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Evolution of Water Marketing in California: Formal vs. Informal Property Rights

By

Damian Blase Bickett

A dissertation submitted in partial satisfaction of the requirements for the degree of

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In

Agricultural and Resource Economics

In the Graduate Division of the University of California, Berkeley

Committee in charge:

Professor Michael Hanemann, Chair
Professor David Sunding
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Abstract

Evolution of Water Marketing in California: Formal vs. Informal Property Rights

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Damian Blase Bickett

Doctor of Philosophy in Agricultural and Resource Economics

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This dissertation tells the story of how users in California have come to reallocate their water through markets. I attempt to improve upon earlier work and explain what changed within water marketing as well as why things changed. Using regression analysis to analyze these changes is difficult because of the tremendous heterogeneity among users and because discrete changes in the laws do not correspond immediately to transfer activity. I use regression analysis in what follows, but understanding water marketing evolution necessitates case studies and a historical understanding as well. Therefore, I present a lot of history to place these recent changes in context, changes that many argue spurred recent market development. I discuss the different types of water transfers and present data on their trends and development, and then explain what changes mattered over time, bolstered by regressions using a fairly complete 30 year transfer dataset.

Underlying much of my work, and especially part II, is the notion that murky water rights in California affect water marketing. To show how water rights affect water markets, I explain how they are murky in California by focusing on the administration of water rights and the institutional structure in California, and then I show how these notions hinder markets. Furthermore, I contrast California with Wyoming, the originator of the Wyoming water right system upon which California's system is based. Despite their similarities on paper, Wyoming's water right institutions and administration are different, and these differences produce different outcomes. Lastly, I use groundwater basin data to understand how California's unregulated resource affects transferability of surface water.

Part I:

Starting in the late 1950s, economists argued that reallocation through water marketing would be a more efficient way to accommodate new water demands. However, water transfers have been essentially invisible until 1990. What explains this change, and what doesn't? This section reviews this history of water marketing and the major changes affecting water markets, providing a narrative for understanding how water has been reallocated in California through markets and by other means. This narrative highlights the continuity between early administrative decisions and the outcomes today, whereas previous research explaining recent water market trends emphasizes the importance of recent water market legislation (without comprehending the genesis of these changes). A careful analysis shows that many of the legal

changes have little causal effect on California's water market. Using a more comprehensive and accurate dataset than in previous research, this paper also explains the trends in water marketing.

Part II:

In what ways does the water right system affect marketing? One way to understand how California's water right system affects marketing is to understand Wyoming's system. Both Wyoming and California have appropriative right systems, but the tenets of appropriative water law do not simply apply to California. I explain how Wyoming's system is much cleaner, and present some data to show that this has real effects on the ground. In addition, because California water marketing data only show who actually does participate in the market, transfers that fail are ignored. To grasp why transfers fail is as important in understanding why they develop, and I present examples of the numerous transfers that failed in California as a result of murky water rights. Finally, I use groundwater data to lend support to the contention that murky water rights hinder a district's ability to transfer water.

Acknowledgements

I thank Michael Hanemann for continued guidance, especially his push for historical understanding. I also thank Sandy Park for helping me complete this task. My parents also gave me just enough nudging to see this to completion. Furthermore, many water district managers and USBR and DWR personnel helped me along the way, conveying to me some of their local knowledge about how California water flows. I probably gathered data from more than a hundred people from all areas of the state and even Colorado and Wyoming, and most were very willing to share data despite what I had been told about a reticence to discuss water rights and water issues. I am quite grateful for their input.

Introduction

From the time of hydraulic mining onwards, the vast majority of the state's water supply has been used for purposes other than urban water use – first for hydraulic mining and then, by about 1884, for agriculture.¹ Following the US entry into World War II, California's population exploded and its industrial economy was transformed. In the short interval between 1940 and 1950, California's population leapt from 6.9 to 10.6 million.² In response, during the 1950's the state engaged in an elaborate planning exercise to engineer a massive expansion in the state's water supply, including both the creation of a new State Water Project and a significant expansion of the federal Central Valley Project.

Starting in the late 1950's, economists began to argue that reallocation through water marketing would be an economically more efficient way to accommodate the growth in urban and industrial demand for water than investing in costly new water supply projects.³ However, key political decisions made in 1960 meant that the engineering projects moved ahead. And while the state's population continued to grow in the post-war era, reaching 20 million in 1970 and almost 30 million in 1990,⁴ water transfers were essentially invisible from the water policy arena until well into the 1980s. They have become a permanent fixture only since the mid-1990s.

Why did water marketing not occur decades earlier in California? Why did it take off when it did? Why are certain types of water sold, but not others? Why are certain owners of water rights selling water, but not others? Why is water sold via certain types of transactions, but not others?

A subset of these questions was addressed in an article recently published by several prominent Western water experts.⁵ They emphasize the importance of changes in the legal definition and regulation of water rights in California as influences on the extent and nature of water marketing over the period 1987-2005. In the first part of the dissertation, I revisit this question while considering a longer time period, extending back to the late 1970s and continuing through 2008. While I certainly agree that changes in the legal definition and regulation of water rights can be determinants of the trends in water market activity, I disagree with their assessment. First of all, I think the timing and pattern of legal change in California is somewhat different than theirs: some of the changes they cite were less momentous than they imply, and there were some significant changes which they overlook. Secondly, their statistical analysis correlating changes in the volume and pattern of water market activity with identified changes in legal rights and regulations is not convincing. To explain the development of water markets in California and the changes affecting them, I explain the system upon which the market is based. I start by describing the different types of transfers within this system. To explain the rise of

¹ N. Hundley, *The great thirst: Californians and water-a history* (Univ of California Pr, 2001), 78–79.

² United States., *United States census of population, 1950. Number of inhabitants, California. Total for cities, small areas, counties, urban & rural.* ([Washington]: U.S. Govt. Print. Off., 1951), sec. 5–7, <http://www2.census.gov/prod2/decennial/documents/37778768v2p5.zip>.

³ J. C Dehaven and J. Hirshleifer, "Feather river water for southern California," *Land Economics* 33, no. 3 (1957): 204.

⁴ US Census Bureau, "Urban and Rural Population: 1900 to 1990", July 2011, <http://www.census.gov/population/censusdata/urpop0090.txt>.

⁵ Jedidiah Brewer et al., "Water Markets and Legal Change in California, 1987-2005," *Washington University Journal of Law and Policy* (2008), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1079685.

marketing, I then discuss the major changes during the past 50 years to this system and the associated epochs in water market development.

The next part of the dissertation focuses on water rights and administration in California. Water rights do not operate here as the textbooks say they do, and understanding this is important to understand the development of water markets. I outline the rise of water rights administration in California, discuss specific transfers that failed in California and how they are related to the murky water right system, and then explain how California compares to Wyoming, the state with a very similar water right administration system.

This research is important for two reasons. First, California's complex water market is misunderstood in the literature. Numerous papers⁶ make reference to California's water market and preface their description with a discussion of appropriative rights and their transferability. However, appropriative rights are not transferred in California. Second, water markets have tremendous potential for efficiency gains – some interests within California are still pushing for very expensive, inefficient⁷ surface water storage projects.

It is astounding how many new uses of water have been accommodated since 1850 without markets. Firstly, plenty of terrain in California has abundant water, either surface or ground or both. For these areas, new users have no trouble acquiring water because there is no need to reallocate – property rights may exist on paper, but they are irrelevant in practice. For the remaining users, scarcity led to multiple options: users could litigate to acquire water, cooperate and agree to share, overdraft abundant groundwater at the expense of future generations or attempt to buy out older uses. As discussed later, many users had success with the litigation option,⁸ gradually stripping water away from the original users. Given this behavior, it is not surprising that the incentive to reallocate through the market remained muted for so long. Now, however, markets do play a significant role, and this research puts water marketing development in context.

⁶ See, for example, Z. Donohew, "Property rights and western United States water markets*," *Australian Journal of Agricultural and Resource Economics* 53, no. 1 (2009): 85-103; M. Czetwertynski, "The Sale And Leasing Of Water Rights In Western States: An Overview For The Period 1990-2001," *Water Policy Working Paper 2* (2002); Brewer et al., "Law and the New Institutional Economics"; D. Zilberman, "Water Marketing in California and the West," *International Journal of Public Administration* 26, no. 3 (2003): 291-315; H. Chong and D. Sunding, "Water markets and trading," *Annu. Rev. Environ. Resour.* 31 (2006): 239-264.

⁷ Temperance Flat Reservoir has a benefit/cost ratio of 1.06:1. To get this overly optimistic figure, the US Bureau of Reclamation assigns water values upwards of \$700 per acre-foot.

⁸ The following noteworthy cases resulted in reallocation, and they will be discussed later. See, for example, *Lux v. Haggin* 69 Cal. 255 (1886); *TULARE DIST. v. LINDSAY-STRATHMORE DIST.* 3 Cal.2d 489 (1935); *John Elmore v. Imperial Irrigation District* 159 Cal. App 3d 185 (1984).

TABLE OF CONTENTS

I EVOLUTION OF WATER MARKETING	1
1. THE HISTORY	1
1.1 IRRIGATED LAND AND WATER PROJECTS	4
2. TRANSFERABILITY AND WATER RIGHTS	6
2.1 TRANSFER PURPOSES	7
2.2 WATER RIGHT ALLOCATION.....	8
2.2.2 <i>Water Right Allocation Estimates</i>	9
2.3 SURFACE WATER RIGHT TRANSFERABILITY	10
2.4 SURFACE WATER CONTRACT TRANSFERABILITY	10
2.5 GROUNDWATER RIGHT TRANSFERABILITY	11
3. WATER MARKETING DEVELOPMENT AND ALTERNATIVES.....	11
3.1 TRANSFERABILITY DEVELOPS THROUGH THE COURTS	12
3.2 REALLOCATION BY THE COURTS.....	13
3.2.1 <i>Transfers Away from Riparians</i>	15
3.3 REALLOCATION THROUGH THE SWRCB.....	16
3.4 OTHER EFFICIENCY ENHANCING ACTIVITY	17
3.5 WHY ISN'T LAND REALLOCATED LIKE WATER?	18
4. WATER MARKET DEVELOPMENT	18
4.1 MID-1900S DEBATE.....	19
4.2 1971-1982	21
4.3 GOVERNOR'S COMMISSION.....	24
4.4 IMPERIAL IRRIGATION DISTRICT-METROPOLITAN WATER DISTRICT	29
4.5 YUBA COUNTY WATER AGENCY	31
4.6 1987-92 DROUGHT.....	32
4.7 1992 – CENTRAL VALLEY PROJECT IMPROVEMENT ACT	38
4.8 SWP MARKETING	39
4.8.1 <i>Monterey Agreement</i>	40
4.8 ENVIRONMENTAL WATER ACCOUNT	43
4.9 2002 – SB 221 – DEVELOPERS AND WATER.....	44
4.10 SUMMARY AND MAJOR CHANGES.....	44
5. DATA ANALYSIS.....	45
5.1 TRANSFER CATEGORIES.....	46
5.1.1 <i>Short-Term</i>	46
5.1.2 <i>Short-Term – Swaps</i>	47
5.1.3 <i>Long-Term / Permanent</i>	47
5.1.4 <i>Long-Term Substitute</i>	47
5.2 TRANSFER TRENDS	47
5.2.1 <i>Decade Averages</i>	47
5.2.2 <i>Transfers Compared to Annual Water Use</i>	48
5.2.3 <i>Annual Variability</i>	48
5.3 PREVIOUS EMPIRICAL ANALYSIS IN THE LITERATURE	50
5.3.1 <i>Regression Replications</i>	51
Data Adjustment Details	51
5.3.2 <i>Transfer Count Regression</i>	52
Discussion	52
5.3.3 <i>Transfer Volume Regression</i>	53
5.4 ECONOMETRIC ANALYSIS OF CHANGES	53
5.4.1 <i>Scarcity Changes</i>	53

5.4.2 Other Important Changes (recap).....	55
5.4.3 Regressions and Discussion.....	55
5.5 TREND CONCLUSIONS	58
II AMBIGUOUS RIGHTS AND THEIR EFFECT ON MARKETING	59
1. THE HISTORY	59
2. APPROPRIATIVE RIGHTS IN WYOMING AND CALIFORNIA.....	65
2.1 QUANTIFICATION IN WYOMING	66
2.2 QUANTIFICATION IN CALIFORNIA	67
2.2.1 Statements of Diversion and Use	69
2.2.2 Adjudicated Water Systems in California	70
2.2.3 Flexibility within Adjudicated Basins.....	71
2.2.4 Adjudicated Quantities.....	72
2.2.5 Face Value and Water Right Quantities.....	72
2.3 PRIORITY IN WYOMING.....	74
2.4 PRIORITY IN CALIFORNIA.....	75
2.4.1 Sacramento Diverters and shortages in the 1920s.....	76
2.4.2 Term 80 and Term 91.....	78
2.4.3 Priority within Adjudicated Streams	80
2.5 APPURTENANCY.....	81
2.6 FORFEITURE	82
2.7 SUMMARY OF KEY DIFFERENCES IN WATER RIGHT ADMINISTRATION	83
3 TRANSFERABILITY IN WYOMING	84
3.1 TEMPORARY TRANSFERS	84
3.1.1 Limitations to Wyoming’s short-term market.....	87
3.2 PERMANENT TRANSFERS.....	88
3.3 TRANSFER PERCENTAGES COMPARISON	88
3.5 WHY THE DIFFERENCES?	89
4. FAILED TRANSFERS IN CALIFORNIA	90
4.1 MCARTHUR RANCH.....	90
4.2 ANDERSON FARMS CO. TO BERRENDA MESA WATER DISTRICT.....	91
4.3 CITY OF TRACY.....	92
4.4 THE ORIGINAL CVPIA TRANSFER	94
4.5 NATOMAS CENTRAL MUTUAL WATER COMPANY	96
4.6 MWD AND PALO VERDE	97
4.7 RICE FARMERS AND MWD	98
4.8 CADIZ WATER SALE TO LA	99
4.9 BASS BROTHERS—SAN DIEGO WATER DEAL.....	100
4.10 CABIN BAR RANCH.....	101
5 GROUNDWATER DATA AND MURKY WATER RIGHTS.....	101
ECONOMETRIC APPROACH	102
CONCLUSIONS.....	105
TABLES	106
FIGURES	122
REFERENCES	140
APPENDIX	162
MEASURING WATER USE AND WATER RIGHTS ACCOUNTING IN CA	162
Historical Origins of Reporting Requirements	162
Local Deliveries	163

<i>Riparian Usage Estimation</i>	163
<i>Governor’s Commission Estimate</i>	164
<i>Pre-1914 Water Rights</i>	165
<i>Bad Data</i>	165
OLDER DATA ON WATER TRANSFERS:	166
<i>CVP</i> :.....	166
<i>SWP</i> :	166
<i>Post-1914 Water Rights</i> :	166
<i>Other</i> :.....	166
INTERNAL MARKETS	167
<i>Missing Data for Internal Markets</i>	167

I Evolution of Water Marketing

1. The History

California has a distinctive system of water rights. The current structure is hardly by design – instead, the courts and the legislature have imposed a rather odd mishmash of water rights on California. When California entered the Union in 1850, one of the actions taken by its first Legislature was to adopt the common law of riparian rights for surface water, originally imported from England and the governing doctrine in the rest of the Union. Riparian rights entitle the owner of land bordering a surface water body (“riparian” land) to use and share with other riparians the water flowing past his property.⁹ While riparian rights require no permits or licenses, they apply only to the water that would naturally flow in the stream. Riparian rights do not allow the user to divert water for storage or to use it on non-riparian land. Riparian rights remain with the riparian land when it changes ownership. Unlike the appropriative right, use does not create the right, and nonuse does not terminate it.

California’s entry into the Union was preceded (and caused) by the Gold Rush. Following the discovery of gold, the independent-minded miners in California proceeded simply to take water they needed. Water development proceeded on an unprecedented scale as miners built extensive networks of flumes and waterways to work their claims. The water carried in these systems often had to be transported far from the original river or stream. Riparian rights could not apply to this use of water because the miners had no legal ownership of the land, and the use often occurred at locations some distance from the stream, and therefore not on riparian land.¹⁰ This did not deter the miners. They applied the same “finders-keepers” rule to water that they did to their mining claims - it belonged to the first miner claiming ownership. To stake their water claims, the miners developed a system of “posting notice” at the site of diversion.¹¹ It enabled others to divert available water from the same river or stream, but their rights existed within a hierarchy of priorities. This system, based on “first in time, first in right,” became the basis for the modern doctrine of appropriative water rights.¹² In 1851, the Legislature recognized the appropriative water right system as having the force of law, and the courts later ratified the appropriative doctrine.¹³ Thus, a “dual system” came into being in California in which appropriative rights coexisted side-by-side with riparian rights.

In addition to the dual system of surface water rights,¹⁴ a feature of California’s system was that it functioned virtually without the involvement of state agencies. Prior to 1872, appropriative water rights could be acquired in California by simply taking water and putting it to beneficial use.¹⁵ In 1872, the Legislature established a procedure for perfecting an appropriative water right. Priority could be established by posting a notice of appropriation at

⁹ This is referred to as the ‘rocking chair’ principle: “landowners could simply sit and look at their water, and no one could deprive them of their right and use the water elsewhere.” Hundley, *The great thirst*, 85.

¹⁰ M. T. Kanazawa, “Efficiency in western water law: the development of the California doctrine, 1850-1911,” *The Journal of Legal Studies* 27, no. 1 (1998): 165.

¹¹ A. D Tarlock, “The Illusion of Finality in General Water Rights Adjudications,” *Idaho Law Review* 25 (1989): 275.

¹² Tarlock, “The Illusion of Finality in General Water Rights Adjudications.”

¹³ *Irwin v. Phillips* 5 Cal. 140 (1855).

¹⁴ Today, California also recognizes pueblo, prescriptive, stockpond, livestock, small domestic and other water rights, These will be mostly ignored because they are a miniscule portion of the total water use.

¹⁵ Hundley, *The great thirst*, 71.

the point of diversion and recording a copy of the notice with the respective County Recorder within ten days.¹⁶ Construction of a diversion facility was to commence within sixty days of the posting and had to be pursued with diligence until completion. However, simply using the water without recording a copy of the notice was still valid subject to the qualification that the appropriative right did not attach until the beneficial use commenced.¹⁷ The result was a very permissive system with only a passive role for state government in the administration of appropriative water rights, and no role in the administration of riparian rights.¹⁸ Disputes over both appropriative and riparian water rights were resolved through litigation in state courts. In effect, the courts administered surface water rights in California as there were no state agencies to do so. This was an untidy, and not inexpensive, arrangement.¹⁹ It was also the arrangement adopted initially by most other western states.

California's dual system was tested in a monumental legal battle between Miller and Lux, downstream riparian right holders, and James Haggin, an upstream appropriator on the Kern River whose diversions in the drought year of 1877 virtually dried up the river. The California Supreme Court ruled on *Lux v. Haggin*, first in 1884 and then again in 1886.²⁰ The Court essentially upheld the dual system. It ruled that the riparian doctrine was law in California. But, it also ruled that under certain conditions – if the appropriator began using water from a stream *before* a riparian had acquired his property – the appropriation doctrine would prevail.²¹

California retained its allegiance to the system of posting notices until 1914, despite a thirty year effort by reformers to replace it.²² Water rights reform finally came about following the election of a reform governor and a reform legislature in 1910.²³ The legislature passed the Water Commission Act in 1913, but riparian interests along with water and power companies launched a referendum²⁴ on the bill which voters rejected 50.7% to 49.3%.²⁵ Therefore, after 1914, all unappropriated California surface waters were subject to the State Water Commission's

¹⁶ The information contained at the Records offices was practically worthless for determining entitlements and priority. E. Mead, *Irrigation institutions: a discussion of the economic and legal questions created by the growth of irrigated agriculture in the West* (Macmillan, 1903)..

¹⁷ R. R Kletzing, "Prescriptive Water Rights in California: Is Application a Prerequisite," *Cal. L. Rev.* 39 (1951): 369.

¹⁸ The settlers "preferred freedom of action, they wanted few or no restrictions on their freedom to utilize streams" R. G Dunbar, *Forging new rights in western waters* (University of Nebraska Press, 1983), 87.

¹⁹ There was no restriction on the number of appropriations that might be made of a stream. There was no provision for the recordation of *the completion* of diversion projects. Thus, a person could plan a diversion facility and post and record a notice of appropriation, but never complete the project. Consequently, it was impossible to determine the number and priorities of appropriations on a stream except through an expensive adjudication lawsuit (Dunbar, 1983). The only way to apportion streamflow among users in times of scarcity was for one or more of the parties to initiate a law suit – neither a cheap nor a timely mechanism (the dispute between Lux and Haggin, triggered by drought in 1877 was adjudicated in 1886). Furthermore, although agricultural pre-1914 appropriative rights are capped by historical use, municipal pre-1914 rights may not be. San Francisco, for example, currently uses not more than 300 mgd but claims an inchoate right of 400 mgd from the Tuolumne River..

²⁰ *Lux v. Haggin*.

²¹ This ruling led to the Wright Act of 1887, allowing the creation of irrigation districts (quasi-governmental agencies) with the power to condemn riparian rights. See D. J Pisani, "From the family farm to agribusiness: the irrigation crusade in California, 1850-1931" (1984): 255.

²² Dunbar, *Forging new rights in western waters*, 126.

²³ *Ibid.*, 128. Major concerns of the reform movement were to prevent speculation in water rights and to restrict growing hydroelectric monopoly power

²⁴ Pisani, "From the family farm to agribusiness," 366.

²⁵ J. L Sax, "We Don't Do Groundwater: A Morsel of California Legal History," *U. Denv. Water L. Rev.* 6 (2002): 300.

authority.²⁶ The Commission had no authority over surface water appropriated before 1914, and these rights came to be known as pre-1914 water rights. A person wishing to appropriate water after 1914 applied for a permit from the Commission.²⁷ If the Commission determined that surplus water was available,²⁸ the permit was granted. The permit holder then had the right to take and use the water according to the terms of the permit.²⁹ Upon compliance with the permit terms, the Commission issued a license, and the appropriative right became confirmed. Noncompliance meant a permit could be revoked.³⁰ However, the Commission never developed a network of administrative officials like that in Colorado or Wyoming who monitored diversions and enforced priority.³¹ Instead, the Commission had only “a limited role in resolving disputes and enforcing rights of water holders, a task left mainly to the courts.”³²

Whereas appropriative rights were limited to “reasonable and beneficial” uses of the water, “riparians were subject only to the needs of other riparians on the same stream, frequently with wasteful results.”³³ The framers of the Water Commission Act had wanted to abolish riparian rights, but they could not accomplish this.³⁴ Instead, the Act stipulated that unused riparian water would revert to the state after 10 years of nonuse.³⁵ However, the Commission had little power to enforce this provision – the large riparian landholders could ignore the Commission and instead seek relief with the courts, and this portion of the law was eventually struck down by the courts.³⁶

The freedom of riparian right holders to use water in a profligate manner was dramatically illustrated in *Herminghaus v. South. California Edison Co.*³⁷ The court held that under the riparian doctrine the riparian owner was entitled to the full flow of the stream even

²⁶ Dunbar, *Forging new rights in western waters*, 128.

²⁷ A federal case indicated that the State Water Commission may not have been the exclusive method for acquiring a right until 1923. See M. Archibald, *Appropriative Water Rights in California: background and issues* (Governor’s Commission to Review California Water Rights Law, 1977), 10. Also, B. T. Andrews and S. K. Fairfax, “Groundwater and Intergovernmental Relations in the Southern San Joaquin Valley of California: What Are All These Cooks Doing to the Broth,” *University of Colorado Law Review* 55 (1983): 166.

²⁸ The applicant must show water availability – the Board doesn’t actually determine water availability and relies on lack of protests as a signal that water is available. S. T. Harding, *Water in California* (NP Publications, 1960), 45..

²⁹ As Harding (*Ibid.*, 52.) points out, however, the SWRCB has been quite lax in this process. Shasta and Friant reservoirs, two of the largest in the state, were completed and began operations in the early 40s, 20 years before the SWRCB granted a permit to the USBR for their dams. These examples are not unique. The permit terms also change over time. For example, all permits now dictate a maximum annual use.

³⁰ Until it issues a license, the Board reserves jurisdiction over the permit to protect the public interest and ensure water availability (CA Water Code, §1394). Even if licensed, failure to beneficially use portions of an appropriative water right for 5 years forfeits the unused portion (Water Code, Sect. 1241).

³¹ Dunbar, *Forging new rights in western waters*, 128.

³² 182 Cal. App. 3d 82 (1986), p.170 (italics in original). The ruling goes on to explain that: “Because water rights possess indicia of property rights, water rights holders are entitled to judicial protection against infringement, e.g., actions for quiet title, nuisance, wrongful diversion or inverse condemnation. ... It bears reemphasis that the Board’s role in examining existing water rights to estimate the amount of surplus water available for appropriation does *not* involve adjudication of such rights.”

³³ *United States of American v. State Water Resources Control Board* 182 Cal. App. 3d 82, 171 (1986).

³⁴ Pisani, “From the family farm to agribusiness,” 364.

³⁵ M. C. Miller, “Riparian Rights and the Control of Water in California, 1879-1928: The Relationship between an Agricultural Enterprise and Legal Change,” *Agricultural History* (1985): 12.

³⁶ Miller, “Riparian Rights and the Control of Water in California, 1879-1928.”

³⁷ *Herminghaus v Southern Cal Edison Co.* 200 Cal. 81 (1926).

though Herminghaus needed less than 1% of the peak flow to flood her lands,³⁸ thus depriving the upstream appropriator – a power company serving most of the population of Southern California – of water for the generation of hydropower.³⁹ The ruling caused a wave of outrage. In response, the legislature passed a constitutional amendment in 1928 subjecting all water users – riparians and appropriators alike – to the universal limitation that water use must be reasonable and for a beneficial purpose.⁴⁰

Thus, by World War II, California had not progressed very far in developing a manageable system of surface water rights suited to the aridity of the West. It had minimal authority to regulate withdrawals of groundwater,⁴¹ and unlike many other western states, it retained riparian rights alongside appropriative rights.⁴² Beyond that, its administration of appropriative water was poor.⁴³ It retained the early practice of relying on courts not only to define the limits of appropriative rights but also, in most cases, to quantify them. Most of the river basins in California remained adjudicated.⁴⁴ The State Water Commission and its successor entities⁴⁵ had no authority over pre-1914 appropriative rights. With post-1914 rights, it had little authority to enforce these rights – enforcement was still left to the courts – and it lacked a local staff network which could monitor them on the ground.⁴⁶

1.1 Irrigated Land and Water Projects

Understanding the trends in water supply development and irrigated land are important to give context to Californian water right development. Irrigation spread throughout California

³⁸ B. E Gray, “In search of Bigfoot: The common law origins of article X, section 2 of the California constitution,” *Hastings Constitutional Law Quarterly* 17 (1989): 262.

³⁹ 200 Cal. 81 [252 P. 607], appeal dismissed 275 U.S. 486 [72 L.Ed. 387, 48 S.Ct. 27]

⁴⁰ Cal. Const., art. X, § 2.

⁴¹ To get a right to groundwater, one has to own the land where the well is located and one simply extracts the water and uses it for a beneficial purpose. Groundwater appropriation is also possible for use on non-overlying lands if basin ‘surplus’ exists.

⁴² Dual systems of riparian and appropriative rights also still survive in Kansas, Nebraska, North and South Dakota, Oklahoma, Oregon, Texas and Washington. Texas, Oregon, South Dakota and Kansas restrict their riparian rights to the amounts of actual beneficial use made at the time of enactment of appropriative laws. Washington and Nebraska also impose limitations to unused riparian rights. North Dakota and Oklahoma have less clear riparian laws. See W. A Hutchins, *Water rights laws in the nineteen Western States* (Natural Resource Economics Division, Economic Research Service, United States Dept. of Agriculture, 1977), 14.

⁴³ Other states do not have such poor administration. In Oklahoma, for example, they know that in 2005, 1,746,080 acre-feet of water was withdrawn for all uses; 63% from surface water sources and 37% from groundwater sources. See <http://www.owrb.ok.gov/util/waterfact.php>

⁴⁴ For a map of most adjudicated streams, see SWRCB, “Water Rights Judgments/Determinations”, June 2011, http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/judgments/. Colorado, by contrast, actively pushed for the unitary adjudication of river basins. Laws enacted in 1899 and 1903 provided the courts with the authority to initiate an adjudication of all water rights in a district. A 1919 law required any claimant to an appropriative right to submit a claim for adjudication by January 1, 1921 or forfeit his right. The legislature also established a biennial diligence requirement for conditional water rights. The adjudication laws were recodified and unified in the 1943 Adjudication Act which “continued to anticipate the issuance of unitary decrees addressing all surface rights within the water district” (Hobbs, 1999, p. 9). Other states have had similar pushes.

⁴⁵ The current name of the successor agency is the State Water Resources Control Board (SWRCB). We use this name from now on, except when referring to specific historical event in the past.

⁴⁶ California’s Water Commission Act, passed in 1913, was probably too late given the strength of established water rights. Other western states had much slower development and therefore more ease in establishing an administrative agency to enforce water rights. See D. J Pisani, “Water Law Reform in California: 1900-1913,” *Agricultural History* 54, no. 2 (1980): 317.

during the late 1800s and 1900s, quadrupling from one million acres to four million from 1890 to 1920.⁴⁷ The development of the centrifugal pump around 1900 was partly responsible for this increase, allowing farmers to access water at depths below 30 feet. This was a major change, and would have a lasting effect on California water usage.⁴⁸ After 1900, much of the increase in irrigated land came from groundwater – many new farms relied exclusively on groundwater, but many farms that previously irrigated exclusively with surface water drilled a well to have a more diverse supply portfolio. The following chart displays census data on irrigated acreage broken down by water source.

Insert Figure 1 – Irrigated Acreage

The lack of control over groundwater created an interesting political economy situation – while farmers used more and more groundwater, and expanded irrigation to lands farther and farther away from surface sources, water tables began to drop, and the state government chose to bring in supplemental surface supplies to prevent further drops in the water table.⁴⁹ The state government saw the need to plan for its water future, and authored a state water plan that outlined major new surface storage developments.⁵⁰ The projects were initially going to be state-financed, but the state couldn't sell bonds during the Depression for the initial project storage facilities, and the Bureau of Reclamation stepped in to construct what would become the Central Valley Project (CVP).⁵¹ This would mark the beginning of a tremendous increase in surface storage project construction, as shown in the following chart.

Figure 2 – Dam Building vs. Population

Federal involvement in water development would continue past the Depression – the CVP underwent a major expansion in the 1950s,⁵² and the last major component of the CVP, New Melones reservoir on the Stanislaus River, was completed in 1980.

Despite this prodigious expansion in surface storage and the increase in irrigated land that accompanied it, Southern California would remain thirsty. Therefore, planning began in the 1950s for another major north-south water transfer project, dubbed the State Water Project (SWP), built and operated by the California Department of Water Resources (DWR). The project was primarily aimed at urban areas in Southern California, but agricultural areas in and around Kern County would also contract for water. The project was designed to be built in two phases – the first being Oroville Dam on the Feather River, the 444 mile long California Aqueduct and the associated pumping facilities and the second being the Peripheral Canal and

⁴⁷ Giannini Foundation of Agricultural Economics, *California agriculture: dimensions and issues* (University of California, Giannini Foundation of Agricultural Economics, Division of Agriculture and Natural Resources, 2003), 4.

⁴⁸ California Department of Water Resources, *California's groundwater - Bulletin 118, Update 2003* ([Sacramento Calif.]: Dept. of Water Resources, 2003), 24; Andrews and Fairfax, "Groundwater and Intergovernmental Relations in the Southern San Joaquin Valley of California," 164; M. Kanazawa, "Origins of Common-Law Restrictions on Water Transfers: Groundwater Law in Nineteenth-Century California," *The Journal of Legal Studies* 32, no. 1 (2003): 171–176.

⁴⁹ Andrews and Fairfax, "Groundwater and Intergovernmental Relations in the Southern San Joaquin Valley of California," 170.

⁵⁰ California Division of Water Rights, *Report to the legislature of 1931 on state water plan, 1930* ([Sacramento, California State Print. Office, 1930), 37, <http://www.waterplan.water.ca.gov/docs/previous/CalWaterPlan1930.pdf>.

⁵¹ Hundley, *The great thirst*, 255.

⁵² Lawrence B. Lee, "California Water Politics: Opposition to the CVP, 1944-1980," *Agricultural History* 54, no. 3 (July 1, 1980): 415–416.

other finishing touches to the project to bring the total annual yield to 4.23 million acre-feet. Because demand in 1960 was far less than 4.23 million acre-feet, the second phase of the SWP was planned for completion when estimated demands necessitated it.⁵³

Generally speaking, the SWP created abundance for agricultural and urban State Water Contractors. Even though Southern California urban Contractors had escalating contract quantities based on prospective population growth, they still did not elect to take their full allocation every year, mainly because the cost of pumping made SWP water more expensive than other locally available supplies. DWR then offered this and other excess water for sale to other Contractors at the cost of delivery.⁵⁴ Agricultural Contractors in the Southern San Joaquin Valley were quite happy with this arrangement, and reaped the benefits to the tune of \$25 million a year by the mid-1980s.⁵⁵ The abundance would slowly disappear as urban users' populations grew. This coincided with reductions in Metropolitan Water District's⁵⁶ Colorado River supplies, reductions in Los Angeles' diversions from the Owens Valley, and reductions in Metropolitan's exports from the Sacramento-San Joaquin Delta, all of which led to scarcity and increased focus on transfers, which I explain in more detail below.

At a simple level, the history shows increasing population coupled with increased supply construction until the late 1970s. Then, between 1976 and 1982, this relationship changes drastically, spurring many changes I describe in the following sections. First, I present more detail on water rights and transferability.

2. Transferability and Water Rights

Defining "water transfer" is difficult and necessitates some imprecision. I define a water transfer as an intentional, voluntary change in the type or location of use between two parties, accompanied by a change in the using party.⁵⁷ I use "location of use" broadly to mean changes in the historical location of use regardless of what the *place of use* may be on the water right license.⁵⁸ I use the term using party to refer to either a water right holder or a contractor (individual⁵⁹ or district) empowered to transfer their water. Although new water rights do reallocate water from fish and wildlife dependent on the original hydrology, and new water rights also reallocate from people indirectly if they destroy existing uses (e.g. recreation, gravel

⁵³ Hundley, *The great thirst*, 280; F. Quinn, "Water Transfers: Must the American West Be Won Again?," *Geographical Review* (1968): 118; Ronald B Robie and Russell R Kletzing, "Area of Origin Statutes - The California Experience," *Idaho Law Review* 15 (1979 1978): 431.

⁵⁴ This water was labeled Article 22 water based on the contract provision authorizing its delivery. See Hundley, *The great thirst*, 297.

⁵⁵ *Ibid.*

⁵⁶ Metropolitan, or Met, or MWD, is the urban Southern California wholesaler.

⁵⁷ For environmental transfers, although the fish cannot negotiate and agree to any transfer, I assume that the agency acting on their behalf is able to do so, and therefore these count as a transfer under my definition. Our definition is mostly consistent with other definitions in the literature. The National Research Council *Water Transfers in the West Efficiency, Equity, and the Environment* (Washington, D.C: National Academy Press, 1992), 2, defines transfers as "a change in the point of diversion or a change in the type or location of use." This definition is too broad, as a change in the point of diversion may not represent a water transfer unless also accompanied by a change in the using party. Ideally, we could follow the SWRCB's Water Transfer Workgroup Report definition: "A water transfer is a reallocation of water among water users." This definition works if we clarify that water users are rights holders or contractors, and that a reallocation may be temporary.

⁵⁸ Water transfers between CVP Contractors, for example, frequently do not incur a change in either the purpose or place of use, which covers a large swath of the central valley.

⁵⁹ Data limitations will prevent us from looking at individual water user behavior.

collection, hunting), these changes are not intentional or voluntary as there is typically no agreement or discussion between the two parties.⁶⁰

This definition still is imperfect. For example, when urban agencies expand into agricultural land, the urban water agency may choose to use the water supplies previously used on that land. In this case, the water is not changing its historical place of use, but the type of use is changing. But my definition also requires there to be a voluntary, intentional agreement between the two parties. If both the agricultural and urban users rely on surface water, then the agricultural supplier and the expanding urban entity will typically negotiate an intentional transfer. However, if both use groundwater, the urban entity will simply expand its pumping while the farming community cuts back. In the latter case, there is no intentional agreement possible because in most areas in California, neither group has a quantified right to transfer. It is therefore not counted as a transfer, but has the same effect as the transfer in the former case.

In the US, surface and ground water are typically controlled by the individual states, and water rights are created state-by-state under the laws of individual states. Moreover, the laws governing surface water and groundwater are typically very different, with looser regulatory control (at most) exercised over groundwater. Within surface water, there is an important distinction between the right to divert water from a stream or to pump water from an aquifer versus the right to receive water that a user might have as a member of an irrigation district, say, or as a contractor with the CVP or the SWP. The former is a water right, and the latter a water contract. Transferability is typically thought of within the surface water right system, but all water rights and contracts are potentially transferable.

2.1 Transfer Purposes

Sellers sell water because there are differences in the value marginal product / marginal benefit of water between the seller and buyer, and when those differences result in large gains from trade, transfers may occur between users. Put differently, sellers may sell if they have a good substitute for water or they are satiated with their supply, and buyers buy because they need water as an input to the agricultural production process or to meet urban demand.

In addition, once a user has access to storage, every acre-foot used today has a user cost in that it cannot be used tomorrow. This is especially important if conditions change and next period is dry. These users prefer to trade with their future self, and they can do so by storing water. Storage capacity limits restrict this behavior, and therefore changes in reservoir conditions may force users to seek a transferee for excess water that might otherwise be spilled for flood control reasons. This technically fits the theme of one user with a very low value marginal product selling water to one with a higher value marginal product, but it is a result of unique, temporary conditions that may have nothing to do with the normal productivity of water on the farm. These transfers turn out to be common.

California's water market is characterized by users trading both because their permanent input needs are changing and because their temporary needs are changing. Most of the market activity in California results from changing temporary needs. Most previous empirical work analyzing Water Strategist data⁶¹ break the market into sales and leases, but this ignores the

⁶⁰The possible exception to this is a new groundwater well in an abundant area – in that case, new uses of water may not take water away from any existing user, although with groundwater, existing users of the water are hard to determine.

⁶¹ Donohew, "Property rights and western United States water markets*"; Brewer et al., "Law and the New Institutional Economics"; J. Brewer et al., "Water Markets in the West: Prices, Trading, and Contractual Forms,"

heterogeneity within leases. A more useful categorization yields four categories, briefly described below in the table and then in more detail in the data section.

Insert Table 3

2.2 Water Right Allocation

Comprehensive data on water rights does not exist for historical and economic reasons. Pre-1914 appropriative water rights were acquired without the involvement of an administrative body, and rights were limited to a beneficial amount but rarely quantified, partly because the benefits of quantification did not always outweigh the costs.⁶² Based on the powers enumerated in the Water Commission Act, the Division of Water Rights did aim to revisit existing appropriative rights and quantify them, but this was never systematically done,⁶³ and so appropriators that acquired rights after 1913 did so from an agency that could only *estimate* how much water was available for appropriation.⁶⁴ To estimate water availability, the Division of Water Rights had two choices – they could check all existing water rights that were in the area and calculate water consumption during different scenarios, or they could rely on the appropriator to publicize the proposed new water right, and then see if any other water rights holder protested. As mentioned previously, the new Division of Water Rights was not empowered with strength from the legislature. They therefore took the easier step of assuming water was available for appropriation unless nearby water rights holders protested.⁶⁵

With this type of system in place, neither the water users nor the Water Rights Board had a strong incentive to monitor diversions closely. Without complaints from water users, why upset the status quo? Similarly, users with abundant water had no need to seek precise stream regulation and better quantification if they typically had enough water for their needs. The lack of monitoring and measuring diversions feeds back to also discourage vigorous enforcement of water rights in California, discussed later in this research.⁶⁶

An early example of the problems associated with the loose administration of water rights occurred in 1920, the first critically dry year since passage of the Water Commission Act. A dry winter coupled with increasing rice plantings during World War I led to concerns that upstream

Economic Inquiry 46, no. 2 (2008): 91-112; R. Howitt and K. Hansen, “The Evolving Western Water Markets,” *Choices* 20, no. 1 (2005): 59-63; Czetwertynski, “The Sale And Leasing Of Water Rights In Western States”; T. C. Brown, “Trends in water market activity and price in the western United States,” *Water Resources Research* 42, no. 9 (2006): 9402.

⁶² See discussion about the move towards individualized rights in C. M Rose, “Energy and efficiency in the realignment of common-law water rights,” *J. Legal Stud.* 19 (1990): 261.

⁶³ Governor’s Commission to Review California Water Rights Law., *Governor’s commission to review California water rights law : final report.* (S.I.: S.n., 1978), 12, 17.

⁶⁴ This estimation included senior appropriative rights on file and claimed as pre-1914 rights in addition to riparian use, which was difficult to estimate because riparians were senior to most appropriators (as a result of the 1886 case *Lux v. Haggin*) and because until 1928, riparians did not owe a duty of reasonableness to other appropriators.

⁶⁵ J. S. Bain, R. E. Caves, and J. Margolis, *Northern California’s water industry: the comparative efficiency of public enterprise in developing a scarce natural resource* (Published for Resources for the Future by the Johns Hopkins Press, 1966), 68.

⁶⁶ First, SWRCB enforcement of priority is less effective if users can still take water from the stream via a hydrologically connected groundwater basin or other surface right. In addition, the SWRCB has no interest in seeing groundwater tables drop precipitously. Therefore, their interest in enforcing surface water rights is somewhat compromised by the incentive to protect groundwater supplies and because they are aware that some users can evade their enforcement actions.

Sacramento River diverters would cause havoc on downstream delta users. Although the State Water Commission⁶⁷ mailed a letter to all water users along the Sacramento, explaining that junior users would be cut back if conditions warranted,⁶⁸ users' collaboration and cooperation obviated the need for state action.⁶⁹ Most accounts of the situation indicated that it would be impossible at the time to ascertain the water rights on the river, and the diverters knew this. Therefore, if they couldn't rely on the State Water Commission for enforcing priority, their options were either 1) to take what they wanted, damn the downstream users, or 2) to cooperate. Understanding that choice (1) would likely result in costly litigation without producing a speedy resolution, and that in most years, plenty of water was available, users chose to cooperate to address this temporary problem.⁷⁰ Furthermore, I think that many farmers knew that they used water profligately, practically irrelevant when water was cheap and abundant. But when scarcity increases, users could improve efficiency drastically as long as they felt confident everyone else was doing their part. This is exactly what happened in the Sacramento River case – users voluntarily agreed to follow the advice of a third party commission.⁷¹

2.2.2 Water Right Allocation Estimates

Despite the lack of crisp water right data in California, it is still useful to estimate the average annual water diversions under the different water right types:

Insert Figure 3 – Avg Water Use in CA – 1998-2005

Figure 4 – Avg Water Use in CA – 2004-2009

The SWRCB only administers appropriative post-1914 water rights. This includes the CVP and SWP, Metropolitan Water District's share of the Colorado River, East Bay MUD's diversions, a portion of Los Angeles' diversions from the Owens Valley, and about 4 million acre-feet of other rights. However, although the SWRCB manages this chunk of supply, it does not have complete control over these users' water supplies because California irrigators seek diversity – many farmers receive water from multiple rights to ensure dry year supplies are adequate. 26% of irrigated farms rely only on groundwater, but closer to 60% use at least some groundwater, illustrated in the following table.⁷²

Insert Table 2

The Department of Water Resources monitors well depth throughout the state, but they do not collect actual extraction data – the data they do have for groundwater extraction outside of adjudicated basins is estimated as a residual category.⁷³ Their estimates are very close to USGS estimates for 2005.⁷⁴

⁶⁷ Their name changed to the "Division of Water Rights" around 1922, and later to the "Water Rights Board" and later to the "State Water Resources Control Board," I try to use the correct name based on the time period.

⁶⁸ California, *Notice to Water Users from the Sacramento River System* (San Francisco: The Commission, 1920).

⁶⁹ Sacramento-San Joaquin River Problems Conference, Sacramento Chamber of Commerce, and California, *Proceedings of the Sacramento River Problems Conference* (Sacramento: Pub. by Sacramento Chamber of Commerce and Division of Water Rights, 1924), 164. For more on this, see part II.

⁷⁰ *Ibid.*, 164.

⁷¹ For more details, see Part II

⁷² United States, *2008 Census of Agriculture* (Washington, DC: U.S. Dept. of Agriculture, National Agricultural Statistics Service, 2008) Table 11.

⁷³ DWR uses land use surveys to estimate cropping patterns and water needs. All surface supplies are then tracked at the Detailed Analysis Unit (DAU) level. All needs that are estimated to be unmet from available surface supplies

2.3 Surface Water Right Transferability

In the U.S. in general, and California in particular, surface water is considered to be owned by the state (or by the people of the state), and therefore it cannot be privately owned. What can be privately owned is a usufructuary right, a right to divert the resource from the stream and apply it to a beneficial use under specific conditions (for example, a specific time, place and type of use). It is this usufructuary right that may be transferred for either appropriative, or in unique cases, riparian rights. Temporary (single-year) transfers of this usufruct right are more common than permanent or longer-term transfers, but all durations are possible.

2.4 Surface Water Contract Transferability

In addition to appropriative and riparian water rights, many users receive water through a district which has a water contract with a major water project. The largest contract relationships are between the State Water Project and the federal Central Valley Project. The CVP has contracts for 9.41 million acre-feet⁷⁵ while the SWP contracts for 4.17 million acre-feet.⁷⁶ The following table lists the major wholesalers and the approximate water right or contract quantity.⁷⁷ To put these in perspective, Californians use close to 42 million acre-feet of water per year, 79% of which goes to agriculture.⁷⁸

Insert Table 1

Although wholesalers are subject to seniority cutbacks based on their water right, they typically distribute water to their district contractors equally rather than based on seniority. Each wholesaler has their own internal rules for how their contractors may trade water within their project area – some allow the permanent assignment of the contract rights and obligations to another contractor, and most allow users to set up temporary transfers. Usually, the water must stay within the wholesaler’s network.⁷⁹ This discussion also applies to the contract relationship between a district and an individual grower.

are assumed to come from groundwater. Michael McGinnis, “Phone Conversation with Michael McGinnis, Engineer”, March 10, 2011.

⁷⁴ *Estimated Use of Water in the United States in 2005* (Reston, Va: U.S. Geological Survey, 2009).

⁷⁵ USBR Mid Pacific Region, “2008 Water Rates and Deliveries”, February 4, 2010. This includes 2,711,921 acre-feet of water for Sacramento River Settlement Contractors and San Joaquin River Exchange Contractors. In addition, some of the remaining 6,699,570 acre-feet of Water Service Contracts are only available in dry years (EBMUD for example has an 133,000 acre-foot contract that has a 165,000 acre-foot cap in any 3 year period, in addition to only being available in dry years) or wet years (Friant contractors have large wet-weather Class II contracts for 1.4 million acre-feet). SWP contract quantities were originally for 4,230,000 AF, but have been slightly reduced to 4,170,000. The actual project yield has been far less, mainly because of the absence of the Peripheral Canal.

⁷⁶ CA DWR, *The California State Water Project: Bulletin 132* (Sacramento: The Resources Agency of California, Dept. of Water Resources, n.d.)2007, Table B-4.

⁷⁷ Kern Cty WA and Metropolitan WD are themselves wholesalers of SWP water, redistributing the water to members.

⁷⁸ California Department of Water Resources, *California Water Plan Update 2009 Volume 5-Technical Guide - Water Portfolios*, Bulletin 160 (Sacramento, Calif: California Dept. of Water Resources, 2009), <http://www.waterplan.water.ca.gov/technical/cwpu2009/>.

⁷⁹ The CVP became the exception to this rule – in 1992, it changed its rules to allow transfers to non-CVP users. This will be discussed more in the CVPIA discussion below.

2.5 Groundwater Right Transferability

Beginning in 1903,⁸⁰ to get a right to groundwater in California, one has to own the land where the well is located and one simply extracts the water and uses it for a beneficial purpose. In general, as there is no formal groundwater regulatory structure, groundwater property right disputes must be settled in the courts. Overlying owners that pump groundwater for use on their own land create an *overlying right*, while users that pump water for use on land that they do *not* own create an appropriative groundwater right⁸¹ Overlying groundwater users owe a duty of reasonableness to their neighboring overlying users. Transferring this groundwater to another user would involve moving the water itself rather than selling the actual right to the water, and this happens in certain circumstances.⁸² Appropriative groundwater rights are legally transferable, but there are very few examples in practice. A third class of groundwater rights are much more important for transferability – in urban Southern California, many groundwater basins have been adjudicated, and the basin users now have precisely quantified rights, made up of what used to be overlying, appropriative or prescriptive rights. These rights are typically transferable depending on the individual basin rules, and have active temporary and permanent transfer markets.⁸³

3. Water Marketing Development and Alternatives

A growing population with changing needs and desires, coupled with steadily improving technology, meant that water use changes continually. New users acquire water

- from available groundwater
- from seawater/wastewater (desalination/filtration)
- from fresh surplus surface water available
 - because of a lack of scarcity
 - because the original users cooperate to exploit economies of scale and are able to serve new users with the same existing supply
- involuntarily from others
 - by developing a prescriptive right
 - through litigation
- through eminent domain
- voluntarily from others
 - through a formal transfer (both riparian and appropriative)
 - by purchasing land which had water rights (surface or ground) attached
- through the courts – “new” water became available through the courts’ interpretation of reasonable and beneficial use

As is evident, water transfers are only one way to reallocate water. A more common viewpoint, however, is that without marketing, water uses established years ago are anachronistic:

⁸⁰ *Katz v. Wilkinshaw* 141 CA 116 (1903).

⁸¹ Cities that pump groundwater and provide it to residents are technically appropriators, and they are junior to the overlying users.

⁸² During droughts, farmers with access to groundwater may pump more than they need, dumping the excess into the local distribution network to serve other farmers in need. This has happened most recently within the CVP system.

⁸³ See recent issues of Rodney Smith, ed., *Water Strategist* (Claremont, Calif: Stratecon, n.d.).

It would be astonishing... if the allocation of the state's water resources that occurred over the course of the last one hundred forty years represented the optimal distribution for the late twentieth and early twenty-first centuries.⁸⁴

This viewpoint assumes that the lack of transferability indicates that water uses begun years ago are still continuing today. In what follows, I trace the development of water markets in early court decisions and explain the myriad ways in which water has been reallocated among users outside of markets. This history helps explain why marketing developed when it did, and it shows the innovative ways in which water flows towards new uses over time.

