010	John Spencer	CDF&G, Scott River Trust	188	Agr to Env	Far North	Far North	No
2010	Ed Gozarino et al.	CDF&G, Scott River Trust	13	Agr to Env	Far North	Far North	No
2010	John Letton	CDF&G	2,000	Agr to Env	Far North	Far North	No
2010	North Marin WD	CDF&G, Lagunitas Creek Watershed Working Group, NMFS	112	M&I to Env	Bay Area	Bay Area	No
2011	Eastern Municipal WD	CDF&G	2,500	M&I to Env	So Cal	So Cal	No
2011	Hayden Ranch Family Limited Partnership	CDF&G, Scott River Trust	5	Agr to Env	Far North	Far North	No
2011	U.S. National Park Service	CDF&G, Giacomini Wetland Restoration Project	896	Agr to Env	Bay Area	Bay Area	No
2012	Oro Loma WD	Westlands WD	4,000	Agr to Agr	SJ Valley	SJ Valley	CVP
2012	Southern San Joaquin MUD	Kern-Tulare WD	5,000	Agr to Agr	SJ Valley	SJ Valley	CVP

SOURCES: based on author-collected data. See Technical Appendix A for details.

NOTES: Seller and Buyer acronyms: California Department of Fish and Game (CDF&G), East Bay Municipal Utilities District (EBMUD), flood control and water conservation district (FCWCD), irrigation district (ID), limited liability corporation (LLC), Metropolitan Water District of Southern California (MWDSC), municipal utility district (MUD), National Marine Fisheries Service (NMFS), resource conservation district (RCD), services district (SD), U.S. Fish and Wildlife Service (USF&WS), water agency (WA), water district (WD), water management authority (WMA), water storage district (WSD). Purpose abbreviations: agriculture (Agr), environment (Env), municipal and industrial (M&I). In some cases for mixed use entities ("Mixed"), purpose has been assigned by authors based on principal use (agricultural or municipal and industrial). Regional abbreviations: Sacramento Valley (Sac Valley), San Francisco Bay Area (Bay Area), San Joaquin Valley (SJ Valley), Southern California (So Cal). Where specific information on environmental transfers was not available, we have assumed that they are for use within the source region.

TABLE B9
Long-Term Transfers

Year	Seller	Buyer	Maximum Delivery (af/year)	Contract Duration (years)	Purpose	Region of Origin	Region of Destination	Within Project?
1979	MWDSC	Kern County WA	10,572	9	M&I to Agr	So Cal	SJ Valley	SWP
1982	MWDSC	Dudley Ridge WD	2,122	4	M&I to Agr	So Cal	SJ Valley	SWP
1983	MWDSC	Devil's Den WD	685	2	M&I to Agr	So Cal	SJ Valley	SWP
1987	Imperial ID	MWDSC	110,000	35	Agr to M&I	So Cal	So Cal	Colorado R.
1992	Palo Verde ID	MWDSC	93,000	3	Agr to M&I	So Cal	So Cal	Colorado R.
1995	Byron-Bethany ID	Alameda County FCWCD, Zone 7	2,000	5	Agr to M&I	Bay Area	Bay Area	No
1995	Modesto ID	City of Modesto	67,200	10	Agr to M&I	SJ Valley	SJ Valley	No
1997	Solano County WA	Mojave WA	10,000	10	M&I to M&I	Bay Area	So Cal	SWP
1998	Westside WD	Colusa County WD	25,000	25	Agr to Agr	Sac Valley	Sac Valley	CVP
1999	Byron-Bethany ID	Alameda County FCWCD, Zone 7	5,000	15	Agr to M&I	Bay Area	Bay Area	No
1999	Merced ID	USF&WS	12,500	13	Agr to Env	SJ Valley	SJ Valley	No
1999	Mercy Springs WD	Pajaro Valley WMA, Santa Clara Valley WD, Westlands WD	6,260	25	Agr to Mixed	SJ Valley	Bay Area	CVP
1999	Oakdale ID	Stockton East WD	15,000	11	Agr to Mixed	SJ Valley	SJ Valley	No
1999	Oakdale ID	USF&WS	15,000	13	Agr to Env	SJ Valley	SJ Valley	No
1999	San Joaquin River Group Authority	USF&WS	110,000	13	Agr to Env	SJ Valley	SJ Valley	No
1999	South San Joaquin ID	Stockton East WD	15,000	11	Agr to Mixed	SJ Valley	SJ Valley	No
2000	Oakdale ID	USF&WS	11,000	12	Agr to Env	SJ Valley	SJ Valley	No
2000	Placer County WA	Sacramento Suburban WD	29,000	25	Mixed to M&I	Sac Valley	Sac Valley	No
2001	Kern County WA	Western Hills WD	8,000	35	Agr to M&I	SJ Valley	SJ Valley	No
2001	San Bernardino Valley Municipal WD	MWDSC	20,000	14	M&I to M&I	So Cal	So Cal	SWP
2002	South San Joaquin ID	Cities of Escalon, Manteca, Lathrop	75,000	30	Agr to M&I	Bay Area	Bay Area	No
2003	Coachella Valley WD	MWDSC and San Luis Rey Indians	4,500	75	Mixed to M&I	So Cal	So Cal	Colorado R.
2003	Coachella Valley WD	San Diego County Water Authority	21,500	75	Mixed to M&I	So Cal	So Cal	Colorado R.
2003	Imperial ID	Coachella Valley WD	103,000	75	Agr to Mixed	So Cal	So Cal	Colorado R.
2003	Imperial ID	MWDSC and San Luis Rey Indians	11,500	75	Agr to M&I	So Cal	So Cal	Colorado R.

TABLE B9 (continued)
Long Term Transfers

Year	Seller	Buyer	Maximum Delivery (af/year)	Contract Duration (years)	Purpose	Region of Origin	Region of Destination	Within Project?
2003	Imperial ID	San Diego County Water Authority	58,200	75	Agr to M&I	So Cal	So Cal	Colorado R.
2003	Imperial ID	San Diego County Water Authority	100,000	75	Agr to M&I	So Cal	So Cal	Colorado R.
2003	Imperial ID	Salton Sea mitigation water	100,000	75	Agr to Env	So Cal	So Cal	Colorado R.
2003	Nickel, LLC	Newhall Land and Farming Company	1,607	30	Agr to M&I	SJ Valley	So Cal	No
2003	Palo Verde ID	MWDSC	111,000	35	Agr to M&I	So Cal	So Cal	Colorado R.
2003	Woodbridge ID	City of Lodi	6,000	44	Agr to M&I	SJ Valley	SJ Valley	No
2004	Cucamonga Valley WD	Santa Margarita WD	4,250	3	M&I to M&I	So Cal	So Cal	No
2004	Kings County	LeMoore Naval Air Station	5,000	31	Agr to M&I	SJ Valley	SJ Valley	No
2004	Stevinson WD	USF&WS	4,675	3	Agr to Env	SJ Valley	SJ Valley	No
2005	Modesto ID	City of Modesto	67,200	45	Agr to M&I	SJ Valley	SJ Valley	No
2005	Stony Creek WD	Colusa County	127	5	Agr to Agr	Sac Valley	Sac Valley	CVP
2006	San Joaquin River Exchange Contractors Water Authority	San Luis Delta Mendota Water Authority	80,000	10	Agr to Agr	SJ Valley	SJ Valley	CVP
2007	Buena Vista WSD & Rosedale Rio Bravo WSD	Castaic Lake WA	11,000	40	Agr to M&I	SJ Valley	So Cal	SWP
2008	Grassland WD	USF&WS	10,000	3	Agr to Env	SJ Valley	SJ Valley	No
2008	San Bernardino Valley Municipal WD	Crestline-Lake Arrowhead WA	1650	10	M&I to M&I	So Cal	So Cal	SWP
2008	City of Sand City	California-America Water Company	300	15	M&I to M&I	Central Coast	Central Coast	No
2008	Stevinson WD	USF&WS	8,863	3	Agr to Env	SJ Valley	SJ Valley	No
2008	Yuba County WA	DWR & USBR*	200,000	17	Agr to Mixed	Sac Valley	Various	No
2010	Patterson ID	Santa Clara Valley WD	13,350	4	Agr to M&I	SJ Valley	Bay Area	CVP
2012	Merced ID	USF&WS	25,000	2	Agr to Env	SJ Valley	SJ Valley	No
2012	Central California ID	San Luis WD, Panoche WD, Del Puerto WD, Westlands WD	20,500	2	Agr to Agr	SJ Valley	SJ Valley	CVP
2012	Firebaugh Canal WD	San Luis WD or Westlands WD	5,000	2	Agr to Agr	SJ Valley	SJ Valley	CVP
2012	Byron Bethany ID	Westlands WD	5,000	5	Agr to Agr	SJ Valley	SJ Valley	CVP
2012	Stevinson WD, East Side Canal and Irrigation Company	San Luis Canal Company	5,000	10	Agr to Agr	SJ Valley	SJ Valley	CVP
2012	Madera ID	Root Creek WD	10,000	23	Agr to Agr	SJ Valley	SJ Valley	No