3.1 Transferability Develops Through the Courts

Because appropriative rights are property, they are transferable like other property,⁸⁵ and an owner of a right established prior to the 1913 Water Commission Act may change aspects of the water right to effect a transfer without any entity's approval.⁸⁶ Transferability of one's own property is not a new concept. However, social norms ensured that one's enjoyment of property did not come at the expense of a neighbor. If a water transfer caused an injury, the injured party could ignore it if minor, work out a resolution with the offender, or pursue resolution in court. With a lack of scarcity, or if the changes did not substantially alter the stream flow, other affected users (if any) would have no reason to complain. With increased scarcity, complaints did arise, and the courts sanctioned transfers in these cases only if the changes were not injurious to other legal users of the water. Thus, basic water transfer law stipulated that they were possible, but they could not injure any other user.⁸⁷ This law developed from the body of common law, and the legislature eventually codified it in 1913. Close to one hundred years later, the same basic rules still apply.⁸⁸

In granting appropriative water rights holders flexibility, the courts desired to maximize the utility of water for the user. According to Samuel Wiel,⁸⁹ water rights were deemed by the courts to be changeable to protect a miner's property.

By appropriating a stream the law has always considered that a right of property was conferred, and being property, the owner may enjoy it as he will, so long as he does no injury to others, just as he may a farm or a horse or other property. The law, hence, has always regarded the right as independent of means or place or purpose of use or of point of diversion.⁹⁰

⁸⁴ B. E. Gray, "Shape of Things to Come: A Model Water Transfer Act for California, The," *Hastings West-Northwest Journal of Environmental Law and Policy* (1996): 25.

⁸⁵ Samuel Charles Wiel, *Water rights in the western states: the law of prior appropriation of water* (Bancroft-Whitney company, 1911), 529; Gray, "Shape of Things to Come," 24.

⁸⁶ Now, they are subject to the California Environmental Quality Act if the action requires approval from a public agency, which it almost certainly does. This is discussed later.

⁸⁷ Wiel, *Water rights in the western states*, 532.

⁸⁸ See *California Water Code*, 2011, sec. 1725–45.

⁸⁹ *Water rights in the western states*, 529. He and other experts do not mention water transfers as we think of them today. See A. E Chandler, *Elements of Western Water Law* (San Francisco: Technical publishing co, 1918); Wiel, *Water rights in the western states*; Gavin William Craig, *Selected Cases on Water Rights and Irrigation Law in California and Western States* (San Francisco: Bancroft-Whitney Co, 1910).

⁹⁰ Wiel, *Water rights in the western states*, 529.

For example, appropriators wanting to abandon gold mining for timber extraction ought to be able to, and the courts decided the purpose of use was changeable.⁹¹ In addition, the courts said that extending a ditch to work a different mine was desirable (if the first mine failed, for example), and so changes in the place of use were allowed.⁹² The point of diversion was similarly changeable.⁹³

Although no change in the water right should injure another user, Wiel points out that in the early days of public domain mining, there were very few other diverters, and so injury concerns were less important – the focus was solely on development.⁹⁴

But as the lands become settled and appropriations also increase, the government is no longer the only one concerned. Private rights of others are now also concerned. Hence, while in the early days the chief consideration was the freedom of change without loss of priority, in latter days the prohibition of injury is becoming the more important; as settlement advances, will become the most important, and in time practically prohibit change altogether.⁹⁵

His words would prove to be quite prescient, and thus in California, water *right* transfers are quite limited.⁹⁶

The laws allowing changes in a water right were not conceived under the idea that one user may sell his excess water to another. In fact, appropriative law as it developed from mining camps specifically aimed to prevent idle holding of water for speculation, and the mining camp customs encouraged use by new claimants if another miner did not need the water anymore, specifying that a lack of use forfeited the right.⁹⁷ In addition, early mining codes limited claim sizes, all part of a general effort to “spread the wealth around.”⁹⁸ Therefore, the idea that a new miner would have to buy an existing water right from someone who no longer planned on using it was nonsensical. Therefore, the courts, in treating appropriative rights like property, allowed behavior which was partly in opposition to the appropriative customs that developed within the mining camps. Yes, owners could alter the place of use, point of diversion, and type of use without losing priority, but designating water rights as property also sanctions their ability to sell a water right and profit from it, even if they could no longer make use of the water.⁹⁹

3.2 Reallocation by the Courts

In some cases, society accommodated new water users through the courts’ power to ensure existing water uses were reasonable and beneficial, a requirement for all water uses at the

⁹¹ Ibid., 531.

⁹² Ibid.

⁹³ Ibid., 530.

⁹⁴ Ibid., 535.

⁹⁵ Ibid.

⁹⁶ Essentially, the market today is dominated by transfers of imported water, for which the injury provisions do not apply (See *Stevens v. Oakdale Irr. Dist.* 13 Cal. 2d 343 (1939).).

⁹⁷ M. T. Kanazawa, *The Extralegal Origins of First Possession: Water Law during the California Gold Rush* (Department of Economics Working Paper, Carleton College, 2005), 10.

⁹⁸ Ibid., 11.

⁹⁹ Permanently selling a water right falls into two broad categories – either another user wants to buy out a content owner currently using the water, or the current owner may no longer have a need for the water and seeks to sell. Both are seemingly similar, but in the latter case, the water would revert to the public for subsequent appropriation, and selling this right generates animosity.

root of western water law.¹⁰⁰ This concept is vague, and the courts can gradually restrict what they (and society) view as a reasonable or beneficial use in order that water is used in the most productive way.¹⁰¹ The very fact that society chose to adhere to this concept meant that the water right owner *never had full ownership of a water right*. The courts and society always had a right to decide if a particular water use was beneficial or reasonable. Instead of relying on the ability of more profitable uses to nudge out less profitable ones through negotiation, courts had the authority to deem specific uses unreasonable in the face of new evidence. And while this was added to California's constitution in 1928, the idea was not new – it was evident in the famous 1855 decision which confirmed appropriation.¹⁰²

There are many examples of court reallocation, typically motivated by new users trying to convince courts or the legislature that older uses were anachronistic or wasteful. For example, before 1884, it was reasonable to blast water at hillsides to mine gold until farmers with flooded fields became angry enough to sue to stop this practice.¹⁰³ This ruling was not done with the intent to reallocate water, but it had that effect because the court decision essentially ended the practice of hydraulic mining.¹⁰⁴ Similarly, before 1935, winter irrigation was deemed a beneficial use, used to prepare fields as well as to drown gophers.¹⁰⁵ Afterwards, the use of water to drown gophers was deemed wasteful, and other users could reap the benefits from the new abundance. Adverse environmental effects from water diversions led to another major reallocation from Los Angeles in the 1980s. Los Angeles' diversions from the Mono Basin were approved with reservation by the SWRCB in 1940, but later deemed contrary to the public trust to prevent degradation of Mono Lake.¹⁰⁶ As a result, Los Angeles Department of Water and Power had to reduce its diversions from the Owens Valley to accommodate this “new” environmental use. Before the 1987-92 drought, LADWP diverted close to 500,000 acre-feet per year from Owens Valley, but since the 1994 ruling stipulating that they must decrease pumping to restore the lake level, their average diversions have been closer to 300,000 acre-feet.¹⁰⁷ And in perhaps the most famous example, flooding of the Salton Sea caused by excess irrigation runoff in the Imperial Irrigation District led to a forced water reallocation to Metropolitan Water District.¹⁰⁸

¹⁰⁰ Wiel, *Water rights in the western states*, 504.

¹⁰¹ “Water Resource Economics: The Analysis of Scarcity, Policies, and Projects,” *MIT Press Books 1* (2006); S. K. Olson and E. K.L. Mahaney, “Searching for Certainty in a State of Flux: How Administrative Procedures Help Provide Stability in Water Rights Law,” *McGeorge L. Rev.* 36 (2005): 87.

¹⁰² See *Irwin v Phillips*, discussed in Gray, “In search of Bigfoot,” 241.

¹⁰³ *WOODRUFF v. NORTH BLOOMFIELD GRAVEL MINING CO.* Circuit Court, D. California 18 F. 753 (1884)

¹⁰⁴ Hundley, *The great thirst*, 79.

¹⁰⁵ *TULARE DIST. v. LINDSAY-STRATHMORE DIST.*

¹⁰⁶ *National Audubon Society v. Superior Court*, 33 Cal.3d 419 (1983).

¹⁰⁷ LADWP, *Annual Owens Valley Operations Plan for Runoff Year 2010-11*, Conditions in the Owens Valley Enhancement and Mitigation Project Status Status of 1991 Environmental Impact Report Mitigation Measure Status Status of Other Studies, Projects, and Activities (Bishop, Calif: LADWP, 2010), 42.

¹⁰⁸ The original complaint was from a landowner on the shore of the Sea. See *John Elmore v. Imperial Irrigation District*. For a description of the transfer, see B. M. Haddad, *Rivers of Gold: Designing Markets To Allocate Water In California* (Island Press, 2000), 74; Hundley, *The great thirst*, 470; *Water Transfers in the West Efficiency, Equity, and the Environment*, 234.

3.2.1 Transfers Away from Riparians

Riparian users used to enjoy supremacy over their appropriative competition, leading many water experts to condemn the doctrine as wasteful and inappropriate in an arid state like California.¹⁰⁹ The situation on the ground turned out to be different as the courts and society gradually stripped some of this power away. Riparian supremacy stemmed from the previously mentioned case *Lux v Haggin*¹¹⁰ case, which put practically no legal restraint on riparian use. The downstream riparian landowner Miller and Lux sued Haggin, an upstream appropriator, after he built the Calloway Canal off the Kern River. During the particularly dry year of 1878 and 1879, Calloway diversions siphoned practically the entire Kern flow, killing 16,000 cattle downstream. Miller and Lux offered 75% of the flow to Haggin if Haggin would agree to send the rest downstream.¹¹¹ He did not agree, was sued, and lost.¹¹² Interestingly, although the outcome pleased the downstream riparians, they did not choose to enjoin Haggin from diverting. Instead, they granted him a portion of the summer and winter flow in exchange for a dam on Buena Vista Lake.¹¹³ This point is important – from a simple view, the outcome was inefficient – it preserved the entire flow for the pasture-irrigating riparian at the expense of the higher-value crop producing appropriator. However, the parties mitigated the adverse effects of the decision through voluntary grants of water, sanctioned by the judge. This transfer was likely the first major formal water transfer in California, only possible because a judge stipulated precise entitlements and because there were two main parties, significantly reducing transaction costs and facilitating Coasian bargaining.

Voluntary grants were not the only way to transfer riparian water.¹¹⁴ The legislature gave towns and cities, and later, irrigation districts, the right to seize water rights through eminent domain,¹¹⁵ although in practice, this turned out to be quite difficult.¹¹⁶ They also sanctioned adverse possession as a way to acquire water away from a riparian. While Miller and Lux and other large riparian interests did fight and enjoin their upstream appropriators, many other smaller riparians would not complain if upstream appropriators took some water, and these uses ripened into prescriptive rights.¹¹⁷

The legislature, by constitutional amendment and through the 1913 Water Commission Act, also attempted to remove some of the supremacy that riparians had over appropriators. Section 42 of the Water Commission Act limited water use to 2.5 acre-feet per acre for uncultivated lands.¹¹⁸ Section 11 of the Water Commission Act stipulated that if riparians did not use water for 10 years, they lost their right. Both of these provisions were overturned by the

¹⁰⁹ See discussion in Miller, “Riparian Rights and the Control of Water in California, 1879-1928,” 12.

¹¹⁰ *Lux v. Haggin*.

¹¹¹ Pisani, “From the family farm to agribusiness,” 206.

¹¹² The ruling created three possibilities for appropriators – they could use groundwater, they could build mountain storage projects to capture flood flows, assuming riparians didn’t have right to flood flows, or they could form an irrigation district. The third option is critical to understanding the nature of California in the 1870s and 1880s – land was the game in town, and irrigation districts enabled land speculation to continue. Donald Pisani, History Professor, “Phone Conversation with Donald Pisani”, March 2011.

¹¹³ Henry Miller, *Contract and agreement between Henry Miller and others of the first part, and James B. Haggin, and others of the second part*. ([S.l.: s.n., 1888).

¹¹⁴ Kanazawa, “Efficiency in western water law,” 172.

¹¹⁵ Pisani, “From the family farm to agribusiness,” 247.

¹¹⁶ *Ibid.*, 268–269. *Lux v. Haggin* actually confirmed that irrigation was a public use, and therefore eminent domain was a valid action to further irrigation. See *Ibid.*, 229.

¹¹⁷ Miller, “Riparian Rights and the Control of Water in California, 1879-1928,” 6.

¹¹⁸ *Water Commission Act*, 1913, Sec. 42.

courts.¹¹⁹ However, the legislature was eventually successful in reducing riparian power in the *Herminghaus* case, discussed briefly earlier.¹²⁰ The court sided with Herminghaus, giving her the right to the natural flow of the river, in effect forcing 99% of the flow to stay in the channel in order for her to divert her 1%.¹²¹ Just as in *Lux v. Haggin*, the establishment of rights and low transaction costs (only two main parties involved), coupled with the inefficient ruling, led Southern California Edison to negotiate, and through eminent domain, purchased the Herminghaus land and water rights for \$1,000,000.¹²² After the 1928 constitutional amendment (Article X, Section 2), the next significant ruling arose forty years later, when riparians in Marin County could no longer use a stream for gravel collection if it prevented Marin Municipal WD from building a domestic reservoir upstream.¹²³ Again, the courts stepped in to reallocate water use from one party to another, this time serving the greater good, and therefore no additional bargaining among the parties was necessary.

3.3 Reallocation through the SWRCB

In contrast to court sanctioned transfers, post-1914 water rights were formally changeable with State Water Resources Control Board approval. Essentially, if the SWRCB could determine that the change would not injure another legal user, then a water right change was approved.¹²⁴ However, if the SWRCB granted authority to change a water right, and the change caused an injury, disputes could still end up in court. Before 1980, although there were minor changes in water rights, there were hardly any formal water transfers before the SWRCB. As Stephen Smith points out,¹²⁵ however, they were definitely legal.

Besides determining the lack of an injury for water transfers, after 1970, the SWRCB had to follow the California Environmental Quality Act (CEQA) which required agencies to prepare an environmental impact report (EIR) if a proposed project had “potentially significant environmental impacts.”¹²⁶ Granting permission to change a water right qualified as a “project,”¹²⁷ and so all water transfers would require an EIR unless the transfer proponents showed the transfer was unlikely to cause significant impacts. Many changes in water rights

¹¹⁹ *TULARE DIST. v. LINDSAY-STRATHMORE DIST.*, [CSL STYLE ERROR: reference with no printed form.].

¹²⁰ *Herminghaus v Southern Cal Edison Co.*

¹²¹ Gray, “In search of Bigfoot,” 262.

¹²² M. C Miller, “Water Rights and the Bankruptcy of Judicial Action: The Case of *Herminghaus v. Southern California Edison*,” *The Pacific Historical Review* (1989): 103. This wouldn’t be necessary after the 1928 constitutional amendment – requiring flood waters to irrigate pasture was not a reasonable use if it prevented an upstream hydropower project.

¹²³ *Joslin v. Marin Municipal WD*, 67 Cal.2d 132, (1967)

¹²⁴ The original Water Commission language stipulates that all proposed water right changes be published in the local county paper once a week for four consecutive weeks. If anyone protested, the Board would set a date for a hearing at least one month after the publication period. *Water Commission Act*, sec. 16. A cursory look at Board decisions (see Application 10011, 650, 6455, 5178, etc.) shows more than a few with less than two month approval time, indicating a lack of protests. This confirms my basic understanding that the Board uses the absence of complaint to assume injury-free water right changes.

¹²⁵ S. C. Smith, “The Rural-Urban Transfer of Water in California,” *Natural Resources Journal* 1 (1961): 68. I discuss these examples in detail in the next section.

¹²⁶ See §21000 of Division 13 of the California Public Resources Code.

¹²⁷ The definition of “project” was significantly expanded to include public agencies granting permits with the landmark case *Friends of Mammoth v. Board of Supervisors*, 8 Cal.3d 247 (1972).

were minor, and thus could claim exactly this,¹²⁸ avoiding the costly EIR procedure. Still, this extra transfer hurdle would prove more important as CEQA gained importance.

Contract delivery transfers from large post-1914 water right wholesalers deserve special mention – typically, a wholesaler’s water right allows many uses (irrigation, municipal, recreation, power) and has a large place of use.¹²⁹ Movements of water from one contractor to another within the same wholesaler’s network do not require SWRCB approval because the water is still used according to the terms of the license or permit on file in Sacramento. This is not to say that these transfers happen freely – the wholesaler often has its own approval process governing reallocation of contract water.¹³⁰

Currently, the SWRCB must approve all changes in the place of use, point of diversion or purpose of use, but this was not always the case. The original Water Commission Act only required permission for changes in the point of diversion.¹³¹ In 1921, changes in the place of use also required approval, and in 1925, changes in the purpose of use similarly required approval.¹³² These adjustments were not random – changes in the point of diversion would have potentially large impacts on neighboring water users,¹³³ whereas changes in the place of use were less threatening – users irrigating new agricultural land from the same water right may alter the return flow pattern, but doing so would necessitate abandoning the current canal, a large waste, or extending the existing canal, likely causing only minor changes in the return flow pattern.¹³⁴

3.4 Other Efficiency Enhancing Activity

In addition the reallocation possibilities mentioned so far, increases in efficiency could still occur without any reallocation. Although not necessarily a transfer by my definition, changes in ownership of the water right where the physical water use aspects might remain the same could still represent an increase in the productivity of water. For example, a user diverting from a ditch may give way to a mutual water company, which may later give way to a larger water district.¹³⁵ Each still served water to the original use, but the changes were generally in the direction of increased efficiency, capitalizing on the tremendous economies of scale inherent in surface water provision. The downside to this is that as users relinquished their rights to mutual

¹²⁸ This is called a Negative Declaration by the lead agency. See, for example, SWRCB, “Water Right Application 8552”, October 26, 1984, <http://swrcb2.waterboards.ca.gov/ewrims/wrims-data/1002382%20a008552.pdf>.

¹²⁹ The CVP for example has a place of use covering a large swath of the Central Valley.

¹³⁰ The CVP has different divisions corresponding to different project features and geographical areas. Water transfers within the same Division are generally approved without review, subject to certain conditions. See Brian E Gray, *Water Transfers in California, 1981-1989* ([San Francisco: University of California, Hastings College of the Law, 1990), 64–7. The SWP, on the other hand, is more reticent in allowing transfers within its boundaries. I discuss this more later.

¹³¹ *Water Commission Act*, sec. 16.

¹³² The code was changed in 1921 to include changes in the place of use (see statutes 1921 ch. 329) and in 1925 to include changes in the purpose of use. See Sidney Twichell Harding, “Principles Governing the Transfer in place of use of water rights” (none, 1928), WRCA..

¹³³ Anecdotal evidence points to this still being the case today – the recent transfer between Conaway Ranch and the cities of Davis and Woodland was facilitated by using the original diversion works of Conaway, therefore avoiding the need for a new endangered species permit for a diversion facility. See Doug Baxter, “Conversation with Doug Baxter, City of Woodland”, February 24, 2011.

¹³⁴ Miners were not dictating water policy anymore, but had they been involved, they likely would be more concerned about changes in the point of diversion too – a miner, if he wanted to work new land, either altered the point of diversion and worked a new claim near the river, or extended an already built canal.

¹³⁵ Smith, “The Rural-Urban Transfer of Water in California,” 68.

water companies and public districts, the ability to transfer water gradually shifted away from the farmer and to the district.¹³⁶

3.5 Why isn't land reallocated like water?

It is useful to discuss differences in water and land that make land transactions in the marketplace common while water reallocations have mostly occurred outside of the marketplace. Part of the explanation may be the ease in which the state gets involved in water law decisions, setting a precedent for continued reliance on the state to accommodate new uses. In the late 1800s in California and much of the west, land was available from the public domain, much like water, and extremely large estates and water rights emerged.¹³⁷ Progressives and others preferred many small irrigators,¹³⁸ each owning their farm, rather than one massive monopolist renting land and water to new settlers, and the state government in the Progressive era was empowered by the people to further this goal.¹³⁹ Their most memorable product was the 1913 Water Commission Act, but the Act would mainly focus on preventing new water monopolies while current large landholders were not threatened with expropriation. Why? One reason may be that land exhibits excludability whereas water exhibits aspects of a public good, and the courts and the legislature had no way of furthering their wishes for small landholders without directly confiscating land from large landowners.¹⁴⁰

Water molecules, on the other hand, typically had multiple users, and when these users were numerous enough to create conflict, the courts and the legislature could get involved and had the option of siding with the new users. Unlike land, it also was difficult to exclude a new water user from taking water already being used – users could locate upstream and simply take the water. This, coupled with the potential downstream externalities of water use, forced the courts to make judgments about the relative merits of water uses. This intrusion from above set a strong precedent that complete ownership of water never belonged to the original user. Rather, a water user merely has a right to use water today and the hope that it could continue tomorrow. It also set a precedent for using the courts for reallocation rather than the marketplace. As the number of users increased, the desire and possibility for reallocation from above occurred alongside the desire of economists to facilitate voluntary market reallocation. Basically, as the number of competing users increased, the security of the property right decreased, a troubling problem for market reallocation.

4. Water Market Development

Water marketing growth would begin to occur in the late 1980s, but scholars disagree on why. Increasing scarcity is assumed, but besides this, have the legal changes spurred the market?

¹³⁶ For an example of the difficulty of individuals vs. water companies selling water, see CA DWR, *The 1976-1977 California drought: a review* (The Agency, 1978), 96.

¹³⁷ Miller and Lux, for example, owned over 800,000 acres in the Central Valley. See Miller, "Riparian Rights and the Control of Water in California, 1879-1928," 3.

¹³⁸ This was also one of the goals of the Reclamation Act of 1902.

¹³⁹ Pisani, "From the family farm to agribusiness," 358, 368.

¹⁴⁰ Of course, land ownership has slowly changed over time as environmental restrictions limit what can be done on land, zoning restrictions prevent full use of property, etc.

This section provides a narrative of major events that were significant in California water marketing development.

4.1 *Mid-1900s Debate*

In the 1950s, economists pushed for formal water markets as a better way to reallocate water to needy users from those with excess.¹⁴¹ This was not a theoretical exercise – planning for the SWP and a large increase in the CVP prompted a study of possible alternatives, and economists were at the forefront. However, it was an open question if the system of water rights in place mid-century would support voluntary reallocation, and California’s water right system definitely complicated planning for new sources.¹⁴²

Stephen Smith, with input from other water scholars at Berkeley and the State Water Rights Board, mentions that although uncommon, water rights transfers to urban areas did happen, and the lack of additional transfers was primarily the result of abundance—scarcity was not in force as of his writing in 1960.¹⁴³ “The conclusion from these experiences is that water rights have not been a material block in the economic change from rural to urban water use.”¹⁴⁴ This conclusion is based on the lack of scarcity, but also on a few small transfer examples which showed to Smith that water rights could accommodate changing needs.

The examples he points to are interesting. Application 10011¹⁴⁵ is a small diversion along Willow Creek, tributary to the Feather River in the Sierra Nevada Mountains. The applicant expanded the place of use to incorporate the city of Portola, and the purpose of use was expanded to include municipal use. The original point of diversion did not change, nor did the user cease the original irrigation use, although a closer point of diversion was added nearer to the city. The second example given is for Application 8496,¹⁴⁶ originally an industrial and domestic use right, along Graeagle Creek in Plumas County. Here, a buyer bought out the dying Graeagle Lumber Company, subdivided lots and expanded the local millpond water right to include irrigation purposes to irrigate nearby agricultural land in the valley. The Graeagle Lumber Company’s mill pond remained the sole point of diversion, but agricultural land in nearby sections was added to the place of use. Closely related Application 8495 had similar changes to its water right, changing expanding potential uses to also include domestic and irrigation in addition to hydroelectric use.¹⁴⁷

Neither of these transfers changed the original point of diversion or altered the original use of water. Instead, they merely expanded the place of use to accommodate a new use, almost as if the new users were working from an entirely new water right. Mountainous areas have very little irrigable land and sparse populations, so it seems likely that these changes would not affect

¹⁴¹ Dehaven and Hirshleifer, “Feather river water for southern California”; Bain, Caves, and Margolis, *Northern California’s water industry*.

¹⁴² V. Ostrom, “State administration of natural resources in the West,” *The American Political Science Review* (1953): 479.

¹⁴³ “The Rural-Urban Transfer of Water in California.”

¹⁴⁴ S. C. Smith, “Legal and Institutional Controls in Water Allocation,” *Journal of Farm Economics* 42, no. 5 (1960): 1354.

¹⁴⁵ SWRCB, “Water Right Application 10011”, March 10, 1960, <http://swrcb2.waterboards.ca.gov/ewrims/wrims-data/1002581%20a010011.pdf>.

¹⁴⁶ SWRCB, “Water Right Application 8496”, June 1956, <http://swrcb2.waterboards.ca.gov/ewrims/wrims-data/1002341%20a008496.pdf>.

¹⁴⁷ Smith, “The Rural-Urban Transfer of Water in California,” 68; “Graeagle Merchants Association - History”, n.d., <http://www.graeaglemerchants.com/history.htm>; SWRCB, “Water Right Application 8496.”

other water users. Therefore, I find it hard to agree with Smith that these examples provide evidence that water rights are not a hindrance to urban reallocation. He may be right, but without scarcity and no one to complain, the water right is practically irrelevant. The water remained in the same area, just serving a different use. The owners did not move water to use elsewhere at the expense of the original use, and the water right quantity never came into question because of abundance. Therefore, there were no concerns about unfairness resulting from an owner trying to sell water he wasn't entitled to or trying to sell water he no longer needed.¹⁴⁸

Smith's view that water rights were not hindering rural-urban reallocation was not shared by other economists. In 1956, Jerome Milliman, writing his dissertation at UCLA on Metropolitan Water District, argued that the lack of efficient pricing led to the push for new water supplies.¹⁴⁹ This criticism was part of a more general attack on centralized planning allocations compared to what he saw as a more efficient allocation by the market: "Insofar as possible, water rights should be defined and given legal certainty so that allocation of water between competing uses and users can take place through the market mechanism."¹⁵⁰ His focus was on preventing the new Feather River Project (State Water Project), but would also apply to the closely associated San Luis Unit extension of the Central Valley Project, both very expensive capital projects. Ultimately, economists would lose this part of the debate.

In addition to calling for formal water transfers, some economists also investigated whether the current water right system would actually support water transfers as scarcity increased. Mason Gaffney¹⁵¹ criticized water right flexibility, arguing that the legal language surrounding appropriative rights and the occasional transfer make them seem transferable, but with so many conditions on the sale, in practice they turn out to be non-transferable: "The empirical fact is undeniable. There is no market for appropriative rights worthy of the name. They simply are not bought and sold freely, despite crying needs for water transfers in every area."¹⁵² Gaffney wrote about the same time as Smith, but focused on agricultural users and their inability to transfer water in the Kaweah River basin. That two professors could write about water markets and reach a different conclusion indicates the diverse makeup of California at the time. In certain areas, Gaffney was right – scarcity existed, and transfers were not able to alleviate the shortages because the courts imposed conditions on transfers to prevent injuries, conditions that effectively made them infeasible.¹⁵³ Furthermore, Smith wouldn't necessarily argue with Gaffney – Smith's examples of possible transfers didn't rely on precisely defined water rights.

¹⁴⁸ Besides these minor reallocations to urban areas, Smith also mentions the steady urban expansion into previously irrigated land as one way rural users have transferred their water to urban users. Acquiring land with water rights remains popular today, especially when the right in question is groundwater. Smith, "The Rural-Urban Transfer of Water in California," 69.

¹⁴⁹ J. Hirshleifer and J. W. Milliman, "Urban water supply: A second look," *The American Economic Review* (1967): 169-178.

¹⁵⁰ J. W. Milliman, "Water law and private decision-making: a critique," *Journal of Law and Economics* 2 (1959): 63.

¹⁵¹ "Diseconomies inherent in western water laws: a California case study," *paper for Western Agricultural Economics Research Council, Tucson, Ariz* 23 (1961).

¹⁵² M. Gaffney, "Economic aspects of water resource policy," *American Journal of Economics and Sociology* 28, no. 2 (1969): 140.

¹⁵³ The important case referenced in Gaffney is *TULARE DIST. v. LINDSAY-STRATHMORE DIST.*

Hirshleifer, De Haven and Milliman confirmed Gaffney's conclusions.¹⁵⁴ They mention a few transfers but conclude "Nevertheless, it seems that...water planners will go to considerable lengths to develop presently unutilized supplies rather than to consider shifts of use between already-developed sources." As they mention, it is because "...In most jurisdictions water rights are not clearly defined...As a consequence, the market processes that ordinarily direct resources to uses that maximize their productivity...are either severely limited or prevented entirely from operating."¹⁵⁵

Bain, Caves and Margolis also concur, but blame the lack of marketing primarily on enforcement of appropriative water law.¹⁵⁶ This is an interesting shift in focus – Gaffney and Hirshleifer, DeHaven and Milliman did not criticize the enforcement of water rights but rather focused on the courts' stifling behavior.¹⁵⁷ Instead, Bain, Caves and Margolis discuss the problems created when the State Water Rights Board grants rights. They did "not generally determine in detail the aggregate of existing prior rights or the existence and size of a surface supply of water."¹⁵⁸ This criticism is valid, but was nothing new in 1966.

4.2 1971-1982

Some of the early push for marketing resulted from a National Water Commission Study authorized by Congress.¹⁵⁹ Congress authorized the Central Arizona Project, Bridge and Marble Canyon Dams, and other lesser Colorado projects in 1965, leading to concerns that these projects would use more water than the Colorado River could supply. This led to a push to study water supplies, and in 1968 Congress authorized money for a National Water Commission.¹⁶⁰ Charles Meyers and Richard Posner contributed to the National Water Commission Report with a background study of water transferability, advocating for increased use of water transfers to deal with expected shortages.¹⁶¹ They confirm that transfers are still rare in California – between 1959 and 1969 there were no requests of the SWRCB to change water rights to effect a transfer.¹⁶²

Meyers and Posner also focus on possible transfer hindrances in the water code. The legal code governing water districts, the largest water rights holders by volume,¹⁶³ limited districts' ability to serve water to non-district lands. In addition, there were restrictions on

¹⁵⁴ J. Hirshleifer, J. C. DeHaven, and J. W. Milliman, "Water Supply: Economics, Technology, and Policy.," *Chicago: University of Chicago* (1960).

¹⁵⁵ *Ibid.*, 363.

¹⁵⁶ Bain, Caves, and Margolis, *Northern California's water industry*.

¹⁵⁷ Gaffney, "Diseconomies inherent in western water laws," 35; Hirshleifer, DeHaven, and Milliman, "Water Supply," ??.

¹⁵⁸ Bain, Caves, and Margolis, *Northern California's water industry*, 68. I confirmed this in talking with SWRCB staff, who said that lack of protests was taken as evidence that existing rights holders could accommodate the new diversion.

¹⁵⁹ United States., *New directions in U.S. water policy summary, conclusions, and recommendations from the final report of the National Water Commission*. ([Arlington Va.]; For sale by the Supt. of Docs. U.S. Govt. Print. Off. Washington, 1973).

¹⁶⁰ T. M. Schad, "The National Water Commission Revisited Perspective on National Water Policy Studies, with some Implications for Changes in Future Water Policy," *Water Resources Bulletin* 14, no. 2 (1978): 303.

¹⁶¹ C. J. Meyers and R. A. Posner, "Market Transfers of Water Rights: Toward an Improved Market in Water Resources" (1971).

¹⁶² *Ibid.*, 8.

¹⁶³ This claim is easily confirmed by considering that the CVP, SWP, Colorado River, Kings River, Kern River, and most others are used by agricultural water districts.

district owned property (which includes water rights) and how districts could dispose of it.¹⁶⁴ Meyers and Posner thought these stipulations may prevent a more robust water market, but without court decisions to rule on those aspects yet, they conclude that districts could probable legally lease water to another user, but they remained skeptical that water right sales to another user were legal because of the provisions governing district property disposal.¹⁶⁵ The National Water Commission's was largely ignored.¹⁶⁶

Attention to water marketing resurfaces later, when scarcity hits home in 1976 with the driest year since 1934 (fourth driest on record) followed by the driest year on record.¹⁶⁷ The SWP met 100% of their contractors' requests in 1976 while the CVP delivered 100% to all contractors save the Friant Division, who received a 75% Class I allocation.¹⁶⁸ In 1977, the SWP cut municipal users by 10% and agricultural users by 60%,¹⁶⁹ and the CVP cut its settlement and exchange contractors by 25%, its agricultural users by 75%, and its municipal and industrial users by 50%.¹⁷⁰ Although users absorbed many of these decreases in supply, groundwater users drilled 10,000 new wells,¹⁷¹ pushing groundwater usage to 60% of total water usage.¹⁷² The following shows drought impacts on water supply:

Insert Table 4

The United States Bureau of Reclamation, using the 1977 Emergency Drought Act, set up a water bank in mid-April 1977, reallocating 46,438 acre-feet.¹⁷³ The water came from willing sellers in northern Californian counties (Butte, Sutter, Sacramento and Colusa) and was delivered to south of the delta contractors (those experiencing the greatest cuts).¹⁷⁴ The water made available came mainly from the stored base supply (and some from groundwater substitution) of Sacramento River Settlement Contractors,¹⁷⁵ and mainly from mutual water companies because the Drought Act made it impossible to pay individual farmers that ceded their rights to a district.¹⁷⁶ The enabling legislation allowed some profit incentive to motivate sales as

¹⁶⁴ Meyers and Posner, "Market Transfers of Water Rights," A1.20–A1.34.

¹⁶⁵ Ibid., A1–32.

¹⁶⁶ Schad, "The National Water Commission Revisited Perspective on National Water Policy Studies, with some Implications for Changes in Future Water Policy."

¹⁶⁷ CA DWR, *The 1976-1977 California drought*, 1.

¹⁶⁸ Joseph Santos and California Department of Water Resources, *The California drought, 1977 an update* ([Sacramento] :: The Department of Water Resources, 1977), 12. The Friant Division has contracts for 800,000 acre-feet of reliable Class I supply and close to 1,400,000 acre-feet of Class II supply, a much less reliable and cheaper supply. USBR Mid Pacific Region, "2008 Water Rates and Deliveries."

¹⁶⁹ CA DWR, *The 1976-1977 California drought*, 39.

¹⁷⁰ Ibid., 41.

¹⁷¹ M. Gaffney, "What price water marketing?: California's new frontier," *American Journal of Economics and Sociology* (1997): 482.

¹⁷² R. E Howitt, "Water in California: A Resilient System Under Pressure," *University of California Agricultural Issues Center, Davis, California, Position Paper* (1991): 3.

¹⁷³ CA DWR, *The 1976-1977 California drought*, 95–97.

¹⁷⁴ R. W Wahl and F. H Osterhoudt, "Voluntary transfers of water in the West," *National Water Summary* (1985): 119.

¹⁷⁵ Settlement Contractors were users that diverted from the Sacramento River before the USBR built Shasta Dam, and they settled with the Bureau for a secure supply of water (base supply) in return for giving the Bureau control over their water supply. In addition, many of these users purchased additional project supplies for late summer needs when their base supply is not sufficient.

¹⁷⁶ CA DWR, *The 1976-1977 California drought*, 96.

long as no seller gained an “undue profit.”¹⁷⁷ In addition, less well-known is the fact that users reallocated 138,000 acre-feet during 1977 outside of the special USBR water bank, using existing authority in their contracts.¹⁷⁸ These transfers were temporary reallocations within the CVP network, similar to those that occur frequently today.

The Department of Water Resources facilitated 400,000 acre-feet of exchanges among its members using surplus Colorado River water.¹⁷⁹ Metropolitan Water District agreed in February 1977 to take surplus water from the Colorado River (i.e. from Mexico) and to give up a like portion of its State Water Project allocation to other State Contractors and interested parties.¹⁸⁰ DWR also acted as a broker to reallocate 35,279 acre-feet slated for groundwater replenishment from southeastern California districts to southern San Joaquin Valley users.¹⁸¹ MWD did not profit off the exchange.¹⁸²

Outside of the major projects, there were a few small transfers, but they were likely based on pre-1914 water rights and therefore detail is lacking.¹⁸³ More importantly, the SWRCB heard¹⁸⁴ two proposals for transfers and denied them. The first involved the city of Roseville attempting to sell effluent which had already been appropriated downstream, an easy denial.¹⁸⁵ The second and more interesting proposal involved Anderson Farms Company (AndCo) in Yolo County attempting to sell water to Berrenda Mesa WD in Kern County, 234 miles south. Anderson proposed to relinquish its surface water and pump groundwater instead (or perhaps even pump groundwater directly into the Toe Drain) for redirection in the Delta¹⁸⁶ and subsequent use by Berrenda Mesa WD.¹⁸⁷ The SWRCB deemed that this transfer relied on an unreasonable method of diversion and that it was not in the public interest based mainly on its effects on local neighbors and based on Anderson’s unquantified right to Toe Drain surface water.¹⁸⁸ I discuss this transfer in more detail later.

¹⁷⁷ R. W. Wahl, “Market transfers of water in California,” *West-Northwest* 1 (1994): 59.

¹⁷⁸ DWR and UCLA, *Buying and Selling Water in California: How Does It Fit into the State’s Water Policy Portfolio?: Proceedings and Summary of the Conference* ([Los Angeles: Public Policy Program, UCLA Extension, 1986), 42.

¹⁷⁹ California Department of Water Resources, *The continuing California drought*. ([Sacramento]: State of California the Resources Agency Dept. of Water Resources, 1977), 85, http://www.water.ca.gov/drought/docs/13_drought_continuing.pdf.

¹⁸⁰ The SWRCB only had jurisdiction for the portion of MWD’s SWP exchange that went to Marin County, which received water starting on June 7, 1977 in San Rafael. See *Ibid.*, 87.

¹⁸¹ CA DWR, *The California State Water Project: Bulletin 132*.

¹⁸² CA Assembly Office of Research, *A Marketing Approach to Water Allocation* (Sacramento, Calif: The Office, 1982), 15.

¹⁸³ *Ibid.*, 117.

¹⁸⁴ The SWRCB has jurisdiction over changes in post-1914 water rights – many of the within-project transfers involve no changes in the overlying water right. However, in this case, the SWRCB became involved not through its jurisdiction over post-1914 surface rights but from complaints. The complaints allege impairment of other wells in the area or request that the pumping not be initiated until it is established that the increased pumping will have no adverse effects on the groundwater basins of Yolo County. See SWRCB, “In the Matter of Review of Proposed Groundwater Transfer Plan, ANDERSON FARMS COMPANY / BERRENDA MESA WATER DISTRICT, Proponents, COUNTY OF YOLO, ET AL., Complainants.” (SWRCB, 1977).

¹⁸⁵ CA Assembly Office of Research, *A Marketing Approach to Water Allocation*, 19.

¹⁸⁶ Actually, AndCo proposed to release its water into the delta to satisfy DWR’s salinity requirements, meaning that DWR could therefore hold more water back in Oroville. However, because of the extreme drought, minimum instream flow requirements on the Feather River would have prevented DWR from holding back any more water from the Feather River.

¹⁸⁷ SWRCB, “Water Right Decision 1474.”

¹⁸⁸ CA Assembly Office of Research, *A Marketing Approach to Water Allocation*, 19.

Interestingly, a prominent water marketing expert thought that the transfer was a good idea, but that public policy needed to be changed to facilitate marketing: “It seems to me that this is one of the few cases in which public policy can be changed so that everybody can get a bigger slice of the pie.”¹⁸⁹ Put differently – if only the legislature would fix the laws, water marketing could then flourish and produce tremendous gains from trade. This statement is actually indicative of a failure to understand the root problems with water transferability in California – to assume that a legislative fix exists or did exist as of 1980 is to ignore the previous 100 years of Californian history. This theme – that transfers were desirable but there were specific legal hurdles that prevented win-win reallocations – was nevertheless widespread at the time. It would lead to the creation of the Governor’s Commission to Review California Water Rights Law, starting a twenty-plus year trend of attempting to tweak the laws to facilitate markets.

4.3 Governor’s Commission

Ronald Robie, Director of the Department of Water Resources starting in 1975, pushed Governor Brown to appoint a Commission to study water rights in order to address concerns he had over environmental flows, pre-1914 and riparian right regulatory separation, unregulated groundwater and water transfers.¹⁹⁰ The success of recent water quality legislation encouraged Robie to pursue reforms with water rights,¹⁹¹ and the Governor obliged and appointed a Commission to investigate what water right fixes were necessary to ensure that the water right system was adaptable and capable of promoting efficient use. The last major review of water rights was at the time of the Water Commission Act of 1913, 64 years before. The opening letter summed up the motivation for investigation:

Why tamper with existing water rights and processes? I would suggest that while our current system may have served us fairly well up until the present, this should not be attributed to an inherent goodness of the case-by-case court decision approach. Rather, our lack of water crises is more likely a result of our active development of water supply projects. Those projects...prevent reallocation pressures from becoming more binding.¹⁹²

They believed that the water rights system, with a few modest legislative changes, could ameliorate scarcity. They also recognized that improvements in efficiency do not require permanent transfers.

Short-term transfers of water or water rights may be adequate to improve productivity. The Commission has therefore considered... modest revisions in the law to enhance the transferability of water rights.¹⁹³

The Governor’s Commission outlined proposed reforms, and the legislature would follow with legislation enacting some of the proposed reforms. California still did not administer

¹⁸⁹ SWRCB, *Phase I of the Bay-Delta Estuary Hearing*, 63 vols. (Sacramento: State Water Resources Control Board, 1987), http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/decision_1641/transcripts/bd_transcripts.shtml December 10.

¹⁹⁰ R. B Robie, “Governor’s Commission: A Reminiscence, The,” *McGeorge L. Rev.* 36 (2005): 13.

¹⁹¹ *Ibid.*, 14.

¹⁹² Governor’s Commission to Review California Water Rights Law., *Governor’s commission to review California water rights law*, 5 (introduction letter).

¹⁹³ *Ibid.*, 62.

groundwater, recognized decades ago as a major deficiency in California water law,¹⁹⁴ and the legislature did not address this nor other tougher reforms, leading some to call the Governor's Commission a failure.¹⁹⁵ However, the Commission's recommendations have received lots of attention,¹⁹⁶ and because many of their recommendations affected water marketing, and because the Governor's Commission started the process of repeated legislative tweaking to facilitate marketing, understanding some of the reforms is important to understand water marketing development. The following outlines the timing of some of the changes in the late 1970s and early 1980s.

1979- Water Code § 1011 – Water Conservation and Forfeiture

The legislature added legislation stipulating that conservation of water was a beneficial use, and non-use due to conservation was not subject to forfeiture.¹⁹⁷ This code was amended in 1982 to stipulate that this water may also be transferred.¹⁹⁸ This section was amended in 1995 to make clear that the right to the conserved water reverted to the transferor at the conclusion of the transfer.¹⁹⁹

The original aim of the legislation was to protect farmers from forfeiture proceedings if they fallowed land due to lack of labor and therefore couldn't use water. Only later did the focus shift to transferability and the incentive to free up water for other users. Technically, if a user conserved water and could irrigate the same area with less water, the right shrank to the amount he beneficially used. While the shrinking happens after five years of reduced use, in practice, the shrinking would never happen until the right is adjudicated because the SWRCB does not actively monitor and measure diversions.²⁰⁰ After the legislation, conservation practices are not supposed to decrease the appropriate right from the original amount, but this requires that there be an *original amount*. Because of the lack of measurement and quantification, most rights holders do not have a agreed upon quantity from which to calculate conservation savings, so to make use of this provision, specific ongoing behaviors were necessary to show the relationship between consumptive use and conservation efforts. The accounting system remains quite complicated,²⁰¹ and so the incentive to actually conserve and transfer remains weak. Although a few districts in the southern Sacramento Valley took advantage of the provision for some minor

¹⁹⁴ Edward Hyatt and Harold Conkling, *Major Deficiencies in California Water Law: Paper to Be Delivered by Edward Hyatt, January 11, 1940, Before Central Valley Water Resources Committee at Stanford University*, 1940.

¹⁹⁵ H. C Dunning, "Governor's Commission: Success or Failure, The," *McGeorge L. Rev.* 36 (2005): 21.

¹⁹⁶ E. Hanak, *Who Should Be Allowed to Sell Water in California?: Third-Party Issues and the Water Market* (Public Policy Institute of CA, 2003); C. S. Dyckman, "Dynastic Disruption: The Use Efficiency and Conservation Legacy of the Governor's Commission to Review California Water Rights Law Recommendations, A," *McGeorge Law Review* 36 (2005): 175; Brewer et al., "Law and the New Institutional Economics."

¹⁹⁷ Vuich, *An act to add Section 1198.3 to the Labor Code and Section 1011 to the Water Code, relating to rights, and declaring the urgency thereof, to take effect immediately*, *CA Water Code*, 1979.

¹⁹⁸ Katz, *An act to amend Sections 109, 1010, 1011, and 1427 of, to add Chapter 3.6 (commencing with Section 380) to Division 1 of, and to add Chapter 6.6 (commencing with Section 1435) to Part 2 of Division 2 of, the Water Code, relating to water.*, *CA Water Code*, 1982.

¹⁹⁹ Costa, *An act to amend Section 1011 of the Water Code, relating to water.*, *CA Water Code*, 1996.

²⁰⁰ SWRCB, *In the Matter of Water Right Permits in the Sacramento-San Joaquin Delta Watershed: In Which the Board Reserved Jurisdiction to Change the Season of Diversion (term 80 Permits)* (Sacramento: SWRCB, 1984), 27. See discussion in the next part of this dissertation for more detail.

²⁰¹ SWRCB, "In the Matter of Licenses 1050, 2814, 3109, 3110, 9794, and 9989 NATOMAS CENTRAL MUTUAL WATER COMPANY, Petitioner.", 1999, 22–27, http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1999/wro99-12.pdf.

transfers,²⁰² eventually the SWRCB disallowed that type of transfer because of the uncertainty and difficulty involved.²⁰³

Browns Valley ID may be the only district which conserved *with the intention to sell*, saving about 3,100 acre-feet per year.²⁰⁴ BVID initiated a canal improvement project in 1990 to eliminate massive losses and save money, but also with the intent to use Water Code § 1011 and 1706 to transfer the excess.²⁰⁵ Although the pipelining project did decrease seepage, only the seepage that nearby vegetation actually evapotranspired was available for transfer. The remaining “conserved water” did not represent a decrease in consumptive use because it recharged the local aquifer.²⁰⁶

1980 – WC § 1244 – Water Transfers Considered Waste

As mentioned earlier, the laws allowing changes in a water right were not conceived under the idea that one user may sell his excess water to another. Instead, if a user no longer needed water, the idea was that the water would revert to the public, available for new appropriation. Unable to profit from selling a water right, a user has little incentive to abandon his water right or to declare that he no longer needs it. Markets can remedy this situation by transmitting scarcity information, but in attempting to transfer water, a water right holder is indicating that they no longer “need” the water. Water right holders therefore feared losing their transfer water,²⁰⁷ and so legislators added Water Code § 1244, stipulating that transferring water was not evidence of waste or unreasonable use.

§ 1244 concludes by stating that “This section does not constitute a change in, but is declaratory of, existing law.” This statement, coupled with the fact that transfers did occur before 1980, indicates that this legislation likely did not have an impact. Furthermore, this *legislation* has not changed the *law* on the ground – regardless of what the water code says, prominent users still claimed that their transfer proposals provoked more scrutiny of their water rights.²⁰⁸

²⁰² SWRCB, “Water Right Order 1999-012”; SWRCB, “Water Right Order 2000-08”, 1999, http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/2000/wro2000-08.pdf; SWRCB, “Water Right Order 2000-09”, 1999,

http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/2000/wro2000-09.pdf.

²⁰³ Peter Yolles, “Interview with Peter Yolles, formerly of Western Water Company”, March 21, 2007.

²⁰⁴ This is further confirmed because users making use of this water code section must also file periodic statements with the SWRCB, and there are very few districts that actually report realistic numbers based on my examination of many records within the SWRCB records room in Sacramento.

²⁰⁵ Browns Valley ID, “BVID Board Resolution 3-7-90-1”, March 1990, http://bvid.org/files/um_apdx_g.pdf.

²⁰⁶ Browns Valley ID, “Analysis of Water Conserved Under the Upper Main Water Conservation Project” (MBK Engineers, Sacramento CA, May 2002), http://bvid.org/files/um_apdx_g.pdf.

²⁰⁷ R Stavins and Environmental Defense Fund.; Metropolitan Water District of Southern California (Calif.); Imperial Irrigation District (Calif.), *Trading conservation investments for water : a proposal for the Metropolitan Water District of Southern California to obtain additional Colorado River water by financing water conservation investments* (Berkeley Calif. (2606 Dwight Way Berkeley 94704): EDF, 1983), 113; Governor’s Commission to Review California Water Rights Law., *Governor’s commission to review California water rights law*, 66.

²⁰⁸ State Water Resources Control Board, “Revised Water Right Decision 1644 - In the Matter of: Fishery Resources and Water Right Issues of the Lower Yuba River”, July 16, 2003, 23, http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1644revised.pdf.

For a discussion of legislation vs law, see Friedrich A. von Hayek, *Law, Legislation and Liberty: A New Statement of the Liberal Principles of Justice and Political Economy*, Phoenix ed. (Chicago: University of Chicago Press, 1978), 127. This is also not unique to California – Bauer confirms this in Chile, where despite the government’s

1980 – § 1725/1735 – Procedures for Temporary Transfer / CEQA Exemption

To enhance efficiency, one of the goals of the Governor's Commission was to facilitate voluntary reallocation.²⁰⁹ Water Code sections 1725-1735 confirmed that users could temporarily transfer water for less than one year²¹⁰ and also established criteria: the SWRCB would grant permission if the transfer 1) would not injure other water users, 2) would only transfer the consumptively used portion, and 3) would not unreasonably affect fish, wildlife or other instream beneficial uses.²¹¹ Because meeting these requirements likely made the California Environmental Quality Act redundant, this section also exempted short-term transfers from CEQA.²¹²

The CEQA exemption, upon first glance, would be expected to facilitate transfers. However, if the SWRCB can conclude that the proposed transfer water would be consumptively used in the absence of the transfer, and that fish and wildlife would not be unreasonably affected, it would stand to reason that this transfer would avoid the CEQA requirement to prepare a full Environmental Impact Report.²¹³

The lasting effect of this new water code addition seems to be the standardization of procedures to temporarily transfer water, but it is difficult to determine how important these statutes were for a couple reasons. First, as mentioned earlier, temporary transfers did occur before 1980. Secondly, although these measures passed in 1980, it took 7 years until a district used the provisions to transfer a large amount of water.²¹⁴ And when water marketing proponents mention examples of marketing, they typically list examples which did not use these standardized procedures.²¹⁵

1980 – § 1740 – Rights Revert After Completion

In farmer surveys²¹⁶ about the potential for water marketing, farmers mentioned that they were concerned about getting their water back after a transfer. The Governor's Commission recognized this, but they also said that this view "has not been the law in California... Nevertheless, the perception that a water user may forfeit his water right due to a temporary transfer suggests that an affirmative statement to clarify existing law is desirable."²¹⁷ This legislation specified that all rights reverted to the transferor at the end of the transfer.

effort to make water a private good, the situation on the ground will not conform. See C. J. Bauer, "Results of Chilean water markets: Empirical research since 1990," *Water Resources Research* 40, no. 9 (2004): W09S06.

²⁰⁹ S. S. Slater, "Prescription for Fulfilling the Promise of a Robust Water Market, A," *McGeorge L. Rev.* 36 (2005): 261.

²¹⁰ The SWRCB initially created a separate transfer category for those transfers which are unlikely to substantially injure other legal users but are difficult to foresee in advance. This transfer process was not exempt from CEQA, and was rarely used. The transfer language was removed in 1988.

²¹¹ *California Water Code*, sec. 1725-35.

²¹² *Ibid.*, sec. 1729.

²¹³ For an example, see discussion of Yuba County Water Agency, following. It could be argued that the environmental mindset has also changed since 1980, perhaps making the CEQA process more cumbersome for projects, and therefore the exemption matters more today than it did then. However, the pressure on the SWRCB to pay attention to environmental affects has likely similarly grown.

²¹⁴ Gray, *Water Transfers in California, 1981-1989*, 46.

²¹⁵ MWD-IID and the vast majority of 1991 Drought Bank transfers did not need SWRCB approval.

²¹⁶ CA Assembly Office of Research, *A Marketing Approach to Water Allocation*.

²¹⁷ Governor's Commission to Review California Water Rights Law., *Governor's commission to review California water rights law*, 66.

Considering that this issue resurfaced in the early 1990s despite the passage of this law,²¹⁸ and considering that existing law did not support the farmers' fears,²¹⁹ this addition seems to have had little effect.

1982 – § 380-387 – Surplus Water Sales

The Governor's Commission, following similar discussion in the National Water Commission,²²⁰ was concerned that water district codes restricted transfers to surplus water, a vague potential hindrance. To get around this, the legislature added that "all public agencies authorized by law to serve water" could sell surplus water as long as it was surplus or if it was voluntarily given up for the transfer duration.²²¹ The code also defined surplus water as that which is in excess of needs or that which a user agrees to forego.²²² In addition to Water Code § 1725-35, §380-387 provided another set of laws governing short-term transfers (there are now five²²³).

This code is redundant and likely had little effect. First, most major types of districts already had provisions in their enabling legislation allowing leases of surplus water.²²⁴ Second, districts that participated in the 1977 Bureau of Reclamation water bank had no trouble transferring without these changes. Finally, these particular statutes, the only ones that require the SWRCB to ensure that transfers do not "unreasonably affect the overall economy of the area from which the water is being transferred," have never been used.²²⁵

The provisions listed above have been heralded as the most important legal changes²²⁶ setting the stage for improved water marketing. It is hard to conclude, however, that these changes had causal effects: substantial activity did not occur until 1987, small transfers took place before the passage of these statutes, some of the legislation was redundant, and complaints of waste or other similar allegations that the legislation was supposed to silence still arose. It is also quite possible that the additional regulatory requirements may have impeded transferability. Cliff Lee, Governor's Commission member and water law expert, described the legal changes up until the mid 1980s as "schizophrenic," encouraging and discouraging transfers at the same time.²²⁷ A schizophrenic legal climate is a bad way to encourage good planning and water use decisions.

²¹⁸ See Drought Water Bank section for discussion on similar laws.

²¹⁹ Governor's Commission to Review California Water Rights Law., *Governor's commission to review California water rights law*, 66.

²²⁰ Meyers and Posner, "Market Transfers of Water Rights."

²²¹ *California Water Code*, sec. 380–387.

²²² *Ibid.*, sec. 383.

²²³ Gray, "Shape of Things to Come," 30.

²²⁴ See *California Water Code*, sec. 22259, 31023, 35425, 71612, 55336. for sections dealing with Irrigation Districts, County Water Districts, California Water Districts, Municipal Water Districts and County Waterworks Districts, respectively. All of the language in these sections is at least 50 years old, and most sections date to the original enabling statute according to Lexis-Nexis Academic.

²²⁵ See Gray, "Shape of Things to Come," 31. Also, the bill's author, Richard Katz, was much more optimistic at the time, however, stating that as of the early 1980s, "the legal impediments to (a water market) have been removed" and that the "1982 legislation that was signed into law contains the protections necessary for a water market to work in California DWR and UCLA, *Buying and Selling Water in California*, 145.

²²⁶ Hanak, *Who Should Be Allowed to Sell Water in California?*; Dyckman, "Dynastic Disruption"; Gray, "Shape of Things to Come"; B. E. Gray, "Modern Era in California Water Law, The," *Hastings Law Journal* 45 (1993): 275.

²²⁷ DWR and UCLA, *Buying and Selling Water in California*, 122.

4.4 Imperial Irrigation District-Metropolitan Water District

From 1980 to 1987, the SWRCB only approved 18,000 acre feet for transfer.²²⁸ However, starting in 1980, Imperial Irrigation District (IID) and the Metropolitan Water District (MWD) of Southern California begin working on a major conservation transfer with the help of the Environmental Defense Fund. This unique transfer was difficult to execute, partly because IID never wanted to actually relinquish water,²²⁹ and partly because the water rights involved were not precisely quantified. The details provide an interesting story of one of the most famous transfers in the west, heralded as a model for others.²³⁰

Metropolitan WD entered the 1980s with looming scarcity. Arizona began construction of the Central Arizona Project in 1973, and although diversions didn't begin until 1985,²³¹ Metropolitan's take from the Colorado River contributed to a combined California withdrawal of more than 4.4 million acre-feet, California's allotted cap.²³² These surplus diversions were in jeopardy as Arizona ramped up their withdrawals.²³³ Los Angeles, the largest and most influential member of MWD, also faced reduced diversions from its Mono Lake tributaries as a result of National Audubon lawsuits.²³⁴ Then, the SWRCB began²³⁵ the Bay-Delta hearings hoping to improve salinity and fish conditions in the Delta. One possibility was to revert to 1985 diversion levels, which would be a decrease in supply for MWD because it was significantly increasing its SWP deliveries in the years just after 1985.²³⁶ Although this was not the chosen route, the expectation was clear – Delta diversions into the California Aqueduct were likely to be lower in the future. State voters also rejected by referendum the Peripheral Canal addition to the SWP in June 1982, further dimming hopes of a perpetually full California Aqueduct.²³⁷

MWD's general manager Carl Boronkay sought a new direction for the utility,²³⁸ and he spent months convincing Tim Quinn, an economist at Rand Corporation, that they could use his insight into the nexus of politics and economics. MWD had a policy of not hiring economists, so this change was truly representative of a shift in the agency's focus.²³⁹ At the urging of Boronkay, Tim Quinn also met with Zach Willey and Tom Graff, environmentalists calling for reallocation from Imperial Irrigation District to its urban neighbors.²⁴⁰ This relationship would prove quite fruitful.

²²⁸ Gray, "Shape of Things to Come," 60–61. This ignores the temporary changes involving the USBR and DWR which are not transfers but rather a sharing of diversion points in the Delta.

²²⁹ Haddad, *Rivers of Gold*.

²³⁰ *Ibid.*, 81.

²³¹ W. M Hanemann, "The central Arizona project" (2002).

²³² Haddad, *Rivers of Gold*, 69.

²³³ *Ibid.*

²³⁴ Judith Layzer, *Natural experiments : ecosystem-based management and the environment* (Cambridge Mass.: MIT Press, 2008), 243.

²³⁵ Or more accurately, began again. See Michael Hanemann and Caitlin Dyckman, "The San Francisco Bay-Delta: A failure of decision-making capacity," *Environmental Science and Policy* (2009).

²³⁶ MWD's SWP Table A deliveries doubled from 683,000 acre-feet in 1985 to 1.4 million acre-feet in 1990.

²³⁷ Gray, "Modern Era in California Water Law, The," 260.

²³⁸ Carl Boronkay, Timothy Quinn, Malca Chall, "The passage of the Central Valley Project Improvement Act, 1991-1992 : the Metropolitan Water District perspective", 1997, 45–46, An oral history conducted in 1997 by Malca Chall, Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 1999., <http://www.archive.org/details/passagecentral00bororich>.

²³⁹ *Ibid.*, 44.

²⁴⁰ *Ibid.*, 46.

On June 17, 1980, John Elmore, a farmer on the shores of the Salton Sea in the Imperial Valley, filed a complaint with the Department of Water Resources alleging that IID was wasting water.²⁴¹ The excess water flowed into the Salton Sea, flooding his land and forcing him to build earthen dikes. DWR investigated and estimated that IID could save 368,000 acre-feet of water through conservation and that lining the All-American Canal would prevent the loss of an additional 70,000 acre-feet.²⁴² As the primary issue was with water rights and the beneficial use of water, the SWRCB took over the situation and concluded that IID was not using water reasonably, directing them to submit a plan to conserve 100,000 acre-feet by July 1985.²⁴³ The SWRCB reserved jurisdiction to continue to direct IID to action, and it did so 4 years later when IID had not remedied the situation, ordering them to conserve 100,000 acre-feet by 1994.²⁴⁴ This was only seen as an initial step, however, because although the District's original compliance goal was to reduce Salton Sea inflow by 100,000 acre-feet, the SWRCB found that 367,900 acre-feet was an admirable long-term goal.²⁴⁵

Metropolitan Water District was keenly interested in this water, and began negotiations with IID to buy that water. After many arduous negotiating sessions, IID eventually relented to pressure in late 1988²⁴⁶ and sold 106,110.²⁴⁷ MWD is not paying for the water but rather for 16 conservation projects as well as for indirect impacts and costs that IID incurs as a result of the deal.²⁴⁸ Had IID not relented to the pressure to sign an agreement, they could have lost control or title to some of their water, the worst outcome for IID.²⁴⁹

Despite water code § 1011 stipulating that any cessation in use based on conservation is a reasonable beneficial use, not to be used as the basis of any forfeiture proceeding, the legislature still found it necessary to pass § 1012.²⁵⁰ § 1011 states that water conservation under an appropriative right is not cause for forfeiture, but IID felt insecure because their right is not technically appropriative but rather a federal contract right. Therefore, § 1012 repeats § 1011 but changes the wording to deal with Colorado River water used under contract as opposed to used under an appropriative right.²⁵¹

While the wasted water was a nuisance to John Elmore, the Salton Sea was a key piece of the Pacific Flyway.²⁵² The lake and salinity levels fluctuated naturally, and transfer proponents

²⁴¹ Stavins and Environmental Defense Fund.;Metropolitan Water District of Southern California (Calif.);Imperial Irrigation District (Calif.), *Trading conservation investments for water*, 45.

²⁴² Ibid., 47.

²⁴³ State Water Resources Control Board, "Imperial Irrigation District - Alleged Waste and Unreasonable Use of Water", June 1984, 69,

http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1600.pdf.

²⁴⁴ SWRCB, "Imperial Irrigation District Order to Submit Plan and Implementation Schedule for Conservation Measures", 1988, 44, http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/orders/1988/wro88-20.pdf.

²⁴⁵ Ibid.

²⁴⁶ Gray, "Modern Era in California Water Law, The," 299.

²⁴⁷ The original agreement was for 100,000 acre-feet, but due to complications with Coachella Valley Water District, the final agreement was for an additional 6,110 acre-feet. See Ibid., 303.

²⁴⁸ Ibid., 300; Carl Boronkay, Timothy Quinn, Malca Chall, "The passage of the Central Valley Project Improvement Act, 1991-1992," 20; Haddad, *Rivers of Gold*, 80.

²⁴⁹ Haddad, *Rivers of Gold*, 77,78.

²⁵⁰ Gray, "Modern Era in California Water Law, The," 305.

²⁵¹ *California Water Code*, sec. 1012.

²⁵² Hundley, *The great thirst*, 471.

thought that harm to the Sea would be minimal.²⁵³ Still, the legislature absolved Imperial Irrigation District of any liability resulting from adverse effects on the Salton Sea.²⁵⁴ The legislature did not say that the Salton Sea has no right to the water, only that if there were adverse effects, the rest of us would pay for them.

If the SWRCB had not forced IID to conserve water, this transfer likely doesn't happen.²⁵⁵ Even with the SWRCB leaning on them, they ended up only transferring about one-third of what was considered waste, and that amount was still much less than the million-plus acre-foot suggestion by Vaux & Howitt.²⁵⁶ Murky property rights further complicated the transfer. IID, Palo Verde Irrigation District (PVID), the Yuma Project and Coachella Valley Water District (CVWD) all shared the 3.85 million acre-feet first priority to the Colorado River under the Seven Party Agreement and the Boulder Canyon Project Act – they did not have quantified shares.²⁵⁷ CVWD claimed it, as a senior appropriator to MWD, would be entitled to any water forfeited/wasted by IID.²⁵⁸ CVWD sued IID, MWD and the USBR soon after the agreement, settling out of court in late 1989 for assurances that MWD would take no more than 116,000 acre-feet per year, and that MWD would provide Coachella with 50,000 acre-feet in dry years.²⁵⁹

In summary, this much heralded rural to urban transfer was a lengthy, arduous and complex negotiation, but more importantly for this narrative, the transfer took place without necessitating SWRCB approval. Because MWD was junior to IID, any conserved water from IID flowed directly to MWD under the Seven Party Agreement. The point of diversion and place and type of use did not change for MWD in this deal²⁶⁰ so no change in the water right was needed. The legislature still felt compelled to specifically address third-party impacts and waste/reasonable use to smooth negotiations, revealing another key piece of evidence that the water transfer laws recently passed were inadequate. This indicates the failure of proactive legislative tweaking to bring about water marketing.

4.5 Yuba County Water Agency

From 1980 to 1987, the SWRCB only approved 18,000 acre-feet for transfer,²⁶¹ but Yuba County Water Agency (YCWA) would change this starting in 1987, and from 1987 through 1991, YCWA would transfer 822,700 acre-feet generating close to \$30 million in revenue.²⁶² YCWA was a large wholesale agency in the Sierra Nevada foothills, and they built a large reservoir in 1970 capable of serving a much higher demand that currently existed within Yuba County. By the mid-1980s, YCWA needed revenue to make up for overly-generous, revenue-deficient member agency contracts, and had a new General Manager familiar with reservoir

²⁵³ Stavins and Environmental Defense Fund.;Metropolitan Water District of Southern California (Calif.);Imperial Irrigation District (Calif.), *Trading conservation investments for water*, 127.

²⁵⁴ *California Water Code*, sec. 1013.

²⁵⁵ Gray, "Modern Era in California Water Law, The."

²⁵⁶ "Managing water scarcity: An evaluation of interregional transfers," *Water Resources Research* 20, no. 7 (1984): 785-792.

²⁵⁷ Stavins and Environmental Defense Fund.;Metropolitan Water District of Southern California (Calif.);Imperial Irrigation District (Calif.), *Trading conservation investments for water*, 8,10.

²⁵⁸ Haddad, *Rivers of Gold*, 81.

²⁵⁹ Rodney Smith, ed., *Water Intelligence Monthly* (Claremont, CA: Stratecon, n.d.) Jan 1990, 8.

²⁶⁰ Joseph Vanderhorst, "RE: 2003 rice option question", November 12, 2010.

²⁶¹ Gray, "Shape of Things to Come," 60–61.

²⁶² State Water Resources Control Board, "Revised Water Right Decision 1644," 22.

operation to maximize water storage.²⁶³ They would begin a long-term process of selling tremendous amounts of water, primarily to the California Department of Water Resources, using the new water code procedures for temporary and trial transfers (§ 1725 and § 1735).

Three aspects of these transfers are important for this narrative. First, in speaking with the district, they did not believe that the new marketing laws were causal in jumpstarting their transfer program.²⁶⁴ Secondly, despite § 1244 stipulating that transfers were not evidence of waste, the transfers would bring scrutiny and YCWA would be criticized for what was seen as an overly generous water right, even to the point where drought transfers in 1992 were curtailed.²⁶⁵

Finally, the most important aspect is the 1988 transfer's CEQA implications. Unlike other state-approved transfers, YCWA's second large transfer in 1988 was a trial transfer.²⁶⁶ Trial transfers were not exempt from CEQA, but in this case, after the initial study and comment period, DWR, who was the lead agency and transferee, adopted a Negative Declaration within two months, asserting that "the project does not have the potential to cause a significant environmental impact."²⁶⁷ This transfer proposed to release over 110,000 acre-feet to satisfy Sacramento-San Joaquin Delta salinity standards, allowing DWR to withhold more water in nearby Lake Oroville for use next year. If this transfer, one of the largest short-term transfers from a single agency in California's short water marketing history, qualified for a Negative Declaration under CEQA and therefore avoided the need to prepare an Environmental Impact Report, it is difficult to conclude that the exemption from CEQA for all short-term transfers under § 1725 had much of an effect.

After the Governor's Commission Report and subsequent policy changes designed to remove barriers to transfer, it was difficult to point to any transfer that had been causally affected by the Report's recommendations. The Yuba County transfers were carried out under the temporary procedures set up in 1980 (§ 1725 and § 1735), but because those transfers were possible beforehand, because the CEQA exemption didn't appear to matter, because the YCWA Board began to actively seek money (supply side) and because the Delta Salinity standards only became binding in the late 1980s (demand side),²⁶⁸ attributing the transfer to the legislature's action is not based on evidence. Still, the legislature kept tweaking the water code to facilitate water transfers as if next time they would get it right.

4.6 1987-92 Drought

The next chapter in California's water marketing development starts with the major drought of 1987 to 1992. California experienced six sustained dry or critically dry years,

²⁶³ Scott Matyac, Water Resources Manager, Yuba County WA, Telephone, May 2010. PG&E owned the rights to all power generated from New Bullards Bar reservoir for the first 30 years, but did not have control over reservoir operation. However, up until then, the reservoir had been operated as if PG&E were in control.

²⁶⁴ *Ibid.*

²⁶⁵ L. J MacDonnell and T. A Rice, "Moving Agricultural Water to Cities: The Search for Smarter Approaches," *Hastings W.-NWJ Env. L. & Pol'y* 14 (2008): 126.

²⁶⁶ This was one of only three trial transfers approved before the legislature rescinded this portion of the water code.

²⁶⁷ SWRCB, "In the Matter of Permits 15026, 15027, and 15030 on Applications 5632, 15204, and 15574 of YUBA COUNTY WATER AGENCY, Petitioner, CALIFORNIA SPORTFISHING PROTECTION ALLIANCE, Protestant", 1988, 9, http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/orders/1988/wro88-12.pdf.

²⁶⁸ This may only be partially true – I have not been able to find specific data confirming that they only became binding in the late 1980s. They may have been binding legally, but with wet years, this was irrelevant.

culminating in the lowest storage level in Shasta since 1977.²⁶⁹ Major cities dependent on surface supplies instituted rationing, conservation pricing and other demand management tools,²⁷⁰ in addition to water transfers. From 1987 through 1990, northern California districts transferred 550,000 acre-feet across the delta, 95% coming from YCWA.²⁷¹ Unlike the other sellers, YCWA typically transferred water directly to DWR which acted as a middle man, much like the water bank process coming in 1991.

In 1991 after four consecutive dry winters and in the midst of a 5th, the Department of Water Resources delivered 30% of its urban water entitlements from the State Water Project and none of its agricultural entitlements.²⁷² The Central Valley Project announced a 25% reduction for its Settlement and Exchange Contractors, a 50% reduction for municipalities, and a 75% cut for other agricultural users.²⁷³

To ameliorate the drought, the Governor created a Drought Action Team in February 1991, directed by the head of the DWR. They were tasked with coordinating a drought response, including advising whether to call on the Governor to declare a statewide emergency due to the drought conditions.²⁷⁴ Although 23 counties declared local emergencies by the end of 1991,²⁷⁵ the state as a whole never did.²⁷⁶ The Drought Action Team also suggested creating a water bank where DWR would act as a middle man, coordinating buyers and sellers of water. The bank facilitated sales from 351 northern buyers in 1991 to 12 districts south of the delta. Although the bank purchased 820,000 acre-feet, 265,000 acre-feet were left in storage and 165,000 acre-feet were necessary for Delta water quality.²⁷⁷ Of the remaining 390,000 acre-feet, urban agencies purchased 78%, 215,000 of which went to MWD.²⁷⁸ The source of the water was as follows:

Insert Table 5

²⁶⁹ California DWR, “CDEC Historical Data,” *California Data Exchange Center*, July 27, 2011, <http://cdec.water.ca.gov/cgi-progs/queryForm?url=selectQuery>.

²⁷⁰ DWR, *Drought Contingency Planning Guidelines for 1989* (Sacramento, CA (P.O. Box 942836, Sacramento, 94236-0001): The Dept, 1989), 58.

²⁷¹ Damian Bickett, *Water Transfer Data Set, 1976-2010*, 2010.

²⁷² The SWP met all demands in 1987, 1988 and 1989. In 1990, the SWP would end up with a final allocation of 50% to agricultural users, 100% to urban users. In 1992 45% went to both. See CA DWR, *Final Monterey Plus environmental impact report* (Sacramento, 2010), 13–6,

http://www.water.ca.gov/environmentalservices/docs/mntry_plus/FEIR.pdf; Benedykt Dziegielewski and U.S. Army Engineer Institute for Water Resources., *Lessons learned from the California drought (1987-1992)* (Fort Belvoir Va. ;[Springfield VA: The Institute ;;Available from the National Technical Information Service, 1993), 91.

²⁷³ California Department of Water Resources, “The 1991 Drought Water Bank”, 1991, 1, http://www.water.ca.gov/drought/docs/10_1991-water_bank.pdf.

²⁷⁴ J. Jones and California. Dept. of Water Resources, *Preparing for California’s Next Drought: Changes Since 1987-92* (Dept. of Water Resources, 2000), 29–31.

²⁷⁵ *Ibid.*, 31.

²⁷⁶ An emergency would have allowed allocation of water without regard to rights, and the state could have condemned certain people's water for use somewhere else. (A Retrospective of California's 1991 Emergency Drought WaterBank, Howitt Moore and Smith, 1992)

²⁷⁷ B. E Gray, “Market and the Community, The,” *Hastings West-Northwest Journal of Environmental Law and Policy* 1 (1994): 21–23.

²⁷⁸ Gerald L Boles, *Draft Program Environmental Impact Report: State Drought Water Bank* (Sacramento, CA: State of California, Resources Agency, Dept. of Water Resources, 1993), xxv.

Despite the success of the 1991 Water Bank,²⁷⁹ what is the Bank's lasting effect on water marketing? What role did water rights play? First of all, many third party concerns were brushed aside during the Bank's operation, despite laws on the books to protect them. Some transfers were possible without SWRCB approval, which offers some protection to third parties in determining whether to approve a transfer. But surprisingly, even among the post-1914 rights transferors, the SWRCB was surprisingly reticent to exert its authority. For example, some users that pumped groundwater and sold their surface water (groundwater substitution) did so under SWRCB-controlled post-1914 water rights. DWR, however, convinced²⁸⁰ the SWRCB that groundwater substitution transfers were actually groundwater transfers, and *therefore did not need SWRCB approval*.²⁸¹ Similarly, CVP Settlement Contractors that transferred water from their base supply²⁸² were able to classify their water as coming from their original pre-1914 or riparian water right, even though the USBR now used a post-1914 license to appropriate this water.²⁸³ The SWRCB agreed with these determinations as they had little incentive to stand in the way of the drought bank – rather than arguing that it ought to have more control over the exempted transfers, the SWRCB chose to "make the water bank work. (They) were not looking for things to argue about."²⁸⁴

Therefore, despite the legislative effort to craft a coherent transfer policy to encourage market participation while protecting third parties from adverse market effects, during the 1991 drought, the Board only chose to exert jurisdiction over 2 of the 351 signed contracts – sales from storage from post-1914 rights belonging to Oroville-Wyandotte Irrigation District and Yuba County Water Agency.²⁸⁵ This illustrates the legislature's inability to create a water transfer framework that works when needed, and these examples do not support the idea that the legislature "created the legislative backbone for transfers in California."²⁸⁶ Rather than a backbone, they created a rib or two.

Drought Legislation

Besides the Drought Bank, the legislature also passed emergency legislation aimed at facilitating water transfers. I describe the major changes below, but like before, the net effect of the changes is likely pretty small.

1991 – AB 9 (Cortese) – District Ability to Sell

In case district transferability was still hampered by internal rules governing surpluses, despite the fact that similar transfers had already occurred, legislators passed AB 9 in the 1991 spring extraordinary legislative session. This temporary provision stipulated that water agencies (1) could contract with drought water banks if it was in the best interest of the water supplier and

²⁷⁹ Gray mentions that virtually all accounts labeled the 1991 Bank a success. See Gray, "Market and the Community, The," 24.

²⁸⁰ Convinced is a strong word – as Gray points out, the SWRCB essentially acquiesced throughout the process. Ibid., 35.

²⁸¹ Ibid., 29.

²⁸² See note 175

²⁸³ Gray, "Market and the Community, The," 28.

²⁸⁴ Part of the issue was the Governor's recent behavior towards the SWRCB during the bay-delta hearings, essentially telling them to lay low of else face consequences. This created a strong incentive to do nothing, and explains their unwillingness to "get in the way" of DWR during the 1991 DWB proceedings.

²⁸⁵ Gray, "Market and the Community, The," 28.

²⁸⁶ Dyckman, "Dynastic Disruption," 191.

if no user will receive less than the allocated amount from the district without their consent, and (2) could transfer water regardless if it was surplus to the needs of the district.²⁸⁷

1991 – AB 10 (Costa) – Transfer and Forfeiture

Water market proponents still claimed that water bank participants were nervous about selling water because they might not be able to recover their water once transferred. Therefore, throwing statutes stipulating this was not the case seemed to appease participant concerns,²⁸⁸ and this particular provision added that "No temporary transfer shall affect water rights."²⁸⁹ If this law had any effect, it was primarily psychological – like AB 9, AB 10 was *confirmatory of existing law*.²⁹⁰

AB 9 and 10 were incorporated permanently into law as AB 2897 in 1992 which, besides the changes listed above, also stipulated that surface water transfers

pursuant to this article may not replace that water with groundwater unless the groundwater use is either of the following:

(a) Consistent with a groundwater management plan adopted pursuant to state law for the affected area. (b) Approved by the water supplier from whose service area the water is to be transferred and that water supplier, if a groundwater management plan has not been adopted, determines that the transfer will not create, or contribute to, conditions of long-term overdraft in the affected groundwater basin.²⁹¹

Did these laws actually change the situation on the ground? Water Code Section 1220 provides an idea of AB 2897's effectiveness. Water Code §1220, passed in 1984,²⁹² stipulated that

No groundwater shall be pumped for export from within the combined Sacramento and Delta-Central Sierra Basins... unless the pumping is in compliance with a groundwater management plan that is adopted by ordinance pursuant to subdivision (b) by the county board of supervisors...²⁹³

This law was therefore on the books during the 1991 Drought Bank, and despite much of the groundwater originating from the Sacramento and Delta-Central Sierra Basin, the transferred water was not considered groundwater by DWR and instead *classified as surface water* to avoid § 1220.²⁹⁴ This same water, however, was *classified as groundwater to avoid SWRCB transfer jurisdiction*. Therefore, while the legislature may have passed AB 2897 with seemingly-similar

²⁸⁷ Dziegielewski and U.S. Army Engineer Institute for Water Resources., *Lessons learned from the California drought (1987-1992)*, A-4.

²⁸⁸ Gray, "Market and the Community, The," 27.

²⁸⁹ Dziegielewski and U.S. Army Engineer Institute for Water Resources., *Lessons learned from the California drought (1987-1992)*, A-5.

²⁹⁰ Brian E Gray, "The 1991 Water Bank: A Legal Analysis of Water Transfers from Yolo and Solano Counties", n.d.

²⁹¹ *California Water Code*, sec. 1745.10.

²⁹² Gray, "Market and the Community, The," 34.

²⁹³ *California Water Code*, sec. 1220.

²⁹⁴ Gray, "Market and the Community, The," 35.

groundwater restrictions, the evidence indicates that these legislative changes are not the same as the law on the ground.

The Drought Bank was a success because it enabled users to market water quickly, including riparian users that typically cannot transfer their water as they do not have a quantified right. And as mentioned, DWR facilitated other transfers by convincing the SWRCB to accept their legal analyses. Therefore, the success of the Water Bank was in its ability to *work around the murky system*.

1991 – § 1020 – Water Leases

Some water marketing proponents believed that the short-term transfer statutes (sections 1725 and 1735) were still too onerous, preventing suppliers from offering up their water on the market.²⁹⁵ This new legislation offered districts owning post-1914 *and pre-1914* appropriative water another alternative for transferring water. The legislation allowed parties to avoid SWRCB jurisdiction if their transfer was between two districts (as opposed to individuals), but limited transactions to 25% of the water entitlement and mandated additional water for delta outflow if the transfer went through the delta.²⁹⁶ Originally, transfers under this legislation were also exempt from CEQA, but opposition forced bill proponents to remove the CEQA exemption in later amendments, and the final bill ended up with enough substantial procedural hurdles that short-term transfers were now more difficult under this section than using either § 1725 or § 1735.²⁹⁷

The thrust behind the bill made sense – the SWRCB approved most transfer applications, but typically added “carriage water” requirements to ensure that users included enough extra water for cross-delta transfers to account for losses and salinity repulsion. Therefore, the bill imposed that requirement on all cross-delta transfers,²⁹⁸ stipulated that transfers must have enforceable no-injury provisions,²⁹⁹ limited transfers to 25% of a user’s or district’s usual water application,³⁰⁰ and then eliminated the “middle man” (the SWRCB) for district to district transfers.³⁰¹ The belief was that the legislature can replace the regulator by requiring transfers meet strict criteria. However, besides ignoring the unintended consequences of blanket approvals, this bill also shows how legislators still viewed the “transfer problem”: legislators believed that transfers were not happening because of the transaction costs involved, so if they could simplify the procedure and expedite the processing time, they could induce more supply.³⁰² This viewpoint ignores the underlying issues that motivate large transaction costs and is akin to blaming food shortages on a lack of supermarkets. Consequently, to my knowledge, this legislative section has never been used to transfer water since its passage.³⁰³

²⁹⁵ Jim Costa, “Letter to Governor Pete Wilson re: AB 1605” (CA Governor’s Office - Governor’s Chaptered Bill File, September 23, 1991).

²⁹⁶ *California Water Code*, sec. 1020–1031.

²⁹⁷ CA DWR?, “Governor’s Chaptered Bill File re: AB 1605” (CA Governor’s Office - Governor’s Chaptered Bill File, 1991), 14–17.

²⁹⁸ *California Water Code*, sec. 1027.

²⁹⁹ *Ibid.*, sec. 1021.

³⁰⁰ *Ibid.*

³⁰¹ *Ibid.*, sec. 1022.

³⁰² Jim Costa, “Letter to Governor Pete Wilson re: AB 1605.”

³⁰³ It essentially has all the requirements of § 1725 et seq. but without the CEQA exemption, so this is not surprising.

1991 – Individual Water Transfers

During the drought, in addition to blaming the transfer approval process, the idea that the district stood in the way of a more fluid market gained traction. The water lease provisions mentioned above were partially aimed at stripping power from the SWRCB, but other proposed bills wanted to strip districts of their power to deny a transfer from an internal landowner. The Environmental Defense Fund, after helping consummate the IID-MWD deal in 1987,³⁰⁴ wanted to find additional water for southern California. Broadview Water District and Firebaugh Canal Water District, agricultural districts in the central San Joaquin Valley, each had some landowners who were agreeable to marketing their water, but a transaction never followed.³⁰⁵ In talking with Zach Willey, EDF water transfer expert, part of the motivation to pass legislation allowing individual landowners to transfer water without their Board's approval was rooted in these failed negotiations in the late 1980s.³⁰⁶ Again, the idea was to eliminate the middle-man, assuming that the district's reticence to approve a landowner transfer was irrational. Three bills³⁰⁷ attempting to do this all failed. I return to this important failure when discussing the CVPIA later.

1992 – § 10753 – Groundwater Management Plans

Because 33% of drought bank water came from groundwater substitution, and this was concentrated even more in Yolo County,³⁰⁸ legislators passed AB 3030 granting authority to local agencies to adopt groundwater management plans (GMPs). This was not a new concept, but the idea never had enough support until 1992. Although districts were now able to implement groundwater monitoring programs and replenishment activities as part of their GMP, after the legislation, they still had no realistic authority to restrict their users' pumping.³⁰⁹ Furthermore, many districts already "managed" their groundwater with the price they charged for surface water.³¹⁰ The net effect of this requirement is unclear, and after 1999, all groundwater substitution transfers would have to come from areas with a GMP or have assurance that the transfer would not contribute to overdraft.³¹¹

Summary

A cursory glance at the numerous laws passed during the drought indicates that they *authorized* the transfers that took place, when actually, much of the legislation arose

³⁰⁴ How much EDF actually helped is debateable. See Carl Boronkay, Timothy Quinn, Malca Chall, "The passage of the Central Valley Project Improvement Act, 1991-1992," 19.

³⁰⁵ Richard Conniff, "Water Marketing A Deal That Might Save A Sierra," *Time Magazine*, April 3, 1989, <http://www.time.com/time/printout/0,8816,957390,00.html>.

³⁰⁶ Zach Willey, "CVPIA Question", December 11, 2010.

³⁰⁷ See AB 2090 in 1991, AB 97 in 1993 and AB 52 in 1994..

³⁰⁸ Gray, "Market and the Community, The," 22.

³⁰⁹ *California Water Code*, sec. 10753.9. Part C says the following "Nothing in this part shall be construed as authorizing the local agency to limit or suspend extractions unless the local agency has determined through study and investigation that groundwater replenishment programs or other alternative sources of water supply have proved insufficient or infeasible to lessen the demand for groundwater." Essentially, if they are unable to bring in outside water, then perhaps a district may think about limiting extractions.

³¹⁰ Merced Irrigation District is a great example. See Jonah Lamb, "To recharge groundwater, Merced Irrigation District lowers rate for some growers," *Merced Sun Star*, June 16, 2010, <http://www.mercedsunstar.com/2010/06/16/1461378/to-recharge-groundwater-merced.html>.

³¹¹ See § 1745.10 which subjected all water bank transfers to this requirement. Later, in 1999, all GW substitution transfers would have to adhere to this, not just water bank-type transfers.

concurrently with the activity it authorized and there was ample redundancy. Major proposed changes – stripping middle-men of their power and vesting transfer rights with landowners – failed. The actual water marketing experience gained by the participants and the signal it sent to the water community on the power of the market to make water available is likely the main lasting effect of the 1990s drought,³¹² and I return to this in the empirical section.

4.7 1992 – Central Valley Project Improvement Act

Because the CVP is such a large component of California water use, changes in CVP management that may affect marketing are important to understand. As the largest wholesaler in the state,³¹³ marketing within the CVP has the potential for large efficiency gains. In 1992, a major reorganization of the CVP, which added fish and wildlife protection as a project purpose and which authorized greater transferability for districts and farmers, among other reforms, passed Congress.³¹⁴ Furthermore, water pricing reform was passed to encourage conservation – now, instead of take-or-pay contracts, Contractors pay just for what they actually request.³¹⁵ In addition, Contractors paid an increasing block rate for their water with steps at 80% and 90%,³¹⁶ the intention being to have Contractors request less than their full allocation.

For this research, the most important parts of the CVPIA dealt with water marketing. The bureau's transfer policy constantly evolved over time, reacting to needs rather than forming coherent policy.³¹⁷ Now, there were explicit transfer guidelines in place. Previously, CVP contractors in the same division (project area) have traded ample quantities of water on a short-term basis as those were the only types possible,³¹⁸ but now the CVPIA allowed transfers across divisions and only gave preferential treatment to same-division transfers.³¹⁹ More importantly, the CVPIA allowed transfers to non-CVP Contractors,³²⁰ although none have occurred.³²¹

The CVPIA also granted individual farmers the right to transfer water without district approval, as long as the amount was less than 20% of the district's contract quantity.³²² This provision was similar to failed state legislation granting this right to all California water districts, but it was able to pass despite agricultural user objections.³²³ Most importantly, like the provision allowing transfers to non-CVP districts, this provision has not yielded a single

³¹² Carl Boronkay, Timothy Quinn, Malca Chall, "The passage of the Central Valley Project Improvement Act, 1991-1992," 51-52.

³¹³ D. E Noll, "Analysis of Central Valley Project Improvement Act," *San Joaquin Agric. L. Rev.* 3 (1993): 4.

³¹⁴ Noll, "Analysis of Central Valley Project Improvement Act."

³¹⁵ *Central Valley Project Improvement Act of 1992, title 34, 106 Stat. 4600*, 1992, sec. 3405 (d) (4).

³¹⁶ *Ibid.*, sec. 3404 (d).

³¹⁷ B. E Gray, B. C Driver, and R. W Wahl, "Transfers of Federal Reclamation Water: A Case Study of California's San Joaquin Valley," *Envtl. L.* 21 (1991): 911; Gray, "Modern Era in California Water Law, The."

³¹⁸ Gray, *Water Transfers in California, 1981-1989*, 62,67.

³¹⁹ *Central Valley Project Improvement Act of 1992*, sec. 3405 (a)(1)(M).

³²⁰ *Ibid.*, sec. 3405 (a)(1)(F).

³²¹ Loomis (1994) predicted, conservatively, that this provision would result in 160,000 acre-feet transferred to non-CVP users.

³²² *Central Valley Project Improvement Act of 1992*, sec. 3405 (a)(1).

³²³ I. Fischhendler and D. Zilberman, "Packaging policies to reform the water sector: the case of the Central Valley Project Improvement Act," *Water resources research* 41, no. 7 (2005): W07024.

transfer.³²⁴ Despite the lack of success, the provision did encourage at least one district to implement rules for internal transfers, an unintended but significant side effect of the CVPIA.³²⁵

For environmental restoration, the CVPIA directed the USBR to manage 800,000 acre-feet for the environment, in addition to acquiring increased water for wildlife refuges.³²⁶ Before 1992, wildlife refuges averaged 422,251 acre-feet, and it was highly variable – only 121,700 acre-feet were firm supplies.³²⁷ Since passage of the Act, dependable supplies to refuges have averaged 386,000 acre-feet.³²⁸ As part of their requirement to dedicate and manage 800,000 acre-feet of water for fish and wildlife purposes, the Department of Interior acquired over 2.2 million acre-feet since 1994, close to 140,000 acre-feet per year.³²⁹

4.8 SWP Marketing

Similar to the CVP, important changes within the SWP may have led to an increase in marketing activity, especially after users settled their disagreements with the Monterey Agreement. Although State Water Project Contractors had some flexibility in disposing of excess supplies, they were mostly limited in their ability to move water amongst each other before 1994 because no clear guidelines existed and all transfers required DWR approval.³³⁰ The lack of a transfer policy did not seem to upset the State Contractors, primarily because in the early decades of the project, most users were in their ramp-up phase – their contracts were written with a steadily increasing allocation until they reached their maximum contract quantity.

Although certain groups were not happy with their contracts, not until the early 1990s did their concerns finally lead to contract renegotiations. First of all, SWP contracts are take-or-pay, so the Contractor pays the fixed costs regardless of delivery amount.³³¹ Because pumping water over the Tehachapis or to the Santa Barbara coast was expensive, urban users commonly refused portions of their entitlement even though they still paid the fixed cost associated with that

³²⁴ See Areias transfer discussion in part II of this research.

³²⁵ Carl Boronkay, Timothy Quinn, Malca Chall, “The passage of the Central Valley Project Improvement Act, 1991-1992,” 124.

³²⁶ *Central Valley Project Improvement Act of 1992*, sec. 3406 (b)(2).

³²⁷ Independent Review Panel, “Undelivered Water - Fulfilling the CVPIA Promise to Central Valley Refuges”, November 3, 2009, ES-2, <http://www.cvpia-independentreview.com/refugesReports.html>.

³²⁸ *Ibid.*

³²⁹ This number may seem like a far cry from the 800,000 acre-feet directive, but the accounting used to determine compliance with CVPIA is not based solely on simple transfers – it also includes water acquired through the EWA program and water used to meet Endangered Species Act and the Delta Water Quality Control Plan. The accounting methods used have been very controversial and have resulted in numerous lawsuits between environmentalists and water users. The Department of Interior has also been criticized for their lack of adherence to the spirit of the law in managing the 800,000 acre-foot provision See Independent Review Panel, *Listen to the River an Independent Review of the CVPIA Fisheries Program* (S.I: U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, 2008), 42. and USBR and U.S. Fish and Wildlife Service, *CVPIA Administrative Proposal: Management of Section 3406(b)(2) Water (800,000 Acre-Feet)* (Sacramento, Calif: U.S. Bureau of Reclamation, Mid-Pacific Region, 1997).

³³⁰ For a description of DWR’s transfer policy, see Madalene Mary Curie, “A Distinct Policy Which Forms a Market Within the California State Water Project,” *Water Resources Research* 21, no. 11 (n.d.): 1718. DWR is still reticent to approve temporary transfers and instead presses for exchanges.

³³¹ CA DWR, “Draft Monterey Plus environmental impact report” (California Department of Water Resources, October 2007), 3–2, http://www.water.ca.gov/environmentalservices/docs/mntry_plus/DEIR%20-%20Volume%201/03%20History%20Background.pdf. See article 33 and 21 or the original contracts.

water.³³² In addition to this excess water, like any large project, the SWP could deliver more water than its users needed in the beginning. All of this surplus water was available cheaply to contractors, and agricultural users in the southern San Joaquin Valley took advantage of it and grew dependent on it.³³³ As mentioned above, MWD began gradually increasing their draw on the delta in the mid-1980s (see Figure 7 – Ramped Up Deliveries to MWD), due mainly to increased scarcity within the Los Angeles Department of Water and Power (see Figure 6 – Owens Valley Exports to Los Angeles). Therefore, to the dismay of the agricultural users, the amount of surplus water available would mostly disappear starting in 1988.³³⁴

Insert Figure 6 & Figure 7

The take-or-pay provision also caused problems for agricultural users. In the original contracts under Article 18 (a), DWR could cut up to 50% of an agricultural user's deliveries before one drop was removed from an urban district.³³⁵ SWP agricultural contractors received 50%, 0% and 45% allocations in 1990, 1991 and 1992, respectively,³³⁶ and because districts still had to pay for the water, agricultural areas without groundwater³³⁷ were hit especially hard. Kern County Water Agency's Assistant General Manager described the situation as "an economic death spiral," and so to escape the situation, users wanted to restructure the financing of the SWP.³³⁸

4.8.1 Monterey Agreement

Contractors resolved these disputes in December, 1994, with the Monterey Agreement, named for the location of the meetings. I discuss the major elements below.³³⁹

Permanent Transfer Provisions

Entitlement sales were *not* explicitly forbidden in the original DWR contracts (see Article 41).³⁴⁰ However, Metropolitan Water District, the largest urban contractor, was reticent to seek more entitlement through the market because of the uncertainty surrounding the process. Myron

³³² Michael Storper and Richard Walker, *The price of water : surplus and subsidy in the California State Water Project* (Berkeley Calif.: Institute of Governmental Studies University of California Berkeley, 1984), 22, http://oldweb.geog.berkeley.edu/PeopleHistory/faculty/R_Walker/Walker_35_Storper.pdf.

³³³ *Ibid.*, 11; Hundley, *The great thirst*, 297; Michael Storper and Richard Walker, *The Expanding California Water System, in San Francisco Bay, use and protection.*, ed. William J. Kockelman (USGS, 1982), 181, http://oldweb.geog.berkeley.edu/PeopleHistory/faculty/R_Walker/Walker_25_Storper.pdf.

³³⁴ Hundley, *The great thirst*, 299.

³³⁵ California Department of Water Resources, *Management of the California State Water Project.*, Bulletin 132 ([Sacramento Calif.]: State of California Resource Agency Dept. of Water Resources, 1996), chap. 1, <http://www.water.ca.gov/swpao/docs/bulletin/95/view/text/cha1.htm>.

³³⁶ CA DWR, "Draft Monterey Plus environmental impact report," 2–7.

³³⁷ This area includes some of Lost Hills WD and Wheeler Ridge-Maricopa WSD and most of Belridge WSD and Berrenda Mesa WD – a rough rule is everything to the west of the California Aqueduct. SWRCB, *Phase I of the Bay-Delta Estuary Hearing*, August 13, 1987 9AM.

³³⁸ CA DWR, "Monterey Plus EIR Scoping Meeting" (presented at the Monterey Plus EIR Scoping Meeting, Bakersfield, February 6, 2003), pt. Testimony of Jim Beck, http://www.water.ca.gov/environmentalservices/mplus_transcript.cfm.

³³⁹ For more details, see CA DWR, *The California State Water Project: Bulletin 132*, chap. 10, 1996/1996, Ch 10.

³⁴⁰ One example is the Devil's Den transfer to Castaic Lake Water Agency. For details of that transfer, see Haddad, *Rivers of Gold*, chap. 7.

Holburt of MWD explains why buying Berrenda Mesa Water District's³⁴¹ entitlement is not a good idea.³⁴²

The Berrenda-Mesa Water District is trying to sell a state water entitlement and the district does not have a state water contract entitlement... The contract is between the state and Kern County Water Agency, not between the state and Berrenda-Mesa, so that's one reason.

The second reason is that it is an agricultural entitlement, which means that in times of shortage, that entitlement has to take... up to a 50 percent cut in any one year and 100 percent cut of the entitlement in any seven-year period.³⁴³ That's a much less desirable type of contract than Metropolitan Water District and the other municipal and industrial users have in the state contract.

Thirdly, Metropolitan has a contract for 2,100,000 acre-feet a year of state water. That's far beyond our current needs, and the problem is not entitlement, the problem is the state is not building the additional facilities to increase its water supply and meet the demands during dry periods. We don't seek additional entitlements. We seek the state to perform and produce additional water to meet those entitlements.

And finally... until Kern County makes a decision whether or not they wish to give up that entitlement, there's really no point in taking any further action.³⁴⁴

This conversation sums up the primary disagreements among State Contractors. MWD was not interested in buying more agricultural water that potentially provided nothing in dry years, they were frustrated that the state did not plan to complete SWP construction so MWD could consistently expect their full entitlement, and they saw no point in pursuing a transfer until Kern County Water Agency (KCWA) and Berrenda Mesa resolved their property right dispute. Up until the Monterey Agreement, Kern's policy was to prohibit out-of-county transfers.³⁴⁵ Berrenda Mesa and others disagreed with that policy – although they were not technically the contracting party with the Department of Water Resources, 20 years of use established a de facto property right.

As a result of the Monterey Agreement, Contractors agreed to add the following language to the contracts:

Individual contractors may transfer entitlements among themselves in amounts in addition to those otherwise provided for in this article. The State shall expeditiously

³⁴¹ BMWD was a subcontractor of Kern County Water Agency along the west side of the San Joaquin Valley with little to no groundwater availability. They were one of four potential sellers in that area.

³⁴² SWRCB, *Phase I of the Bay-Delta Estuary Hearing*, vols. August 12, 1987, 1pm.

³⁴³ Article 18(a) of all contracts reads as follows: "(a) In any year in which there may occur a shortage due to drought or other temporary cause in the supply of project water available for delivery to the contractors, with the result that such supply is less than the total of the annual entitlements of all contractors for that year, the State shall, before reducing deliveries of project water to all contractors, reduce the delivery of project water to each contractor using such water for agricultural purposes by a percentage, not to exceed fifty percent (50) in any one year or a total of 100 percent (100) in any series of seven consecutive years, of that portion of the contractor's annual entitlement for the respective year which is to be put to agricultural use as determined by the State..."

³⁴⁴ Kern County Water Agency contracted for close to a million acre-feet of SWP entitlement, portioning this amount out to 16 entities within Kern County, Berrenda Mesa being one.

³⁴⁵ Nipomo Community Services District, "Evaluation of Alternative Supplemental Water Supplies" (Bookman-Edmonston Engineering, Inc., July 1994), 4-3, http://ncsd.ca.gov/Library/Supplemental_Water/BOOKMAN%20EDMONSTON/EVALUATION%201994.pdf.

execute any necessary documents and approve all contracts involving permanent sales of entitlements among contractors, including permanent sales among Urban Contractors.³⁴⁶

KCWA was also specifically directed to approve 130,000 acre-feet of entitlement transfers from its frustrated member agencies. Since then, Tulare Lake Basin WSD and Metropolitan WD³⁴⁷ have also permanently reallocated portions of their contracts. Urban agencies were the expected recipients of these entitlement sales.

TurnBack Pool

The Monterey Agreement created a TurnBack Pool, a mechanism for temporary disposal of excess entitlement. Sellers still paid for part of the water if they sold it – buyers only pay half of the Delta Water Rate (think capital cost) as well as any transport costs if done in pool A (before February 15th), and 25% of the Delta Water Rate and transport costs if done in pool B (after February 15th).³⁴⁸ As an example, in 2004, 17,240 acre-feet were sold to the TurnBack Pool—9,240 af from pool B and 8,000 af from pool A. The water came from 6 contractors (two north of the delta, 4 south of the Tehachapis) and was bought by 12 districts, most going to Metropolitan Water District and Kern County Water Agency. Although this pool is a useful method to temporarily reallocate water, sellers would much rather work out a creative exchange. Otherwise, sellers to the TurnBack Pool pay at least half the fixed cost for a portion of water they never use. Therefore, with lower recent allocations, Contractors are using their ability to save water for the following year (carryover water) rather than the TurnBack pool for flexibility, and the TurnBack pool is currently of little significance:

Insert Figure 8 – SWP TurnBack Pool Data 1996-2009

Deletion of Article 18 (a)

Agricultural contractors happily negotiated the deletion of article 18(a), the provision allocating shortages to agricultural users before urban users. Now, all Contractors share cuts equally³⁴⁹ as they recognized that the current priority system was unsustainable.³⁵⁰ This increased the value of agricultural entitlements tremendously.

³⁴⁶ CA DWR, “Water Supply Contract Between the State of California Department of Water Resources and Kern County Water Agency (Original with Amendments)”, November 15, 1963, 203, http://www.water.ca.gov/swpao/docs/wsc/KCWA_O_C.pdf.

³⁴⁷ Metropolitan sold to lower its fixed costs during wet and normal years. However, it still retains rights to storage in San Luis based on its original Table A entitlement as well as other benefits, and can call back the water in dry years from Coachella Valley WD and Desert Water Agency. See CA DWR, *The California State Water Project: Bulletin 132*, vol. 2004, pg 117; Coachella Valley WD, Metropolitan WD, Desert WA, “THE 2002 EXCHANGE AGREEMENT”, 2002, http://www.cvwd.org/news/publicinfo/Exhibit_12_12_23_2002.pdf.

³⁴⁸ “The price for Pool A water will be \$17.49 (50 percent of the 2009 Delta Water Rate) for each acre-foot of water purchased or sold. Also, the price for Pool B water will be \$8.74 (25 percent of the 2009 Delta Water Rate) for each acre-foot of water purchased or sold. In addition...the purchasing contractor shall pay DWR the 2009 Transportation Variable Operations, Maintenance, Power, and Replacement Component charges and the Off-Aqueduct Power Facilities Charges for Turn-Back Pool water delivered.” According to <http://water.ca.gov/swpao/docs/notices/09-01.pdf>

³⁴⁹ The Governor could still declare an emergency and allocate to urban users first. See California Department of Water Resources, *The Monterey agreement : statement of principles by the state water contractors and the State of California, Department of Water Resources for potential amendments to the state water supply contracts.* ([Sacramento Calif.: The Dept., 1994). Also see discussion in Hundley, *The great thirst*, 512.