TABLE B9 (continued)
Long Term Transfers

Year	Seller	Buyer	Maximum Delivery (af/year)	Contract Duration (years)	Purpose	Region of Origin	Region of Destination	Within Project?
2012	Butte County	Dudley Ridge WD, Belridge WSD, Berrenda Mesa WD, Lost Hills WD, Wheeler Ridge-Maricopa WSD	24,832	2	Mixed to Agr	Sac Valley	SJ Valley	SWP
2012	Butte County	Palmdale WD	10,429	2	Mixed to Agr	Sac Valley	So Cal	SWP
2014 (pending)	San Joaquin River Exchange Contractors Water Authority	SJ Valley wildlife refuges, Tulare Lake Basin wildlife refuges, Kern County WA, Santa Clara Valley WD, EBMUD, Contra Costa WD, Pajaro Valley WMA	150,000	25	Agr to Mixed	SJ Valley	SJ Valley, Bay Area	Partially within CVP

SOURCES: Based on author-collected data. See Technical Appendix A for details.

NOTES: See notes to Table B8. *As described in the main report, this transfer (known as the "Yuba Accord" supplies SWP and CVP contractors with dry year supplies and provides water for the Environmental Water Account for the first eight years.

Appendix C: Detailed Data on Groundwater Banking

TABLE C1
Kern County Bank Balances by Participants' Region (acre-feet)

Year	All Banks a/						Kern Water Bank	
	Kern County	San Joaquin Valley	Southern California	San Francisco Bay Area	Unknown	Total	Kern County	Kings County
1990	0	0	0	0	91,663	91,663	0	0
1991	0	0	0	0	91,663	91,663	0	0
1992	0	0	0	0	50,164	50,164	0	0
1993	0	0	45,377	0	50,164	95,541	0	0
1994	0	0	45,377	0	50,164	95,541	0	0
1995	215,590	1,492	90,377	0	50,164	357,623	215,590	1,492
1996	337,534	14,805	175,877	46,080	50,164	624,460	337,534	14,805
1997	436,557	24,436	289,709	86,580	40,131	877,413	436,557	24,436
1998	703,442	45,794	351,725	116,775	40,131	1,257,867	703,442	45,794
1999	735,757	47,023	511,612	178,884	40,131	1,513,407	735,757	47,023
2000	772,782	47,918	648,111	233,829	40,131	1,742,771	772,782	47,918
2001	821,709	52,116	591,048	211,285	40,131	1,716,289	698,320	46,292
2002	777,340	51,413	612,648	228,998	40,131	1,710,530	685,200	45,589
2003	810,850	51,392	708,491	281,468	40,131	1,892,332	677,459	45,568
2004	760,879	52,413	596,096	293,834	40,131	1,743,353	647,794	46,589
2005	1,212,078	81,910	680,148	406,390	40,131	2,420,657	963,852	65,930
2006	1,599,421	110,740	711,030	493,890	40,131	2,955,212	1,202,434	78,734
2007	1,361,401	122,672	576,019	472,526	40,131	2,572,749	997,511	74,710
2008	1,088,594	90,147	439,921	446,089	30,098	2,094,849	790,921	54,339
2009	916,708	98,489	299,079	404,553	20,065	1,738,894	652,241	37,038
2010	907,272	122,745	491,831	465,344	10,032	1,997,224	643,647	23,293
2011	1,400,225	203,920	826,378	551,277	10,032	2,991,832	1,030,954	70,295

SOURCES: Based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes balances stored for off-site parties of the following banks: Arvin-Edison WSD, Berrenda Mesa WSD, Cawelo WD, City of Bakersfield, Kern Delta WD, Kern Water Bank, North Kern WD, Rosedale-Rio Bravo WSD, Semitropic WSD, West Kern WD. Data for Buena Vista WSD, which also stores water for offsite parties, were not available. Most of these banks manage additional storage through formal banking arrangements or informal conjunctive use operations for groundwater users within their jurisdictions.