³⁵⁰ Speaking 9 years later at a Scoping Meeting for the new Monterey EIR, as mentioned above, KCWA employees all discussed the “economic death spiral” that was imminent if the shortage provision wasn’t changed. Furthermore,

Deletion of Article 18 (b)

Article 18(b)³⁵¹ in water users' contracts stipulated that DWR shall reduce overall entitlements in the case of permanent shortage. This deletion was just a paper adjustment with no direct effect³⁵² on entitlements once Article 18(a) was adjusted. If 18(a) had not been repealed, then agricultural districts would prefer, all else equal, to invoke 18(b) so that DWR does not impose shortages as frequently.³⁵³

The Monterey Agreement is an important example of how clarification of property rights facilitates water market development. Before 1994, Contractors had yearly water allocations, but that precision did not translate into well-defined property rights: (1) there was tremendous uncertainty over subsequent allocations because agricultural user resentment over shortage policies put the sustainability of the project in question, (2) the project had natural variability which would only get worse with the Bay-Delta proceedings, and (3) the future of SWP construction was not clear. These conditions were not conducive to SWP entitlement markets. The Monterey Agreement solved (1), and this agreement over long-standing property right disputes between Contractors helped facilitate Coasian bargaining. I return to this theme in the empirical section.

4.8 Environmental Water Account

CalFed, the state-federal partnership tasked with improving water supply and ecological health in the delta, created the Environmental Water Account (EWA) in 2000.³⁵⁴ Primarily, its creation was spurred by salmon and other species' possible extinction.³⁵⁵ The EWA bought³⁵⁶ or

litigation against the state was imminent and was only avoided with the Monterey Agreement. Otherwise, KCWA claimed they "were going down" and were "going to take a lot of folks with us." CA DWR, "Monterey Plus EIR Scoping Meeting."

http://www.des.water.ca.gov/mitigation_restoration_branch/rpmi_section/projects/transcripts_index.cfm

³⁵¹ Article 18(b) reads: "In the event that the State is unable to construct sufficient additional conservation facilities to prevent a reduction in the minimum project yield, or if for any other reason there is a reduction in the minimum project yield which... threatens a permanent shortage... the maximum annual entitlements of all contractors, except to the extent such entitlements may reflect established rights under the area of origin statutes... shall, by amendment of Table A... be reduced proportionately by the State to the extent necessary so that the sum of the revised maximum annual entitlements of all contractors will then equal such reduced minimum project yield..."

³⁵² The Planning and Conservation League argued that the deletion was actually substantive, and that its deletion warranted more evaluation. They and others claimed that city planners based land use decisions on these paper entitlements, and as cities relied more and more on these paper entitlements, pressure would increase to turn them from paper into wet entitlements. Therefore, PCL saw Article 18(b) as a positive check on urban growth. See *Planning and Conservation League et al. v. Department of Water Resources* 84 Cal. App. 4th 315A (2000).

³⁵³ To see the effect of this provision, imagine just two contractors holding all the entitlements—Metropolitan Water District with 2 million acre-feet of entitlement and Kern County Water Agency with one million acre-feet. If DWR declares a 50% permanent shortage, their new entitlements would be 1 MAF and .5 MAF, respectively. In a year with only 1.25 million acre-feet available. MWD would receive all of the water with no shortage adjustment, and only one million acre-feet if DWR declared a permanent 50% shortage.

³⁵⁴ Hundley, *The great thirst*, 419–420.

³⁵⁵ A. W. Brandt, "Environmental Water Account: The California Experience, An," *U. Denv. Water L. Rev.* 5 (2001): 426.

³⁵⁶ Environmental transfers are more palatable politically than using the public trust doctrine to adjust water rights. The program is nevertheless controversial because some feel it is improper to pay water users for behavior that they feel should be illegal. See John Gibler, "Water for People and Place" (Public Citizen, November 2005), 32; Mike Taugher, "Paper shuffle allows for vast supply of easy money," *Contra Costa Times*, May 23, 2009, http://www.contracostatimes.com/news/ci_12437335?source=pkg.

reshuffled water deliveries from willing sellers in order to help migrating fish, purchasing more than one million acre-feet during its history.³⁵⁷

Insert Figure 9 – EWA Transfers

Does the EWA represent a net increase in transfer activity or did it crowd out private transfer activity? The EWA spent close to \$183,000,000 from 2000 to 2007 years buying 1.25 million acre-feet from willing sellers.³⁵⁸ Most of the water came from either KCWA or from YCWA, with most of the money buying more expensive water from KCWA. YCWA has been a major participant in water marketing, but as the following figure shows, a post-2000 trend is not evident in YCWA transfers. Because sellers are scarce, it is possible that the EWA crowded out other transfers rather than bringing new sources of water to market.

Insert Figure 10 – YCWA Transfers 1985-2009

KCWA supplies are different – most of their water came from previously banked groundwater in developed groundwater banks in Kern County, and instead of physically transporting this water to the Delta from Kern County, the EWA simply curtailed deliveries of new surface supplies and Kern sellers either did without or recovered a similar amount from their bank. Interestingly, Kern County is one of the few agricultural counties that is able to effectively bank groundwater and keep most (not all) users happy. This has enabled them to exploit their storage space to buy water when cheap and sell when dear. The data do not show a spike in activity after 2000 (see Figure 11), even though Kern County districts sold close to half a million acre-feet to the EWA.

Insert Figure 11

While Kern County districts are definitely at the forefront of agricultural marketing, the development of the Kern Water Bank after the Monterey Agreement likely did much more to spur marketing than the EWA.

4.9 2002 – SB 221 – Developers and Water

In the interest of ensuring new housing developments had water, and also likely to put a curb on urban growth, this bill required developers to show they had viable water supplies for all new housing developments above 500 homes.³⁵⁹ If the development occurs within a district, then the district may agree to provide new connections. But if not, or if the development is outside of an urban provider's boundary, the bill may encourage developers to purchase water through the market to meet the requirement. Although there were loopholes in the legislation,³⁶⁰ the bill seems to have restricted housing growth³⁶¹ and may encourage more transfers to urban agencies.

4.10 Summary and Major Changes

The 25 years from the late 1970s until the early 2000s saw a very large increase in water marketing. In the beginning of this period, water transfers were concentrated within the CVP, and they did not use price to allocate. Using price was a big step, as was expanding the market

³⁵⁷ The EWA is now discontinued, but a long-term contract between DWR and YCWA accomplishes similar aims.

³⁵⁸ Teresa Geimer, CA DWR, "Summary of EWA Actual Water Purchases 2001-2007", December 7, 2009.

³⁵⁹ Sheila Kuehl, *SB 221* ([Sacramento, CA: California Legislature, 2002).

³⁶⁰ Dyckman, "Dynastic Disruption," 202.

³⁶¹ E. Hanak, "Is Water Policy Limiting Residential Growth? Evidence from California," *Land economics* 84, no. 1 (2008): 31.

outside of the large projects. Both of these changes occurred during the 1991 Drought Water Bank, which represented “an extraordinary statement about the power of market forces.”³⁶² In addition to the Drought Bank, within the SWP, State Water Contractors had been arguing for years about allocations, shortages and transferability. Once they finally worked out the differences in 1994, the internal SWP market ballooned. The CVP also experienced a marked increase in activity, although it is harder to pinpoint the CVPIA as the culprit compared.

Giving credit to the legislature for this change in activity seems misplaced – many state laws mentioned above approved behavior already occurring, were passed and never used, or were redundant. Conditions in the Delta certainly altered the trading landscape as well – the CVP would begin to buy environmental water in the early 1990s, the Environmental Water Account would buy water starting in 2000.

5. Data Analysis

In this section, I investigate the extent to which the water marketing data support my claims. Good water marketing data are necessary for this, but the data are incomplete because there is not a single entity with regulatory control of all transfers. The State Water Resources Control Board monitors all changes in post-1914 water rights, but if a transfer occurs within a water right, only if the water right owner records and reveals that information will the data typically find their way to an aggregator.³⁶³ Most large wholesalers do record and publish this information, while most small wholesalers (individual districts, for example) do not. Pre-1914 water right transfers typically do get recorded, but there is no guarantee of that.

Previous empirical research on California water markets uses Water Strategist data, an incomplete but assumed to be representative dataset covering western water transactions. The Water Strategist misses many transactions from the Central Valley Project, State Water Project and other sources, missing therefore a large part of California’s short-term water market. The coverage is also inconsistent, especially with groundwater (not the focus of this research). On the other hand, the Water Strategist data includes prices, which makes it attractive to some researchers.

My dataset – an amalgamation of Water Strategist data and data from large wholesalers (CVP, SWP, others) – is more complete but still not perfect. I combined Ellen Hanak’s database³⁶⁴ with that of Bob Fournier’s CVP transfers database from the US Bureau of Reclamation, Gary Libecap’s Water Strategist data (the same used by Brewer et al.), data from Bulletin 132 covering the State Water Project³⁶⁵ and other data from larger agencies that for some reason was left out of the previous sources.

Primarily my data lacks data from smaller wholesalers that allow internal markets.³⁶⁶ Furthermore, just as members within a wholesaler transfer water, farmers within districts do as well.³⁶⁷ These farmer to farmer markets are important but ignored for lack of data.³⁶⁸

³⁶² Carl Boronkay, Timothy Quinn, Malca Chall, “The passage of the Central Valley Project Improvement Act, 1991-1992,” 51-52.

³⁶³ The CVP, for example, monitors water transfers within its network and makes their data available.

³⁶⁴ Hanak does a fantastic job of consolidating data from different sources and then spot checking it for accuracy. See Hanak, *Who Should Be Allowed to Sell Water in California?*.

³⁶⁵ DWR data on the SWP is only partially complete after 2006 because of the delay in publishing Bulletin 132.

³⁶⁶ Solano County Water Agency is one prime example of missing data.

³⁶⁷ There are a few districts that stand out with active internal markets (Westlands WD, Arvin-Edison WSD, Berrenda Mesa WD), but others I talked to also allow internal marketing.

5.1 Transfer Categories

To better understand the trends within water markets, I disaggregate water transfers into temporary, usually one year or less transfers, and longer, more permanent transfers. I also make an additional distinction between recurring short-term transfers that are substituting for a long-term transfer, and short-term transfers that are very simple to carry out (akin to borrowing a cup of sugar from a neighbor). I explain the category details below.³⁶⁹

5.1.1 Short-Term

This category includes those transfers *between water rights* and/or those that *require substantive approval* from the SWRCB or other authority. In addition, although transfers across the delta but within the SWP and CVP do *not* require SWRCB approval, the SWRCB has continuing authority over delta flows and their imposed restrictions diminish cross-delta transfers. Therefore, those transfers that occur under the explicit or implicit authority of the SWRCB are listed in this category, as well as short environmental leases.³⁷⁰ As an example of a short-term transaction, Metropolitan Water District in 2003 solidified an option agreement with Sacramento Valley rice growers. They received approval from the SWRCB for temporary rice fallowing transfers of up to 80,000 acre-feet from 8 Sacramento districts.³⁷¹ These transfers typically involve a market price.

³⁶⁸ Farmer to farmer market transactions are important, but are not the only way to reallocate water within a district. In a family, a dad does not auction off rides to school for his children, and similarly in a water district, a general manager may have enough intimate knowledge to allocate water within based on different member needs. Many districts have methods to spread water around to their less fortunate users (typically meaning those without (good) groundwater), although they refrain from using a market. The benefits of markets are that they reveal information and bring buyers and sellers together, facilitating mutually beneficial trades. However, within small districts, where the General Manager is familiar with crop needs and his members' alternative water supplies, he likely can achieve some of the efficiency gains that an internal market reallocation would produce without using price incentives. This may be somewhat unique to water provision, where sharing in times of scarcity rather than selling for a market price still prevails in many areas. In these cases, a district may encourage (financially or otherwise) a user with good groundwater to pump all his supply and release that surface water for other users, spreading the pain around. This is crucial because while many users have groundwater, not all do (See Table 2 - close to 60% of irrigated farms in CA have access to groundwater), and the others that do not hopefully have favorable district management that allows them to benefit from groundwater availability.

³⁶⁹ Many authors make the long-term/short-term distinction. However, Libecap chooses an alternative way to present the data – short-term leases are combined with long-term leases/permanent sales using a *committed* acre-feet measure. For example, IID's transfer to MWD in 1987 for 110,000 acre-feet is discounted by 5% and summed for

the first 20 years (even though it was a 35 year lease), counting for $\frac{110000(1 - \frac{1}{1.05^{20}})}{.05} = 1,370,843$ acre-feet.

This is one way of combining the figures to get an idea of how much is reallocated in a given year.

³⁷⁰ Putting environmental leases in the short-term category is somewhat arbitrary – there is not an end user, so the transfers are neither between or within water rights. Typically, they do require approval from the state or federal officials which is more than just a formality. Furthermore, environmental transfers are almost always done for a market price, which makes the short-term category more appropriate.

³⁷¹ MWD exercised its options on February 15th, but by April, the SWP Allocation had increased to 90%, making it impossible to deliver the water because their Table A deliveries took priority. The water was partially lost into the Pacific Ocean, and the remaining 47,124 was stored in Shasta, where it remains until the unlikely possibility that the stars align and conditions allow fulfillment of the IOU.

5.1.2 Short-Term – Swaps

In contrast to short-term transfers, short-term swaps are short transfers (less than one year) which take place primarily *within the same water right* and are possible *without substantive third-party review*. This category is primarily comprised of within-CVP and within-SWP transfers. By far, most of these trades occur within agriculture. For example, in 1999, Madera Irrigation District purchased 1,100 acre-feet from three nearby irrigation districts. All were CVP contractors connected to Millerton Lake on the San Joaquin River. The irrigation districts sold the water, left over from the previous year, because of the threat that their reservoir would spill their water.³⁷² Typically these transfers do not involve a market price.

5.1.3 Long-Term / Permanent

This category includes long-term leases (over 5 years) and permanent water right sales and contract assignments. In California, this category is primarily contract assignments within the CVP and SWP (e.g. Broadview WD selling its 27,000 acre-feet CVP contract to Westlands WD in 2006). The sale of Lower Kern River rights in 2000 is the *only recent sale* of actual surface water rights in California where the water changed ownership and place of use. In addition, many adjudicated groundwater rights are permanently transferred. Except in unique circumstances,³⁷³ these trades involve a market price for water.

5.1.4 Long-Term Substitute

To add another layer of reality, a fourth category is warranted for short-term transfers that do not actually serve a short-term purpose. Some districts trade frequently with the same buyers, in effect consummating a long-term transfer through a series of short-term deals. For example, Glide WD frequently purchases about 2,300 AF per year from nearby Kanawha WD. In addition, until recently, the California Department of Water Resources and the Bureau of Reclamation purchased environmental water on an annual basis, usually from the same sellers. Although there are now long-term deals in place, I classify the temporary precursors to these deals as well as ongoing short-term deals as long-term substitute transfers.

5.2 Transfer Trends

This section displays transfer trends and places the numbers into context within California.

5.2.1 Decade Averages

The following charts show the past three decades of transfer averages by category:

Insert Figure 12 - Average Yearly Transfers, 1980s

Figure 13 - Average Yearly Transfers, 1990s

Figure 14 - Average Yearly Transfers, 2000s

Short-term transfers climb from 64,731 acre-feet in 80s to around 250,000 over the next two decades. Short-term swaps increase as well, climbing from 94,166 in the 80s to 167,450 in the 2000s. Despite the increase, this category is far less important today, accounting for only 22%

³⁷² Smith, *Water Strategist*, July/Aug 1999.

³⁷³ In 2002, as part of the Quantification Settlement Agreement, MWD transferred 100,000 acre-feet of its SWP entitlement to Desert WA and Coachella Valley WD. The recipients did not pay a premium for the water, but this transfer was unique and part of the broader QSA settlement. See footnote 347.

compared to 43% in the 80s and 31% in the 90s. Long-term substitutes have increased over time too from 20% to 29% of the market total. Long-term/permanent transfers have also grown, accounting for 7% in the 80s but 16% today.

These pie charts only show annual averages of trades consummated in the periods listed. Long-term leases and permanent sales, however, imply obligations into the future. For example, because MWD signed a 35 year agreement with Imperial Irrigation District in 1988,³⁷⁴ the transfer only shows up in the long-term data in the 1980s, but IID transferred over 100,000 acre-feet to MWD this year. In the following pie chart, I replicate the chart from the 2000s (Figure 14above) but also include water reallocated previously under a long-term agreement or from a permanent sale.³⁷⁵

Insert Figure 15

By 2009, close to 700,000 acre-feet was delivered to users as a result of previous permanent contracts since the late 1970s. This figure represents an estimate of the amounts *delivered* under these contracts and leases – closer to 1,400,000 acre-feet of water contract entitlements have actually been reallocated on paper since then, but annual fluctuations in supply dampen this figure. For the recent decade, these previous reallocations averaged 564,865 acre-feet, compared to 657,770 acre-feet transferred each year temporarily and 124,944 acre-feet in new long-term transfers.

5.2.2 Transfers Compared to Annual Water Use

Between 1998 and 2005, Californians used an average of 40,600,000 acre-feet of water,³⁷⁶ including 15,000,000 from groundwater.³⁷⁷ Agriculture used the majority at close to 30,800,000 acre-feet. Therefore, in recent years, a narrow view of what counts as a transfer indicates that 3% of surface water ($\frac{782,714 \text{ af avg annual surface transfers}}{25,600,000 \text{ avg.annual surface use}}$ - see Figure 14 - Average Yearly Transfers, 2000s) is transferred on an annual basis. Including estimates of water reallocated as a result of previous long-term agreements yields closer to 5% ($\frac{1,347,579 \text{ af avg annual surface transfers}}{25,600,000 \text{ avg.annual surface use}}$ - see Figure 15 - Average Yearly Transfers, 2000s).

5.2.3 Annual Variability

The following charts display annual variability in the different transfer categories:

Insert Figure 16 and Figure 18

Short-term transfers are quite variable based on rainfall and other drivers. The following table displays the major changing components within this category:

³⁷⁴ The 35 year period actually begins in 1998 when MWD takes 106,110 acre-feet. Haddad, *Rivers of Gold*, 87.

³⁷⁵ I had to assume amounts delivered under permanent CVP or SWP reallocations were equal to the contract amounts adjusted by the yearly USBR and DWR allocation percentages.

³⁷⁶ California Department of Water Resources, *California Water Plan Update 2009*, Bulletin 160 (Sacramento, Calif: California Dept. of Water Resources, 2009), 4–22, <http://www.waterplan.water.ca.gov/cwpu2009/index.cfm>.

³⁷⁷ California Department of Water Resources, *California Water Plan Update 2009 Volume 5-Technical Guide - Water Portfolios*. These figures fluctuate greatly – combined use ranges from 33.9 MAF in 1998 to 44.1 MAF in 2004, mostly due to changes in groundwater pumping, where the use was 10 MAF in 1998 and 17.7 MAF in 2001. DWR publications also mention that the environment “uses” 30 to 40 million acre-feet referring to Delta outflow instream and Wild and Scenic River requirements. I ignore these numbers when discussing overall water use.

Insert Table 6 - Short-Term Transfer Components

The 1977 drought represented the first major uptick in activity as Metropolitan Water District transferred 400,000 acre-feet of entitlement to DWR for use within other thirsty agencies. In return, they took a like amount of surplus water from the Colorado River. In the late 1980s, Yuba County Water Agency began a series of transfers, accounting for most of the growth then. The 1991 Drought Water Bank shows up as the largest single year, but after the drought, short-term transfer levels remained at much higher levels than before. The next major uptick occurs around 2001, spurred mainly by the introduction of the Environmental Water Account but also large purchases from Westlands Water District trying to make up for recent low CVP allocations. The following chart displays CVP allocations for south-of-delta contractors since 1975:

Insert Figure 17 - Historical CVP Allocations

Short-term swaps display less of an easily identifiable trend, picking up in the 1990s but then falling back more recently. Most of the increase is due to the SWP TurnBack Pool, although Westlands WD also accounts for part of the increase. The following table displays short-term swap data by decade:

Insert Table 7 - Short-Term Swap Components

Intra-CVP trades comprise the majority of long-term substitute transfers, although the major change in this category has been the rise in environmental trading. The US Bureau of Reclamation consummated numerous short-term deals with users in the northern San Joaquin Valley, eventually culminating in a long-term deal, and therefore I classified the precursor deals as substituting for a long-term transfer. Westlands WD, likely as a result of its reduced allocations which seem to be the new norm,³⁷⁸ also began to trade frequently with the same set of buyers in most years. The following table displays long-term substitute data:

Insert Table 8 - Long-Term Substitute Components

Long-term and permanent transfers occur throughout this period, gradually reallocating more over time. The largest transfers have been Colorado River reallocations between MWD and IID and San Diego and IID, environmental reallocations on the San Joaquin River and its tributaries and permanent transfers within the SWP after the Monterey Agreement. Figure 18 displays these trends. The lower yellow line represents new long-term or permanent deals consummated in that year. The top (red) line represents the cumulative total water committed under long-term agreements, while the blue/yellow line is adjusted for estimates of actual deliveries. For example, although Coachella Valley WD bought 12,000 acre-feet of Berrenda Mesa's entitlement in 2005,³⁷⁹ in general because the SWP never completed construction of phase two,³⁸⁰ and more specifically because of recently increased Delta restrictions,³⁸¹ the SWP cannot consistently deliver 100% of entitlements. The recent dip is therefore mostly due to very low SWP and CVP allocations, but also to agreements that have a slow start-up phase.³⁸²

³⁷⁸ USBR Mid Pacific Region, "WaterSupply and Yield Study", March 2008, 2-7, <http://www.usbr.gov/mp/cvp/docs/Water%20Supply%20and%20Yield%20Study.pdf>.

³⁷⁹ The EIR was not completed until 2007.

³⁸⁰ Hanemann and Dyckman, "The San Francisco Bay-Delta: A failure of decision-making capacity," 718.

³⁸¹ Ibid., 721.

³⁸² The San Diego-IID agreement reallocates close to 300,000 acre-feet, but not until years later will the parties reach that number.

In summary, an easily identifiable trend does not exist in California's water market. Rather, there are changes occurring within different transfer categories and within different water right areas. CVP users do many of the same things as they did in the 1980s, but south-of-delta Contractors face a significantly different climate today than they did twenty years ago, and the increased scarcity shows up in the database, both in the permanent and temporary market. 2011 SWP activity is not very different from the 1980s – Monterey loosened restrictions on permanent transfers in 1994, and then activity flourished, but now it is back to a trickle. Temporary transfers were absent then, and despite the TurnBack Pool, they have mostly disappeared as well as users prefer to exchange water.

Private transfers are more complicated. Water right sales have not changed – essentially, none take place. Between private rights holders, however, there are temporary reallocations, and this does represent a change compared to 20 and 30 years ago. However, this trend is becoming less and less private – many of the largest sellers find it easiest to sell to the state or federal government.

5.3 Previous Empirical Analysis in the Literature

A recent paper by Glennon, Libecap and Brewer³⁸³ outlines major legal changes and judicial decisions affecting transferability since 1980, attempting to explain the rise in water marketing just as I do. They focus primarily on the legal aspects, discussing many of the same laws as I do above. They conclude that these laws were important and facilitated marketing.

For example, they state that the legislature *allowed* the transfer of conserved and surplus water in 1986,³⁸⁴ an odd statement considering that surplus water was transferable according to most district creation statutes.³⁸⁵ On the other hand, they seem to be correct about conserved water – before 1979, deliberate actions to lessen consumptive use also would decrease one's water right (in adjudication). Even so, the legislation's actual conservation incentives only led in practice to one district actually conserving water with the intention to sell. Similarly, they mention that decreed riparian rights³⁸⁶ were now transferable as of 1988, but as evidence they refer to a section of the water code passed in 1988 which is practically identical to one added in 1980. Referring to the CVPIA, they assert that individuals could now transfer their water without district approval, and while technically true, in practice it has never happened. The authors go on to discuss minor changes in 1999 which, if truly important, would have mattered as of 1980 when very similar laws were passed, not as of 1999 when the legislature passed redundant updates.

As I explain above, many legal changes do not alter the transfer situation on the ground, and therefore their legal analysis is a bit perfunctory and too easily attributes causality to legislative statutes. Moreover, even if their analysis of the legal changes were correct, their empirical conclusions are still not very robust.

³⁸³ Brewer et al., "Law and the New Institutional Economics."

³⁸⁴ Ibid., 8.

³⁸⁵ See FN 224

³⁸⁶ These are riparian rights that are quantified by adjudication and subject to a court decree along with appropriative rights along the stream.

5.3.1 Regression Replications

To address concerns that their analysis does not properly identify the effects of the legal and judicial changes over the past 30 years, I replicate and improve upon their annual regressions. They explain both *aggregate annual transfer counts* and *volumes* in a yearly regression with lagged population change, a precipitation index and different yearly dummies³⁸⁷ as their independent variables. They are primarily interested in the dummy variable signs, assuming that a positive and significant sign indicates a year in which favorable water marketing laws were passed or judicial decisions facilitating water marketing occurred, and negative variables represent the opposite. Using marketing data from 1987 to 2005 from the Water Strategist and a Poisson model, they find a significant positive effect of laws/judicial decisions on aggregate transfer counts in 1989, 1991 and 2003 and a negative effect in 2000. They also explain volume with a similar specification but used Ordinary Least Squares (OLS) instead of a Poisson model, and their results were not as convincing. Still, they found fairly significant positive dummy effects in 1989 and 2003 as well as a fairly significant positive population effect.

Data Adjustment Details

To investigate the robustness of their results, I clean up the Water Strategist data. Much of the current literature³⁸⁸ on water marketing relies entirely on the Water Strategist publication for water marketing data, resulting in a few drawbacks. The Water Strategist does cover all western states, typically includes price information on transfers and is readily available online. However, they report proposed transactions which may not actually happen, they report proposed quantities without correcting them for actual amounts transferred, they double count some transfers because they report both a transfer at the time of negotiation and again at the time of completion,³⁸⁹ they do not consistently cover adjudicated groundwater transfers over time (they have better coverage over the last 10-15 years), they do not cover all groundwater basins,³⁹⁰ they do not include the vast majority of transfers within the Central Valley Project (I have not been able to discern a pattern among those that are included), and they also miss a few others. In addition to the reasons listed above, the Water Strategist dataset includes many transactions which do not qualify as transfers. For example, groundwater banking arrangements, exchanges and recycled water sales are important but not properly considered a transfer.³⁹¹

³⁸⁷ A 1991 dummy, for example, was 0 from 1987 until 1990 and then 1 in all subsequent years.

³⁸⁸ Czetwertynski, "The Sale And Leasing Of Water Rights In Western States"; Brewer et al., "2006 Presidential Address Water Markets in the West"; Brewer et al., "Law and the New Institutional Economics"; Donohew, "Property rights and western United States water markets*"; Brown, "Trends in water market activity and price in the western United States"; Howitt and Hansen, "The Evolving Western Water Markets."

³⁸⁹ This was mainly a problem in the drought bank years where they would report who was willing to sell, and then later, they would report who purchased from the bank.

³⁹⁰ The basins covered are all in Southern California adjudicated basin transfers governed by unique basin laws. These transfers are unaffected by changes in surface water law.

³⁹¹ Groundwater banking arrangements are storage space rentals – they do not involve water moving from one user to another. Exchanges are similar – they typically involve one user taking more of one source of water in exchange for relinquishing the same amount of CVP or SWP supply to a neighbor. Recycled water sales to retail customers connected by special pipes are similarly excludable – at some point, this may have counted as a transfer, but now these golf courses and others are normal customers, and so counting these is akin to counting my monthly residential water purchase as a transfer – the line must be drawn somewhere.

To show these discrepancies a little more clearly, Table 9 summarizes data from the Water Strategist during the period 1987-2005.

Insert Table 9 - Water Strategist Inaccuracies

During that period, there were just over 11 million acre-feet of transfers. Nearly 10% were double-counted transfers (counting sales to and from a water bank) or proposed transfers that never panned out (Rusty Areias' deal with MWD in the early 1990s). Another 1.2 million acre-feet were groundwater banking storage arrangements, recycled water sales or exchanges. I choose to also exclude groundwater transactions from adjudicated basins – not because they are not transfers, but because the coverage in the Water Strategist is inconsistent and incomplete, and because my primary focus is on changing surface water institutions. These adjustments knock out 30% of the Water Strategist data. In addition, 5.5 million acre-feet of activity in my database is absent in the Water Strategist data. Therefore, basing analysis and drawing conclusions from the Water Strategist dataset is akin to using preliminary GDP forecasts – trends may come through, but snapshots of the overall economy based on these figures leaves something to be desired.

5.3.2 Transfer Count Regression

I replicate their transfer count regression and use different datasets and specifications to create the following regression table:

Insert Table 10

The first eight columns use the Water Strategist data (the first four columns use the as-published Water Strategist data, the next four columns exclude exchanges, middleman sales, etc.), and the last eight use my more comprehensive data. Because the dependent variable is between 8 and 52 transfers per year, I also include OLS results for each specification, shown in blue in Table 10. Within these divisions, some regressions are based on the 1987-2005 period (replicating Brewer et al.) and others use a longer period. Finally, in specifications (9) - (12), I exclude transfers carried out under a previous long-term transfer. The Water Strategist does not include all transfers carried out under a previous long-term transfer,³⁹² and furthermore, continuing transfers are not based on changing laws in the year they occur and so including them in the dependent variable is misleading – if a long-term transfer is consummated in 1993, for example, any transfer based on this agreement will occur in 1994 regardless of new 1994 legislation.³⁹³

Discussion

The first column compares well to Brewer et al.'s original results – most of the variables are similar in magnitude and significance, although unlike their results, precipitation is positively related to transfer count. Specification (9) and (10) are the most logical to focus on – they have more comprehensive data, no recurring long-term transfers and a longer time period. The OLS

³⁹² For example, the 35 year transfer between IID and MWD shows up in 1987, but each yearly transfer of water between the parties under this agreement does not. On the other hand, the long-term environmental transfer between the San Joaquin River Group Authority and the USBR's Water Acquisition Program shows up in the early 2000s, but so do the associated yearly quantities transferred by the parties under their agreement. For the most part, this is the exception, and therefore excluding ULTs from the analysis mimics previous work better.

³⁹³ Some contracts include clauses that vary quantities and prices with rainfall, but these regressions focus on transfer counts and ignore prices.

regression in specification (9) only has two significant variables – the 1991 dummy variable and precipitation. Precipitation has an inverse effect on transfers, but this is not the case for the Poisson specification, and both are significant. The other covariates are insignificant in the OLS regression. Therefore, it seems that with better data, drawing conclusions about years other than 1991 are a stretch – most of the variables lose their significance as I improve the regression models.

5.3.3 Transfer Volume Regression

I replicate the above analysis but now focus on transfer volumes as the dependent variable, and the results are presented in Table 11.

Insert Table 11

My results mimic Brewer et al.'s in column (1), and as I adjust the Water Strategist data and replicate the analysis with my data, some of the signs change and some of the variables lose or gain significance. Again, the most comprehensive dataset – my data without under-long-term transfers – shows that 1991 has a positive effect on volume and 2003 imposes a negative effect, in addition to a positive population trend.

5.4 Econometric Analysis of Changes

The previous analysis indicates that increasing population leads to more demand, but California has had decades of increasing demand, so it seems unlikely that this plays a role in causing transfers in the late 1980s. The time trends deserve more attention – is the 1991 trend the result of the Drought Bank? What really happened in 2003 to deter transferability, if anything? What might the population trend variable be hiding? Would a better measure of precipitation fit the data better? Does a panel dataset of districts or district groups better answer these questions? I attempt to address these questions with my own regressions.

However, while I attempt to improve upon earlier work, using regression analysis to analyze changes in water marketing is difficult because of the tremendous heterogeneity and the issue of causality. For example, in 1991, both the Drought Water Bank and new water transfer legislation was passed. Using a dummy variable starting in 1992 will not be able to identify which of these changes, if any, mattered. Therefore, I attempt to attach these yearly dummy variables to segments of the district population that ought to be affected by the laws, and this proves fruitful. Still, there are other changes occurring at the same time, and using regressions to pin down causality is still imperfect, especially because changes that may affect water marketing may take years to show up in the data. I present my attempt at regression analysis below, but understanding water marketing evolution necessitates case studies and a historical understanding as well.

5.4.1 Scarcity Changes

Scarcity surely propels water marketing, but scarcity in general is hard to measure, especially aggregate water scarcity in California. The literature measures scarcity using precipitation and runoff compared to population or agricultural and urban water withdrawals as a percentage of total water availability.³⁹⁴ Similarly, I investigate dam capacity, population,

³⁹⁴ F. R Rijsberman, “Water scarcity: Fact or fiction?,” *Agricultural Water Management* 80, no. 1-3 (2006): 5–22.

irrigated acres and water withdrawals over time:³⁹⁵

Figure 21 – Scarcity Trends

As the chart indicates, dam capacity grew markedly in the 20th century, but petered out around 1980.³⁹⁶ The top line charts acre-feet of dam capacity per person, a crude measure of the water storage per person which relates to water availability per person. Because most developed supply is used within agriculture, I also chart the storage capacity per acre-foot of need. To calculate need, I assume that each irrigated acre needs three acre-feet, the average applied water rate for all irrigated land in California.³⁹⁷ Similarly, urban demand is close to one acre-foot per four people.³⁹⁸ Therefore, I create the red line depicting the ratio

$$\frac{\text{Surface Storage Capacity}}{3 * \text{irrigated_acres} + \frac{\text{population}}{4}}$$

and it has the same general shape as the storage capacity per capita trend, but does not decrease as steeply after 1980 because many irrigated acres are going out of production during this time.

The United States Geological Survey publishes water withdrawal estimates every five years,³⁹⁹ starting in 1950, and the 3rd line (purple) displays

$$\frac{\text{water withdrawals}}{3 * \text{irrigated_acres} + \frac{\text{population}}{4}}.$$

All trends generally begin their decline in the 1970s, providing evidence that scarcity increases from this point forward.

Withdrawals from the Sacramento-San Joaquin Delta present further evidence of increased scarcity. Ever since 1922, when Antioch sued upstream diverters over salinity intrusions in the Delta,⁴⁰⁰ different interests have argued over Delta allocations. The main exporters are the SWP and the CVP, both of which have large pumping plants near Tracy, CA. They pump water into their canals to send directly to users and to store in San Luis Reservoir, a jointly owned and operated off-stream reservoir southwest of Tracy. In doing so, the pumps disrupt the normal flow of the Delta, trapping nearby fish and confusing anadromous fish seeking the Pacific Ocean. As a result, environmental officials and judges have curtailed diversions, and recent diversions are low compared to 2001-2005 even though the last five years had on average higher runoff than the previous five.⁴⁰¹

Insert Figure 22 - Delta Exports, 2001-2010

³⁹⁵ Sources – for population, see US Census Bureau, “Resident Population and Apportionment of the U.S. House of Representatives”, 2001, www.census.gov/dmd/www/resapport/states/california.pdf. For dam building, see Division of Safety of Dams, “Dams Within the Jurisdiction of the State of California”, 200AD, <http://www.water.ca.gov/damsafety/docs/Jurisdictional2010.pdf>. For water withdrawals, see A. D Konieczki, *Studies Examine Historical Water-Use Trends, and Climate-Groundwater Interaction.*, AZ Water Resources Supplement, 2004; Geological Survey (U. S.), *Estimated Use of Water in the United States in ...*, 1950-198 : U.S. Geological Survey circular ([Reston, Va.?): U.S. Dept. of the Interior, Geological Survey, 1950).

³⁹⁶ The chart is slightly misleading, however, because while surface storage construction has decreased, many users have invested in groundwater storage projects.

³⁹⁷ See, for example, United States, *2008 Census of Agriculture*.

³⁹⁸ CA DWR, “Statewide Water Data 1972-2003”, n.d., www.waterplan.water.ca.gov/docs/portfolio/faf_data/ca72-03%20.xls.

³⁹⁹ Because they break down use into agricultural and urban use, we can look at the *agricultural water withdrawal per acre* and *urban water per capita* trend lines as well.

⁴⁰⁰ *Town of Antioch v. Williams Irrigation District* 188 Cal, 451 (1922).

⁴⁰¹ CA DWR, “Water Year Hydrologic Classification Indices”, n.d., <http://cdec.water.ca.gov/cgi-progs/ioidir/WSIHIST>.

This reduction in flow has unclear effects on transferability. The standard story says that those who receive less water would be expected to seek additional supplies in the market. However, because the pumps cannot operate fully in early summer, there is no extra room to move transfer water across the Delta. In addition, once the pumps are allowed to resume full pumping (typically in July, as is evident in the chart), Water Contractors have first priority. Therefore, constrained users developed groundwater storage projects to ameliorate scarcity and bank water in the off-season. Users developed two major banks, the Kern and Semitropic Water Banks, in the 1990s, and the first withdrawals from these banks occurred in 2001.⁴⁰²

5.4.2 Other Important Changes (recap)

In addition to scarcity, some important changes have primarily affected one of the three main types of users – those that receive water from the CVP, the SWP, or from their own water right. For CVP water users, the major change has been the CVPIA in 1992. For State Water Contractors, the major event was the Monterey Agreement in 1994, and for the remaining private users, there are a couple potential trigger events. The 1991 Drought Water Bank, primarily affecting sellers in the Sacramento Valley and the northern San Joaquin Valley, may have provided the initial market experience to encourage these sellers to sell again. Tim Quinn, former Deputy General Manager of MWD, argues that the effect was felt throughout the state, and was a very significant event in California water marketing history:

I can remember sitting in meetings in February 1991 when people scoffed at the notion of water transfers and water marketing. They said, “You won’t be able to buy any water. Maybe you’ll get 100,000 acre-feet. This is a very dry year. Nobody’s going to be willing to sell you water because it’s just too dear.” But, lo and behold, in the water bank, through no particular magic, a price was established at \$125 to the farmer. The next thing you knew, within less than a two-month window, at the price of \$125 an acre-foot, the water bank purchased 800,000 acre-feet of water, gross. It was an extraordinary statement about the power of market forces.⁴⁰³

Environmental uses also spurred activity, led by a renewed focus on the Delta and a refusal to reallocate water to the environment away from users by fiat. Lastly, of course, the passage of the numerous laws purporting to help transferability may also have improved fluidity, as discussed earlier. The major change was the standardization of procedures to temporarily transfer water, but while these likely helped users reallocate water, so many transfers have been accomplished without using these statutes that it is hard to determine how crucial that legislation is to marketing.

5.4.3 Regressions and Discussion

To address these major events using my data, I create a panel dataset of transfers and run nine fixed effects regressions – three at the district level, three at the district group

⁴⁰² Hanak, *Who Should Be Allowed to Sell Water in California?*, 101.

⁴⁰³ Carl Boronkay, Timothy Quinn, Malca Chall, “The passage of the Central Valley Project Improvement Act, 1991-1992,” 51.

level,⁴⁰⁴ and CVP/SWP/private level. For the district regressions, I cluster the errors based on the district group (CVP, SWP, other).⁴⁰⁵ I then use a difference-in-difference approach to estimate the effects of specific events on transfers within district groups. My independent variable is the transfer volume, and this is explained by the variables listed in Table 13.

Insert Table 12 - Regression Variable Descriptions

Besides the *rainindex* variable, all independent variables are similar to yearly dummies. For example, to investigate the effect of the Monterey Agreement, I add a *monterey* variable which takes a value of 1 for years 1995 and later. To see the difference between this effect on all districts and this effect on just the State Contractors, I include an interaction term (*monterey_state=Monterey*state*). The *cvpia* terms are similar. These regressions focus only on **short-term transfers** (including those that substitute for a long-term transfer).

Insert Table 13 – Panel Regression

Regressions (1) through (3) use the 365 districts that sell during 1980 to 2009 as the unit of analysis. Column (1) uses all types of short-term transfers, column (2) focuses only on short-term swaps, and column (3) ignores short-term swaps.

These regressions lend support to the hypothesis that the Monterey Agreement bolstered trading. Among State Contractors, the Agreement appears to boost trading by 4,000 acre-feet. Interestingly, the CVPIA has an insignificant effect on short-term transferability among federal contractors (*cvpia_fed*) despite the aims of the legislation. This indicates that the CVPIA was not a watershed moment but rather one more step in the steady relaxation of transfer policies, and this legislation merely confirmed the general trend on the ground. Furthermore, as mentioned earlier, some of the major legal changes (individual users' ability to sell without district approval and CVP users' ability to sell to non-CVP contractors) didn't actually change the situation on the ground.

If scarcity drives water marketing, then wetter years ought to reduce the need to transfer water. Looking at short-term transactions in general, rainfall has a negative effect, indicating that transfers do decline in wetter years. However, among swaps, rainfall is insignificant. In addition to including a rainfall index variable (*rainindex*),⁴⁰⁶ I also interact this variable with different transfer categories to investigate if precipitation affects each differently (*rain_federal* and *rain_state*). Both federal and state users transfer *more* during drier periods, and the net effect is a wash for these districts. Swaps seem unaffected,⁴⁰⁷ lending support to my

⁴⁰⁴ I break districts down into major water right and geographic location groups: CVP delta (includes the Exchange Contractors and Westside users), CVP eastside, cvp north, cvp settlement/exchange, private north, private south of delta, private southern CA, and state.

⁴⁰⁵ 60% of districts in this analysis are CVP districts (federal), 15% are state (SWP) and the rest are private.

⁴⁰⁶ The Sacramento Valley Water Year Index = $0.4 * \text{Current Apr-Jul Runoff Forecast (in maf)} + 0.3 * \text{Current Oct-Mar Runoff in (maf)} + 0.3 * \text{Previous Water Year's Index}$ (if the Previous Water Year's Index exceeds 10.0, then 10.0 is used). The San Joaquin Valley Water Year Index = $0.6 * \text{Current Apr-Jul Runoff Forecast (in maf)} + 0.2 * \text{Current Oct-Mar Runoff in (maf)} + 0.2 * \text{Previous Water Year's Index}$ (if the Previous Water Year's Index exceeds 4.5, then 4.5 is used). My *rainindex* geographically matches the Sacramento and San Joaquin indexes to the districts depending on their location, and is better suited to California rainfall measurement because it is based on runoff, not rainfall, an important distinction given California's massive amounts of natural and artificial storage.

⁴⁰⁷ Flood releases affect transferability, especially in the Friant Division of the CVP. However, while most of these transfers would all be classified as swaps, the lack of any significant trend is likely due to the small size of Millerton

classification of this category of water transfers. They are important for water users, but they do not vary based on typical scarcity indicators.

Because many users have access to storage, rainfall and runoff this year matter, but so do previous rainfall levels. To address how this, I include lagged rainfall variables, and the effects are similar except for the coefficients in column (2), which are now significant and negative for CVP users and significant and positive for SWP users. Why would the SWP and CVP users behave differently? SWP users have take or pay contracting, and if they must take the water regardless, there is an incentive to find a home for it. In general, the effect of rainfall is hard to isolate – many districts behave differently depending on their location and access to surface and ground storage.

There is no general time-trend among users, although the State Contractor activity does display a negative trend. This makes sense – because SWP Contractors reallocated water permanently during the late 1990s and early 2000s, this lessened the need to reallocate short-term, and users also have experimented with new ways to exchange water without losing half the fixed cost as they would if they used the TurnBack Pool.

Some claimed that the 1991 drought water bank spurred the market.⁴⁰⁸ In addition the Water Strategist said the following soon after 1991:

...pressure for expanded water marketing is growing. The drought taught a lot of farmers how much cities valued water and, sooner rather than later, this awareness will carve new channels for water to flow from rural to urban customers.⁴⁰⁹

The Drought Bank therefore is an experience and diffusion story – proponents thought bank participants gained experience and therefore water marketing should be easier in the future. To investigate this, I add a dummy variable (*dwb_sell_91* which equals one for districts participating in the Drought Bank in all years after 1991) to test this claim. The effects seem to be small and limited to swaps, indicating that perhaps the negative effects of the Drought Bank, although small in total,⁴¹⁰ led to discord in the areas of origin, and perhaps this added scrutiny scared these sellers away from future marketing opportunities.⁴¹¹

However, if participation is what mattered, then both buyers and sellers ought to gain from the experience. If I expand the variable to look at sales activity from both buyers and sellers of the original 91-91 Drought Bank, the effect is much more pronounced. These districts sell an additional 3,700 acre-feet per year.⁴¹²

Insert Table 14 – Panel Regression 2

Lake, the main storage reservoir for the Friant Division – flood releases happen both in wet winters and in dry winters because storage is relatively small.

⁴⁰⁸ See D. Zilberman et al., “Individual and institutional responses to the drought: the case of California agriculture,” *Water Resources Updates* 121 (2002): 17–21; Zilberman, “Water Marketing in California and the West”; Carl Boronkay, Timothy Quinn, Malca Chall, “The passage of the Central Valley Project Improvement Act, 1991-1992.”

⁴⁰⁹ Smith, *Water Strategist* Jan 1994.

⁴¹⁰ R. E. Howitt, N. Y. Moore, and R. T. Smith, *A Retrospective on California’s 1991 Emergency Drought Water Bank* (California Dept. of Water Resources, 1992).

⁴¹¹ Hanak, *Who Should Be Allowed to Sell Water in California?*, vii.

⁴¹² This is despite that East Contra Costa Irrigation District, Yuba County Water Agency and a few others consummate long-term deals later on, in effect reducing their short-run transfer ability.

For added robustness, I also collapse the panel data into small groups based on geographic origin. I create eight subgroups (e.g. CVP settlement contractors as one group) and run the regressions again, shown in columns (4) through (6). Nothing changes substantially. The last three regressions (columns (7) through (9)) then do the same but break the data into only three groups – CVP users, SWP users and private users. I used the Sacramento rainfall index because I could no longer use the geographic-specific *rainindex*. Again, nothing changes substantially.

Long Run Trends

There are so few long-term transfers that a panel dataset is not practical as there are too many zeros. Instead, I investigate patterns, if any, in the number of long-term transfers consummated per year. The data are displayed in the following chart:

Insert Figure 21 - LT Transfer Counts

In the following regression table, I use a Poisson specification to estimate what may have motivated these transfers. Long-term transfer counts are the dependent variable:

Insert Table 15 - Long-Term Poisson Regression

Short-term rainfall ought not to affect long-term transfer decisions, and the regression confirms that. The year trend is significant and negative, and the 1989 and 2000 dummies are positive, but this analysis is not very convincing that something happened in 1989 and 2000 to drastically alter the picture considering the timeline of historical events shaping California's water market.

5.5 Trend Conclusions

In general, water transfers occur haphazardly and trying to explain their occurrence with data available is difficult. The Monterey Agreement, rainfall and the Drought Bank all seem to play a role in explaining transfer behavior, but there are other factors at work, and so while the data are revealing, my regressions also only explain some of the variability. Column (9), the regression focusing on the largest district grouping (CVP users, SWP users or private users) and ignoring swaps, has the highest r-squared, but I still am only explaining about half of the data variability. The r-squared terms increase markedly when I exclude swaps, again confirming that swaps display no identifiable pattern.

Using a regression to predict long-term transfers is not revealing because there are so few, because the timing is unique for each one, and because it may take years to negotiate a transfer. Therefore, I can conclude that long-term transfers are more likely now than before 1980, but using this data to say much more than that is overreaching. Instead, an analysis of who actually participates in marketing water is more revealing of causality, and I address this in the next part of this research.

II Ambiguous Rights and Their Effect on Marketing

The California water market is not made up of a random assortment of sellers that satisfy the thirsty parties. Rather, California's unique system of water rights created water marketing patterns worth exploring. Because the strength of a water right system depends on the strength of enforcement and administration, in section 2, I outline the development of appropriative rights administration in Wyoming and in California. Both Wyoming and California have appropriative right systems, but the tenets of appropriative water law do not simply apply to California. Wyoming's system, in contrast, is much cleaner, and I present some data in section 3 to show that this has real effects on the ground

In addition, because California water marketing data only show who actually does participate in the market, failed transfer case studies provide a good window into explaining why they failed. To grasp why transfers fail is as important in understanding why they develop, and I present examples of the numerous transfers that failed in California as a result of murky water rights in section 4. Finally, I use groundwater data in section 5 to lend support to the contention that murky water rights hinder a district's ability to transfer water. Before tackling these issues, I first present the history again,⁴¹³ important in understanding how California developed its appropriative right system.

1. The History

California has a distinctive system of water rights. The current structure is hardly by design – instead, the courts and the legislature have imposed a rather odd mishmash of water rights on California. When California entered the Union in 1850, one of the actions taken by its first Legislature was to adopt the common law of riparian rights for surface water, originally imported from England and the governing doctrine in the rest of the Union. Riparian rights entitle the owner of land bordering a surface water body (“riparian” land) to use and share with other riparians the water flowing past his property.⁴¹⁴ While riparian rights require no permits or licenses, they apply only to the water that would naturally flow in the stream. Riparian rights do not allow the user to divert water for storage or to use it on non-riparian land. Riparian rights remain with the riparian land when it changes ownership. Unlike the appropriative right, use does not create the right, and nonuse does not terminate it.

California's entry into the Union was preceded (and caused) by the Gold Rush. Following the discovery of gold, the independent-minded miners in California proceeded simply to take water they needed. Water development proceeded on an unprecedented scale as miners built extensive networks of flumes and waterways to work their claims. The water carried in these systems often had to be transported far from the original river or stream. Riparian rights could not apply to this use of water because the miners had no legal ownership of the land, and the use often occurred at locations some distance from the stream, and therefore not on riparian land. This did not deter the miners. They applied the same “finders-keepers” rule to water that they did to their mining claims - it belonged to the first miner claiming ownership. To stake their water claims, the miners developed a system of “posting notice” at the site of diversion. It enabled others to divert available water from the same river or stream, but their rights existed within a

⁴¹³ This is mainly here to treat the two sections as two papers with distinct separation.

⁴¹⁴ This is referred to as the ‘rocking chair’ principle: “landowners could simply sit and look at their water, and no one could deprive them of their right and use the water elsewhere.” Hundley, *The great thirst*, 85.

hierarchy of priorities. This system, based on "first in time, first in right," became the basis for the modern doctrine of appropriative water rights. In 1851, the Legislature recognized the appropriative water right system as having the force of law, and the courts ratified the appropriative doctrine in *Irwin v. Phillips* in 1855. Thus, a "dual system" came into being in California in which appropriative rights coexisted side-by-side with riparian rights.⁴¹⁵

In addition to the dual system of surface water rights,⁴¹⁶ a feature of California's system was that it functioned virtually without the involvement of state agencies. Prior to 1872, appropriative water rights could be acquired in California by simply taking water and putting it to beneficial use.⁴¹⁷ In 1872, the Legislature established a procedure for perfecting an appropriative water right. Priority could be established by posting a notice of appropriation at the point of diversion and recording a copy of the notice with the respective County Recorder within ten days.⁴¹⁸ Construction of a diversion facility was to commence within sixty days of the posting and had to be pursued with diligence until completion. However, simply using the water without recording a copy of the notice was still valid subject to the qualification that the appropriative right did not attach until the beneficial use commenced.⁴¹⁹ The result was a very permissive system with only a passive role for state government in the administration of appropriative water rights, and no role in the administration of riparian rights.⁴²⁰ Disputes over both appropriative and riparian water rights were resolved through litigation in state courts. In effect, the courts administered surface water rights in California, not state agencies. This was an untidy, and not inexpensive, arrangement.⁴²¹ It was also the arrangement adopted initially by most other western states.

California's dual system was tested in a monumental legal battle between Miller and Lux, downstream riparian right holders and Haggin, an upstream appropriator on the Kern River whose diversions in the drought year of 1877 virtually dried up the river. The California Supreme Court ruled on *Lux v. Haggin*, first in 1884 and then again in 1886.⁴²² The Court

⁴¹⁵ California's dual system was tested in a monumental legal battle between Miller and Lux, downstream riparian right holders and Haggin, an upstream appropriator on the Kern River whose diversions in the drought year of 1877 virtually dried up the river. The California Supreme Court ruled (twice) on *Lux v. Haggin* in 1886. The Court essentially upheld the dual system. It ruled that the riparian doctrine was law in California. But, it also ruled that under certain conditions – if the appropriator began using water from a stream before a riparian had acquired his property – the appropriation doctrine would prevail.

⁴¹⁶ Today, California also recognizes pueblo, prescriptive, stockpond, livestock, small domestic and other water rights. These will be mostly ignored because they are a miniscule portion of the total water use.

⁴¹⁷ Priority did not attach until beneficial use of the water commenced.

⁴¹⁸ The information contained at the Records offices was practically worthless for determining entitlements and priority Mead, *Irrigation institutions*..

⁴¹⁹ Kletzing, "Prescriptive Water Rights in California."

⁴²⁰ The settlers "preferred freedom of action, they wanted few or no restrictions on their freedom to utilize streams" Dunbar, *Forging new rights in western waters*, 87.

⁴²¹ There was no restriction on the number of appropriations that might be made of a stream. There was no provision for the recordation of *the completion* of diversion projects. Thus, a person could plan a diversion facility and post and record a notice of appropriation, but never complete the project. Consequently, it was impossible to determine the number and priorities of appropriations on a stream except through an expensive adjudication lawsuit (Dunbar, 1983). The only way to apportion streamflow among users in times of scarcity was for one or more of the parties to initiate a law suit – neither a cheap nor a timely mechanism (the dispute between Lux and Haggin, triggered by drought in 1877 was adjudicated in 1886). Furthermore, although agricultural pre-1914 appropriative rights are capped by historical use, municipal pre-1914 rights may not be. San Francisco, for example, currently uses not more than 300 mgd but claims an inchoate right of 400 mgd from the Tuolumne River..

⁴²² *Lux v. Haggin*.

essentially upheld the dual system. It ruled that the riparian doctrine was law in California. But, it also ruled that under certain conditions – if the appropriator began using water from a stream *before* a riparian had acquired his property – the appropriation doctrine would prevail.

Other western states followed a different path and largely rejected riparianism.⁴²³ In 1882, the Colorado Supreme Court declared the riparian doctrine to be “inapplicable to Colorado,” and established prior appropriation as the exclusive right to surface water in Colorado. This departure from common law was eventually adopted by all the mountain states, including Arizona and Alaska. The Plains states and the other Pacific states recognized riparian rights, but made appropriation the exclusive method of acquiring new rights after a certain date.⁴²⁴

The California system whereby the courts administered surface water rights by hearing lawsuits brought by water users became the object of intense debate in Colorado between 1878 and 1881. The central concern was the weaknesses of posting notices and relying on court adjudications. There was no centralized record of appropriations (they were scattered among the county seats), and no mechanism for verifying diversions or enforcing priority save through litigation. Three alternatives were considered in Colorado. One was to create a system of public officials – water commissioners – who would determine the priority of water rights on a stream and allocate water according to this priority. While this proposal was not adopted, legislation enacted in 1879 did provide for the creation of irrigation districts around the state and the appointment in each of a water commissioner who was to enforce the distribution of water based on prior rights. However, the water commissioners had no power to resolve disputes or conflicts in prior rights – those were to be left for the courts. A second alternative which was considered retained water right determination within the domain of the courts. This alternative provided for a judge to appoint a referee who would take testimony to substantiate claims to water. Using the evidence gathered by the referee, and acting as an administrative officer, the judge would issue a decree establishing the priorities of each water user. This approach, too, was rejected “because it did not provide for the usual lawsuits initiated by complaints and summons.”⁴²⁵ The third alternative, adopted by the Colorado Legislature in 1881, was even closer to the traditional judicial system. An adjudication procedure would be initiated by a petition of one or more water users. Upon receipt of the petition, the judge was authorized to appoint a referee who would collect evidence and prepare a draft decree establishing priorities of right. The judge would then hold a hearing and issue the decree with possible modifications.

The Colorado procedure was soon found to be problematic. As Dunbar⁴²⁶ notes, “the only limit placed on the number and amount of appropriations was beneficial use and what was beneficial use was a subjective judgment of the court. It made no difference that a stream was overappropriated; one could commence a ditch, file a notice and a map, divert the water, and use them until rights were proved up in an adjudication procedure. Then the ditch owner could successfully claim more than he needed since the judges and referees were usually unfamiliar with the duty of water and the measurement of streams. The state engineer, representing the public, was not allowed to participate in the adjudication and question the accuracy of claims. As a consequence, the courts awarded rights to water in excess of the capacity of streams.”

⁴²³ The account that follows is based on Dunbar, *supra* note 18.

⁴²⁴ Dunbar, *Forging new rights in western waters*, 85.

⁴²⁵ *Ibid.*, 94.

⁴²⁶ *Ibid.*, 98.

Reacting to Colorado's experience, in 1889 the neighboring state of Wyoming created an administrative system. Under what became known as the Wyoming system, the state was divided into several water divisions, corresponding roughly to four major watersheds, and a Board of Control was created consisting of the State Engineer and the superintendents of the water divisions. A person wishing to appropriate water applied for a permit from the State Engineer. If the State Engineer determined that unappropriated water was available and the diversion was not "detrimental to the public welfare," the permit was granted. Upon completion of the project and application of water to the land, the user notified the Board of Control, which issued a certificate of appropriation. The superintendents of each division monitored diversions and enforced priority within their divisions. While adjudication of streams was assigned to the Board of Control rather than the district courts, irrigators could appeal the Board's decisions to the courts.

The Wyoming system spread slowly to other western states.⁴²⁷ The fact that it vested the determination of property rights to surface water in an administrative board rather than the courts was a source of great controversy. This was supported by engineers but opposed by lawyers and some water users. However, it was strongly pushed by federal government as a pre-condition for receiving water projects from the new Bureau of Reclamation, created in 1902. After rejecting the Wyoming System, in 1908 Oregon developed a variant in which the determination of the Board of Control had to be filed with the clerk of the court and any party had thirty days to file an exception, which would trigger a court hearing; otherwise the court would affirm the Board's determination.⁴²⁸

California retained its allegiance to the system of posting notices until 1914, despite a thirty year effort by reformers to replace it. By 1900, most of the largest rivers' normal flows were fully appropriated, leaving new reservoirs as the only source of "new" water.⁴²⁹ After a serious drought in 1898 and 1899, a strong civic action group formed and began advocating for storage, and they asked Elwood Mead, author of Wyoming's water laws, to survey California's water resources.⁴³⁰ Not surprisingly, Mead's report led to a push to adopt Wyoming's successful system, and water rights reform finally came about following the election of a reform governor and a reform legislature in 1910. The Water Commission Act, passed by the legislature but barely approved by the voters in a referendum election in 1914 50.7% to 49.3%,⁴³¹ established a State Water Commission⁴³² and declared all unappropriated California surface waters subject to its authority. Water policy officials hoped that centralizing control and administration would reduce the endless litigation and conflict over water rights, prevent the rampant speculation the legislature enabled with the 1872 law, and tamp down growing hydroelectric company monopoly power.⁴³³ Legislators also acted out of a duty to protect wealth created by investment in irrigation.⁴³⁴

⁴²⁷ Including Nebraska, Nevada, Utah, Idaho, North and South Dakota, New Mexico and eventually Arizona.

⁴²⁸ What became known as the Oregon System closely resembled the procedure adopted by Colorado.

⁴²⁹ Pisani, "Water Law Reform in California," 299.

⁴³⁰ *Ibid.*, 301.

⁴³¹ Sax, "We Don't Do Groundwater," 300.

⁴³² The governor of California, the state engineer, and three members appointed by the governor to four year terms made up the five member commission. They later were called the State Water Rights Board, and currently, the State Water Resources Control Board.

⁴³³ Pisani, "Water Law Reform in California," 313.

⁴³⁴ Mead, *Irrigation institutions*, 204-205.

The Commission had no authority over surface water appropriated before 1914, and these rights came to be known as pre-1914 water rights. A person wishing to appropriate water *after* 1914 applied for a permit from the Commission.⁴³⁵ If the Commission determined that surplus water was available,⁴³⁶ the permit was granted. The permit holder then had the right to take and use the water according to the terms of the permit.⁴³⁷ Upon compliance with the permit terms, the Commission issued a license, and the appropriative right became confirmed. Noncompliance meant a permit could be revoked.⁴³⁸ However, the Commission never developed a network of administrative officials like that in Colorado or Wyoming who monitored diversions and enforced priority. Instead, the Commission had only “a limited role in resolving disputes and enforcing rights of water holders, a task left mainly to the courts.”⁴³⁹

The State Water Commission did not have control over groundwater except for water flowing underground in “known and definite channels.”⁴⁴⁰ The draft language of the Water Commission bill did grant permitting authority over appropriators of groundwater (non-overlying uses), and granted authority to restrict groundwater pumping that affected streams, but these pieces were amended out.⁴⁴¹

Whereas appropriative rights were limited to “reasonable and beneficial” uses of the water, “riparians were subject only to the needs of other riparians on the same stream, frequently with wasteful results.”⁴⁴² The framers of the Water Commission Act had wanted to abolish riparian rights, but they could not accomplish this. Instead, the Act stipulated that unused riparian water would revert to the state after 10 years of nonuse. However, the Commission had little power to enforce this provision – the large riparian landholders could ignore the

⁴³⁵ A federal case indicated that the State Water Commission may not have been the exclusive method for acquiring a right until 1923. See Archibald, *Appropriative Water Rights in California*, 10. Also, Andrews and Fairfax, “Groundwater and Intergovernmental Relations in the Southern San Joaquin Valley of California,” 166.

⁴³⁶ The applicant must show water availability – the Board doesn’t actually determine water availability and relies on lack of protests as a signal that water is available Harding, *Water in California*, 45..

⁴³⁷ As Harding (*Ibid.*, 52.) points out, however, the SWRCB has been quite lax in this process. Shasta and Friant reservoirs, two of the largest in the state, were completed and began operations in the early 40s, 20 years before the SWRCB granted a permit to the USBR for their dams. These examples are not unique. The permit terms also change over time. For example, all permits now dictate a maximum annual use.

⁴³⁸ Until it issues a license, the Board reserves jurisdiction over the permit to protect the public interest and ensure water availability (CA Water Code, §1394). Even if licensed, failure to beneficially use portions of an appropriative water right for 5 years forfeits the unused portion (Water Code, Sect. 1241).

⁴³⁹ 182 Cal. App. 3d 82 (1986), p.170 (italics in original). The ruling goes on to explain that: “Because water rights possess indicia of property rights, water rights holders are entitled to judicial protection against infringement, e.g., actions for quiet title, nuisance, wrongful diversion or inverse condemnation. ... It bears reemphasis that the Board’s role in examining existing water rights to estimate the amount of surplus water available for appropriation does *not* involve adjudication of such rights.” The Commission was authorized to adjudicate all surface rights to a stream system if the public interest warranted it, but this power was not meant to be used when the Commission granted every new water right. See *Water Commission Act*, sec. 24.

⁴⁴⁰ *Ibid.*, sec. 42.

⁴⁴¹ J. L. Sax and State Water Resources Control Board, *Review of the Laws Establishing the SWRCB’s Permitting Authority Over Appropriations of Groundwater Classified as Subterranean Streams and the SWRCB’s Implementation of Those Laws: Final Report* (State Water Resources Control Board, 2002), 38. Sax also points out that the Water Commission bill authors meant to address pumping that affected surface stream flows, but instead of stating that explicitly, they borrowed the phrase “subterranean streams flowing in known and definite channels” from a recent legal ruling.

⁴⁴² 182 Cal. App. 3d 82 (1986), p.171.

Commission and instead seek relief with the courts, and this portion of the law was eventually struck down by the courts.⁴⁴³

The freedom of riparian right holders to use water in a profligate manner was dramatically illustrated in *Herminghaus v. South. California Edison Co.*⁴⁴⁴ The court held that under the riparian doctrine the riparian owner was entitled to the full flow of the stream even though the water was used wastefully to flood her lands, thus depriving the upstream appropriator – a power company serving most of the population of Southern California – of water for the generation of hydropower.⁴⁴⁵ The ruling caused a wave of outrage.⁴⁴⁶ In response, the legislature passed a constitutional amendment in 1928 subjecting all water users – riparians and appropriators alike – to the universal limitation that water use must be reasonable and for a beneficial purpose.⁴⁴⁷

Thus, by World War II, California had progressed the least of the western states in developing a manageable system of surface water rights suited to the aridity of the West. Like most western states, it had minimal authority to regulate withdrawals of groundwater. Unlike many other states, it retained riparian rights alongside appropriative rights.⁴⁴⁸ Beyond that, its administration of appropriative water was the most incomplete.⁴⁴⁹ It retained the early practice of relying on courts not only to define the limits of appropriative rights but also, in most cases, to quantify them. But most of the river basins in California remained unadjudicated.⁴⁵⁰ The State Water Commission and its successor entities⁴⁵¹ had no authority over pre-1914 appropriative rights.⁴⁵² With post-1914 rights, it had little authority to enforce these rights – enforcement was still left to the courts – and it lacked a local staff network which could monitor them on the ground.

⁴⁴³ Miller, “Riparian Rights and the Control of Water in California, 1879-1928.”

⁴⁴⁴ 200 Cal 81 (1926).

⁴⁴⁵ 200 Cal. 81 [252 P. 607], appeal dismissed 275 U.S. 486 [72 L.Ed. 387, 48 S.Ct. 27]

⁴⁴⁶ *Lux v. Haggin* was similarly criticized on efficiency grounds, but perhaps the reaction was muted because both uses were private, whereas in this case, Southern California Edison would provide power for the public.

⁴⁴⁷ Cal. Const., art. X, § 2.

⁴⁴⁸ Dual systems of riparian and appropriative rights also still survive in Kansas, Nebraska, North and South Dakota, Oklahoma, Oregon, Texas and Washington. Texas, Oregon, South Dakota and Kansas restrict their riparian rights to the amounts of actual beneficial use made at the time of enactment of appropriative laws. Washington and Nebraska also impose limitations to unused riparian rights. North Dakota and Oklahoma have less clear riparian laws. See Hutchins, *Water rights laws in the nineteen Western States*, 14.

⁴⁴⁹ Other states do not have such poor administration. In Oklahoma, for example, they know that in 2005, 1,746,080 acre-feet of water was withdrawn for all uses; 63% from surface water sources and 37% from groundwater sources. See <http://www.owrb.ok.gov/util/waterfact.php>

⁴⁵⁰ Colorado, by contrast, actively pushed for the unitary adjudication of river basins. Laws enacted in 1899 and 1903 provided the courts with the authority to initiate an adjudication of all water rights in a district. A 1919 law required any claimant to an appropriative right to submit a claim for adjudication by January 1, 1921 or forfeit his right. The legislature also established a biennial diligence requirement for conditional water rights. The adjudication laws were recodified and unified in the 1943 Adjudication Act which “continued to anticipate the issuance of unitary decrees addressing all surface rights within the water district” (Hobbs, 1999, p. 9).

⁴⁵¹ The current name of the successor agency is the State Water Resources Control Board (SWRCB). We use this name from now on, except when referring to specific historical event in the past.

⁴⁵² In 1965, a law was enacted requiring all pre-1914 and riparian diverters to file with the California water rights agency a statement of diversion and use detailing their water use. With no penalty for non-compliance, there has been little enforcement of this requirement.

2. Appropriative Rights in Wyoming and California

Appropriative rights were created as an alternative to riparian rights. Economists typically assume that in contrast to riparian rights, appropriative rights facilitate marketing:

The well-developed appropriative water rights doctrine in the U.S. west is a basis for water markets. The doctrine allows for water to be claimed, diverted and separated from the land through which the water flows. It can be transported out of basin for use elsewhere. As such, those who buy water rights or lease water can change the location of diversion, timing of use, and nature and site of ultimate use, subject to regulatory approval to protect downstream claimants. With riparian water rights, however, both the land and the water generally have to be purchased if the water is to be used in another manner and the stream flow cannot be seriously impacted.⁴⁵³

It may come as a surprise, then, to learn that the actual property right in California is considerably more ambiguous than conventionally assumed.

Appropriative rights were intended to have the following properties better suited to the circumstances of water use in an arid area:

1. **Quantification** – Unlike a riparian right, an appropriative right is a right to a designated, specific quantity of water.
2. **Priority** – Unlike a riparian right, the exercise of an appropriative right is tied to the date of the original diversion of water under that right. The date of original diversion establishes the seniority of the appropriative right. In the case of limited streamflow, the ability to exercise the right is regulated according to the seniority of the right. Senior rights-holders are permitted to divert their full entitlement before a junior appropriator diverts any fraction of his entitlement.
3. **Appurtenancy** – Unlike a riparian right, water diverted under an appropriative right can be applied to non-riparian land.
4. **Transferability** – Unlike a riparian right, with an appropriative right the right to divert water is separate from the ownership of land and can be transferred to other owners at other locations.
5. **Forfeiture** – Unlike a riparian right, an appropriative right is lost by nonuse and created by use.

In explaining how these tenets apply to California, I also explain how some of them apply in Wyoming, the originator of the “Wyoming System” and the model upon which California’s system was based. As a summary, essentially all of Wyoming water rights are adjudicated, meaning that they have precise quantity allocations that the users and courts recognize. California streams that are adjudicated operate according to court decrees or voluntary agreements, and have some interesting differences with Wyoming. More importantly, most streams are not adjudicated and use crude methods of priority enforcement and administration which makes it difficult to transfer water.

⁴⁵³ Donohew, “Property rights and western United States water markets*,” 90.

2.1 Quantification in Wyoming

Before statehood, Wyoming's water right system might seem messy and unregulated, but this mattered little given the degree of development in the mid to late 1800s. Wyoming first passed an irrigation law in 1875, granting water users near streams the right to divert water (or more likely confirming it) and the right to a right-of-way to build a ditch if they did not own riparian property.⁴⁵⁴ The legislation also gave county commissioners the right to appoint three water commissioners in times of scarcity to divide stream flow. However, they were tasked with allocating by rotation – rights were *not* quantified.⁴⁵⁵ Wyoming's 1886 territorial irrigation law provided for more quantification by directing users to file claims to water in district court,⁴⁵⁶ but just like in California, the incentives created by the new law led to inflated claims⁴⁵⁷ – the state was attempting to distribute a valuable resource without having the enforcement and oversight necessary to prevent fraud or speculation. To fix the expensive and poorly functioning system, upon statehood in 1890, the legislature created a new system based administrative control along watershed boundaries rather than county lines.⁴⁵⁸

Acquisition of an appropriative right now starts with a request for a permit from the State Engineer.⁴⁵⁹ If the required maps and plans⁴⁶⁰ are sufficiently informative so that the State Engineer can understand the scope and location of the project, and if he determines the proposed project will not impair existing water rights or be detrimental to public welfare, he issues a permit for developing the proposed water project.⁴⁶¹ The applicant has a limited time to complete the project, and upon doing so, must submit proof of appropriation, which is then recorded and advertised in a newspaper inviting public inspection. If the Board of Control is satisfied that the appropriation will not conflict with other rights, they issue a certificate of appropriation.⁴⁶² Excluding the costs of creating the application, the whole process today costs around \$100.⁴⁶³

In Wyoming, the Board of Control adjudicates all surface water rights and quantifies them at the rate of one cubic foot per second (CFS) for each seventy acre plot of land.⁴⁶⁴

⁴⁵⁴ Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming" (Cooper Consulting, LLC, June 2004), 11, <http://wwdc.state.wy.us/waterlawhistory.html>.

⁴⁵⁵ Mead, *Irrigation institutions*, 248.

⁴⁵⁶ Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming," 13.

⁴⁵⁷ Mead, *Irrigation institutions*, 249-251.

⁴⁵⁸ *Ibid.*, 252.

⁴⁵⁹ Wyoming, *Wyoming Statutes*, 2010, sec. 41-4-501.

⁴⁶⁰ *Ibid.*, sec. 41-4-507.

⁴⁶¹ *Ibid.*, sec. 41-4-503.

⁴⁶² *Ibid.*, sec. 41-4-511.

⁴⁶³ Wyoming State Engineer's Office, "Fees" (Wyoming State Board of Control, March 18, 2009), <http://seo.state.wy.us/PDF/FeeSchedule.pdf>.

⁴⁶⁴ This was the recommendation of Elwood Mead based on experiments carried out on two plots of land in 1889. On the larger plot of oats, he used close to 4 CFS when he was actually diverting, and then extrapolated the continuous quantity necessary for the same level of irrigation based on a four month growing season. Unlike California, his land in Wheatland (eastern Wyoming) received ten inches of rain during the 1889 growing season, and in general, eastern Wyoming receives substantially more rain than western Wyoming (Wheatland averages close to twice as much precipitation during the growing season as Worland, for example). He recognized that 1 CFS/70 acres would only be an average, that his measurements were made at the field rather than at the stream, and furthermore, that climate varied, but the legislature adopted this suggestion statewide. See Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming," 105. For the original and current laws, see

Assuming a growing season of 125 days,⁴⁶⁵ one CFS continuously diverted for that period yields 248 acre-feet, or about 3.5 acre-feet per acre, assuming no canal seepage. This limit was later adjusted for two periods of right acquisition – those rights acquired before 1945 and those acquired from 1945 to 1985 have a right to divert two CFS.⁴⁶⁶ In times of shortage, although priority applies to the first CFS, the right to divert the second CFS is reduced proportionately and equally within the respective time group. For example, if all 1945-1985 users along a stream are able to divert one CFS but unable to divert two, then they all share the excess over one CFS. Users within the pre-1945 group are similar. However, pre-1945 users are entitled to two CFS before post 1945 owners get anything, just as 1945-1985 users are entitled to two CFS before post-1985 users are able to divert. Users diverting from a reservoir can divert from their stored water much faster than one CFS if they choose, but they may only fill their reservoir once a season, and when they do, they can only divert to storage their allotted rate (which is one or two CFS per 70 acres, depending on their priority), assuming they have priority during that time. Groundwater quantification does not exist. The State Engineer must approve all wells, but the main limits on the extraction quantity are the physical characteristics of the aquifer and the well.

Despite the heterogeneity of Wyoming users, the surface water standard applies to all rights with the exception of those acquired before statehood in 1890. The Board of Control was tasked with quantifying all pre-1890 rights,⁴⁶⁷ but the courts had final authority, and they were not limited to granting only one CFS per 70 acres. By 1922, all streams had been adjudicated,⁴⁶⁸ and although a disgruntled user that failed to claim their water right challenged the constitutionality of the new water law, the courts upheld the process.⁴⁶⁹

The uniform standard of 70 acres per CFS facilitates administration at the expense of flexibility for the water users. Instead of gathering information on crops, soils and weather, an irrigation right is based simply on acreage. The result is that acreage on file with the State Engineer is typically in excess of the acreage actually irrigated because some regions require more than one CFS per 70 acres.⁴⁷⁰ While the irrigated acreage may be recorded and monitored imprecisely, the surface water rights are not.

2.2 Quantification in California

Quantification in California is not nearly so straightforward despite the similarities in historical development. In 1872, the California legislature enacted the first state-wide statutes regulating appropriators, requiring users to post notice at the point of diversion and file a claim in the County Recorder's office with the intent of clarifying appropriators' priority dates.⁴⁷¹ However, it had the regrettable effect of encouraging inflated claims – Appropriators could claim a property right to a specific quantity of water, tacitly sanctioned by the state, and do so without

Wyoming, *Session Laws of Wyoming* (Cheyenne, 1890), chap. 8 section 25. And Wyoming, *Wyoming Statutes*, sec. 41-4-317.

⁴⁶⁵ Western Regional Climate Center, "CLIMATE OF WYOMING", June 2011, <http://www.wrcc.dri.edu/narratives/WYOMING.htm>.

⁴⁶⁶ Wyoming, *Wyoming Statutes*, sec. 41.4.320-330.

⁴⁶⁷ *Ibid.*, sec. 41-4-206.

⁴⁶⁸ M. Squillace, "One Hundred Years of Wyoming Water Law," *Land & Water L. Rev.* 26 (1991): 97.

⁴⁶⁹ *Farm Inv. Co. v. Carpenter* 9 Wyo. 110 (1900).

⁴⁷⁰ M. V McIntire, "Disparity between State Water Rights Records and Actual Water Use Patterns-I Wonder Where the Water Went, The," *Land & Water L. Rev.* 5 (1970): 27.

⁴⁷¹ W. R Attwater and J. Markle, "Overview of California Water Rights and Water Quality Law," *Pac. LJ* 19 (1987): 967.

examination of their claims.⁴⁷² “Paper water” was very easy to “divert” in California, and exaggerations abounded – diverters in the Honey Lake Valley in western California filed claims for enough water to “irrigate twice the land that is ever likely to be watered in the United States.”⁴⁷³ Claims to the Kings River amounted to 750,000 CFS and claims to the San Joaquin River added up to 914,286 CFS, despite that both rivers typically discharged less than 10,000 CFS.⁴⁷⁴

After 1913, users had to apply to the Water Commission for a permit, and the Commission could grant a license once the water had been put to beneficial use. These licenses stipulated a maximum diversion rate, a priority date and, if agricultural, acres to be irrigated. On the surface, it seemed that the Water Commission prevented speculation and ran a tight ship – based on applications received, they reported that for each 100 CFS applied for, permits to 14 CFS were granted (the rest were rejected). Of the 14 CFS permitted, 6 CFS actually were confirmed by a license as having been put to use and the other water right permits were revoked.⁴⁷⁵ The procedure was similar to Wyoming’s except that the California Water Commission granted flexibility to irrigators in determining how much water they needed rather than assigning them one CFS per 70 acres. The six oldest applications⁴⁷⁶ on file with the SWRCB have ratios of acreage to CFS ranging from 42 to 80. The other major difference was that Wyoming rights were adjudicated upon final confirmation, whereas in California, most never were.

Pre-1890 rights in Wyoming and pre-1914 and riparian rights in California illustrate an important contrast. The California Water Commission had the power to ascertain the relative rights (only appropriative rights⁴⁷⁷) of a stream system upon their own initiative,⁴⁷⁸ but *they never took the initiative*.⁴⁷⁹ Early on, their reticence to do so is not surprising – before the *Herminghaus* decision of 1928 and the subsequent constitutional amendment stipulating that reasonable use applies to all users, riparian users could claim entire river flows to flood irrigate their land. Those rights were impossible to quantify. After the amendment, however, riparian

⁴⁷² Mead, *Irrigation institutions*, 189.

⁴⁷³ *Ibid.*, 190.

⁴⁷⁴ *Ibid.*

⁴⁷⁵ Edward Hyatt, California, and California, *Report of Division of Water Resources for Governor’s Biennial Message*, 1929, 13.

⁴⁷⁶ SWRCB, “Water Right License”, n.d., pt. 211, 1986, 3165, 2762, 2871, <http://swrcb2.waterboards.ca.gov/ewrims/wrims-data/>. License 41 has a ratio of 12 acres/ (1/40) CFS, a ratio of 480, well outside the range of the other 5.

⁴⁷⁷ The Water Commission Act was amended in 1917 to stipulate that only appropriative rights were able to be determined by the Commission. See 1917 Statutes, Ch 153, § 25. Later in 1935, their scope was enlarged to include riparian rights (still not groundwater). See 1935 Statutes, Ch 647, § 25.

⁴⁷⁸ *Water Commission Act*, sec. 24.

⁴⁷⁹ They were stripped of the authority to adjudicate upon their own initiative in 1935 in SB 1085’s final revision, where the phrase “upon its own initiative” was deleted from the bill. See California, *Senate Bill 1085*, 1935. However, before this, annual reports listed completed adjudications, and they were all either listed as a court-referenced procedure or a request from a user – none were undertaken by the initiative of the Water Commission. See, for example, California Division of Water Rights, *Biennial report of the Division of Water Rights* (California State Printing Office, 1929). The bill also allowed the Water Commission to determine riparian rights, a power previously stripped in 1917. The change was likely inconsequential because the Division of Water Rights was reticent to appoint a watermaster without concrete promises from users to pay the watermaster’s salary, and doing so had hurt them before on the Carson River. See Pisani, “From the family farm to agribusiness,” 376.

rights were quantifiable,⁴⁸⁰ but the Board still refrained from actively quantifying previous rights.

Wyoming, on the other hand, did quantify its previous territorial rights by 1922, and two incentives likely played a large role. As mentioned above, the presence of riparian diverters in California complicated early adjudications. More importantly, Wyoming's irrigation laws occurred in 1890, when 64,555 people lived there,⁴⁸¹ 6/10 of a person per square mile. California at the time of the adoption of the Water Commission Act had closer to 15 people per square mile.⁴⁸² Wyoming in 1890 had 1,917 irrigators farming 229,676 acres of land,⁴⁸³ whereas California in 1910 had over 2,660,000 irrigated acres,⁴⁸⁴ ten times what Wyoming had when they attempted to regulate water rights. Changing the status quo was likely more difficult in California in 1913 – 500 water cases had reached the California Supreme Court since 1855, and users had been diverting water for over 60 years.⁴⁸⁵ Therefore, although the Water Commission Act of 1913 “probably went as far as possible by legislation to establish a complete and efficient code, however the simple fact was that a direct and efficacious solution was not possible in California, as it had been in the other Western States.”⁴⁸⁶

2.2.1 Statements of Diversion and Use

The Water Commission tried to remedy the difficulties of administering the water right system by eliminating unused riparian rights. Riparians were politically strong in the early 20th century,⁴⁸⁷ and the attempt to eliminate unused riparian rights “was never enforced and was eventually rejected by the court.”⁴⁸⁸ If they couldn't be eliminated, the next logical step was to quantify riparian and pre-1914 rights that did exist. In 1965,⁴⁸⁹ likely as a result of the newly constructed State Water Project, the legislature passed legislation requiring all surface water users to report their diversion quantities on a “Statement of Diversion and Use.”⁴⁹⁰ Post-1914 water rights holders already sent forms to Sacramento detailing their water use, so this new information was thought to complement the existing data on water use in the state.

⁴⁸⁰ Olson and Mahaney, “Searching for Certainty in a State of Flux,” 86. Riparian rights were adjudicated too – see, for example, William A Newsom, “Shady Creek Judgment: San Juan Ridge County Water District vs. Burt L. Burda, et al.” (Superior Court of California, Nevada County, August 16, 1977), http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/judgments/docs/shadycreek_jd.pdf. One user had a small riparian right, which was quantified and given a priority just like the other rights.

⁴⁸¹ U.S. Bureau of the Census, “HISTORICAL DECENNIAL CENSUS POPULATION FOR WYOMING COUNTIES, CITIES, AND TOWNS”, n.d., http://eadiv.state.wy.us/demog_data/pop2000/cntycity_hist.htm.

⁴⁸² United States, *Thirteenth Census of the U.S. Taken in the Year 1910* (Washington, n.d.).

⁴⁸³ United States, *Report on Agriculture by Irrigation in the Western Part of the United States at the Eleventh Census: 1890* (Washington: Govt. print. off, 1894), vii.

⁴⁸⁴ United States, *Fourteenth Census of the United States. State Compendium. California. Statistics of Population, Occupations, Agriculture, Irrigation, Drainage, Manufactures, and Mines and Quarries for the State, Counties, and Cities* (Washington: Govt. Print. Off, 1924), vol. 7, pg 130.

⁴⁸⁵ Edward Hyatt, “Review of Work of Division of Water Rights”, February 1924, 1, Folder No. 1, Edward Hyatt Collection, CA Water Resources Center Archive.

⁴⁸⁶ *Ibid.*, 2.

⁴⁸⁷ Miller, “Riparian Rights and the Control of Water in California, 1879-1928,” 14; Pisani, “Water Law Reform in California,” 317.

⁴⁸⁸ Miller, “Riparian Rights and the Control of Water in California, 1879-1928,” 12-14.

⁴⁸⁹ There was nothing explicit in the bills to restrict riparians as was the case in 1913, but the idea may have been to require reporting first, then pinch back, as Oregon was successful in doing to its riparian users.

⁴⁹⁰ The mandate was weakened two years later by allowing exemptions for areas covered by DWR's hydrologic data bulletins. At the time, the intent was to eliminate duplicitous work.

Regrettably, this new data was not useful and did not enable quantification. Compliance variability is partly to blame – currently, for post-1914 water rights, 68% comply and send in their Progress Reports or Licensee Reports.⁴⁹¹ For pre-1914 and riparian rights holders, only 35% send in Statements of Diversion and Use, 65% of which provide inadequate information.⁴⁹² Until recently, there were no penalties for refraining.⁴⁹³ Upon personal inspection of large users within the Central Valley, most diverters, both pre-1914 and post-1914 sent in data. However, the quality of this data varies. Some users report that they diverted water, but do not offer detailed diversion numbers while others record precise monthly diversions. Some users do not have adequate measuring devices and report acreage irrigated instead. Still, water users are more compliant today than they were 30 years ago, when only 10-15% of riparian and pre-1914 rights holders complied with the law and filed a Statement of Diversion and Use.⁴⁹⁴ Compliance seems to be slowly improving as well, and from 1999-2003, 480 new Statements of Diversion and Use were filed,⁴⁹⁵ gradually inching towards the goal of 100% reporting compliance. Regardless, “the information received is, for the most part, inaccurate.”⁴⁹⁶

2.2.2 Adjudicated Water Systems in California

Much of the contrast in quantification between California and Wyoming arises because Wyoming water rights are adjudicated, and most of California’s are not. Unlike Wyoming, water rights are not adjudicated as a matter of course. If a California water user wishes to have a stream system or groundwater basin adjudicated, they may either bring suit to determine water rights in court, or they may request that the SWRCB determine the rights to the stream system (the statutory procedure).⁴⁹⁷ If they bring suit to determine their water rights, the court may voluntarily refer the proceeding to the SWRCB.⁴⁹⁸ The court-reference procedure is the only method available to determine rights to groundwater. The statutory procedure can only address groundwater that is part of a subterranean stream unless the legislature specifically authorizes groundwater jurisdiction, as they did for the Scott River in Siskiyou County.⁴⁹⁹

It is difficult to determine how many streams and basins are adjudicated because the SWRCB is not always involved. The SWRCB has been involved in 92 water systems in California, most of these small surface streams in the northern half of the state. 13 of those streams do not have a final decree.⁵⁰⁰ A subset of these 92 is either incomplete or lacks a final decree stipulating water rights. Of the 92, 28 stream systems were adjudicated upon petition of one of the water users (the statutory procedure) and 64 came to the SWRCB by way of court

⁴⁹¹ SWRCB, ed., “SWRCB response to Delta Vision” (SWRCB, June 12, 2008).

⁴⁹² *Informational Hearing: Overview of CA Water Rights Laws* (Sacramento Capitol Building, Rm 112, 2009).

⁴⁹³ Water Code § 5105 allows the SWRCB to obtain the diversion numbers itself at the owner’s expense if the diverter fails to turn in a form, but apparently, the SWRCB has never exercised this authority (Rich). They also may fine users for willful misstatements on the forms, but have never done so.

⁴⁹⁴ Governor’s Commission to Review California Water Rights Law., *Governor’s commission to review California water rights law*. Page 18

⁴⁹⁵ Olson and Mahaney, “Searching for Certainty in a State of Flux,” 80.

⁴⁹⁶ Marybelle Archibald and Governor’s Commission to Review California Water Rights Law., *Staff memoranda*, 1977, 3 v3.

⁴⁹⁷ *California Water Code*, sec. 2000/2500.

⁴⁹⁸ Hutchins, *Water rights laws in the nineteen Western States*, vol. 2, pg 468.

⁴⁹⁹ *California Water Code*, sec. 2500.5.

⁵⁰⁰ 10 others appear to have a decree, but it is not published online. See SWRCB, “Water Rights Judgments/Determinations.”

reference. 6 of the 64 court initiated adjudications are for groundwater basins. The California Department of Water Resources publishes a complete list of adjudicated groundwater basins, and there are an additional 16 groundwater basins that have been adjudicated in the courts.⁵⁰¹ In these 16 cases, the court did not elect to use the SWRCB as a referee.

Tracking surface adjudications is more difficult – if a water user brings suit to determine water rights, only the parties named in the suit will have their rights determined. Neither the court, nor the SWRCB if the court refers the case to them, can expand the jurisdiction to include other parties. Therefore, while there are at least 86 complete surface adjudications, there are other streams that have been mostly adjudicated but that did not involve the SWRCB. Major parties along the Kern River, for example, had their water rights determined by the Miller-Haggin Agreement in 1886 and then the Shaw Decree in 1900, named for the judge that decided the case. However, although the parties involved were the major water users, they were not the only users, and while they may act as if they have exclusive control of the river, they do not.⁵⁰² The Kings River is similar – users went through more than 100 lawsuits in the decades before the parties agreed to a diversion schedule in 1927. The nearby Tule is another stream without a complete adjudication, governed by three major lawsuits which adjudicate different water rights but do not address the entire stream.⁵⁰³ The Kaweah River is similarly governed.⁵⁰⁴ In these latter cases, the courts shaped, but were not directly involved in, the final negotiated settlement.

Although there are 86 surface streams that the SWRCB lists as fully adjudicated, there are still discrepancies with these streams. Adjudications completed before 1935 did not have authority to address riparian rights,⁵⁰⁵ and decisions before the 1952 McCarran amendment, which allowed state law to adjudicate federal water right claims, did not have the authority to address federal water rights (e.g. Indian reserved rights).⁵⁰⁶ In addition, many of these adjudications are old and not as precise today as their decree might indicate.⁵⁰⁷

2.2.3 Flexibility within Adjudicated Basins

Among statutory or court-initiated adjudications, the resulting decree typically specifies all rights and assigns each right to a priority class, within which all rights are correlative. The court decrees also stipulate the specific plots of land where each user's rights attach, making

⁵⁰¹ CA DWR, "Adjudicated Ground Water Basins in California", 2004, http://www.water.ca.gov/pubs/conservation/waterfacts/adjudicated_ground_water_basins_in_california__water_facts_3_/water_facts_3.pdf.

⁵⁰² Andy Sawyer describes these adjudications as "voodoo adjudications." Andy Sawyer, "Interview with Andy Sawyer, Asst. Chief Counsel with the SWRCB", May 27, 2011.

⁵⁰³ California Department of Water Resources, *Land and Water Use in Tule River Hydrographic Unit* (Sacramento, 1964), 21.

⁵⁰⁴ California et al., *Kaweah River Flows, Diversions and Service Areas 1939-1949* (Sacramento: Dept. of Public Works, Division of Water Resources, n.d.), 18.

⁵⁰⁵ Article X, Section 2 in 1928 was important in checking the uncertainty of riparian rights in a statutory adjudication. See Olson and Mahaney, "Searching for Certainty in a State of Flux," 86. For an earlier example of a decree where this is a problem, see California Division of Water Resources, *Shasta River adjudication proceeding: judgment and decree in the matter of the determination of the relative rights, based upon prior appropriation, of the various claimants to the waters of Shasta* ([Sacramento: California State Print. Office], 1932).

⁵⁰⁶ A. Goldsby, "THE MCCARRAN AMENDMENT AND GROUNDWATER: WHY WASHINGTON STATE SHOULD REQUIRE INCLUSION OF GROUNDWATER IN GENERAL STREAM ADJUDICATIONS INVOLVING FEDERAL RESERVED WATER RIGHTS," *Wash. L. Rev.* 86 (2011): 186.

⁵⁰⁷ California, *Summary of Operations for Watermaster Service in Northern California ... Season* (Red Bluff, CA: The District, 1986), no. 1998, p 7.

transfers among users difficult. Farmers are typically allowed to rotate water among themselves to improve flexibility and make very short-term exchanges, but there are no transfers occurring within these river systems between farmers as the decrees prevent that.⁵⁰⁸ Court decrees are certainly amendable to change the place of use of a water right, but the watermasters in northern California, with most of the adjudicated surface streams, indicate that it is infrequent.

Streams without court decrees may have more flexibility in transferring water, but it depends on the associated agreement. Unlike court-decreed streams, negotiated adjudications typically seem to allow, at a minimum, transferability within the region. For example, the Miller-Haggin agreement for the Kern River specifically allows water “to be used and disposed of ... in any manner, at any place and for any purpose they (the right holder) may think proper.”⁵⁰⁹ The Kings River Agreement, however, limits the place of use to the Kings River area only – no water may be moved outside of the region.⁵¹⁰

2.2.4 Adjudicated Quantities

Irrigated agriculture covers close to 8,000,000 acres in California. Most water right licenses from the SWRCB and adjudicated rights grant one cubic foot per second of water flow per 40 to 80 acres for irrigation during the growing season. Therefore, the aggregate true water right quantity based on 8,000,000 acres is likely between 100,000 CFS and 200,000 CFS. Groundwater extractions average close to a third of applied water in California (for both urban and agricultural use), so if we assume that this percentage also applies to agriculture, then irrigated agriculture has surface rights to between 70,000 CFS and 140,000 CFS. Of this amount, approximately 8,400 are adjudicated rights covering 700,000 acres. This does not include the additional 4,500 CFS of adjudicated rights in the large Kern/Kings/Kaweah/Tule river area.

2.2.5 Face Value and Water Right Quantities

The SWRCB’s calculation of the face value of a water right provides additional evidence for the lack of water right clarity in California. In 2003, the legislature instructed the SWRCB to recoup its operating costs from water rights holders. In order to determine how much each user should pay, ideally they would allocate costs based on individual water right quantities. Instead, the SWRCB estimated the “face value” of each water right, once again showing that they have no realistic idea of the quantities associated with each appropriative right. The SWRCB defines face value as follows:

⁵⁰⁸ Conversation with Scott River Watermaster, former Pit River watermaster and Shawn Pike, DWR Chief of Watermasters. Essentially, one farmer leaving the water in the river means that the next in line gets it, and the watermaster’s responsibility is to enforce priority order. The exception to this is the Scott River Water Trust’s recent utilization of Water Code § 1707 which allowed them to change the purpose of use of their purchased water rights to boost summer fish flows. These were relatively small transfers. See Smith, *Water Strategist*, no. Feb 2010.

⁵⁰⁹ Miller, *Contract and agreement between Henry Miller and others of the first part, and James B. Haggin, and others of the second part.*, 10. The Shaw Decree of 1900 clarified the upstream rights, but does not seem to restrict transferability: “That the right of each...to divert and appropriate said waters includes the right to use the same and furnish the same to others to be used.” Lucien Shaw, “Shaw Decree” (Superior Court of Kern County, August 6, 1900), 10.

⁵¹⁰ Richard M. Moss, “Friant Division Contractor Predicted Response and Ability to Mitigate Anticipated Water Shortages as a Result of San Joaquin River Fishery Restoration Flows”, August 22, 2005, 27, NRDC, et al vs. Rodgers, et al. Case No. CIV-S-88-1658-LKKIGGH.

“The face value of a permit or license is the amount that could be diverted if diversions occurred at the maximum amount authorized under the permit or license during the entire period when the permit or license authorizes diversion, without regard to bypass conditions or other constraints that have the practical effect of limiting diversions without expressly imposing a maximum amount of diversion. (Cal. Code Regs., tit. 23, § 1066, subd. (b). Numerous factors result in the face value of permits vastly exceeding the amount that is available for appropriation. These include, but are not limited to, multiple permits and licenses for repeated diversion and re-diversion of the same water before it is delivered to its ultimate destination, return flows from conveyance losses or after use (including non-consumptive uses), and permit and license conditions such as bypass requirements and Term 91 that limit diversions but do not reduce face value. Face value also includes large amounts authorized to be diverted to storage, even though the circumstances when there is both sufficient unappropriated water available to divert the full amount authorized and the permitted or licensed project has the storage capacity to capture it all may occur rarely, perhaps only once when the reservoir is first filled. The authorization to divert the face value amount is a benefit to the water right holder, as it provides both flexibility and the ability to divert in times of abundant supply for use in times of shortage. *The face value of permits and licenses, however, is not a good measure of amounts likely to be used or the availability of unappropriated water.*” (emphasis added)⁵¹¹

To reiterate this point, the total face value of all post 1914 water rights is close to 320,000,000 acre-feet.⁵¹² The total face value of all pre-1914 appropriative rights and riparian rights is 211,430,956, although this is an estimate.⁵¹³ The combined amount is far in excess of the current applied use of around 42 million acre-feet.⁵¹⁴⁵¹⁵

In conclusion, California water rights are not well quantified, despite what the paper water right may say. California officials understood this, and attempted to remedy it by gathering information on users, but they were never given substantive enforcement power over this provision, and the end result is that the State Water Board’s office in Sacramento has years of water right diversion data, most of it worthless for administering water rights. This is different from Wyoming, and it has consequences.

⁵¹¹ “State Water Resources Control Board - Board Meeting Session - Division of Water Rights - March 1, 2011 - Item 10”, March 2011, 8, http://www.waterboards.ca.gov/board_info/agendas/2011/mar/030111_10.pdf.

⁵¹² SWRCB, “eWRIMS Water Rights Search - California Integrated Water Quality System,” *eWRIMS*, n.d., http://ciwqs.waterboards.ca.gov/ciwqs/ewrims/EWServlet?Redirect_Page=EWWaterRightPublicSearch.jsp&Purpose=getEWAppSearchPage.

⁵¹³ *CALIFORNIA FARM BUREAU v. CALIFORNIA STATE WATER RESOURCES CONTROL BOARD*. No. C050289 Appendix (Court of Appeal, 3rd District 2007).

⁵¹⁴ The SWRCB bills users for the entire face value amount, but only expects to collect 60% of the fees, See SWRCB, “In the Matter of the Petition for Reconsideration of PALO VERDE IRRIGATION DISTRICT Regarding Water Right Fee Determinations”, 2004, 9, http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/.

⁵¹⁵ The SWRCB began recently to accept diversion numbers electronically, and among rights with a face-value of less than 10,000 acre-feet, the amounts diverted averaged 25% of the face value of the water right. This figure only includes the 1,377 diverters that actually submitted this information in 2009. SWRCB and Bob Rinker, Fee & Data Management Manager, “2009 Summary Report of Electronic Diversion Data”, 2010.

2.3 Priority in Wyoming

Wyoming's 1875 water right legislation, as mentioned earlier, gave some stream regulation power to water commissioners and directed them to allocate stream flow by rotation.⁵¹⁶ However, they could not impair prior vested rights, and were tasked with rotating the water only among *interested* parties, not those that didn't request it.⁵¹⁷ Wyoming's 1886 territorial irrigation law provided for more stream regulation and adherence to the prior appropriation doctrine, although the legislation specifically required that users request stream regulation in writing – water commissioners were still not supposed to regulate if they weren't wanted.⁵¹⁸

Although today, Wyoming measures and monitors nearly all drainages in the state,⁵¹⁹ this state of affairs did not occur immediately upon the passage of statehood irrigation laws. As of 1914, the Wyoming State Engineer commented that “At least two-thirds of the water used in Wyoming is not measured out to the consumer, and scarcely any is measured at all accurately.”⁵²⁰ Not until the 1960's was it possible to properly administer priority on the major rivers outside of Division 1, the more populated south-east corner of the state.⁵²¹ Other divisions couldn't afford hydrographers, and financial constraints restricted staff levels until all Water Division employees became state employees in 1991.⁵²²

Every water right and well in Wyoming has a priority date, including all rights acquired before 1890. Priority dates are based on actual use before 1890, and based on application date for post-1890 water rights. Because priority regulation only occurs upon request, in many years of plenty, no enforcement is needed and the system works without regulation. In other years, however, enforcement and stream regulation may occur daily. If a senior user believes they are entitled to water, and are not getting their share, they can file a formal written request⁵²³ for regulation of the stream, and water division staff will respond immediately – from 2003 until 2009, more than 96% of calls for stream regulation received a response within two days.⁵²⁴ Facilitating this enforcement action is the fact that it is the duty of the superintendents of the different water divisions to monitor and control headgates, and Wyoming actually places enforcement personnel on the ground throughout the state.⁵²⁵

Thus the story of Wyoming is one of a strong administrative system put in place in 1890, but one that existed only on paper for many regions of the state. For lack of money, or for lack scarcity, much of the state's water users regulated themselves, and only more recently did they have strong enforcement on the ground. Still, if users are not behaving according to their water rights, and no one complains, the Board of Control does not actively antagonize these users.

⁵¹⁶ Mead, *Irrigation institutions*, 248.

⁵¹⁷ Craig Cooper, “History of Water Law, Water Rights & Water Development in Wyoming,” 108.

⁵¹⁸ *Ibid.*, 109.

⁵¹⁹ *Ibid.*, 111.

⁵²⁰ *Ibid.*, 110.

⁵²¹ *Ibid.*

⁵²² *Ibid.*, 111.

⁵²³ Wyoming, *Wyoming Statutes*, sec. 41–3–606.

⁵²⁴ PATRICK T. TYRRELL, STATE ENGINEER, “STRATEGIC PLAN FOR THE WYOMING STATE ENGINEER'S OFFICE AND WYOMING STATE BOARD OF CONTROL PLANNING PERIOD: JULY 1, 2010 TO JUNE, 30, 2014”, August 13, 2009, 14, http://seo.state.wy.us/PDF/Strategic_Plan_2009.pdf.

⁵²⁵ Wyoming, *Wyoming Statutes*, sec. 41–3–603/4.

2.4 Priority in California

California has a somewhat similar outcome to Wyoming, but for different reasons. California does not have real-time stream regulation outside of adjudicated areas.⁵²⁶ Users that file for appropriative rights in California receive an application number based on the order received. This application number dictates priority, implying that during shortages, senior water rights holders receive their full water right before junior users take a drop. Unlike Wyoming, the SWRCB does not have the ability to enforce priority among many different classes of rights. For example, they state on their website:

The State Water Board has jurisdiction over waste and unreasonable use of water and potential impact to public trust resources of the State, regardless of the type of water right being exercised. However, the State Water Board does not have resources to investigate complaints where the parties appear to have valid but competing percolating groundwater, riparian, and/or pre-1914 appropriative claims of right. Disputes involving this type of situation should be resolved by a court.⁵²⁷

Therefore, if both rights are not post-1914 appropriative rights, the courts are the only option for resolution if the parties cannot resolve it themselves. If both rights are post-1914 rights, then if the location is a high-priority area, or if resources warrant it, the SWRCB sends out a letter detailing the complaint to the parties, asking for a response. Typically, it takes two to three months from the initial complaint to get all the responses back. If this does not resolve the dispute, the SWRCB can send out a field inspector⁵²⁸ to collect information and file a report, and can make a conclusion about who has the better right. 70% to 80% of the complaints typically result in a field inspection. The Complaints Division has a goal of 9 months for resolution, but some cases can take years.⁵²⁹ Compared to Wyoming, most users in California do not have anything like Wyoming's active stream regulation, but interestingly, in each place, if users are not complaining, the outcome on the ground is substantively the same.