TABLE C2
Kern County Bank Balances by Type of End User (acre-feet)

Year	All banks (af)				Kern Water Bank	
	Municipal and Industrial	Agriculture	Mixed	Total	Agriculture	Mixed
1990	0	0	91,663	91,663	0	0
1991	0	0	91,663	91,663	0	0
1992	0	0	50,164	50,164	0	0
1993	45,377	0	50,164	95,541	0	0
1994	45,377	0	50,164	95,541	0	0
1995	90,377	176,767	90,479	357,623	176,767	40,315
1996	221,957	260,615	141,888	624,460	260,615	91,724
1997	376,289	362,143	138,981	877,413	362,143	98,850
1998	468,500	609,041	180,326	1,257,867	609,041	140,195
1999	690,496	642,271	180,640	1,513,407	642,271	140,509
2000	881,940	678,393	182,438	1,742,771	678,393	142,307
2001	813,201	679,857	223,231	1,716,289	609,565	135,047
2002	852,514	663,300	194,716	1,710,530	600,320	130,469
2003	1,000,827	709,357	182,148	1,892,332	592,107	130,920
2004	900,798	662,481	180,074	1,743,353	562,915	131,468
2005	1,097,406	1,103,028	220,223	2,420,657	860,111	169,671
2006	1,237,288	1,418,141	299,783	2,955,212	1,082,514	198,654
2007	1,081,313	1,200,873	290,563	2,572,749	879,490	192,731
2008	918,678	926,844	249,327	2,094,849	663,401	181,859
2009	720,175	798,149	220,570	1,738,894	517,152	172,127
2010	973,718	822,343	201,163	1,997,224	496,979	169,961
2011	1,397,273	1,342,848	251,711	2,991,832	879,800	221,449

SOURCES: Based on author-collected data. See Technical Appendix A for details.

NOTES: The table includes balances stored for off-site parties of the following banks: Arvin-Edison WSD, Berrenda Mesa WSD, Cawelo WD, City of Bakersfield, Kern Delta WD, Kern Water Bank, North Kern WD, Rosedale-Rio Bravo WSD, Semitropic WSD, West Kern WD. Data for Buena Vista WSD, which also stores water for off-site parties, were not available. Most of these banks do additional storage through formal banking arrangements or informal conjunctive use operations for groundwater users within their jurisdictions. In some cases for mixed use entities ("Mixed"), purpose has been assigned by authors based on principal use (agricultural or municipal and industrial). For instance, storage by MWDCS and the Santa Clara Valley WD are included as municipal and industrial.

TABLE C3
Metropolitan Water District of Southern California Groundwater Banking Balances

Year	Mojave Basin a/	MWDSC Service Area b/	Colorado River c/	Total Banking Balances in Southern California	MWDSC Kern County Banking Balances d/
1994	-		383,299	383,299	45,377
1995	-		383,417	383,417	90,377
1996	-		356,842	356,842	175,877
1997	-		332,188	332,188	289,709
1998	-		308,286	308,286	351,725
1999	-		253,206	253,206	505,321
2000	-	32,742	262,198	294,940	639,265
2001	-	35,617	238,795	274,412	586,965
2002	-	35,617	232,565	268,182	586,965
2003	24,874	39,335	195,267	259,476	682,808
2004	24,874	80,444	177,400	282,718	541,143
2005	44,874	114,487	276,069	435,430	583,096
2006	44,874	160,775	223,829	429,478	592,500
2007	18,874	206,991	121,387	347,252	428,166
2008	10,379	194,321	56,518	261,218	273,991
2009	2,891	116,089	44,601	163,581	148,352
2010	-	64,936	177,623	242,559	298,109
2011	45,048	46,190	203,267	294,505	550,842
2012	n.a.	55,844	n.a.	n.a.	n.a.

SOURCE: Data collected by the authors from MWDSC.

NOTES: Balances for MWDSC's within-service-area storage are for the fiscal year ending June 30. Mojave, Colorado River, and Kern County balances are for the calendar year. Kern County and Mojave Basin banking balances are not yet available for calendar year 2012.

a/ Water stored by agreement with the Mojave Water Agency.

b/ Water stored by agreement with various member agencies within the MWDSC service area.

c/ Water stored in the Coachella Valley groundwater basin under MWDSC's advance delivery agreement with Coachella Valley Water District and the Desert Water Agency.

d/ From Appendix Table C1. Not included in other totals shown in this table.



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