The big difference between the states occurs when a user does complain, and California's ineffective method of enforcement was not what the proponents of water law reform had in mind when they passed the Water Commission Act,⁵³⁰ but the flaws were evident from the beginning as the following example illustrates.

⁵²⁶ SWRCB, *Water Right Decision 1594*, 27.

⁵²⁷ SWRCB, "Water Rights - Frequently Asked Questions", n.d., http://www.waterboards.ca.gov/waterrights/board_info/faqs.shtml.

⁵²⁸ The SWRCB has 25 staff in the "Enforcement" division and 25 in the "Permitting and Licensing" division. Wyoming, by contrast, has 58 people spread across 4 divisions, and besides a superintendent and assistant superintendent at each division, the rest (e.g. Hydrographer-Commissioners, Water Commissioners, Inspectors) are field personnel. See SWRCB, "Organization Units: Cal/EPA Agencywide Staff Directory," *Water/Regional Water Board Staff Directory*, June 2011,

<http://www.calepa.ca.gov/staffdirectory/org.asp?BDO=7&TIER1=SWRCB&TIER2=DWR>; "Wyoming Water Divisions", June 2011, <http://seo.state.wy.us/divisions.aspx>.

⁵²⁹ This information is courtesy of two employees within the Division of Water Rights, Chuck Rich, and Rich Satkowski. Chuck Rich, "Phone Conversation with Chuck Rich, SWRCB, Division of Water Rights, Complaints Division", August 7, 2006; Rich Satkowski, "Phone Conversation with Rich Satkowski, SWRCB Division of Water Rights Licensing Enforcement.", May 6, 2011.

⁵³⁰ Edward Hyatt and California, "Water Commission Act of California Affords Only Water Problem Solution Ever Proven Satisfactory", 1924, 2, 10-2; Elwood Mead, *Helping Men Own Farms; a Practical Discussion of Government Aid in Land Settlement* (New York: The Macmillan company, 1920), 112.

2.4.1 Sacramento Diverters and shortages in the 1920s

During the first dry period after the imposition of the Water Commission Act, a casual observer could easily make the claim that California water rights were exclusively riparian based on the outcome. After 1913, there were four wet and one above normal water year based on the Sacramento Rainfall Index.⁵³¹ 1920 was the first critically dry year in California after the 1914 Act took effect (see Figure 22 - Sacramento Runoff, 1906-1930), and therefore provides a window into the efficacy of the new legislation.

Insert Figure 22 - Sacramento Runoff, 1906-1930

World War I increased prices for a 100 pound sack of rice from \$2.02 in 1912 to \$5.93 in 1919.⁵³² Rice acreage increased as a result in the Sacramento Valley, leaping from 100 acres planted in 1910 to 154,700 acres planted in 1920,⁵³³ an important trend given that farmers typically applied anywhere between 4 to 11 acre-feet of water per acre on rice fields.⁵³⁴

Insert Figure 23- Increasing Rice Acreage, 1910-1920

Rainfall in winter 1919-1920 was very low, and because of growing rice acreage, users were worried that there would be insufficient water downstream. The flow in July north of Sacramento at Knights Landing was 100 CFS in late July, well below the normal 1,600 CFS normally expected at that time of year.⁵³⁵ In 1920, the Office of the State Water Commission sent two letters in early February to diverters along the Sacramento River, indicating the gravity of the situation, and explaining that junior water rights may be cut back in the event of a shortage.⁵³⁶ They expected rights held with a priority date prior to September 1st, 1918 would be unaffected. They implored rice growers to reduce plantings, or else face the probability of planting and then not having water during the late growing season. To flesh out these details, top officials and water users organized the Emergency Water Conservation Conference February 20th, 1920.

Although the State Water Commission had enough information regarding water use and crop acreage to make a crude prediction, they had nowhere near enough information to rely on appropriative right priorities to allocate water. I think it useful to present the State Water Commission's description of the events leading up to the Conference:

The absence of any determination of the relative rights of claimants to divert water from the Sacramento River made a very difficult situation. The sum total of the proposed diversions for irrigation greatly exceeded the probable supply of the river during the summer. It was a difficult problem to determine who should give up planting to reduce the total water requirements to a figure commensurate with the probable supply in the river. Unless some acreage should be given up, it appeared that there might not only be

⁵³¹ CA DWR, "Water Year Hydrologic Classification Indices."

⁵³² W. Turrentine Jackson, *The Sacramento-San Joaquin Delta: The Evolution and Implementation of Water Policy: An Historical Perspective* (Davis, CA: California Water Resources Center, University of California, 1977), 2.

⁵³³ CA State Water Commission, *Third Biennial Report of the State Water Commission of CA* (Sacramento: F. W. Richardson, Superintendent of State Printing [etc.], 1921), 71.

⁵³⁴ *Ibid.*, 73.

⁵³⁵ Sacramento-San Joaquin River Problems Conference, Sacramento Chamber of Commerce, and California, *Proceedings of the Sacramento River Problems Conference*, 163.

⁵³⁶ California, *Notice to Water Users from the Sacramento River System*.

large losses of crops from lack of water, but that costly and protracted litigation involving the conflicting claims of rival diverters might be precipitated and spread a cloud over the development of irrigation in the Sacramento Valley for years to come. The question as to who should reduce their contemplated rice plantings could not be answered without a determination of the relative rights to the use of the river water. *This being a most intricate task on a stream as large as the Sacramento River and one which would require considerable time for making surveys and investigations and filing claims, no hope could be entertained for its accomplishment in time to be of use in the present season* (emphasis added).⁵³⁷

This statement makes clear that all appropriative rights along the Sacramento River are at best vaguely quantified. Therefore, instead of relying on the water rights in place, users organized and appointed a water supervisor to monitor the river after congregating February 20th. Several large diverters signed an agreement placing their rights in complete control of the supervisor.⁵³⁸ These diverters represented 70% of the irrigated area in the valley.⁵³⁹ Other diverters along the river not initially party to the agreement would later essentially follow suit.⁵⁴⁰ Approximately 50,000 acres were withheld from planting,⁵⁴¹ and in addition, water users were able to use their water more effectively. It was claimed that users achieved a 24% reduction in water use compared to 1919 during the most critical ten days of the season, and this occurred without damage to crops.⁵⁴² Essentially, users shared the resource and the shortages, exactly what the riparian doctrine prescribes.

Dry conditions returned to the region in 1924 with a similar outcome. Users convened a River Problems Conference in Sacramento on January 24th and 25th, 1924, and agreed to pay a water supervisor to measure and monitor the Sacramento River. Funds for the supervisor came from a \$.05 per acre fee from the participants.⁵⁴³ As the agreement says, the water supervisor would rely on *voluntary cooperation* because “the Water Supervisor had no legal authority based upon adjudicated water rights to shut down diversions or distribute water.”⁵⁴⁴ To that end, the Committee of the River Problems Conference sent letters to duck and gun clubs asking them to defer filling ponds until September 15th, among other things.⁵⁴⁵ In addition, they called a second meeting July 19, 1924. In that letter, the Chairman of the Committee of the River Problems Conference called for three things in order to save 37,000 acres of upstream delta crops worth \$5,180,000: 1) a discontinuation of pasture and uncultivated area irrigation, 2) a reduction in water used for rice cultivation and 3) the reduction in water for alfalfa production.

The effects of the 1924 dry period were likely less severe than the 1920 period due to the experience gained earlier as well as the increased prevalence of groundwater. Land irrigated

⁵³⁷ CA State Water Commission, *Third Biennial Report of the State Water Commission of CA*, 153.

⁵³⁸ California Public Utilities Commission, *Annual report*, 1920, 77.

⁵³⁹ CA State Water Commission, *Third Biennial Report of the State Water Commission of CA*, 153.

⁵⁴⁰ Sacramento-San Joaquin River Problems Conference, Sacramento Chamber of Commerce, and California, *Proceedings of the Sacramento River Problems Conference*, 165.

⁵⁴¹ CA State Water Commission, *Third Biennial Report of the State Water Commission of CA*, 51.

⁵⁴² Sacramento-San Joaquin River Problems Conference, Sacramento Chamber of Commerce, and California, *Proceedings of the Sacramento River Problems Conference*, 164.

⁵⁴³ Sacramento-San Joaquin River Problems Conference, *Proceedings of the 2d Sacramento-San Joaquin River Problems Conference, and Water Supervisor's Report, 1924* (Sacramento: California State Print. Off, 1924), 228.

⁵⁴⁴ *Ibid.*, 224.

⁵⁴⁵ *Ibid.*, 233.

with groundwater increased from near 200,000 acres in 1909 to well over 800,000 acres in 1919⁵⁴⁶ to over 1.45 million acres in 1929.⁵⁴⁷ Furthermore, 287,136 acres in 1929 and 355,447 acres in 1929 received supplemental supplies from the ground, mitigating the damaging impacts resulting from severe drought.⁵⁴⁸ This was a large increase from 1919, when only about 90,000 acres had both a surface and an underground supply.⁵⁴⁹⁵⁵⁰ These early dry episodes reveal how California users and water managers approached droughts early in the 20th century, and surprisingly little has changed.

2.4.2 Term 80 and Term 91

In light of this lack of water right information, but primarily as a result of water quality concerns for the Sacramento-San Joaquin Delta, the SWRCB began to develop a crude method of priority enforcement for non-adjudicated areas using terms inserted into water right permits. In 1965, the State Water Board inserted Term 80⁵⁵¹ into all permits issued in the Sacramento-San Joaquin Delta.⁵⁵² Term 80 stipulated that the SWRCB could alter the season of diversion stated in the water right permit, with the expectation that better water right information in the future would lead to restrictions on late summer diversions.

In 1978, the SWRCB adopted Water Right Decision 1485, requiring the State Water Project and Central Valley Project to meet water quality standards in the Delta. Essentially, this decision meant that all diverters in the watershed could divert with impunity, but if the flows in the delta were below certain levels, the two largest diverters – the CVP and SWP – had to release extra water from their reservoirs to ensure the standards were met. The large water projects thus had a strong interest in releasing just what was absolutely necessary, and so began to protest many new water right applications for diversions within the Delta watershed because the SWRCB still did not have enough information to identify summer diversion seasons.⁵⁵³ As a temporary fix,⁵⁵⁴ the USBR agreed not to protest new water right applications if the SWRCB included Term 91 into all new water right permits issued after August 16, 1978⁵⁵⁵ within the Delta watershed. Term 91 disallowed diversions when the SWP and CVP were releasing water

⁵⁴⁶ United States, *Fourteenth Census of the United States: Irrigation 1919 and 1920*, United States (Washington: G.P.O., 1922), 130.

⁵⁴⁷ United States, *Fifteenth Census of the United States: 1930: Irrigation of Agricultural Lands: General Reports and Analytical Tables, Reports by States for Counties, and a Summary for the United States* (Washington: U.S. GPO, 1932), 86.

⁵⁴⁸ United States, *16th Census of the United States, 1940. Land in Drainage Enterprises, Capital Invested and Drainage Works with Statistics for Counties* (Washington, D.C: U.S. Govt. Print. Off, 1942), 133.

⁵⁴⁹ United States, *Fourteenth Census of the United States*, 130.

⁵⁵⁰ Voluntary reductions and cooperation lessened impacts, but not all downstream diverters were happy with the outcome, especially the city of Antioch, located at the junction of the San Francisco Bay and the confluence of the Sacramento and San Joaquin Rivers. With the financial help of other Delta interests, Antioch filed suit on July 2, 1920 against upstream irrigators, asserting its right to salt-free water for municipal use. By the end of the season, they were joined with many other users, and won a temporary injunction in early 1921. The Supreme Court overturned the ruling in March of 1922, much to the pleasure of the Sacramento Valley interests. See Jackson, *The Sacramento-San Joaquin Delta*, 6. and *Town of Antioch v. Williams Irrigation District*.

⁵⁵¹ Permits issued by the SWRCB have certain conditions that all permittees must follow, but over the years, the SWRCB also may include specific terms unique to a particular region or water right holder. This reservation of jurisdiction was labeled term 80, following a loose numerical order.

⁵⁵² SWRCB, *Water Right Decision 1594*, 1.

⁵⁵³ *Ibid.*, 8.

⁵⁵⁴ *Ibid.*, 9.

⁵⁵⁵ *Ibid.*, 8.

to satisfy Delta water quality standards under the assumption that if the large projects were releasing extra water to repel salt in the Delta, junior water rights shouldn't be able to divert.⁵⁵⁶ To enforce this provision, the SWRCB sends letters to all water right holders with Term 91 before the expected curtailment period, averaging 71 days and typically ending in August.⁵⁵⁷ Term 91 is thus an outgrowth of Term 80, which allowed diversion season adjustments, and it eventually was applied to all Term 80 water rights – i.e. post-1965 consumptive water rights that were hydraulically connected to the Delta and above one CFS or 100 acre-feet in storage.⁵⁵⁸ This crude method of priority enforcement was a first step in doing *something*. “Until the adoption of Term 91...the SWRCB made no general effort to regulate water users’ season of diversion on a real-time basis.”⁵⁵⁹

Term 91 was a conservative approach – in many years, unappropriated water likely exists in the late summer months when the SWRCB activates the restriction. Therefore, it was only meant to be temporary until the SWRCB completed a full water-availability analysis. The SWRCB held hearings and technical sessions between 1981 and 1983 to pursue this goal.⁵⁶⁰ The end result was quite telling:

“Staff had originally proposed a comprehensive analysis of water supply and demand which attempted to identify and quantify water usage by all diverters below the foothill reservoirs within the Delta watershed. This approach was discontinued due to the lack of adequate data for factors such as return flow, groundwater accretions, unmeasured tributary inflow, riparian use, appropriative use, and Delta consumptive use.”⁵⁶¹

In other words, the SWRCB, despite collection of Progress Reports, reports of licensees and Statements of Diversion and Use, and despite knowing it did not have this information since at least 1920, still has little information that can *actually be used to administer water rights*. Term 91 is still in operation today, having been invoked to curtail summer diversions in all but four years from 1984 until 2010.

Despite its resemblance to a system of priority enforcement, enforcement is not immediate⁵⁶² nor does Term 91 affect a large portion of existing water rights. There are 12,859

⁵⁵⁶ The junior users were still given priority by way of the Area of Origin statutes. See *Ibid.*, 45–46.

⁵⁵⁷ SWRCB, “Implementing Standard Terms 91 and 93 for the Sacramento-San Joaquin River Delta Watershed”, 2006, http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/licensing/index.shtml#lic4. For curtailment dates, see SWRCB, “Water Diversion Curtailment Dates”, November 10, 2008. Also, see CITY OF DAVIS / CITY OF WOODLAND: WATER RIGHTS APPLICATIONS HEARING, “Number of Term 91 Days 1984-2010 - Exhibit WDCWA-15”, 2010, http://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/daviswoodland/daviswoodland_wdcwa_15.pdf.

⁵⁵⁸ SWRCB, *Water Right Decision 1594*, 27; George Gould, “California,” *Water Law Newsletter* 39, no. 3 (2006): 4, www.rmmlf.org/pubs/waterlaw/WLN%202006-3.pdf.

⁵⁵⁹ SWRCB, *Water Right Decision 1594*, 25.

⁵⁶⁰ *Ibid.*, 9.

⁵⁶¹ *Ibid.*

⁵⁶² During 2000 and 2001, three diverters in the Delta were found to be diverting during a term 91 curtailment period. They were issued a notice of Administrative Civil Liability in 2002, and ordered to pay in 2004. See SWRCB, “In the Matter of Administrative Civil Liability Complaints for Violations of Licenses 13444 and 13274 of Lloyd L. Phelps, Jr.; License 13194 of Joey P. Ratto, Jr.; License 13315 of Ronald D. Conn and Ron Silva, et al.”, 2004, 21, http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/2004/wro2004_0004.pdf. They did pay, and no longer divert during curtailment periods. John Herrick, “Phone Conversation with John Herrick, Attorney for South Delta Water Agency”, May 9, 2011.

active appropriative rights in California.⁵⁶³ 3,186 have been issued between August 16th, 1978 and 2006,⁵⁶⁴ 1,584 of which are in counties within the broad Delta watershed. However, only 129 permits and licenses have Term 91, and 104 have Term 93, a similar term for users within the San Joaquin River watershed.⁵⁶⁵

2.4.3 Priority within Adjudicated Streams

The discussion above details how priority enforcement “works” on most major streams in California, but adjudicated streams have priority details worth noting. Generally speaking, the larger streams in California are not adjudicated. The following shows a crude map of adjudicated Californian streams.

Insert Figure 24 – Adjudicated Streams (bold) in California

The Kings River is an exception, having quantified its water rights by voluntary agreement. In 1920, Kings River water irrigated more acreage than any other single stream in the state.⁵⁶⁶ 29 principal canals irrigated close to 550,000 acres, but the diversity also led to numerous lawsuits.⁵⁶⁷ Kings River diverters sued each other 137 times from 1876 until 1921 but made little progress on overall water right agreement.⁵⁶⁸ The parties finally agreed to a preliminary diversion schedule in the 1920s, and cemented this agreement in 1949.⁵⁶⁹ According to the 1926 schedule, when the Kings River discharge is less than 1,900 CFS, four groups had complete control of the resource – Fresno, Kings County Canals, Laguna and Murphy Slough. If the river were just a trickle at 200 CFS, the same four organizations still split the entitlement. It was split unequally, but between 200 CFS and 1,900 CFS, the groups shared the gain with increasing flows, and they shared the pain in dry years.

At higher and higher river levels, other canal groups begin to take their share, but they do so in the same manner – none takes their entire portion first before another diverter gets any. Rather, as discharge increases, the gains are shared. For example, the Kings County Canal group (People’s Ditch Company, Last Chance Water Ditch Company, Lemoore Canal and Irrigation Company, Lemoore Irrigation District and John Heinlen Company) receives 70 CFS when the river discharge is 200 CFS (this allotment shared with three other groups), 570 CFS when the discharge is 1,900 CFS (shared with the same three other groups), and 1,300 CFS when the flow is 10,000 CFS (shared with at least 27 other diverter groups).⁵⁷⁰ In other words, the essence of priority – “In times of shortage, the newest right holder is cut back first” – essentially does not apply to the Kings River.

⁵⁶³ SWRCB, “eWRIMS Water Rights Search - California Integrated Water Quality System.”

⁵⁶⁴ According to the date on the water right in eWRIMS, the electronic water right information management system. The date on the water right is not always the actual priority date, however, and so this is a crude estimate. See Ibid.

⁵⁶⁵ SWRCB, “Implementing Standard Terms 91 and 93 for the Sacramento-San Joaquin River Delta Watershed.”

⁵⁶⁶ CA State Water Commission, *Third Biennial Report of the State Water Commission of CA*, 75.

⁵⁶⁷ Ibid.

⁵⁶⁸ Governor’s Commission to Review California Water Rights Law., *Governor’s commission to review California water rights law*, 22-23.

⁵⁶⁹ Ibid., 24.

⁵⁷⁰ Charles L Kaupke and California, *Water Master Report for Year 1927: Kings River Discharge and Canal Diversions* (Sacramento: State of California, Department of Public Works, Division of Water Rights, 1928). These numbers are based on the 1926 river schedule – they have been tweaked since then, but the same theme remains. For the current May schedule, see Kings River Water Association, “Kings River Schedule,” *Schedule*, 2011, http://www.kingsriverwater.org/about_us/key_features/schedule.php.

Other adjudications in California seem to follow this pattern – rather than having a senior appropriator A, a less senior B and a junior C, users typically share priority classes with other users, and may have rights in more than one priority class.⁵⁷¹ Rarely was there a simple ordering of A>B>C.

Riparian diverters further complicate adjudication.⁵⁷² Until the Supreme Court ruled that the SWRCB had the authority to give unexercised riparian rights a lower priority than any other rights,⁵⁷³ court decrees were always subject to future riparian claims which would typically precede all other rights.⁵⁷⁴ Furthermore, until 1935, the State Water Board had no authority to address riparian rights,⁵⁷⁵ meaning that statutory adjudications could only determine appropriators' relative rights, excluding potentially significant riparian water users.

2.5 Appurtenancy

Unlike a riparian right, water diverted under an appropriative right can be applied to non-riparian land.

This is certainly true for both Wyoming and California, although in California, applying this principle to distant land often generates ill-will. Although distant appropriations are common in California, some proposals have failed,⁵⁷⁶ and among those that succeed, the area of origin has often been successful in recapturing some of the rents associated with the water. For example, the first major appropriation and transfer – Los Angeles Department of Water and Power's acquisition of the Owens River – led to a legislative pushback forcing Los Angeles to buy more Owens Valley land.⁵⁷⁷ This law would later morph into the broad class of laws dealing with appropriators that abstract water from one watershed and bring it to another, in effect imposing a preference for appropriators that use water within the original watershed.⁵⁷⁸

⁵⁷¹ See for example William A Newsom, "Shady Creek Judgment," 2–3; Harvey, Joseph, *Hallett Creek Adjudication: In the Matter of the Determination of the Rights of the Various Claimants to the Waters of HALLETT CREEK STREAM SYSTEM*, Decree 16291 (Superior Court Lassen County: State Water Resources Control Board, 1984), 18,

http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/judgments/docs/hallettcreek_jd.pdf; Allen, James, *Shackleford Creek Adjudication: In the Matter of the Determination of the Rights of the Various Claimants to the Waters of Shackleford Creek and its tributaries in Siskiyou County, CA*, Decree 13775 (Superior Court Siskiyou County: State Water Resources Control Board, 1950), 32,

http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/judgments/docs/shacklefordcreek_jd.pdf.

⁵⁷² Sidney Twichell Harding, *Water rights for irrigation* (Photolith reproduction by the Stanford University press, 1936), 175.

⁵⁷³ Justice Mosk, *Waters of Long Valley Creek Stream System v. State Water Resources Control Board* 25 Cal.3d 339 (1979).

⁵⁷⁴ Charles S. Franich, *In the Matter of the Determination of the Rights of Various Claimants to the Waters of Soquel Creek Stream System within Santa Cruz County, California*, Decree 57081 (Superior Court Santa Cruz County: State Water Resources Control Board, 1977), 15,

http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/judgments/docs/soquelcreek_jd.pdf.

⁵⁷⁵ See footnote 477

⁵⁷⁶ The Peripheral Canal's failure is the best example. East Bay Municipal Utility District has also had a difficult time acquiring American River Water.

⁵⁷⁷ G. D Libecap, "Chinatown: Owens Valley and Western Water Reallocation-Getting the Record Straight and What It Means for Water Markets," *Tex. L. Rev.* 83 (2005): 2080. The specific statute is available in California Legislature, *California Statutes*, 1925, chap. 109, <http://192.234.213.35/clerkarchive/>.

⁵⁷⁸ Robie and Kletzing, "Area of Origin Statutes - The California Experience," 422.

Regardless, the laws “have never been exercised to recover a single drop of water.”⁵⁷⁹ Again, a reading of the basic tenets of appropriative law would indicate that it does not matter how far the water travels, but in reality, extracting water for use many miles away engenders animosity, and this animosity has real effects.

2.6 Forfeiture

The forfeiture provision is a basic tenet of appropriative law. Because appropriative rights are created by use, a lack of use forfeits the right, and a partial lack of use forfeits part of the right. However, this rests on the assumption that the appropriative system is measured and monitored. In Colorado, the state engineer publishes a list every decade of users that have partially or wholly forfeited their water rights, as shown in the following table:

Insert Table 17 – Example of Colorado Abandonment List

In contrast, Wyoming and California do not actively seek out users to strip them of their water rights, even if they are unused. Both states have numerous voluntarily abandoned water rights – the vast majority (if not the entirety) in California designed to avoid paying newly imposed annual water right fees.⁵⁸⁰ Wyoming also has voluntary abandonments, some of which are motivated by the hassle of changing the place of use to serve subdivisions of former agricultural land.⁵⁸¹ Both states also have involuntary abandonment procedures for complaints initiated by another user. In Wyoming, the complainant must have standing (be using the same source of supply) and expect to have their water supply altered by the offender to file a complaint⁵⁸² – the process is not common, but it does happen.⁵⁸³ In California, since 1980, users have averaged about 40 complaints per year, although most are the result of minor neighborly property disputes or environmentally harmful diversions.⁵⁸⁴ This situation in both states reveals that there are unused rights that likely meet the legal definition of abandonment, but that the Board of Control (in WY) or the SWRCB (in CA) do not actively seek out these users.

Because the California SWRCB does not proactively revoke water rights, the phrase “Use it or lose it” is not really the rule in California. Therefore, California has a strong bias towards the status quo for water rights at the expense of letting water migrate from those who do not use it to those that do. This is most evident if a user wants to transfer water – because the cost of filing a written comment to a post-1914 water right transfer is just the cost of one’s time,⁵⁸⁵ other nearby users have a strong incentive to protest the change and/or argue that a portion of the transferee’s right had been forfeited due to lack of use. On the other hand, during normal times, there is little incentive to complain against another user. There have been many

⁵⁷⁹ Hundley, *The great thirst*, 531.

⁵⁸⁰ Olson and Mahaney, “Searching for Certainty in a State of Flux,” 114, fn 294.

⁵⁸¹ Randy Tullis, “Phone Conversation with Randy Tullis, Stage Engineer’s Office of Wyoming, Division I Superintendent,” May 11, 2011.

⁵⁸² Wyoming, *Wyoming Statutes*, sec. 41–3–401–b.

⁵⁸³ Randy Tullis, “Phone Conversation with Randy Tullis, Stage Engineer’s Office of Wyoming, Division I Superintendent.”

⁵⁸⁴ Chuck Rich, “Phone Conversation with Chuck Rich, SWRCB, Division of Water Rights, Complaints Division.”

⁵⁸⁵ *California Water Code*, sec. 1726 (f). An injured user from a pre-1914 water right transfer must bring suit in court. Potential injured parties may use the EIR process, often required for most pre-1914 water transfers, to address their concerns as well.

examples⁵⁸⁶ of water users attempting to transfer water they did not “own,” and based on the scrutiny that these transfer proposals receive, as well as the publicity they sometimes create, I conclude that water users themselves are keenly aware of others that may adversely affect their supply.

2.7 Summary of Key differences in water right administration

Wyoming assigns quantities to water rights and issues priority dates that everyone trusts, even if they do not use them every day, while in California the water rights records room is full of data that is practically almost useless. As mentioned earlier, Wyoming also has the ability to regulate streamflow and headgates. Technically, California has this power as well, but in practice, they do not have the personnel or information to be able to do this effectively. In contrast, Wyoming has the personnel on the ground to actively respond to requests for stream regulation, able to address the issue within a day or two.

Wyoming’s ability to adjust headgates and rely on their paper water right records is facilitated by their lack of riparian rights. In California, stream without adjudications, and even those that were adjudicated before 1935 (when riparian claims were not subject to the statutory adjudication procedure), have a mix of riparian and appropriative rights, and the SWRCB has no information that allows it allocate water among competing riparian and appropriative users, especially when nearby groundwater users further complicate the issue. If riparians are in dispute, they must use the court system – there is no active enforcement or monitoring.

Wyoming also places groundwater under the same appropriative system as surface water. California landowners, on the other hand, may drill wells and extract water essentially without oversight (unless they are in one of 20 or so adjudicated basins⁵⁸⁷). In Wyoming, a new well requires a permit, and the well is limited to a specific quantity like any appropriative right. They are also subject to priority regulation like any surface right. Like surface rights, using more than is listed on the water right is legal as long as surplus exists.

Another key difference is the difference in residual claimants. The residual claimant in most of California is the Delta environmental interests and to a lesser degree, Delta water diverters. 1) Science does not reveal how much water is needed for the fish and other wildlife – rather, the fish seem to be happy with more water and less happy with less, but there is no quantity that the environment “needs,” nor can the fish speak for themselves. Rather, there are tradeoffs and therefore environmental groups/state agencies must make these tradeoffs and act on behalf of the fish, necessarily prioritizing or de-prioritizing the environment compared to other water users. This creates the incentive for repeated lawsuits from both sides seeking more water. In addition, California has not been able to assign responsibility for cutbacks even if everyone could agree on a number. This exacerbates an already messy system.

In Wyoming, Nebraska is the residual claimant for many of the streams in the scarcer regions. If Wyoming does not deliver precise quantities as stipulated in their court decrees, then agricultural users notice and speak up about it. There is no dispute about the numbers because the tradeoff is clear – a Wyoming irrigator vs. a Nebraska irrigator.

⁵⁸⁶ The main examples are the Areias transfer to MWD, the AndCo transfer to Berrenda Mesa WD, the “Weed water” transfers from Sacramento Valley growers to Southern California, and many more. I discuss the details of these later.

⁵⁸⁷ Even within these basins, some do not actually restrict overlying users but rather ensure that the total amount extracted does not exceed a certain amount. If so, then the basin manager attempts to import additional water to make up the difference.

How do these differences play out on the ground in Wyoming? Besides making it easier to administer water, does it actually lead to a crisper right and in turn, a more easily transferable right? I address that next, and also discuss the legal framework governing Wyoming's transfer system.

3 Transferability in Wyoming

A water right may be transferred to another party upon petition and approval from the Board of Control. Water transfers must not detrimentally affect other legal users, and they are limited by the historic diversion rate and the amount of consumptive use. The Board of Control may also consider the economic loss to the community and the gain to the new place of use in considering the petition to change the water right.⁵⁸⁸

These procedures are the result of statutes passed in 1973 explicitly authorizing permanent transfers.⁵⁸⁹ Before February, 1974, the effective date of the statute, transferors could move water from their land to serve a different use, but doing so cause loss of priority. Temporary transfers have been legal since 1959.⁵⁹⁰ Just as my previous work has shown in California, many different methods of non-permanent water reallocation were still available before 1974 in Wyoming, mainly falling into the category of neighborly swaps.⁵⁹¹ With the passage of the new law, the Board of Control reviewed 36 transfer applications and granted permission for the permanent transfer of 74.77 CFS and 15,915 acre-feet of reservoir rights between 1974 to 1989.⁵⁹² Conversely, practically no water right sales occur in California.

If a new user needs water in Wyoming, there are many potential sources.

- 1) A user may acquire a temporary water use right which allows diversions of up to 2 years and a priority date of the date of the application.⁵⁹³
- 2) A user may divert illegally without a right.
- 3) A user may purchase water and become a customer of an agricultural district or municipality.
- 4) A user may seek a temporary water transfer.
- 5) A user may seek a permanent water transfer.

3.1 Temporary Transfers

Since 1959, Wyoming statutes also allow users to negotiate temporary water use agreements (TWUAs), where a user may temporarily use another's right for up to two years using WY statute section 41-3-110.⁵⁹⁴ The statutes specifically mention allowing transfers for "highway

⁵⁸⁸ Wyoming, *Wyoming Statutes*, sec. 41-3-104.

⁵⁸⁹ M. Squillace, "Water Marketing in Wyoming," *Ariz. L. Rev.* 31 (1989): 98.

⁵⁹⁰ *Ibid.*, 888.

⁵⁹¹ F. J Trelease and D. W Lee, "Priority and Progress-Case Studies in the Transfer of Water Rights," *Land & Water L. Rev.* 1 (1966): 11.

⁵⁹² Squillace, "Water Marketing in Wyoming," 903.

⁵⁹³ WY State Engineer, "Rules and Regulations - Chapter 4 - Water for Highway or Railroad Roadbed Construction or Repair", March 5, 1974, <http://soswy.state.wy.us/Rules/RULES/1795.pdf>.

⁵⁹⁴ Squillace, "Water Marketing in Wyoming," 888.

construction or repair, railroad roadbed construction or repair, drilling and producing operations” and “other temporary purposes.”⁵⁹⁵

If a user only needs the water temporarily, then either option (1) or (4) suffices. The State Engineer charges \$50 for each process,⁵⁹⁶ and approves them quickly.⁵⁹⁷ However, a temporary water use agreement retains the original appropriator’s priority, and likely requires a payment, whereas a temporary water right gains a priority date of whenever the application is filed. Water users that need water in areas that have the potential for stream regulation may find it worthwhile to execute a temporary water use agreement with a senior user, while users in areas unlikely to experience stream regulation have less of an incentive to consummate a deal.⁵⁹⁸ The following table shows the end uses for temporary water use agreements during the recent 14 year period, with the three uses specified in the statute (shown in italics below) accounting for 59% of the total (1,163 out of 1,971).

Insert Table 19 - WY Short-Term Transfer Uses

Since 2000, when better data became available, 1,236 have occurred.⁵⁹⁹ 345 (28%) of these have been transfers of groundwater. 308 (25%) occurred along the North Platte River, most (201) of these being temporary allocations of water from the Bureau of Reclamation’s Glendo reservoir.⁶⁰⁰ Unlike California, these temporary water uses from Reclamation reservoirs are not necessarily “transfers.” Half of Glendo Reservoir, for example, is set aside for Nebraska, and of the remaining Wyoming portion, 10,000 acre-feet per year is still without contract.⁶⁰¹ Therefore, the Bureau sells this water each year to willing buyers.⁶⁰²

Wyoming only presents data on actual amounts transferred using the TWUAs since 2007, and since then, the average size of a transfer has been 300 acre-feet. Of the 460 or so transactions with numbers reported, 283 involve less than 40 acre-feet, shown in the following histogram:

Insert Figure 25 - WY Transfer Size Histogram

The amounts traded are strikingly small compared to California. Of the 3,878 California transfer records from 1980 and 2009, 362 are for trades of less than 100 acre-feet (9.3%). Of these, all

⁵⁹⁵ Wyoming, *Wyoming Statutes*, sec. 41–3–110.

⁵⁹⁶ Wyoming State Engineer’s Office, “Fees,” 1–2.

⁵⁹⁷ John Barnes, “Phone Conversation with John Barnes, WY Surface Water Administrator”, October 12, 2011.

⁵⁹⁸ This is confirmed in discussing the issue with John Barnes. John Barnes, “Email with John Barnes, WY Surface Water Administrator”, October 14, 2011.

⁵⁹⁹ John Barnes, Surface Water Administrator, “Temporary Water Use Agreements Since 2000, Spreadsheet”, 2011. Their computer system was updated in 2000, and Mr. Barnes indicated that the quality of data before 2000 was not as good.

⁶⁰⁰ These temporary reallocations may occur upstream or downstream of the reservoir. For example, if users upstream are short on water, they can buy water from the Bureau and they can then divert more from the Platte River while the Bureau releases the same amount below the river. When the Bureau

⁶⁰¹ John Barnes, “Phone Conversation with John Barnes, WY Surface Water Administrator.”

⁶⁰² The Bureau charges irrigators \$5 per acre-foot and municipal providers between \$40 (Boysen Reservoir) and \$75 (Glendo Reservoir) per acre-foot. See Rodney Smith, ed., *Water Strategist* (Claremont, Calif: Stratecon, n.d.), vols. Sept. 2005, p 7–8.

but 5 occurred within the CVP, and those 5 occurred before 1990.⁶⁰³ Wyoming, in contrast, has many small transfers, allowing small users the opportunity to acquire small amounts of water legally through the system.

The differences in quantities for temporary transfers do not just represent a state with smaller users – clearly, California farmers and cities are far larger than Wyoming’s, and therefore one would expect larger transfers on average. But Wyoming’s system also motivates these smaller deals, and it must run a tight ship to enable such small transfer quantities. In contrast, California users can dig a new well should they want groundwater, impossible in Wyoming without going through the Board of Control. Furthermore, buying city water is more difficult in Wyoming – the nearest city may be farther away, the city may not have as much excess capacity as a California city does because California has far more storage per area,⁶⁰⁴ and Wyoming also enforces the place of use on a city’s water right, requiring a buyer that wants to use city water elsewhere to apply for permission to the state engineer. The following transfer is a good example illustrating these points.

In May 2011, the County of Fremont needed water for road construction and dust control. It could not buy water from a municipal provider because the particular area was 45 miles from the nearest municipal provider.⁶⁰⁵ In this case, the County of Fremont decided to negotiate an agreement to temporarily use the water right of WY State Parks and Cultural Resources, capped at 200,000 gallons during the period of use and no more than 20,000 gallons per day. WY State Parks has a small water right that they use intermittently for landscape irrigation and prospecting demonstrations, and interestingly, in talking with the State Parks superintendent, the “transfer” may *not have any effect* on their water use. The construction company will pump water directly into a water truck from Willow Creek, the source of the State Park’s supply, and unless there is a call on the river from a junior appropriator short on water, both can now divert legally – it is not illegal to divert more than one’s water right if no other user is injured.⁶⁰⁶ A user must have a water right, but in time of surplus, they may divert what they need.

This illustrates an important point – while there are many temporary water use permits granted, many of these may actually indicate an increased total take on the water source if the original user does not have to cut back.⁶⁰⁷ These temporary water use agreements may involve just a nominal fee, and in the WY State Parks – County of Fremont example, no money changed hands.⁶⁰⁸ Essentially, the level of scarcity drives the price, and some oil and gas drillers pay upwards of \$10 per 1,000 gallons, or a couple thousand dollars per acre-foot.⁶⁰⁹

⁶⁰³ This does not include the small transfers made to the different water banks run by the CA Department of Water Resources.

⁶⁰⁴ W.L. Graf, “Dam nation: a geographic census of American dams and their large-scale hydrologic impacts,” *Water Resources Research* 35, no. 4 (1999): 1307.

⁶⁰⁵ Joe Ellis, South Pass City/Point of Rocks Superintendent, “Phone Conversation with Joe Ellis”, October 12, 2011, <http://wyospcr.state.wy.us/intranet/sphsregion3.htm>.

⁶⁰⁶ Wyoming, *Wyoming Statutes*, sec. 41–4–501, 41–4–319.

⁶⁰⁷ Board of Control member Jade Henderson mentioned that water trucks seek out areas where they expect little stream regulation so that they do not have to worry about getting cut off. If users execute a temporary water use agreement and use the same pipeline or ditch as the original appropriator, chances are the original appropriator will have to reduce their water use. Jade Henderson, “Phone Conversation with Jade Henderson, WY Division IV Field Superintendent”, October 12, 2011.

⁶⁰⁸ WY State Engineer, “Temporary Water Use Agreement”, n.d., pt. Order # 9–45, May 5 2011, <https://seoweb.wyo.gov/e-Permit/Common/Home.aspx>.

⁶⁰⁹ *Ibid.*, Order # 11–41, July 2011; Jade Henderson, “Phone Conversation with Jade Henderson, WY Division IV Field Superintendent.”

The fees imposed on transferring parties are also much different in California and Wyoming. Wyoming charges \$50 for a temporary change.⁶¹⁰ A temporary transfer in California costs \$2,000 plus \$.30 per acre-foot greater than 10 acre-feet, in addition to \$850 owed to the CA Department of Fish and Game.⁶¹¹ For example, a 10 acre-foot trade would cost the transferring parties \$285 per acre-foot, likely swamping the gains from trade in all but extreme circumstances. This high cost effectively prohibits parties from using the SWRCB to transfer small amounts of water in California. As discussed earlier, however, there are still small transfers within water districts and between districts belonging to the same water right network (e.g. the CVP). Furthermore, the high price in California is probably not a major hindrance to small water transfers – as recently as 2003, water transfer fees were a flat \$.30 per acre-foot, and small transfers were present but not nearly as prevalent as they are in Wyoming.

Therefore, data on Wyoming’s short-term water market is imperfect – there are many temporary water use agreements, but many of these do not represent a situation where the original water right holder decreases water use so another may use it instead. It may represent this if the streams in question go into regulation, but if not, then there is a net increase in water use rather than a reallocation. Still, given the ease in which these agreements are consummated, Wyoming’s short-term market seems quite robust, and its presence also confirms that the administration is actually much tighter than in California, encouraging users to obtain water through a formal process rather than diverting illegally.

3.1.1 Limitations to Wyoming’s short-term market.

As interpreted by the State Engineer, temporary water use agreements may not be used solely for a change in the place of use. That is, they must have a change in use which may or not be accompanied by a change in the place of use.⁶¹² If this were not the case, an agricultural user could shift water from one area to a new area and effectively bypass the importance of the place of use on the original water right.

In addition, Wyoming statutes seem to imply that temporary water use agreements can be revoked if any owner of a permanent water right cannot satisfy his full right while a temporary user is diverting under a TWUA, regardless of the priority of the permanent owner.⁶¹³ Squillace claims that this statute creates a “serious disadvantage” for temporary rights because they are essentially wholly subordinate to *any* permanent right.⁶¹⁴ However, the latter part of the statute lessens the impact of this statement, only allowing junior users to suspend TWUAs if they can prove that the water saved would then flow to them, and not some other junior user. Section 41-3-110 (c) also limits transferred amounts to consumptive use, making it unlikely that another user would attempt to stop a TWUA unless the shorted party felt that the State Engineer made an error in calculating return flows or if the 50% return flow assumption had not been applied to the right in question. In addition, 41-3-112 states that unlawfully stopping a TWUA is a punishable offense.⁶¹⁵ Therefore, while reading section 41-3-111 by itself seems to indicate that a junior

⁶¹⁰ Wyoming State Engineer’s Office, “Fees.”

⁶¹¹ SWRCB, “Fiscal Year 2010-11 Fee Schedule Summary”, 2011, http://www.swrcb.ca.gov/waterrights/water_issues/programs/fees/docs/fee_schedule_fy1011.pdf.

⁶¹² Pat Tyrrell, Wyoming State Engineer, “Phone Conversation with Wyoming’s State Engineer”, October 2011; Jade Henderson, “Phone Conversation with Jade Henderson, WY Division IV Field Superintendent.”

⁶¹³ Wyoming, *Wyoming Statutes*, sec. 41–3–111.

⁶¹⁴ Squillace, “Water Marketing in Wyoming,” 889.

⁶¹⁵ Wyoming, *Wyoming Statutes*, sec. 41–3–112.

user could call out a senior and stop a TWUA, in practice this does not really happen, an interpretation confirmed by Board of Control member and Water Division IV superintendent Jade Henderson.⁶¹⁶

3.2 Permanent Transfers

Permanent transfers have been legal since 1973, although as Trelease points out, users had other reallocation options before then.⁶¹⁷ Squillace tracks the first 15 years of transfers and records 41 distinct permanent changes averaging 2.2 CFS. Although intervening data is not easily available,⁶¹⁸ from 2006 to 2011, the Board of Control granted 33 petitions to transfer water rights with an average yearly right of approximately 91 acre-feet per year.⁶¹⁹

Just like temporary water transfers, some of these transfers are not quite actual reallocations from person A to person B. For example, the town of Lander, Wyoming, permanently transferred water rights from irrigators near the town so that they could bring more water into their treatment plant to serve the municipality. However, much of the land was no longer irrigated and was practically part of the city already, and the purpose of the transfer was to clean up the paperwork. Because some of the ditches had not been used in a while, only about 30% of the rights transferred.⁶²⁰ Just like temporary transfers, this still illustrates an important point – in California, these types of water right “transfers” are hidden because many municipal users simply drill a new well or pump more water, or they have a water right that was originally granted for their future needs, in effect allowing them to divert more water from their stream under their original right.

3.3 Transfer Percentages Comparison

Municipal and Industrial use accounts for 60,000 AF of surface water and 100,000 AF of groundwater in Wyoming.⁶²¹ Agriculture consumes 2,300,000 AF of surface water and 300,000 AF of groundwater.⁶²² Therefore, transfers represent the following percentages:

Wyoming	Permanent Transfers, % of 2,760,000 AF Annual Use	2006-2011: $\frac{10,122 AF}{5 \text{ years}} \rightarrow 2,024 AF / yr \rightarrow .07\%$ 1974-1989: $\frac{66,535 AF}{16 \text{ yrs}} = 4,158 AF / yr \rightarrow .15\%$
	Temporary Transfers, % of 2,760,000 AF Annual Use	2007-2011: $\frac{137,872 AF}{5 \text{ years}} = 27,574 AF / yr \rightarrow 1\%$ 2007-2011 (excluding Glendo/Boysen Reservoir

⁶¹⁶ Jade Henderson, “Email with Jade Henderson, WY Division IV Field Superintendent”, October 14, 2011.

⁶¹⁷ Trelease and Lee, “Priority and Progress-Case Studies in the Transfer of Water Rights”; Squillace, “Water Marketing in Wyoming.”

⁶¹⁸ The Water Strategist is no help here – it misses most of Wyoming’s transfer market.

⁶¹⁹ Allan Cunningham, Administrator, WY State Board of Control, “WYOMING STATE BOARD OF CONTROL WATER TRANSFERS AUGUST 2006 – AUGUST 2011”, September 2011.

⁶²⁰ John Felix, Water Dept. Supervisor for Lander WY, “Phone Conversation with John Felix”, October 2011.

⁶²¹ Brosz, Jacobs, and University of Wyoming. Division of Agricultural Economics, *Wyoming’s Water Resources*, 4.

⁶²² *Ibid.*, 3.

		$\frac{78,580AF}{5\text{ years}} = 15,716AF / \text{yr} \rightarrow .6\%$ agreements):
California	Permanent Transfers, % of 25,600,000 AF Annual Use	2000-2009: $\frac{124,944AF}{10} = 12,494AF / \text{yr} \rightarrow .05\%$
	Temporary Transfers, % of 25,600,000 AF Annual Use	2000-2009: $\frac{657,770AF}{10} = 65,777AF / \text{yr} \rightarrow 2.6\%$

Although the permanent transfer percentages seem similar, the numbers for California do not include any actual *water right* sales, whereas in Wyoming, they do. Therefore, permanent transfers are relatively more common in Wyoming than in California, with the opposite situation for temporary transfers. This lends support to the claim that the crisp water right system enables users to actually buy and sell appropriative surface water rights.

3.5 Why the Differences?

Wyoming did not get lucky in choosing its system – rather, Elwood Mead carefully developed a system suited for the state at the time, and he did so before large users became entrenched. Furthermore, the Board of Control’s actions did not spur many lawsuits.⁶²³ California’s system in 1913 was modeled after Wyoming’s with Mead’s help, but although water reform proponents desired to have a similar enforcement structure (central Board of Control, water divisions with superintendents), they never were able to develop it because California was far more developed at the time. Instead of small recalcitrant users, which existed in Wyoming,⁶²⁴ the Water Commission was hamstrung from the beginning because of users like Miller and Lux, large riparian users who preferred to argue their position within the courts rather than listening to the Commission.⁶²⁵ At the turn of the century, they owned more than 800,000 acres in California,⁶²⁶ whereas Wyoming irrigated 1.1 million acres in total in 1909.⁶²⁷ California’s large landowners could speak with one voice, and stand in opposition to any change that diminished their property values, making water law reform very difficult.

⁶²³ Only 5 district court and 3 Supreme Court appeals occurred despite 3,900 water right cases from 1890-1902. See note 37, Anne MacKinnon, “Historic and Future Challenges in Western Water Law: The Case of Wyoming,” *Wyoming Law Review* 6, no. 2 (2006): 301.

⁶²⁴ Squillace, “One Hundred Years of Wyoming Water Law,” 97.

⁶²⁵ Pisani, “From the family farm to agribusiness”; Miller, “Riparian Rights and the Control of Water in California, 1879-1928.”

⁶²⁶ Miller, “Riparian Rights and the Control of Water in California, 1879-1928,” 3.

⁶²⁷ United States., *Census of agriculture, 1910* (Washington D.C.: Govt. Print. Office, 1914), 940.

4. Failed Transfers in California

An additional way to see the effects of ambiguous water rights is to examine “the dogs that didn’t bark,” i.e. those transfers which failed to occur. Transfers that do not occur because of murky property rights are often completely absent from any published historical record. But there are records of some transfers that have failed for different reasons, and studying them is useful to note how property rights specifically hinder water transfers along with the incentives created by the system.

4.1 McArthur Ranch

Located north of Lake Shasta along the Fall River, George McArthur of McArthur Ranch proposed to sell a portion of his 60,000 acre-feet pre-1914 water right to San Joaquin Valley agricultural users. This transfer would traverse the Delta, and therefore some background information is necessary to understand these transfers. Because all transfers that cross the delta must use either the CVP or the SWP pumps, their approval is critical. The projects have a single objective – to deliver water to their Contractors – subject to the constraint that they are responsible for meeting Delta water quality standards. The more water they release to improve Delta water quality, the less they have for their Contractors. Therefore, if they are to grant approval to pump someone else’s transfer water, they must determine if new water is made available in the system. If not, and they agree to transfer the water, then they are allowing the transferor to profit at the expense of their Contractors.

McArthur proposed to transfer water made available by fallowing irrigated pasture. USBR staff had concerns over the right’s validity as well as the quantity that McArthur was entitled to.⁶²⁸ Although he was able to sell during the 1991 Drought Water Bank, he has not been able to sell since then despite his strong desire to do so.⁶²⁹ Because the right is pre-1914, the SWRCB has no jurisdiction over the transfer, but the USBR and DWR have filled the regulatory void. Besides generally discouraging small transfers,⁶³⁰ they make it very difficult to transfer water from irrigated pasture and alfalfa because of the difficulty in calculating the evapotranspiration of the crop.⁶³¹ In some cases, pasture may still grow without surface irrigation because it can acquire what it needs from the ground, thus making the calculation of

⁶²⁸ California DWR, *A Catalog of water transfer proposals : draft* ([Sacramento]: Water Transfer Committee, 1986), 12.

⁶²⁹ George McArthur, “Interview with George McArthur”, June 27, 2011, note The following description is based on my phone call with him as well.

⁶³⁰ California DWR and USBR Mid Pacific Region, Resources Management Division, “Draft Technical Information for Water Transfers in 2011”, January 2011, 13, <http://www.water.ca.gov/drought/docs/TechInfoDoc-WaterTransfers-2011.pdf>.

⁶³¹ California DWR, “Water Transfers Based on Crop Shifting and Crop Idling - How to Make Them Work in the Sacramento Valley in 2002”, March 8, 2002, 9, http://www.wto.water.ca.gov/docs/Water_Transfers_Based_on_Crop_Shifting_and_Crop_Idling5_23_02.pdf; USBR Mid Pacific Region, “2010-2011 Water Transfer Program - Final Environmental Assessment”, February 2010, 2-10, http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=4699. This report from the USBR states “Only alfalfa grown north of the American River will be allowed in the 2010-2011 Water Transfer Program but fields must be completely disced under, or prior to, July 1 of transfer year. Alfalfa is not allowed if it is grown in the foothills, in the Delta, in areas with high water tables, or land irrigated with water that does not come from the Sacramento or Feather Rivers or their tributaries.” According to George McArthur, this position results from their impression of the 1991 Drought Water Bank in that they paid Delta users to fallow irrigated pasture when the water availability in the ground likely meant that they did not get as much as they paid for. George McArthur, “Interview with George McArthur.”

ET very difficult. Pasture land is also typically marginal quality land, and may not be irrigated every year, making it difficult for the irrigator to prove to DWR that he would irrigate in the absence of the transfer. For these and other reasons, McArthur remains frustrated.⁶³²

The fascinating part about this proposal is that McArthur Ranch ought to be a good candidate for transferring water. It uses water to grow pasture, typically considered a low-value crop ideal for water transfers because of the amount of water used and because of the minimal impact on the local agricultural economy. In addition, McArthur Ranch is upstream of the Delta and therefore hydrologically connected to the majority of California's water users. DWR and other state agencies are directed to "encourage voluntary transfers of water and water rights,"⁶³³ but it is hard to see how preventing transfers from irrigated pasture and alfalfa encourages users to transfer their water, especially when those crops account for close to 432,000 acres in the Sacramento hydrologic region.⁶³⁴

This case also illustrates the impenetrable fog that is a California appropriative water right. First of all, to proceed with a water transfer and have it approved by DWR, DWR must agree on the irrigated acreage. DWR requires five years of cropping pattern information with field parcel maps, aerial photos and a statement that the user will not use the water elsewhere.⁶³⁵ Staff limitations lead them to focus on the larger districts. Then, they estimate evapotranspiration of applied water, adjusting it for regional differences as well as groundwater availability. This applies to most crops excluding, but not limited to, the idling of irrigated pasture/alfalfa if water use on those lands "cannot be easily verified by metered use of applied surface water and drainage water."⁶³⁶ Therefore, although the water right yields plenty of water for George McArthur to consumptively use a portion to grow feed for his cattle, and although his neighbors recognize and respect his water right, the right is not only unquantified, but deemed so vague that DWR will not even attempt to quantify how much the McArthur Ranch is entitled to.

4.2 Anderson Farms Co. to Berrenda Mesa Water District

During the 1977 drought, Anderson Farms Company (AndCo), an 11,335 acre farming operation in Yolo County,⁶³⁷ desired to transfer its water to Berrenda Mesa Water District, an agricultural district in Kern County reliant on SWP water. Berrenda Mesa does not have groundwater access, and had 28,000 acres of permanent crops⁶³⁸ which were threatened by the severe drought. AndCo had both riparian rights and groundwater rights, and they proposed to pump groundwater continuously and discharge it into Toe Drain, a tributary of the delta and the source of their riparian surface water right. When they needed water themselves for irrigation during the growing season, they proposed to use groundwater instead, forgoing their normal

⁶³² Frustrated is a nice term. He claims the folks in the USBR and DWR he dealt with are "lazy middle management bureaucrats that don't want to do any more than they have to" because they won't make the effort to figure out how much water he is entitled to. Ibid. In addition, some of his water rights are in the adjudicated Cow Creek system. Because the decree does not make it clear if these rights may be transferred out of the area, DWR asked McArthur to get a judge's opinion, but apparently, this has not happened yet.

⁶³³ *California Water Code*, sec. 109. Rice growers also have an incentive to prevent competition in the water transfer market, an important point according to McArthur. George McArthur, "Interview with George McArthur."

⁶³⁴ California DWR, *Irrigated Crop Acres and Water Use - Hydrologic Region*, 2001, http://www.water.ca.gov/landwateruse/docs/annualdata/2001/ag_hr_2001.xls. This number is for reference – not all of this is off limits.

⁶³⁵ California DWR, "Water Transfers Based on Crop Shifting and Crop Idling," 6–7.

⁶³⁶ Ibid., 9.

⁶³⁷ SWRCB, "Water Right Decision 1474," 2.

⁶³⁸ Ibid., 3.

riparian right diversions. Their proposed transfer had two main problems. It was likely that their plan would not add new water to the system because the proposed pumping would create a large cone of depression, sucking water from the hydrologically connected Sacramento River.⁶³⁹ In addition, their riparian surface water right, which they would refrain from using to free up water for Berrenda Mesa, likely would not have nearly as much water available during the drought season.⁶⁴⁰

The SWRCB decided that the proposal was not in the public interest nor was it a reasonable method of diversion, and directed the Department of Water Resources⁶⁴¹ to abide by their decision. They did believe the transfer was “badly needed” and did not want to discourage this type of activity in the future: “We want it well understood, however, that we do not mean to discourage innovative attempts to transfer water in times of need. What we are saying is that such proposals must be well thought out and not have the potential of unreasonably harming others.”⁶⁴²

The dominant water right theme is the lack of quantification and priority which thwarted this proposal. AndCo had two correlative rights, meaning that it had water that was potentially transferable, but not without some effort on its part to estimate how much it was entitled to. AndCo’s riparian right may or may not have had fresh water available during the 1977 season, but ex ante, there was no good way to tell. They had no priority over other users sharing the source, and the same was the case with their groundwater supply. They may use a correlative share of groundwater on their overlying land, but only could take surplus water to give to Berrenda Mesa. Again, calculating surplus water availability was practically impossible without a complete adjudication, which would be further hampered by the interconnectedness of the Sacramento River and the Yolo groundwater basin.

4.3 City of Tracy

In 1993, Tracy adopted its general plan for directing land use and future development. The plan discussed, among other things, a need to acquire 29,000 AF more potable water for the expected population expansion.⁶⁴³ Specifically, it mandated that new developments have adequate water supply by directing the city to look to its neighboring agricultural districts and more distant entities for more water. In 2001, Tracy adopted its groundwater management plan, allowing groundwater pumping to increase from 6,000 to 9,000 AF per year to meet temporary demand while permanent replacement sources were still being sought. Tracy also partnered with other local cities in the South County Surface Water Supply Project, a treatment plant and pipeline aimed at providing the city with an additional 10,000 AF from the Stanislaus River. In addition, the city wanted to replace highly-mineralized groundwater with better quality surface water as stipulated by its treatment plant expansion EIR. Tracy also continued to seek agricultural water. The West Side Irrigation District and Banta Carbona Irrigation District border the city, and because Tracy has gradually expanded and eaten up farmland in these two districts, the districts are not farming as many acres as they have historically. All three are Central Valley Project contractors which receive their supply from the Delta Mendota Canal, and

⁶³⁹ Ibid., 7.

⁶⁴⁰ Ibid.

⁶⁴¹ DWR owns the pumps and conveyance system necessary to deliver water to Berrenda Mesa.

⁶⁴² SWRCB, “Water Right Decision 1474,” 14.

⁶⁴³ For details on sources for this paragraph, see Nicholson, J., *Sierra Club v. The West Side Irrigation District (City of Tracy)* 128 Cal. App. 4th 690 (2005).

Tracy successfully acquired portions of their CVP contracts. However, their attempts to acquire water further south proved fruitless.

In 1997, Grupe Development Co. bought Widren Water District, a single-owner 800 acre district on the valley's west side. The district had a 2,990 AF contract from the Central Valley Project. Grupe wanted to use the water to supply its proposed 5,500 acre housing project just outside of Tracy, 80 miles to the north. As Grupe controlled the entire district board, it voted to send the district's CVP water north. So, instead of Widren withdrawing the water from the Delta Mendota Canal, the city of Tracy would do so, only 80 miles "upstream."

Insert Figure 25 – City of Tracy and Centinella, Widren and Westlands Water Districts

The county of Fresno declares that it opposes all surface water transfers out of the county, even transfers of water that do not originate in Fresno (e.g. CVP water).⁶⁴⁴ Fresno cares that the water exports may encourage increased groundwater pumping and will set a precedent for more water exports, harming their \$5 billion farm economy.⁶⁴⁵ As a result of this and other proposed deals, the County of Fresno in early 2000 drafted a ground and surface water ordinance,⁶⁴⁶ restricting transfers and groundwater pumping resulting from certain activities.⁶⁴⁷

Fresno vigorously opposed the Grupe-Widren transfer, suing twice.⁶⁴⁸ Neither of these suits went to trial. However, they did dissuade Grupe from pursuing the transfer—the Tracy City Council refused to pay for the lawsuit, and so Grupe sold Widren and looked elsewhere for its water,⁶⁴⁹ eventually using water from neighboring Byron-Bethany Irrigation District instead.⁶⁵⁰ The water was from BBID's pre-1914 water right on the San Joaquin River, and needed no approvals. Westlands Water District eventually purchased Widren's supply, keeping it within Fresno County.

There are two points worth noting. Fresno is not arguing based on their ordinance that restricts groundwater transfers out of the county. In fact, the ordinance, besides requiring a

⁶⁴⁴ Mark Grossi, "Fresno vows to oppose water sale," *Fresno Bee*, March 5, 2003, Final Edition edition, sec. Local News, B1; Fresno County, *Code of Ordinances*, 2011, chap. 14.03 - GW Management, <http://library.municode.com/index.aspx?clientID=14972&stateID=5&statename=California>.

⁶⁴⁵ "Fresno County Farm Bureau: Fresno County Ag", June 2011, <http://www.fcfb.org/Fresno-Ag/Fresno-Ag.php>.

⁶⁴⁶ Westlands WD, located largely within Fresno County, worked with the county on drafting the ordinance as they have a huge stake in ensuring they are still allowed to buy the water they need every year. According to their website (<http://www.westlandswater.org/topics/grdwtrord.htm>), they are somewhat disappointed that the county required an extra layer of approval for most water transfers.

⁶⁴⁷ Fresno County, *Code of Ordinances*, chap. 14.03.

⁶⁴⁸ Their first suit claimed they weren't adequately involved in the transfer proposal, and the second suit in 1999 alleged that Tracy buying Widren and stacking the board violates conflict-of-interest laws.

⁶⁴⁹ Grupe did not need that water immediately for their proposed Tracy Hills development. California state law mandated an average of no more than 600 houses built each year for the city of Tracy, and as the council had already been approving close to 1200 per year, as of 2007, there was a growth moratorium, and the new Tracy Hills development wasn't expected to start until 2014.

⁶⁵⁰ In 2002, Tracy also looked into buying the contract of Centinella Water District, another small CVP district 30 miles north of Widren. Centinella's single owner committed his land to a habitat conservation bank and his 2,500 AF CVP entitlement was no longer needed. Although the details are not clear, the city negotiated with the seller, but the water is now assigned to Westlands Water District. Public Works director Steve Bayley told me "The City abandoned the negotiations based on perceptions that the environmental analysis would show impacts within Centinella WD from assignment of this water to Tracy. There are no documents, we just let discussions die." Basically, they were worried about spending too much money and time on a relatively small amount of water. Tracy expected to pay close to \$2.5 million for the water, and instead, Westlands now has it.

permit, offers no real help for Fresno in this case.⁶⁵¹ Furthermore, the developer claimed that continued farming at Widren would use water from groundwater sitting above the Corcoran Clay layer. A reduction in this poor quality water would most likely help rather than hurt other farmers concerned about salt.⁶⁵² Therefore, although the transfer from Widren to Tracy was legally possible, the opposition from Fresno over groundwater killed it. Groundwater is a common-pool resource, and without quantification of the groundwater rights, Grupe Development could not credibly commit to refraining from pumping more groundwater once the transfer was complete.

4.4 The original CVPIA transfer

Part of the intent of the 1992 Central Valley Project Improvement Act was to give CVP contractors a stronger property right to facilitate reallocation. After 1992, CVP Contractors now had the right to sell to non-CVP entities. Furthermore, if individual users within a district wanted to sell their allotment, they did not need district approval if the amount was less than 20% of the district contract.⁶⁵³ The law, however, has proven fruitless.

Areias Dairy Farms, run by Assemblyman Rusty Areias, first attempted to sell under the CVPIA in 1993. The 2,800 farm was within Central California Irrigation District, one of the four San Joaquin River Exchange Contractors.⁶⁵⁴ MWD specifically targeted the San Joaquin Exchange Contractors because the water is reliable – only 4 times in the past 36 years have they received less than a 100% allocation, and in those drought years, they still received 75%.^{655 656}

Insert Figure 29 – Central CA ID and MWD

32,000 AF over 15 years would flow south to Metropolitan Water District for which Areias would receive \$175 per acre-foot. In 7 of the 15 years, MWD would be allowed to take 100% of

⁶⁵¹ A common feeling among transfer proponents was stated by Charles McNiesh, General Manager of the Pajaro Valley WA. “Legally, we could probably make this deal work without Fresno County, but practically, we do need Fresno County to support this.”

⁶⁵² Westlands, interestingly, says the following about transfers: “Like most water managers in the Valley, we are concerned with surface water leaving an overdrafted groundwater basin. Impacts resulting from transfers must be mitigated. In the specific case of the Widren Water District/City of Tracy long-term reassignment of water, the amount of water is minimal and there may be some relief in a drainage impacted area; we support the concept.”

⁶⁵³ The motivation for this portion of the law comes primarily from Metropolitan Water District’s recent experience with Palo Verde Irrigation District as well as Environmental Defense Fund’s experiences with farmers in the northern San Joaquin Valley (mainly Broadview WD and Firebaugh Canal WD). In each case, farmers were willing, but district boards were reticent to allow transfers. See

⁶⁵⁴ The Exchange Contractors exchanged their riparian and pre-1914 water rights to the San Joaquin River for supplies from the Delta. The USBR could then capture and export their old water supplies for use in the Friant-Kern Canal.

⁶⁵⁵ Westlands WD, “Historical CVP Allocation”, 2009,

http://www.westlandswater.org/wwd/usbr/water_allocations_historical.pdf?title=Summary%20of%20Water%20Supply%20Allocations.

⁶⁵⁶ The water was also likely cheaper than from any regular CVP contractor. The CVPIA required transferors under certain circumstances to pay the full cost rate on the amount transferred. MWD would argue that this part of the act did not apply because the water was technically not Reclamation water but rather water diverted from the Exchange Contractors’ original rights on the San Joaquin River. Otherwise, USBR would require MWD to pay an additional \$42 per acre-foot subsidy payback. See J.A. Savage, “The selling of water,” *California Journal*, June 1, 1994, sec. Feature. For subsidy repayment provisions, see M. Weinberg, “Assessing a Policy Grab Bag: Federal Water Policy Reform,” *American Journal of Agricultural Economics* (2002): 541-556.

Areias' supply—about 4,600 AF. In total, MWD agreed to pay close to \$5.6 million for the water, finalizing the deal in June of 1994.⁶⁵⁷ Local farmers, irrigation district board members and farming groups all denounced the deal, exacerbated by the fact that Areias was formerly an “arch-foe of water marketing” as a California legislator.⁶⁵⁸ Local meetings in August of 1994 drew standing room only crowds, with almost all present voicing opposition to the deal.⁶⁵⁹ Emotions ran very high—many gave arguments of a domino effect, whereby if Areias sold, others would follow, creating a barren area with tumbleweeds just so L.A. residents could fill their swimming pools.⁶⁶⁰

The amount proposed for sale was a pittance compared to the yearly take of 530,000 AF by the Central California Irrigation District. However, in some years, the dairy farm would send 100% of its allotment south to MWD, legal because it was far less than 20% of the district's allotment. CCID was worried about the domino effect of other farmers choosing to sell, and they implemented a rule restricting individual sales to 20% of an individual's usual allotment,⁶⁶¹ in direct opposition to the federal law. Neighboring farmers were worried about increased groundwater pumping, and despite assuring other farmers that no additional groundwater would be pumped and that the money will be immediately invested in his struggling dairy,⁶⁶² the opposition never backed down. Rusty Areias filed for bankruptcy and Bank of America took control of the struggling dairy farm before a workable proposal materialized.⁶⁶³

This transfer did not fail because of the hypocrisy of Rusty Areias, although that certainly exacerbated the problem. Again, because groundwater is unregulated, as mentioned earlier, farmers transferring surface water have the ability to pump more water to replace what was sold. Outside of fallowing the land, it was difficult for Areias to credibly commit to refrain from pumping, and even fallowing is not an irreversible decision. Therefore, neighbors had saw him as trying to sell something he did not completely own, and helped kill the deal. As Tim Quinn recounts,

They were sending out very strong signals that they would go down to the last man. The last man would fall on his sword on the barricades to stop this individual from transferring water around the control of the district. So, we went about the task of trying to renegotiate the deal so it would conform to the district's policies.⁶⁶⁴

Quinn also makes clear the distinction between legislation and results on the ground.

⁶⁵⁷ J.A. Savage, “The selling of water”; Mark Grossi, “Areias Farms' water deal for L.A. on tap,” *Fresno Bee*, June 30, 1994, Home Edition edition, sec. Telegraph, A1.

⁶⁵⁸ Carl Boronkay, Timothy Quinn, Malca Chall, “The passage of the Central Valley Project Improvement Act, 1991-1992,” 123; Elliot Diringer, “San Jose Assemblyman to Profit From Law He Fought,” *San Francisco Chronicle*, September 23, 1993, Final Edition edition, sec. A22. Areias assumed that his political connections would help, rather than hurt, facilitate the process.

⁶⁵⁹ Garth Stapley, “‘Farmer’ Areias Takes a Dunking,” *Modesto Bee*, August 24, 1994, sec. B1.

⁶⁶⁰ Mark Grossi, “Areias Farms' water deal for L.A. on tap.”

⁶⁶¹ The rule was a result of the CVPIA, and although the Areias deal failed, Tim Quinn cites CVPIA as having some success because it pushed districts to develop a water marketing policy. Carl Boronkay, Timothy Quinn, Malca Chall, “The passage of the Central Valley Project Improvement Act, 1991-1992,” 124; Greg Rice, “Phone Conversation with Greg Rice, Controller of CCID”, February 26, 2007.

⁶⁶² Stapley, “‘Farmer’ Areias Takes a Dunking.”

⁶⁶³ Carl Boronkay, Timothy Quinn, Malca Chall, “The passage of the Central Valley Project Improvement Act, 1991-1992,” 125.

⁶⁶⁴ *Ibid.*, 124.

One of the lessons I have learned is I don't care what the bill says, you can't roll over the agricultural districts like a steam roller and expect to get away with it, even if you're the great and powerful Metropolitan Water District of Southern California. With the Areias transactions, we started to work very hard to maintain benefits but try and make it comply with the policies of the agricultural districts. *By law, we did not have to have their permission* (emphasis added). But, the local politics were clear that we had to develop better relationships with the agricultural districts.

So, despite what a law says about being able to transfer part of a CVP contract without district approval, the reality is much different, even today (2011). Without assuaging the fears of other farmers and the public, who both despise neighbors profiting from a shared resource, a federal decree vesting part of the property right with the owner does nothing.

4.5 Natomas Central Mutual Water Company

Natomas Central Mutual Water Company applied⁶⁶⁵ to the State Water Resources Control Board for a temporary transfer as a result of conservation efforts. Natomas is a CVP Water Rights Settlement Contractor near the Sacramento River south of Sacramento. Although the SWRCB eventually approved 1,995 acre-feet for transfer, Natomas originally hoped to transfer 30,000 acre-feet, and therefore I include this transfer as a partial failure. Furthermore, although Sutter Mutual Water Company and Reclamation District #108 mimicked Natomas and transferred small amounts⁶⁶⁶ in the years immediately after Natomas' approval, none have happened since despite the unchanging circumstances.

Natomas made use of WC § 1011 which stipulated that water conservation is a beneficial use. To claim credit for conservation efforts, districts are supposed to document specific amounts conserved. Natomas first reported conservation amounts in 1993, but the amounts were based on deviations from the highest annual use since 1979 rather than an actual calculation of conserved water. Therefore, their reported diversions and conserved water always summed to 122,908 acre-feet, with the conserved quantity ranging from 4% to 90% of annual reported diversions.⁶⁶⁷ For example, Natomas originally proposed to transfer 14,000 acre-feet, but some of the conservation measures it cited did not actually reduce consumptive use or were unsubstantiated: Water recirculation and improved water management lessened diversions, but increased consumptive use. Laser leveling of fields provided more uniformity of water application and thus may reduce groundwater percolation, but a witness for the USBR claimed

⁶⁶⁵ Western Water Company facilitated the transactions and was the middle man hoping to earn money showing these deals were possible. New management in the mid-1990s spurred Western to begin looking into marketing water instead of just acting as a holding company as it had been doing. It approached the 4 largest districts but Glenn Colusa did not want a middle man to market its water, and so declined to participate. Western approached Natomas and helped apply to transfer 14,000 AF. The following year, they encouraged Reclamation District # 108 and Sutter MWC to participate. Peter Yolles, "Interview with Peter Yolles, formerly of Western Water Company." See also P. L. Yolles, "UPDATE 2000: PROGRESS AND LIMITATIONS IN DEVELOPING A WATER MARKET IN CALIFORNIA" (2000): 76-77.

⁶⁶⁶ Natomas, Sutter MWC and Reclamation District # 108 are the largest three districts in the area after Glenn Colusa ID. They have earthen canals where thirsty weeds evapotranspire water, and their size gives them enough canal miles to have a small but meaningful amount of conserved water.

⁶⁶⁷ Natomas Central Mutual Water Company, "Report of Licensee", n.d., no. 1980-2003, SWRCB Public Records Center.

that this could also lead to a better crop that uses more water. Natomas claimed but did not provide evidence to show that canal lining and crop shifting saved water. Natomas' only legitimate effort was killing thirsty canal weeds, a practice that occurred before 1979 but one that also continued to the present.⁶⁶⁸

The approval of the 1,995 acre-feet was controversial. The USBR, DWR and the State Water Contractors (SWP users) objected on similar grounds, basically arguing that Natomas would be transferring water it did not "own."⁶⁶⁹ A long-term transfer never materialized due in part to Western Water Company's bankruptcy⁶⁷⁰ and in part to Natomas' desire to be cooperative with rather than antagonistic towards DWR and USBR.⁶⁷¹ And although the SWRCB approved the transfers in 2000, afterwards they made a policy of no longer approving them, and none have happened since.⁶⁷²

This transfer reveals the difficulty in vesting a property right to conserved water without a measured and quantified right. Had Natomas and the others had a precise diversion allowance like Wyoming, and if they measured their return flows, then disputes over the transfer would likely disappear. Weed killing likely did lower consumptive use, but the conserved water likely had been used by SWP and CVP users, and regardless, none of this was quantified.

4.6 MWD and Palo Verde

In 1992, Metropolitan Water District successfully negotiated a fallowing transfer with Palo Verde Irrigation District, one of the oldest users along the Colorado River. The transfer was an outgrowth of earlier negotiations in 1986-87 which stalled because of disagreements over price – MWD offered \$135 per acre-foot, and PVID sought \$300.⁶⁷³ The 1991 Drought Water Bank helped Palo Verde farmers compromise on price, showing them that perhaps they were asking too much. While this transfer was initially a success, MWD did not take the water directly but rather stored it in Lake Mead subject to USBR rules. When Lake Mead spilled in 1993, the water flowed to Mexico unused.⁶⁷⁴ Buying water and then having it flow out to sea would happen again to MWD in the northern Sacramento Valley.

⁶⁶⁸ SWRCB, "Water Right Order 1999-012," 22-27.

⁶⁶⁹ Ibid., 4.

⁶⁷⁰ Western Water Company helped facilitate the transfer in order to set a precedent for possible future sales of its rights on the Yuba River. However, by the time the deal went through, instead of a hefty profit, they took a \$20,000 loss on the Natomas-Santa Margarita deal, and eventually filed for Chapter 11 protection. The price garnered from Santa Margarita WD was only 25\$/AF because of questions concerning reliability and timing. Because weeds consume water all the time, the water would be made available continuously, and transferring the water as it "became" available would be difficult. The SWRCB allowed the district to transfer the water on a one-time basis, but exactly when that would occur, exactly how much would be lost to carriage losses through the delta, and if the delta was out of balance that day (smelt, salinity, capacity) provided enough uncertainty to keep the price low.

⁶⁷¹ Tom Barandas, "Interview with Tom Barandas, operations manager for Natomas Central MWC", February 2007; Dale Kasler, "California water-marketing company files for bankruptcy," *Fresno Bee*, May 28, 2005.

⁶⁷² Peter Yolles, "Interview with Peter Yolles, formerly of Western Water Company."

⁶⁷³ Carl Boronkay, Timothy Quinn, Malca Chall, "The passage of the Central Valley Project Improvement Act, 1991-1992," 51.

⁶⁷⁴ Gerald Davisson, "Interview with Gerald Davisson, Engineer with Palo Verde Irrigation District", February 26, 2007, <http://www.crwua.org/AboutUs/OralHistory.aspx>; Palo Verde Irrigation District (Calif.), *Palo Verde Irrigation District land management, crop rotation and water supply program, Riverside and Imperial Counties : draft environmental impact report* (Blythe CA: Palo Verde Irrigation District, 2002), 6-1.

4.7 Rice Farmers and MWD

Metropolitan Water District negotiated option agreements for 205,000 acre-feet from Sacramento Valley districts in 2003.⁶⁷⁵ Most are Central Valley Project Settlement Contractors, and therefore the water transferred is made available from their base supply—that which the USBR recognizes as part of their original rights on the Sacramento River.⁶⁷⁶ Most participating districts solicit requests from their farmers to fallow land at a specified price per acre.⁶⁷⁷ MWD prefers a long-term deal as opposed to single-year option arrangements, but Van Tenney, then general manager of Glenn Colusa Irrigation District, said “Possibly in time we might talk about that, but not now.”⁶⁷⁸

Because MWD does not own the Delta export pumps, the conveyance infrastructure or any storage north of the Delta, if conditions do not work out, MWD risks not being able to have the water delivered. The Delta is “in balance” if the projects have to make specific operational decisions to meet water quality standards.⁶⁷⁹ Put differently, when the Delta is in balance, “all available water is being fully utilized by existing in-basin use, project export, Delta consumptive use, and Delta outflow.”⁶⁸⁰ If the Delta is not “in balance,” then the projects do not have to release water to meet water quality standards, meaning that they are likely pumping as much as they can and there is still plenty of water to flow out the Golden Gate. If the pumps are running at capacity to deliver contract water, there isn’t any more room for transfer water. This was precisely what happened in the 2003 transfer – after they exercised the options in February and March of 2003, the SWP increased its Contractor allocation to 90% from 45%, meaning that the pumps now had much less capacity to wheel transfer water. 100,076 spilled out into the ocean, and the remaining 47,124 was shifted from Lake Oroville to Lake Shasta, where it remains as of 2010.⁶⁸¹ “It is unlikely that this water will ever be repaid to MWD, since repayment needs to occur under certain conditions, including not adversely impacting CVP contractors.”⁶⁸²

Like the Palo Verde deal, a lack of control over the conveyance infrastructure disrupted the water transfer. However, the water transfer did not fail due to poorly defined property rights, despite its similarity to the Areias deal. Both involved water flowing from water-rich districts to MWD, but there are three key differences. The option deals freed up water by fallowing, eliminating neighbors’ concerns that groundwater pumping might increase as a result, the deals were more egalitarian than the Areias deal in that most farmers had the option of fallowing some

⁶⁷⁵ Smith, *Water Strategist*, no. December 2002.

⁶⁷⁶ Despite comments indicating that the transfers should be subject to the CVPIA, the SWRCB points out that these transfers are indeed coming from appropriative rights that the districts hold and not from the contracted supplies. SWRCB, “IN THE MATTER OF LICENSE 1718 (APPLICATION 575), ET AL. TEMPORARY CHANGE INVOLVING THE TRANSFER OF UP TO 57,969 ACRE-FEET OF WATER FROM SEVEN SACRAMENTO RIVER WATER DIVERTERS TO THE METROPOLITAN WATER DISTRICT”, May 13, 2003, 10, http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/2003/wro2003-10.pdf.

⁶⁷⁷ Glenn-Colusa, for example, expected to pay rice farmers \$309/acre based on 3.3 acre-feet evapotranspired for applied water * \$125 MWD payment * 75% (25% held for GCID administrative costs) in the 2005 option deal. If the district receives offers to fallow more acres than is necessary, they have a proportional allocation system set up to allow all farmers who want to participate a chance to do so.

⁶⁷⁸ Sacramento Bee, **December** 18, 2004, Saturday Pg. A3

⁶⁷⁹ SWRCB, *Water Right Decision 1594*, 18.

⁶⁸⁰ *Ibid.*, 18-19.

⁶⁸¹ Politics also exacerbated the storage problem. A dispute over use of MWD’s infrastructure in negotiating a transfer between San Diego and IID led Governor Gray Davis to balk at helping MWD store the water in Oroville.

⁶⁸² Steve Hirsch, Program Manager, Water Transfers and Exchanges, MWD, “2003 rice option question”, February 24, 2010.

of their land if they chose, and the deal was just for one year, allowing the parties to test the arrangement before committing to it.

4.8 Cadiz Water Sale to LA

Cadiz Inc. is a publicly held land and water resource management company. It owns 35,000 acres of land in eastern San Bernardino County east of Twentynine Palms. Although it discusses farming as one of its revenue sources, it never planned on farming its entire 50 square mile block, and currently only farms 1,600 acres near the town of Amboy (north of Joshua Tree NP).⁶⁸³ Initially, they hoped to sell their greatest asset—groundwater—to MWD and then have MWD transfer part of its State Water Project entitlement to the Mojave Water Agency. This would involve Cadiz constructing a 30 mile aqueduct to connect to the MWD’s Colorado River canal to complete the plumbing picture. Although the deal was for a sizable amount of water—40,000 AF—Mojave eventually decided that they could wait ten more years and do without the water as of 1996. Furthermore, a proposed dump near Cadiz property raised doubts about the future quality of the water, a small deterrent in encouraging cities to buy its water.⁶⁸⁴ Finally, environmental studies introduced concern over the health of the aquifer if massive pumping started (salt water intrusion, drying up of springs, etc.). The deal eventually fizzled out, although Cadiz never gave up, and began talking about a combination recharge and transfer project with MWD in the late 1990s.

Keith Brackpool, the CEO/president/chairman of Cadiz, has been involved with Cadiz since the mid 1980s when they began buying land in southern California. Therefore, after 15 years of work, he was heavily invested in making the deal work. Governor Gray Davis, running for re-election in 2000, received \$100,000 for his campaign from Keith Brackpool.⁶⁸⁵ Then, Brackpool was appointed to serve as co-chair on the Governor’s Agriculture and Water transition team, along with Stewart Resnick, another corporate farming giant. It was no surprise, then, that Davis’ administration would encourage transfers. Similar to Areias’ proposed transfer, Cadiz expected that the regulatory hurdles would be simpler because they had political ties.

In 1997, MWD and Cadiz signed an agreement to investigate storing up to 500,000 AF in the aquifer, and during times of drought, MWD would be able to pump back up to 100,000 AF and an undetermined amount of non-banked groundwater.⁶⁸⁶ Eventually, they settled on storing

⁶⁸³ Pascual, Psyche. “Cadiz pins hopes on its water,” The Business Press/California, April 8, 1996

⁶⁸⁴ Cadis vigorously opposed the dump because they claimed their agricultural livelihood was at stake, but everyone knew they just wanted to protect its water to sell it. Rail-Cycle, the name of the proposed landfill, eventually was terminated amid lawsuits and voter opposition.

⁶⁸⁵ “Water marketing: Let’s make a deal”, California Journal August 1, 1999

⁶⁸⁶ During storage operations, Metropolitan will pay \$90 per acre-foot for Colorado River Aqueduct water cycled through the basin (\$50 for put of water and \$40 for return of water), and a \$5 per acre-foot storage fee every year that water is stored in the groundwater basin. On the transfer of water, Metropolitan will pay a base rate of \$230 per acre-foot which will be adjusted according to a water price index. Additionally, recognizing that delivery of CLCI’s high-quality, indigenous groundwater to the Aqueduct provides a significant water quality benefit, Metropolitan will pay CLCI a water quality fee for both transferred and returned water.

The program facilities, including spreading basins, extraction wells, conveyance pipeline and a pumping plant, are estimated to cost between \$125 and \$150 million, and both parties will jointly share these costs. All operational costs of the program, including annual operations, maintenance and energy costs, will be an obligation of Metropolitan.

700,000 AF at a minimum, and buying 1.5 Million Acre Feet of indigenous groundwater over the life of the 50 year agreement.⁶⁸⁷ A pure exchange likely would not have aroused so much opposition, but the whole point, at least from Cadiz's viewpoint, was to sell the water already there, not just bank Colorado River water in wet years. After the details were worked out, MWD finally killed the plan, voting by a slim majority to scrap the deal in October 2002. Cadiz's stock price tumbled immediately after.

Insert Figure 27 - Cadiz stock price

Senator Dianne Feinstein and other environmental and consumer groups strongly opposed the transfer. Consumer groups did not want to see a corporation mine the public's water for profit, despite that Cadiz was the only overlying owner of the Cadiz aquifer. Environmental groups were concerned about animals that relied on springs in the region, claiming that overdraft of the aquifer may dry up springs, hurting the desert tortoise, a threatened species in the area. Dianne Feinstein provided extra muscle in encouraging the MWD board to kill the deal. The board was also concerned by the availability of surplus Colorado River flows in the future. Furthermore, Cadiz was not in perfect financial shape. They were to share the infrastructure costs, which could put MWD in an awkward position if Cadiz couldn't pay. Lastly, project costs were rising, further swaying some board members that the deal was too risky, expensive, and not necessarily worth it.

Basically, Cadiz did not have a quantified right to their groundwater. The desert tortoise and its supporters had an equally valid unquantified claim to the water, and the favorable environmental documents Cadiz produced meant little. However, as of 2011, this proposal has resurfaced, signaling a key difference between this proposal and others – Cadiz plans to pump from an aquifer where it is the *only overlying owner*, and the desert tortoise simply has less clout than a neighboring human user.

4.9 Bass Brothers—San Diego Water Deal

The Bass Brothers, Texas oil and real estate billionaires, bought or optioned to buy 45,000 acres of lands in the Imperial Irrigation District in the early 1990s. They proposed to ship their water entitlements from IID to San Diego, taking water supplied at \$12.50 per acre-foot and selling it for hundreds more. Just like Areias, Cadiz and others, the Bass Brothers claimed political connections would facilitate the deal, and that they had secured the IID board's support.⁶⁸⁸ The Bass Brothers had reason to believe that they would be supported—as the largest single landowner, their voice was important.⁶⁸⁹

However, the proposed deal angered other farmers in the region as would be expected. And even though the Bass Brothers' Western Farms Company was entitled to water for its lands, it did not own the water right—that right was clearly with the Imperial Irrigation District. San Diego backed out in 1996, and decided to work with the district rather than individual landowners.

<http://www.cadizinc.com/c/articles/july15.html> Press Release July 15, 1998

⁶⁸⁷ <http://www.cadizinc.com/c/articles/nov29.html> Press release November 29, 1999

⁶⁸⁸ Hundley, Norris. *The Great Thirst*, 478

⁶⁸⁹ Furthermore, the general manager was the Bass Brothers former water marketing consultant, and questions of influence and stacking the board would later lead to firings and lawsuits in the district.

In this instance, there is not an interconnected groundwater problem as most of Imperial overlies unusable groundwater. But like Areias found out, the district owns and controls the water, and individuals may not assume a property right vests just by land ownership.

4.10 Cabin Bar Ranch

Although Los Angeles Department of Water and Power owns close to 260,000 acres in Owens Valley,⁶⁹⁰ non-LADWP private land in the southern end of the valley still exists. The Cabin Bar Ranch, a 700 acre property near Owens Lake in Inyo County is one of these properties. It has a pure and ample groundwater supply,⁶⁹¹ and the ranch owner decided to market 18,000 acre-feet of water to MWD in the early 1980s, assuming the use of LADWP's aqueducts.⁶⁹² MWD told the owner that the proposal did not meet its requirements in April 1986,⁶⁹³ and Anheuser-Busch bought the property later that year.⁶⁹⁴ Although they proposed to ship their groundwater to their brewery in Van Nuys, CA through Los Angeles' aqueduct,⁶⁹⁵ as of 2000, they had not moved any water.⁶⁹⁶ Crystal Geyser now owns the property with the intention to expand its bottling operations there.

This groundwater transfer is interesting because while Anheuser Busch would have been an appropriator, Crystal Geyser is considered an overlying user because they extract and use the water on land they own (bottling is a use). Crystal Geyser is allowed to use water, but Anheuser Busch has an unquantified right to the basin which could be protested by neighbors and thwarted by environmental documentation.

5 Groundwater Data and Murky Water Rights

An alternative way to see the effects of ambiguous water rights is to examine which districts within California choose to transfer water. Although many factors encourage marketing, in this section, I try to isolate the effect of murky water rights on a district's likelihood of participating in the market.

One way to investigate this is through the interplay between surface and groundwater. Most appropriative rights in California are not quantified or monitored. Furthermore, many surface water users also use groundwater. Groundwater pumping is largely unregulated in the central valley, and because surface water use directly affects the underlying groundwater aquifer, the correlative groundwater right "infects" the surface right. Put differently, users attempting to reallocate 'their' supply may have trouble because the presence of groundwater means that they don't own the entire "bundle of sticks." The following example motivates the idea that groundwater availability matters to users.

⁶⁹⁰ Libecap, "SYMPOSIUM OF WATERBANKS, PIGGYBANKS, AND BANKRUPTCY," 2.

⁶⁹¹ Martin Forstenzer, "Tasty Water Transforms Tiny Olanca," *Los Angeles Times*, June 14, 1996.

⁶⁹² California DWR, *A Catalog of water transfer proposals*, 10.

⁶⁹³ Ibid.

⁶⁹⁴ Patrice Apodaca, "Anheuser-Busch Plan to Bring Water to Brewery Could Set Precedent," *Los Angeles Times*, November 20, 1990.

⁶⁹⁵ They would test a 1986 bill by Assemblyman Katz which stipulated that a public agency must allow use of conveyance facilities to facilitate water transfers if unused capacity existed. *California Water Code*, sec. 1810.

⁶⁹⁶ For this claim, see editorial in the LA Times. "A Toast to Nature," *Los Angeles Times*, November 3, 2000. However, while they did not move any water, they got credit for not pumping their Owens Valley supplies, thus assuring their bottling plant of more reliability should LADWP need to ration. "The Lay of the Land: Summer 2004: Diversions and Dislocations Tour Day 1", n.d., <http://www.clui.org/lotl/v27/day1.html>.

In 1994, a farmer within the Central California ID attempted to sell his surface water supply to Metropolitan WD, legal after CVPIA. He was thwarted by neighbor opposition, in part stemming from their concern that he would pump groundwater instead. Despite him assuring the crowd at district meetings that he would not increase his groundwater pumping, a nearby Los Banos neighbor still asserted “This may very well injure our property,” referring to changes in their shared aquifer⁶⁹⁷. Metropolitan and the farmer soon gave up on the transfer in the face of overwhelming opposition.

There are more examples of groundwater playing a crucial role in surface water transfers. The (second) most celebrated transfer in California – from Imperial ID to MWD – involves a district which has no usable groundwater.⁶⁹⁸ Within the State Water Project, major permanent sellers within Kern County came from the west side of the valley, most of whom have no groundwater below. Within the CVP, the story is similar – small districts along the west side comprise the majority of permanent contract sellers. The Cadiz Transfer, listed above as a failed transfer, is reported to have life, and Cadiz happens to be the only overlying owner of the groundwater resource. From these many examples, it seems probable that shared resources affect resource reallocation. In times of emergency, neighbors may allow a short-term transfer even if they share ownership. But if a user wants to permanently reallocate, they must have a recognized, concrete right – the complete bundle of sticks.

Econometric Approach

If neighboring users are afraid that surface water transfers, even those restricted to just the original consumptive use, may affect their groundwater table, they may try to block the transfer. The fear, irrational or not, that third-parties have about water marketing inhibits water marketing. If this is the case, we ought to observe water market participation varying spatially based on groundwater attributes. Districts without groundwater basins ought to have the easiest time transferring because they will inflict no damage on neighbors. On the other hand, districts that share a basin with many other users may have a much more difficult time doing so. Furthermore, groundwater availability and basin attributes ought to affect different types of transfers. Because short-term transfers are often local, moving water temporarily next door would not arouse disputes. On the other hand, permanently reallocating water will.

The following regressions use the cumulative transfer volume (1981-2008) at the district level as the dependent variable (the independent variables are described in Table 12). The sample consists of districts within California, most of which are within the Central Valley. Non-sellers are included in the first two columns, but columns three and four replicate the analysis with all non-sellers (those that never sell water) dropped from the dataset. Columns 1 and 3 include just short-term transfers (including swaps) while columns (2) and (3) focus on long term and long-term substitute transfers.

Insert Table 16 - Regression of Cumulative District Sales

⁶⁹⁷ Stapley, “‘Farmer’ Areias Takes a Dunking.”

⁶⁹⁸ Mexicans were reliant upon the All American Canal seepage, but they have little sway. In addition, even though the waste water from IID is ‘unusable’, it does replenish the Salton Sea, and only after the legislature exempted IID from any adverse effects on the Salton Sea as a result of the transfer did it proceed. Now, however, the QSA is under attack for this very same issue.

The results support the claim that long-term reallocation transfers come from areas without groundwater. The marginal effect of not overlying a groundwater basin yields an expected increase of between 17,000 and 35,000 acre-feet in long-term sales, although the effect on long-term sales using all districts is not very significant. The effect on short-term selling is insignificant. This is important because it reveals that groundwater basins do not affect short-term sales, confirming that it is a long-term concern about pumping that drives neighbor animosity that can derail transfers.

In addition, districts that overlie a groundwater basin but do not share it with anyone else ought to have a much easier time reallocating water.⁶⁹⁹ I include the number of users that share the basin with the district, using DWR-defined sub-basins, and this confirms the story – a shared basin decreases the quantities sold. Each additional district within the basin causes at least a 100 acre-foot decrease in expected sales. Focusing the regression on just sellers does not substantively alter the regressions.

It is also possible that poor district location decisions within the CVP and SWP are finally yielding reallocations. For example, farmers reliant only on project water thought that with a dependable supply, they could sustain their operations. With less reliability than expected within the SWP and CVP, users may finally be pushed to sell. In this case, the lack of a dependable backup supply hurts these farmers much more than those that have good groundwater, and so it could be that neighbor animosity is not limiting transfers. While this has some merit, these spatial decisions are more than 50 years old, so for this theory to hold, these districts would likely be purchasing water on the short term market to augment their supplies. However, the data do not support this – long-term sellers on average are *not* buying as much water compared to other districts – they average twice as much water sold vs. purchased over the entire period.

What about districts within shared groundwater basins – does the level of groundwater affect their ability to sell? For surface users like Yuba County Water Agency, their large storage reservoir enables them to sell repeatedly as it fills almost every year, and their local needs are mostly satiated. Similarly, districts with falling groundwater tables ought to have a much harder time reallocating partly because their neighbors have more of a concern that these transfers will cause an adverse change to their water table. If districts decide to sell water *because* their groundwater table is increasing, this simultaneous decision making makes it hard to isolate causality. To work around this problem, I construct groundwater depth measures and trends based on up to 10 wells immediately surrounding the district. These groundwater well depths are largely exogenous to an individual district's water supply, but close enough that neighbors may blame the transferring district for adverse effects.

The following regression investigates short-term transfers, with district-level fixed effects to control for unobserved district heterogeneity. The independent variables are described in Table 12.

Insert Table 17 - Regression with GW Tables

The first two columns focus solely on short-term and short-term swap transfers. Column (1) uses a 336 district subset of the districts used in Table 16 (it excludes those without access to groundwater). Column (2) restricts the dataset to just those districts that sell at some point

⁶⁹⁹ Cadiz, a land and water resource development company, failed in its initial effort to transfer water to LA, but the deal is not dead as of 2011, interesting for this story because it is *the* owner of the entire basin in question.

during the 1981-2008 period. The CVPIA and Monterey Agreement positively affect short-term transfers. Rainfall decreases transfer activity, as expected. However, neither the time trend, the groundwater level nor the change in groundwater depth matters for short-term transactions. The results are sensible. Because temporary transfers are temporary and probably have little effect on nearby groundwater tables, because they are occasionally done reciprocally, and because they are often done within the same groundwater basin, concern over groundwater is muted.

If we repeat the analysis for long-term and permanent transfers, including long-term substitute transfers, groundwater availability and trends matter. As before, column (3) includes the entire district subset while column (4) focuses on the 57 districts engaging in long-term reallocation. Long-term transfers do exhibit a positive time trend, indicating that reallocation is increasing over time, a promising trend that indicates that at least some agencies are meeting their water supply needs with transfers.⁷⁰⁰ Interestingly, the rainfall trend is positive and significant among the long-term sellers, likely explained by the long-term substitute transfers which are not set in stone – districts trade frequently with their partners but perhaps give more in wet years. Groundwater depth is not important, but the three-year trend in nearby groundwater levels does seem to negatively affect reallocation. Districts with falling water tables (increasing groundwater depth trends) have a reduced likelihood of reallocating water. This means that neighbors may get involved to restrict transfers from short areas, even though they are perfectly legal.

⁷⁰⁰ This result is different from before because I included long-term substitute transfers as short-term transfers.

Conclusions

Although transferability is normally thought of within the appropriative rights system, most rights in California are appropriative in name only, and the presence of groundwater and riparian water, unregulated, correlative resources, affect most of the surface use in California, making the overall right to water less appropriative and more correlative. Districts where sharing is not an issue find it easier to reallocate.

Many have pushed the idea that legislatures can alter this situation with more effective water right monitoring and control. During the Drought Water Bank, the SWRCB stepped aside and let users reallocate without reviewing transfers for third-party impacts. After the Drought Bank, Gray suggested addressing certain segments of the market to facilitate future emergency reallocations and ensure that third parties aren't negatively affected. Droughts require quick action, at odds with the current SWRCB review process. Therefore, he proposed a pre-approval system to map areas where transfers could originate from without necessitating approval during the drought.⁷⁰¹ To do so, he proposed legislation that would eliminate some of the veto power local agencies have to combat adverse groundwater effects and bring in more water rights under the current system of SWRCB-based regulation. Although nothing like this happened explicitly, in effect, DWR does propose guidelines and author environmental documents offering essentially this – if a transferor meets certain requirements, then they can sell to DWR's Dry Year Purchase Program / Water Bank. They never spent the effort, however, to fully map out and determine groundwater flows, fishery effects, fallowing regions, etc.⁷⁰²

The 2009 Drought Water Bank is a good example of the effectiveness of DWR's efforts. The California Department of Water Resources projected 412,000 acre-feet were potentially available for sale⁷⁰³ at \$275 per acre-foot.⁷⁰⁴ The State Water Project had summer wheeling capacity of 300,000 acre-feet or more given their 40% allocation,⁷⁰⁵ but the restrictions placed on transfer methods, the one-size-fits-all pricing and the onerous environmental documentation whittled down the actual transferred amount to 74,102 acre-feet.⁷⁰⁶ This was a disappointment, especially considering the lost crops along the west side of the San Joaquin Valley.

So while Gray's idea to facilitate emergency water banks seems reasonable, it still relies on using the legal system and the legislature to improve the system. Given the history and the continued difference between legislative intent and reality on the ground, this idea seems farfetched, even if it was possible that the legislature will undertake the massive investment to produce a system that is as tightly monitored as Wyoming's. Currently, then, the uncertainty surrounding true appropriative water rights make it all but impossible to reallocate appropriative water rights.

⁷⁰¹ Gray, "Market and the Community, The," 42+.

⁷⁰² Ibid., 45. Hence, McArthur Ranch and others get a raw deal.

⁷⁰³ California Department of Water Resources, "Water Bank Transfers as of May 2009", May 2009, <http://www.water.ca.gov/drought/docs/0509WaterBankTable.xls>.

⁷⁰⁴ Smith, *Water Strategist*, vol. Dec 2009.

⁷⁰⁵ Teresa Geimer and California Department of Water Resources, "2009 Water Bank Presentation", 2009, 18, <http://www.water.ca.gov/drought/docs/122008DWB-Presentation.pdf>.

⁷⁰⁶ E. Hank et al., *Managing California's Water: From Conflict to Reconciliation* (Public Policy Instit. of CA, 2011), 279–280, <http://www.ppic.org/main/publication.asp?i=944>; Smith, *Water Strategist*, vol. Dec 2010, Sep 2008.

Tables

Table 1

Major California Water Wholesalers			
Wholesaler	Primary Source	Water Right	Water Right/Contract Quantity (estimates, AF)
CVP	Sacramento River	post-1914 App. Right	9,411,491
SWP	Feather River	post-1914 App. Right	4,172,786
Yuba County Water Agency	Yuba River	post-1914 App. Right	400,000
Sonoma County Water Agency	Russian River	post-1914 App. Right	75,000
Metropolitan Water District	Colorado River	post-1914 App. Right	1,100,000
	SWP Wholesaler	Contract	1,900,000
San Francisco Public Utility Commission	Tuolumne River	pre-1914 App. Right	330,000
Kern County Water Agency	SWP Wholesaler	Contract	1,000,000
Solano County Water Agency	Solano Project	Federal Contract	192,350
	SWP Wholesaler	Contract	47,000

Table 2

Irrigated Acres by Source of Water		
	Acres	%
Total Irrigated Acres	7,329,245	
Groundwater		
Only Source	1,923,056	26.2%
Surface Water		
Only Source	2,984,575	40.7%
On-Farm only	293,402	
Off-Farm only	1,191,942	
Multiple Surface Sources	1,499,231	
Surface and Groundwater		
Both GW & Surface Sources	2,421,614	33.0%
Source: 2008 Farm & Ranch Irrigation Survey		

Table 3

Water Transfer Categories in California				
Characteristics	Short-Term -Swaps	Short-Term Transfers	Long-Term/Permanent	Long-Term/Substitute
Description	Transfers within a district or within the same wholesaler (excluding cross-delta transfers)	Short transfers which do not fit in the swap category	Contract sales within a wholesaler (typically the SWP or CVP), long-term leases	Repeated short-term transfers between the same parties which represents an established relationship
3rd Party Review	Often pre-approved or done with little review	Requires SWRCB or more substantial DWR/USBR review, exempt from CEQA	Requires SWRCB or more substantial DWR/USBR review & CEQA	Typically these do not require substantial review.
Duration	≤ 1 year	Mostly ≤ 1 year ⁷⁰⁷	> 5 years, typically much longer	> 9 years

Table 4

Drought Impacts, 1976-1977 ⁷⁰⁸				
Water Year ⁷⁰⁹	Sacramento River Runoff % of normal	San Joaquin River Runoff % of normal	CVP Deliveries	SWP Deliveries
1976	46%	33%	6 MAF	2 MAF
1977	28%	18%	3.3 MAF ⁷¹⁰	.9 MAF ⁷¹¹

Table 5⁷¹²

Water Bank Source	Number of Contracts	Source Share
Fallowing	328	50%
Groundwater Substitution	19	33%
Surface Water Storage	4	17%

⁷⁰⁷ Included are also 2-5 year leases, but these are fairly rare.

⁷⁰⁸ CA DWR, *The 1976-1977 California drought*, 41.

⁷⁰⁹ The 1976 water year starts with winter 1975 to follow the rainy season.

⁷¹⁰ The Central Valley Project cut deliveries 25-75% – Exchange and Settlement Contractors were cut back 25%, while most agricultural contractors saw their deliveries cut by 75%. Urban contractors were cut between 50% and 75%. Their normal deliveries were closer to 7 million acre-feet.

⁷¹¹ The State Water Project cut deliveries by 60%, and the 900,000 acre-feet delivered includes an emergency 400,000 acre-feet exchange involving Metropolitan Water District’s Colorado supply.

⁷¹² Gray, “Market and the Community, The,” 21.

Table 6 - Short-Term Transfer Components

Short-Term				
	Notable Changing Components			
	Total	Environmental Transfers	1991 Drought Bank	Westlands WD
1980	58,558	4,708	0	545
1990	272,426	39,952	78,366	59,618
2000	274,654	163,036	0	37,714

Note: All figures are per-year averages, in acre-feet

Table 7 - Short-Term Swap Components

Short-Term Swaps			
	Notable Changing Components		
	Total	SWP Pool	Westlands WD
1980	94,006	0	5
1990	203,947	70,210	22,290
2000	160,581	47,954	5,596

Note: All figures are per-year averages, in acre-feet

Table 8 - Long-Term Substitute Components

Long-Term Substitute			
	Notable Changing Components		
	Total	Environmental Transfers	Westlands WD
1980	44298	0	1,923
1990	153428	51,796	46,969
2000	222535	47,966	90,214

Note: All figures are per-year averages, in acre-feet

Table 9 - Water Strategist Inaccuracies

Data Comparison between my database and the Water Strategist Acre-Feet traded, 87-05	
WS Transfers 1987-2005, Brewer et al.	11,058,161
Egregious middle men and mistakes	1,001,661
GW Banking	272,089
GW (mostly adjudicated)	1,217,486
Retail recycled water sales	368,871
Exchanges	626,073
WS Transfers 1987-2005, after adjustments	7,571,981
Transfers 1987-2005, my data	13,062,557
Excluded/Missing from WS	5,490,576

Table 10 - Replication Regressions

Replicating Regressions, Yearly Transfers as Dependent Variable, Poisson and OLS								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	cnt_87_05	cnt_87_05	cnt_87_09	cnt_87_09	cnt_87_05	cnt_87_10	cnt_87_05	cnt_87_10
	Poisson	OLS	Poisson	OLS	Poisson	Poisson	OLS	OLS
	WS	WS	WS	WS	WS	WS	WS	WS
VARIABLES					adjusted	adjusted	adjusted	adjusted
lag_annual_population	0.147*** (0.0377)	3.956** (1.363)	0.0483 (0.0325)	0.648 (2.753)	-0.0303 (0.0456)	-0.000814 (0.0397)	-0.605 (1.305)	-0.141 (1.301)
precipitation	-0.0368*** (0.0102)	-0.859** (0.331)	-0.0564*** (0.00821)	-1.578** (0.643)	-0.0333*** (0.0114)	-0.0264*** (0.00946)	-0.616* (0.317)	-0.520 (0.304)
d_1989	0.782*** (0.271)	10.98 (7.012)	0.764*** (0.271)	10.03 (15.82)	0.870** (0.341)	0.880*** (0.341)	7.952 (6.713)	8.066 (7.476)
d_1991	0.803*** (0.190)	22.21*** (7.032)	0.715*** (0.191)	20.07 (15.79)	0.411* (0.243)	0.432* (0.240)	7.724 (6.733)	8.076 (7.461)
d_2000	-0.424*** (0.144)	-12.79** (5.437)	-0.284** (0.145)	-8.481 (12.16)	-0.0805 (0.183)	-0.124 (0.178)	-1.796 (5.205)	-2.420 (5.747)
d_2003	0.268* (0.159)	7.147 (5.751)	0.485*** (0.137)	15.96 (11.54)	0.317* (0.184)	0.260 (0.168)	6.452 (5.506)	5.483 (5.454)
Constant	1.968*** (0.415)	-0.487 (13.27)	2.982*** (0.344)	34.64 (25.46)	2.610*** (0.503)	2.288*** (0.432)	21.45 (12.71)	16.62 (12.03)
Observations	19	19	23	23	19	23	19	23
R-squared		0.738		0.481			0.514	0.451

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	cnt_81_09	cnt_81_09	cnt_87_05	cnt_87_05	cnt_81_09	cnt_81_09	cnt_87_05	cnt_87_05
	Poisson	OLS	Poisson	OLS	no_ULT	no_ULT	no_ULT	no_ULT
	my data	my data	my data	my data	my data	my data	my data	my data
lag_annual_population	0.0647*** (0.0142)	8.321 (5.899)	0.0322* (0.0173)	3.971 (7.037)	0.0449*** (0.0153)	5.023 (4.661)	0.0319* (0.0179)	3.612 (6.825)
precipitation	-0.0265*** (0.00287)	-2.660** (1.012)	-0.0266*** (0.00460)	-3.231* (1.778)	-0.0209*** (0.00314)	-1.856** (0.809)	0.0296*** (0.00480)	-3.322* (1.724)
d_1989	0.128 (0.0844)	2.073 (30.59)	0.112 (0.103)	8.294 (36.24)	0.200** (0.0878)	12.76 (23.94)	0.0961 (0.105)	6.641 (35.15)
d_1991	0.587*** (0.0856)	69.57** (33.53)	0.498*** (0.0929)	62.72 (36.77)	0.458*** (0.0907)	47.76* (26.44)	0.505*** (0.0957)	59.35 (35.66)
d_2000	0.183*** (0.0583)	35.14 (27.00)	0.248*** (0.0618)	42.36 (28.17)	0.147** (0.0633)	25.57 (21.11)	0.147** (0.0654)	22.56 (27.32)
d_2003	0.0453 (0.0549)	2.296 (26.09)	0.0135 (0.0667)	0.535 (32.63)	-0.0505 (0.0599)	-9.598 (20.32)	-0.0791 (0.0744)	-13.59 (31.65)
Constant	4.511*** (0.118)	88.90* (46.92)	4.761*** (0.175)	122.1 (68.92)	4.447*** (0.125)	84.34** (36.35)	4.772*** (0.181)	122.2* (66.84)
Observations	30	30	18	18	29	29	18	18
R-squared		0.714		0.661		0.695		0.543

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Coverage periods are either 1987-2005 (mimics Brewer et al.) or more expansive

Data Sources
WS Water Strategist data as published
WS Adjusted WS data adjusted for irrelevant data and inaccuracies
My Data My dataset, an amalgamation of different sources (see Appendix)
My Data - No ULT Removed transfers carried based on a previous agreement

Table 11

Replicating Brewer. Yearly Volume Transferred (acre-feet) as Dependent Variable								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	87_05	87_09	87_05	87_09	81_09	87_05	81_09	87_05
	WS	WS	WS	WS	my data	my data	my data	my data
VARIABLES			adjusted	adjusted			no_ULT	no_ULT
lag_annual_population	32,988 (44,865)	73,700 (42,852)	-36,637 (23,662)	-4,574 (26,190)	73,797* (37,994)	18,468 (37,657)	64,643** (28,049)	31,282 (36,934)
precipitation	-18,410 (10,908)	-8,835 (10,001)	-12,197* (5,753)	-5,751 (6,112)	-3,362 (6,517)	-9,779 (9,513)	614.0 (4,869)	-12,446 (9,330)
d_1989	409,757 (230,821)	424,217 (246,234)	270,684** (121,737)	277,835* (150,495)	10,400 (197,063)	40,008 (193,936)	44,104 (144,053)	8,395 (190,209)
d_1991	237,127 (231,491)	255,606 (245,760)	-55,404 (122,090)	-29,043 (150,204)	680,182*** (215,982)	583,927** (196,767)	513,519*** (159,082)	554,607** (192,986)
d_2000	-95,454 (178,974)	-145,407 (189,303)	151,291 (94,392)	107,368 (115,699)	366,978** (173,904)	462,472** (150,755)	203,357 (127,032)	222,470 (147,858)
d_2003	360,696* (189,326)	162,787 (179,633)	78,472 (99,852)	-59,012 (109,789)	-91,061 (168,025)	28,000 (174,621)	-268,190** (122,289)	-121,041 (171,265)
Constant	260,621 (436,950)	-185,263 (396,286)	572,279** (230,450)	241,514 (242,204)	-49,226 (302,224)	410,117 (368,787)	-158,057 (218,702)	308,134 (361,700)
Observations	19	23	19	23	30	18	29	18
R-squared	0.610	0.438	0.647	0.356	0.804	0.858	0.770	0.740

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Coverage periods are either 1987-2005 (mimics Brewer et al.) or more expansive

Data Sources
WS Water Strategist data as published
WS Adjusted WS data adjusted for irrelevant data and inaccuracies
My Data My dataset, an amalgamation of different sources (see Appendix)
My Data - No ULT Removed transfers carried based on a previous agreement

Table 12 - Regression Variable Descriptions

Variable	Description
state	State Water Contractor
federal	CVP Contractor
rainindex	Sacramento or San Joaquin rainfall index, location dependent
rain_federal	rainindex*federal
rain_state	rainindex*state
lag_rainindex	Rainindex lagged one year
Lag_rain_fed	Rain_fed lagged one year
Lag_rain_state	Rain_state lagged one year
cvpia	0 before 1992, 1 after
cvpia_fed	cvpia*federal
monterey	0 before 1994, 1 after
monterey_state	monterey*state
year	time trend
year_state	time trend*state
year_fed	time trend* federal
dwb_sell_91	1 for all post-1991 years for districts that participated in the drought water bank
lag_sell	amount sold last year
lag_annual_population	last year's change in population
precipitation	Statewide precipitation measure
Sacindex	Sacramento Rainfall Index
Sac_federal	Sacindex*federal
Sac_state	Sacindex*state
Lagsacindex	Sacindex lagged one year
d_1989	1 for 1989 and all years after
d_1991	1 for 1991 and all years after
d_2000	1 for 2000 and all years after
d_2003	1 for 2003 and all years after
lag_sales	lagged sales amount
area_use	District Area (acres)
nowg_overlie	District does not overly a usable GW basin
shared_with	# districts sharing the same gw basin(s)
gw_3yr_chng	change in groundwater depths from 3 years ago
expord_k	Dummy for Hanak's county export ordinances
gwdepth_avg	average depth that year

Table 13 – Panel Regression

Fixed Effects Regression, SHORT-TERM Yearly Transfer Volume as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	districts short-term	districts swaps	districts no swaps	8groups	8groups swaps	8groups no swaps
cvpia	1,164** (413.7)	404.8 (252.9)	2,205* (1,065)	46,890* (22,646)	12,780 (7,538)	34,111 (20,819)
cvpia_fed	-547.9 (807.4)	22.67 (517.6)	-1,733 (1,237)	-14,874 (37,473)	6,863 (21,599)	-21,737 (23,149)
monterey	81.47 (438.7)	-558.2** (194.1)	1,356 (1,055)	4,139 (19,858)	-21,891* (10,210)	26,030 (22,474)
monterey_state	4,260*** (421.1)	3,261*** (165.4)	1,423 (1,062)	164,716*** (20,754)	97,107*** (8,921)	67,609** (22,900)
rainindex	-360.2*** (72.87)	9.705 (10.79)	1,062*** (96.10)	-14,731*** (3,781)	519.1 (410.8)	-15,250*** (3,767)
rain_federal	355.4*** (78.79)	-16.61 (17.91)	1,064*** (123.9)	14,490** (4,162)	-1,105 (990.8)	15,595*** (3,778)
rain_state	269.1** (80.02)	-13.77 (8.522)	922.0*** (116.8)	11,143** (4,130)	-666.8 (435.6)	11,810** (4,127)
lag_rainindex	-115.7 (70.26)	10.05* (5.245)	-343.3 (203.8)	-4,780 (2,814)	440.3 (253.9)	-5,220 (2,778)
lag_rain_fed	87.04 (73.09)	-31.17** (10.62)	323.1 (213.7)	3,228 (3,048)	-1,667* (768.2)	4,895 (2,877)
lag_rain_state	205.0** (70.87)	135.4*** (5.143)	321.2 (205.4)	8,259** (2,859)	3,630*** (258.8)	4,629 (2,824)
year	-53.66 (31.70)	9.056 (11.52)	-126.4 (109.5)	-2,195 (1,192)	510.6 (432.5)	-2,706* (1,211)
year_state	-129.0*** (25.57)	125.8*** (8.863)	-39.10 (89.19)	-4,981*** (893.6)	-3,828*** (477.3)	-1,153 (1,040)
year_fed	64.74 (35.61)	-2.578 (25.14)	134.9 (94.98)	2,774 (1,618)	-440.4 (1,014)	3,214* (1,364)
dwb_sell_91	75.27 (1,995)	-192.4* (98.74)	-610.9 (2,313)			
sacindex						
sac_federal						
sac_state						
lagsacindex						
Constant	62,718 (47,268)	8,183 (30,860)	104,735 (91,297)	2.919e+06 (2.155e+06)	388,536 (1.262e+06)	2.531e+06 (1.717e+06)
Observations	10,585	8,990	4,698	232	232	232
R-squared	0.014	0.015	0.030	0.263	0.227	0.268
Number of id	365	310	162	8	8	8

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13, Continued

VARIABLES	(7) 3groups	(8) 3groups swaps	(9) 3groups no swaps
cvpia	77,197*** (651.5)	30,388 (15,061)	46,809* (14,443)
cvpia_fed	15,971*** (770.9)	19,146 (9,534)	-3,175 (9,239)
monterey	-53,368* (13,340)	-106,924 (90,681)	53,556 (82,884)
monterey_state	233,438*** (3,416)	191,324 (87,606)	42,114 (84,192)
rainindex			
rain_federal			
rain_state			
lag_rainindex			
lag_rain_fed			
lag_rain_state			
year	480.0 (726.0)	4,166 (4,086)	-3,686 (3,718)
year_state	-9,875*** (183.0)	-8,922 (4,693)	-953.6 (4,511)
year_fed	7,660*** (39.87)	-1,158 (493.1)	8,818*** (477.8)
dwb_sell_91			
sacindex	-20,891*** (341.0)	3,897 (4,196)	-24,787** (4,135)
sac_federal	29,368*** (31.25)	-2,292** (386.5)	31,659*** (374.5)
sac_state	17,216*** (174.0)	-4,016 (4,462)	21,232** (4,288)
lagsacindex	-1,095 (2,549)	838.4 (1,766)	-1,934 (1,468)
Constant	661,114 (1.429e+06)	-1.582e+06 (4.769e+06)	2.243e+06 (4.119e+06)
Observations	87	87	87
R-squared	0.461	0.267	0.498
Number of id	3	3	3

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 14 – Panel Regression 2

Fixed Effects Regression, SHORT-TERM Yearly Transfer Volume as Dependent Variable, Drought Bank Sellers and Buyers Flagged			
VARIABLES	(10) districts	(11) districts swaps	(12) districts no swaps
cvpia	965.3 (517.6)	399.1 (281.5)	1,625 (1,707)
cvpia_fed	-442.9 (812.9)	20.70 (533.1)	-1,362 (1,743)
monterey	115.9 (437.0)	-557.3** (191.3)	1,405 (1,057)
monterey_state	4,052*** (447.5)	3,257*** (133.8)	1,304 (1,187)
rainindex	-352.3*** (75.90)	9,834 (12.77)	-1,050*** (116.1)
rain_federal	346.7*** (81.62)	-16.74 (19.68)	1,052*** (142.2)
rain_state	249.0** (86.80)	-14.11 (13.30)	905.6*** (148.9)
lag_rainindex	-113.5 (68.42)	10.11 (5.850)	-336.8 (196.9)
lag_rain_fed	85.17 (72.01)	-31.17** (11.06)	318.1 (209.5)
lag_rain_state	210.2** (69.58)	135.5*** (4.153)	323.6 (200.2)
year	-44.65 (26.24)	9.185 (13.67)	-115.6 (85.68)
year_state	-170.2*** (21.21)	-126.5*** (18.16)	-71.82 (63.30)
year_fed	53.56 (30.99)	-2.809 (26.15)	120.3 (75.56)
dwb_sellbuy_91	3,699*** (226.6)	54.25 (700.4)	3,061*** (794.4)
Constant	66,118 (45,543)	8,346 (30,658)	112,974 (87,089)
Observations	10,585	8,990	4,698
R-squared	0.018	0.015	0.033
Number of id	365	310	162
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Table 15 - Long-Term Poisson Regression

Poisson Regression, Long-Term Transfers			
VARIABLES	(1) long-term	(2) long-term	(3) long-term
cvpia	-13.67 (1,201)	-13.73 (1,200)	-13.67 (1,200)
monterey	16.51 (1,201)	16.51 (1,200)	16.60 (1,200)
sacindex	0.0171 (0.0763)	0.0174 (0.0762)	
year	-0.282*** (0.100)	-0.284*** (0.0995)	-0.290*** (0.0951)
d_1989	2.655** (1.109)	2.629** (1.071)	2.593** (1.056)
d_1991	-0.104 (1.241)		
d_2000	2.077*** (0.616)	2.083*** (0.612)	2.036*** (0.575)
d_2003	0.709 (0.557)	0.713 (0.554)	0.756 (0.519)
Constant	559.0*** (199.5)	561.4*** (197.6)	574.4*** (188.5)
Observations	29	29	29
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Table 16 - Regression of Cumulative District Sales

Cross Section OLS Regression Explaining Cumulative District Sales				
VARIABLES	(1) short-term	(2) long-term	(3) short-term sellers_only	(4) long-term sellers_only
state	-1,202 (19,538)	-11,784 (8,317)	-58,662 (49,797)	-38,164** (18,086)
federal	4,013 (9,929)	13,646** (6,325)	-54,053 (38,299)	-950.4 (15,700)
area_use	0.153*** (0.0286)	0.0788** (0.0332)	0.145*** (0.0345)	0.0839*** (0.0318)
nogw_overlie	19,908 (33,307)	17,067 (10,757)	38,374 (59,355)	35,216* (18,172)
shared_with	-74.79 (81.59)	-109.8** (48.95)	-36.04 (173.1)	-191.9** (91.50)
Constant	15,993* (9,583)	7,943* (4,652)	79,023** (38,875)	33,970** (15,104)
Observations	376	376	205	205
R-squared	0.112	0.072	0.135	0.084
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 17 - Regression with GW Tables

OLS Regression, District Transferability and Groundwater Tables, Panel Data				
VARIABLES	(1) short-term	(2) short-term sellers only	(3) long-term	(4) long-term sellers only
year	-6.264 (13.36)	-19.94 (28.61)	32.34*** (8.150)	272.1*** (56.70)
rainindex	-141.6*** (28.24)	-285.6*** (54.67)	25.47 (17.22)	327.6** (138.0)
gw_3yr_chng	-3.707 (4.911)	-6.709 (9.195)	-5.725* (2.995)	-29.71* (16.99)
expord_k	-125.6 (255.1)	-253.1 (476.4)	-209.5 (155.6)	-1,215 (1,064)
gwdepth_avg	6.697 (5.434)	9.683 (10.42)	2.892 (3.314)	11.46 (18.44)
cvpia	459.8* (251.7)	897.1* (494.1)	191.6 (153.5)	-16.81 (1,028)
monterey	5,350*** (605.9)	7,794*** (1,017)	106.0 (369.5)	-2,132 (1,742)
Constant	13,511 (26,589)	41,803 (56,985)	-64,403*** (16,217)	-541,773*** (112,972)
Observations	8,482	4,528	8,482	1,322
R-squared	0.013	0.021	0.007	0.045
Number of id	336	181	336	57
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 18 – Example of Colorado Abandonment List⁷¹³

Example Colorado Abandonment List - December 31 2001							
Structure Name	Source Stream	Decreed Amount	Abandoned Amount	Remaining Amount	Units	Adjudication Date	Appropriation Date
A B C DITCH	SIMON DRAW	2	1	1	C	12/31/1970	5/15/1912
ALBRIGHT SPRING PL AND D	BEAVER CREEK	1	1	0	C	3/7/1966	5/1/1907
ALEXANDER DITCH	RITTER DRAW WILLIAMS CREEK	1	0.5	0.5	C	3/22/1963	12/22/1933
ALEXANDER WELL	CREEK	0.033	0.033	0	C	12/31/1973	10/9/1973
ALLEN NO 1 DITCH	DAWSON DRAW	1.4	0.9	0.5	C	8/14/1962	9/2/1943
AMYS PUMPSITE	COYOTE CREEK	1.5	1.5	0	C	12/31/1979	1/11/1977
ANDERSON WW DITCH #2	PINE DRAW	1	1	0	C	12/31/1983	6/30/1965
ARCHULETA CO WELL NO 1	GROUNDWATER	0.75	0.42	0.33	C	12/31/1979	12/31/1930
ARCHULETA CO WELL NO 2	GROUNDWATER	0.75	0.42	0.33	C	12/31/1979	12/31/1935

⁷¹³ Kenneth Beegles, Division Engineer and Hal Simpson, State Engineer, “Revised Abandonment List”, December 31, 2011, <http://water.state.co.us/pubs/abandonment.asp>.

Table 19 - WY Short-Term Transfer Uses⁷¹⁴

Using Wyoming’s “Temporary Use” Statute W.S. § 41-3-110 (January 1, 1997 through July 31, 2011 statewide)	
Use	Temp Changes by Use
Agricultural	13
Domestic	22
Dust Control	35
Flow-through	4
GW Recharge	5
Industrial	204
Irrigation	292
Municipal	95
<i>*Oil and Gas</i>	350
Pipeline Construction	99
<i>*Railroad</i>	14
<i>*Road Construction</i>	149
Snow Making	1
Stock	38
<i>*Highway Construction</i>	650
Total	1,971

⁷¹⁴ Pat Tyrrell, Wyoming State Engineer, “Water and Energy in Wyoming: Using Wyoming’s ‘Temporary Use’ Statute_ W.S. § 41-3-110” (Wyoming Bar Association, September 16, 2011).

Table 20 - Wyoming Water Timeline

	Wyoming Water Rights Administration	Wyoming Transfers
1860	1868 - Wyoming becomes a territory 1869 - First territorial water laws direct appropriators to not injure others ⁷¹⁵	
1870	1876 – First attempt to grant authority to a watermaster if conditions warrant, but stream regulation is equitable rather than based on seniority ⁷¹⁶	
1880	1886 – Adopts Colorado’s water right administrative system enacted in CO in 1879 and 1881. ⁷¹⁷ Legislation establishes water commissioners in 8 districts, tasked with respecting priority and stream regulation. Requires notice of appropriation filed with county clerk as well as retroactive filing for previous appropriations. ⁷¹⁸ Like other states, <i>laws do not restrict freedom</i> of appropriators to use streams as they see fit. ⁷¹⁹ 1888 – Elwood Mead becomes first territorial engineer, drafts materials related to waters for state constitution in preparation for presentation to Congress in 1889. His proposals were a result of observed failures in Colorado. ⁷²⁰	
1890	1890 – Statehood 1890 – Mead and the legislature craft state’s first water law, the “result was a clean and readable fifteen-page act combining the acceptable attributes of the past thirty years of trial and error in the use of Wyoming’s streams with the emerging science of irrigation.” ⁷²¹ State requires permit and inspection to acquire water right, and it is the exclusive method of acquiring rights. Silent on transferability. 1896 – Wyoming Supreme Court affirms that riparian right “is unsuited to our requirements and necessities, and never obtained in Wyoming.” ⁷²²	1894 – Supreme Court rules water rights are transferable like property ⁷²³
1900	1907 – From 1886 until 1907, water commissioners often worked only one season. In 1907, the legislature rescinded the two year limit, but most still only worked just a very few years until the 1930s and 1940s. ⁷²⁴	1909 – State outlaws water right transfer to prevent speculation, although allows exception for preferred uses (domestic use, transportation) by condemnation and rotation among irrigators. ⁷²⁵
1910	1914 – “At least two-thirds of the water used in Wyoming is not measured out to the consumer, and scarcely any is measured at all accurately.” ⁷²⁶	1913 – Permits (pre-adjudication) were made amendable, but it is unclear how this statute was applied. ⁷²⁷

⁷¹⁵ Craig Cooper, “History of Water Law, Water Rights & Water Development in Wyoming,” 10.

⁷¹⁶ Ibid., 12.

⁷¹⁷ R. G Dunbar, *Forging new rights in western waters* (University of Nebraska Press, 1983), 105.

⁷¹⁸ Craig Cooper, “History of Water Law, Water Rights & Water Development in Wyoming,” 13–14.

⁷¹⁹ Dunbar, *Forging new rights in western waters*, 87.

⁷²⁰ Ibid., 105.

⁷²¹ Craig Cooper, “History of Water Law, Water Rights & Water Development in Wyoming,” 22.

⁷²² Dunbar, *Forging new rights in western waters*, 82.

⁷²³ Trelease and Lee, “Priority and Progress-Case Studies in the Transfer of Water Rights,” 7.

⁷²⁴ Craig Cooper, “History of Water Law, Water Rights & Water Development in Wyoming,” 109.

⁷²⁵ Trelease and Lee, “Priority and Progress-Case Studies in the Transfer of Water Rights,” 11.

⁷²⁶ Craig Cooper, “History of Water Law, Water Rights & Water Development in Wyoming,” 110.

⁷²⁷ Trelease and Lee, “Priority and Progress-Case Studies in the Transfer of Water Rights,” 13.

1920	1922 – All rights acquired before 1890 finally quantified. ⁷²⁸	1921 – Legislature amends 1909 law to allow changes in place of use for reservoir water. ⁷²⁹
1930	Late 1930s – Two hydrographer-commissioners were finally employed by the State Engineer, having water measuring skills and the ability to regulate streams on the basis of measured streamflow and diversions. ⁷³⁰	1934 – Courts confirm exception that pre-1909 rights may be transferred as long as the owner doesn't change. ⁷³¹
1940	1947 – All new wells (except domestic/stock wells) must register with the State Engineer, priority date equal to their filing date. Pre-1947 wells must file statement of claim with State Engineer, acquiring priority based on well completion date. ⁷³² State engineer disappointed at the bill's inadequacy. ⁷³³	1947 – Appropriators could exchange water if supplies were insufficient or if they could make a better use of the water. ⁷³⁴
1950	1957 – Wyoming passes bill requiring permits before well construction, and establishes groundwater districts and sub-districts with elected advisory boards to manage concerns in "critical areas." ⁷³⁵ 1958 – All Divisions have hydrographers, but Water Division 4 still critical: "At present salaries it is not possible to get men to make proper distribution of water, as very few are qualified to make stream measurement by current meter or other methods. Usually a farmer or rancher, without proper training in hydrography, must be relied upon to divide water among his neighbors, which usually proves a thankless job." ⁷³⁶	1952 – Water rights from lands submerged by reservoirs may be transferred. ⁷³⁷ 1955 – Steam plants were granted preferred status and thus could condemn post-1955 rights. ⁷³⁸ 1959 – Temporary transfers legal – originally passed for highway construction purposes, but now any use is acceptable. Statutes now limit transfers to historic consumptive use (State Engineer can assume 50% return flows). They are junior to permanent rights, severely limiting usefulness. ⁷³⁹
1960	Excluding Water Division One, it wasn't until the 1960's that accurate stream regulation when someone "called the river" finally became possible on the major rivers. ⁷⁴⁰	
1970		1973 – State rescinds 1909 law restricting transfers, receives 42 applications between 1974 to 1989. ⁷⁴¹
1980		
1990	1991 – Water Commissioners become state employees as opposed to County employees. ⁷⁴²	
2000	Although staffing permits regulation on all streams, some streams never are regulated, some always are – it depends on the stream and the users. ⁷⁴³	

⁷²⁸ Squillace, "Water Marketing in Wyoming," 874.

⁷²⁹ Trelease and Lee, "Priority and Progress-Case Studies in the Transfer of Water Rights," 12.

⁷³⁰ Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming," 110.

⁷³¹ Trelease and Lee, "Priority and Progress-Case Studies in the Transfer of Water Rights," 11.

⁷³² Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming," 64.

⁷³³ Dunbar, *Forging new rights in western waters*, 179.

⁷³⁴ Trelease and Lee, "Priority and Progress-Case Studies in the Transfer of Water Rights," 15.

⁷³⁵ Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming," 71.

⁷³⁶ *Ibid.*, 110.

⁷³⁷ Trelease and Lee, "Priority and Progress-Case Studies in the Transfer of Water Rights," 16.

⁷³⁸ *Ibid.*, 18.

⁷³⁹ Squillace, "Water Marketing in Wyoming," 888.

⁷⁴⁰ Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming," 110.

⁷⁴¹ Squillace, "Water Marketing in Wyoming," 891.

⁷⁴² Craig Cooper, "History of Water Law, Water Rights & Water Development in Wyoming," 110.

⁷⁴³ Anne MacKinnon, "Historic and Future Challenges in Western Water Law: The Case of Wyoming," 320.

Table 21 - California Water Timeline

	California Water Right Administration	California Transfers
1850	1850 – Statehood - Common Law Riparian Rights Established 1854 – First law addressing water control – a majority of voters could elect water commissioners (in agricultural counties only) to manage ditches and apportion water. ⁷⁴⁴	
1860	1862 – Update to 1854 law, but these laws do not affect wide areas, and are not used. ⁷⁴⁵	
1870	1872 - First statewide law aimed at regulating appropriations requires filing claim with county and posting notice at point of diversion. Leads to inflated claims and is not enforced.	
1880	1886 – CA Supreme Court confirms validity of both Appropriative and Riparian rights	1886 – As a result of <i>Lux v Haggin</i> downstream riparian Miller and Lux transfer summer flows to upstream appropriator Haggin.
1890		
1900	1903 – CA establishes correlative groundwater rights (the CA Doctrine)	
1910	1913 – CA adopts Wyoming System of Water Right administration, excluding groundwater, riparian and pre-1914 appropriative rights from its control.	
1920	1928 – CA amends Constitution to enforce reasonableness upon Riparians	
1930-50		
1960		Economists push transfers as an alternative to the SWP but fail.
1970	1978 – Governor’s Commission to Review CA Water Rights Law – proposes updates to water code, but nothing substantial save for emphasis on short-term transfers. 1978 – Water Right Decision 1485 establishes Delta water quality standards for which the projects bear responsibility, leading to Term 91 as a crude method of priority enforcement.	
1980		1980 – Short-term water transfer statutes passed. 1987 – 1 st large temp transfer from YCWA across the Delta. 1987 – MWD and IID sign conservation transfer.
1990		1991 – Drought Water Bank shows the possibilities of water markets.
2000		Transfers remain mostly temporary except for project reallocations.
2010	Outside of adjudicated basins, most streams are not regulated in real-time. Practically all rights remain unmeasured and unquantified.	DWR and USBR control transfers across the Delta, severely hindering north-south movement because of the lack of quantification and measurement.

⁷⁴⁴ D. J. Pisani, “From the family farm to agribusiness: the irrigation crusade in California, 1850-1931” (1984): 41.

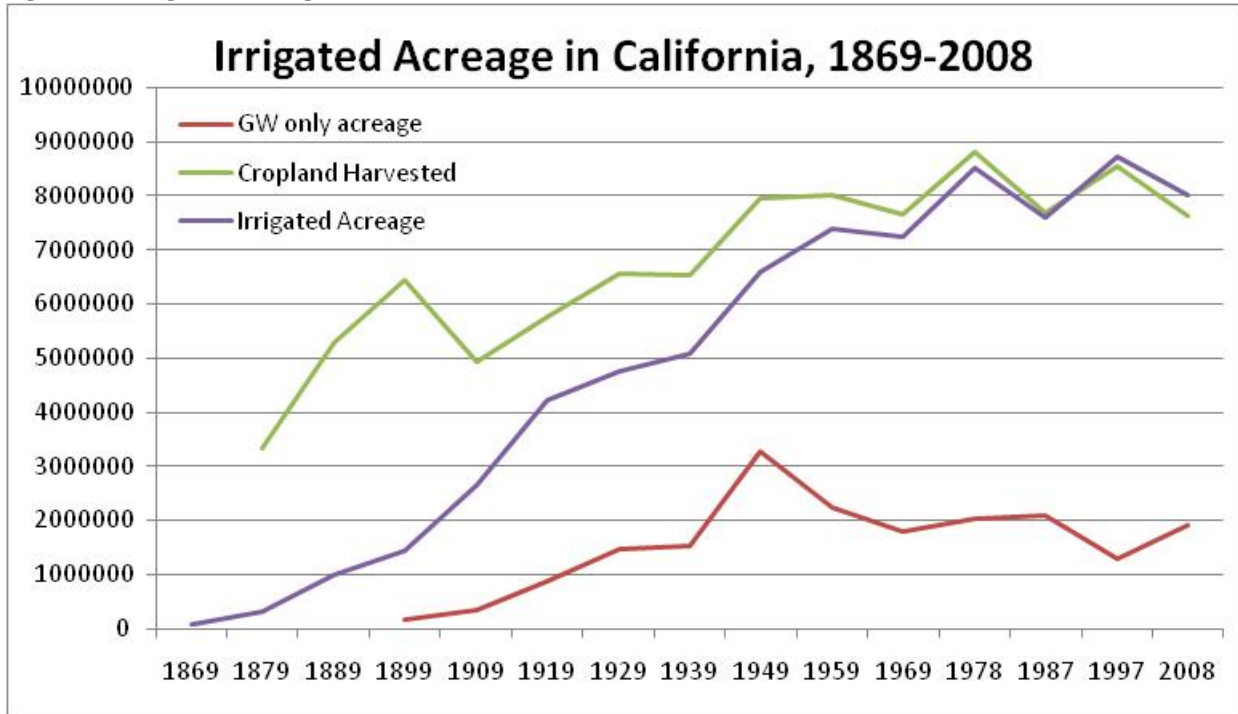
⁷⁴⁵ *Ibid.*, 43.

Table 22

Missing Internal Market Data, Estimates												
Transfer Type	Internal District Transfers				Estimates for Missing Internal Agency Transfers							
	West-lands	Arvin-Edison	Berrenda-Mesa	Delano-Earlimart	KCWA	Kings River	Kaweah River	Tule River	San Fran	Sonoma Cty WA	Solano Cty WA	Total
Swaps	85000	10521	10000	3000	20000	10000	15000			1000	40000	194521
Water Right Sales							500					

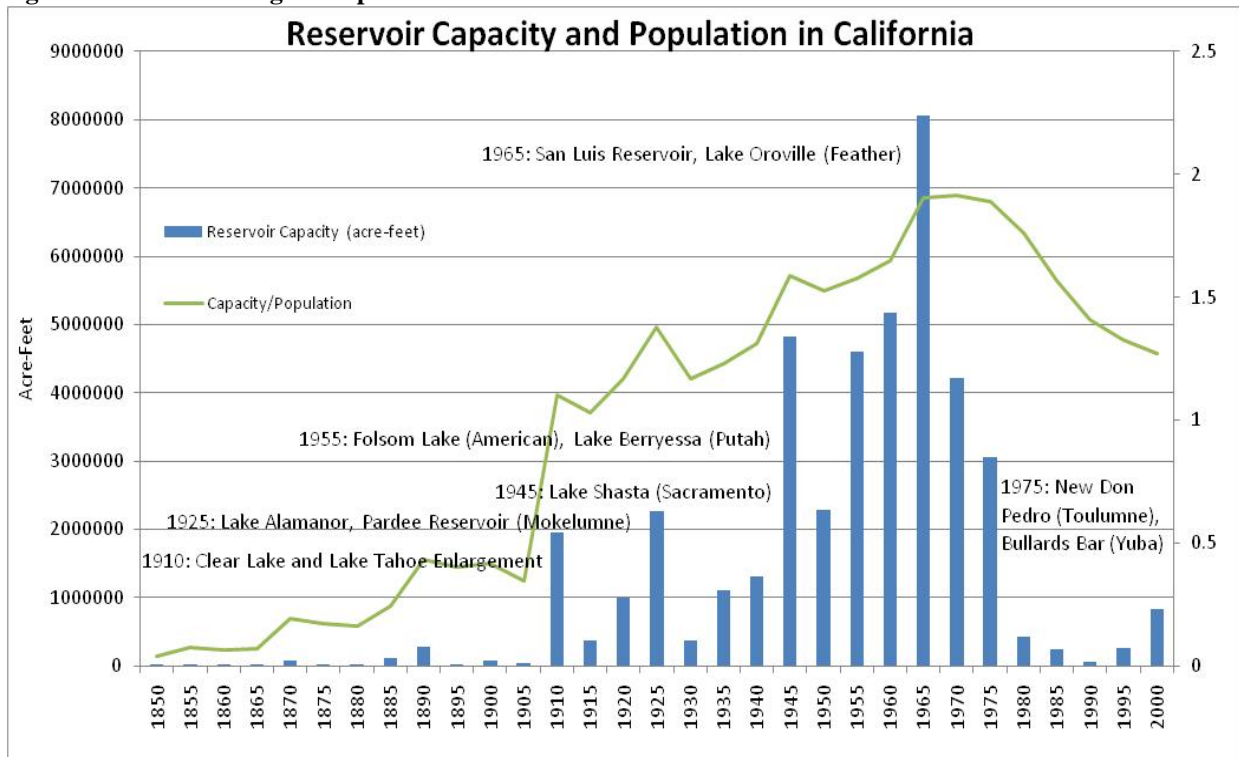
Figures

Figure 1 – Irrigated Acreage⁷⁴⁶



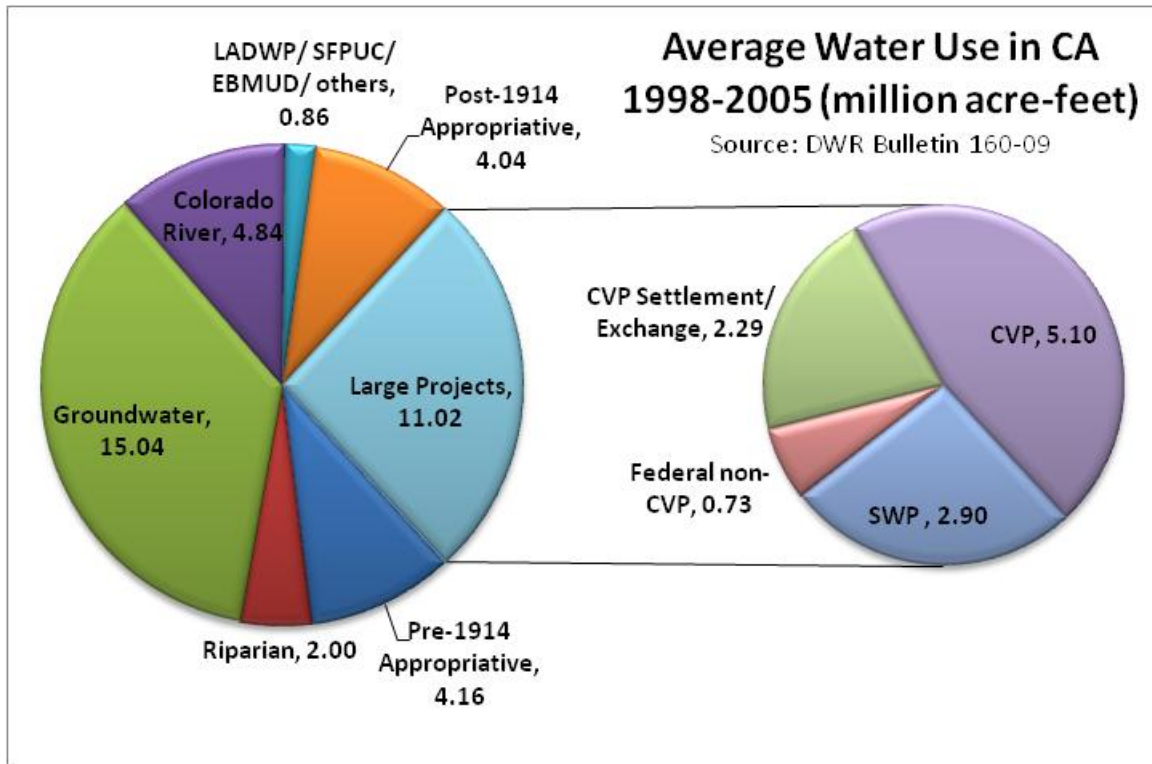
⁷⁴⁶ For irrigated acreage trends, see Giannini Foundation of Agricultural Economics, *California agriculture*, 4. For groundwater-only irrigated acreage, see the following agricultural census reports for each year, and beginning in 1978, the Farm and Ranch Irrigation Survey, a supplement to the Census of Agriculture. Specifically, see United States, *Fifteenth Census of the United States*, 88; United States., *U.S. Census of Agriculture, 1950, Vol. 3- Irrigation of Agricultural Lands.*, 1950, 3-3; United States., *2007 census of agriculture.* (Washington DC: United States Dept. of Agriculture National Agricultural Statistics Service, 2010), 25; United States., *Census of agriculture, 1992.* (Washington D.C.: U.S. Dept. of Commerce Economics and Statistics Administration Bureau of the Census, 1996), 20; United States., *2002 census of agriculture.* (Washington, DC :: U.S. Dept. of Agriculture, National Agricultural Statistics Service., 2004), 25; United States., *1997 census of agriculture.* (Washington D.C.: U.S. Dept. of Agriculture National Agricultural Statistics Service, 1999), 20; United States., *1978 census of agriculture.* (Washington D.C.: U.S. Dept. of Commerce Bureau of the Census, 1982); United States., *1982 census of agriculture.* (Washington D.C.: U.S. Dept. of Commerce Bureau of the Census, 1984), part 5, pg 1.

Figure 2 – Dam Building vs. Population⁷⁴⁷



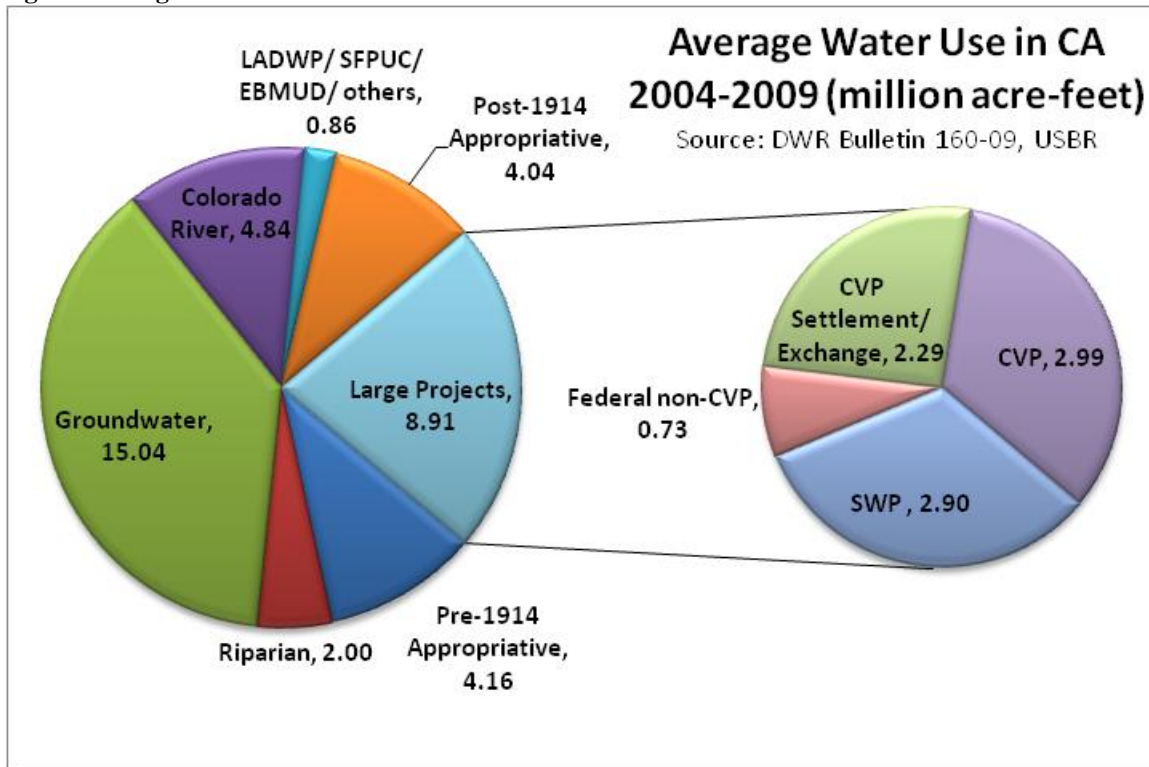
⁷⁴⁷ Division of Safety of Dams, “Dams Within the Jurisdiction of the State of California”; US Census Bureau, “Resident Population and Apportionment of the U.S. House of Representatives.”

Figure 3 – Avg Water Use in CA – 1998-2005⁷⁴⁸



⁷⁴⁸ California Department of Water Resources, *California Water Plan Update 2009 Volume 5-Technical Guide - Water Portfolios*.

Figure 4 – Avg Water Use in CA – 2004-2009⁷⁴⁹



⁷⁴⁹ Ibid.; USBR Mid Pacific Region, “2008 Water Rates and Deliveries.”

Figure 5

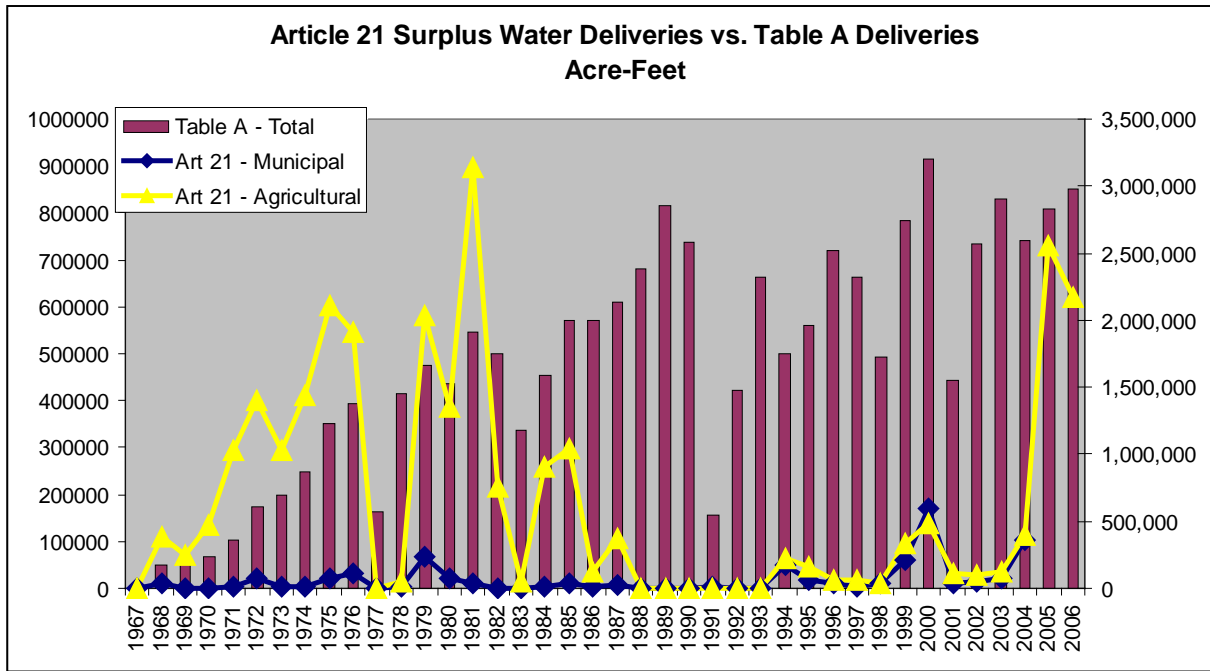


Figure 6 – Owens Valley Exports to Los Angeles

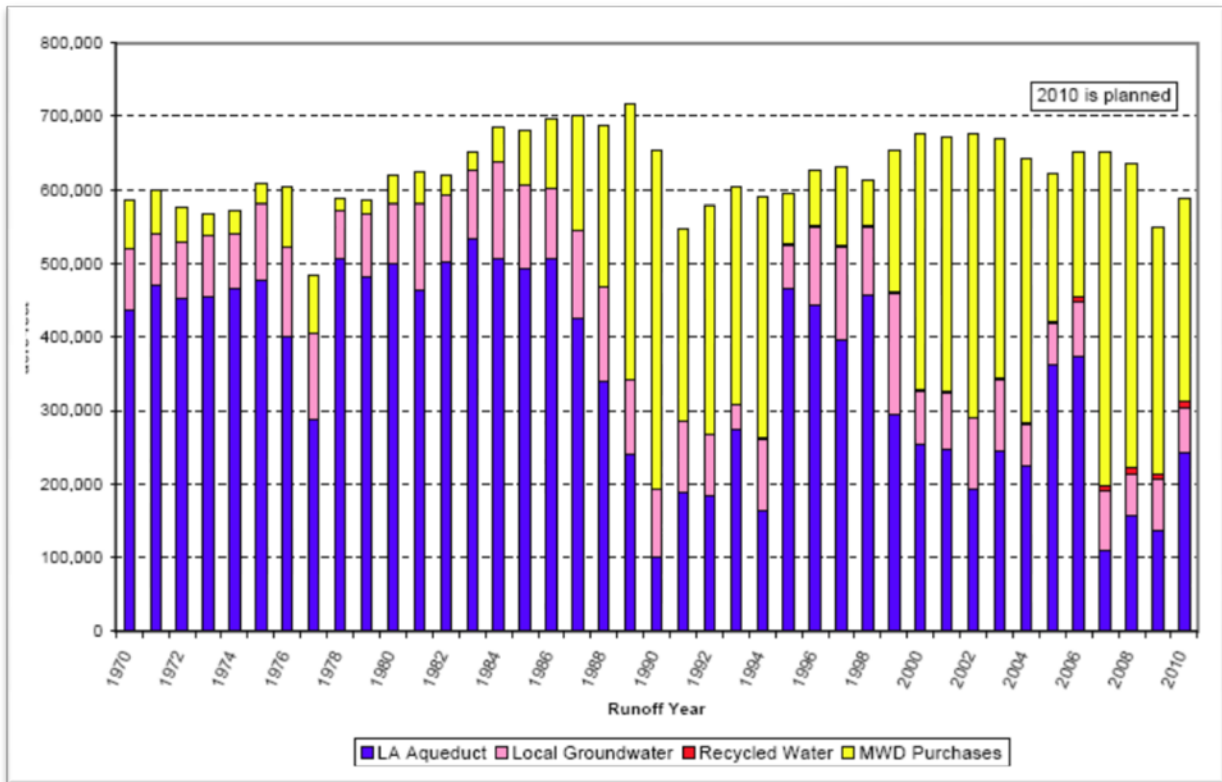


Figure 7 – Ramped Up Deliveries to MWD

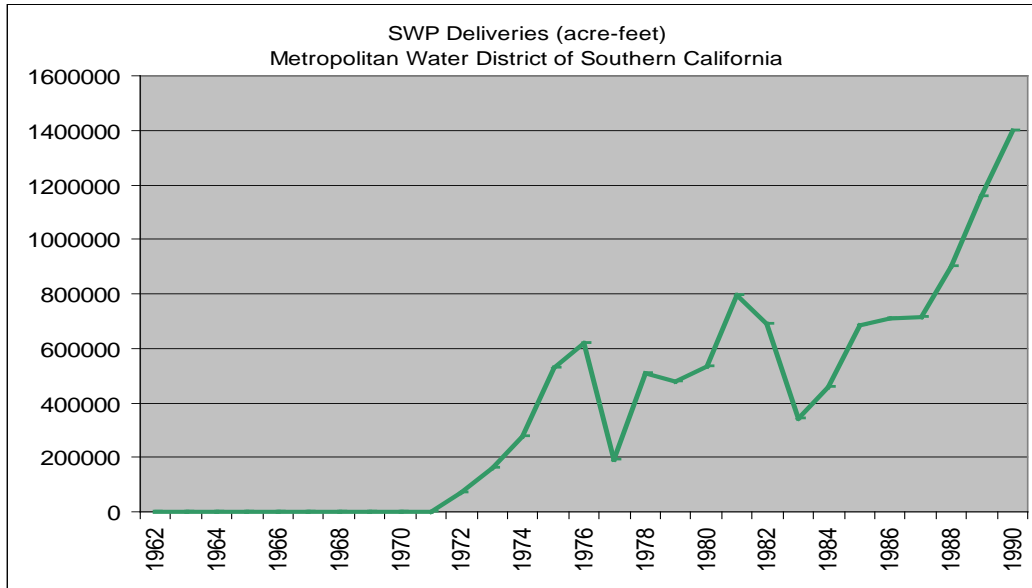


Figure 8 – SWP TurnBack Pool Data 1996-2009

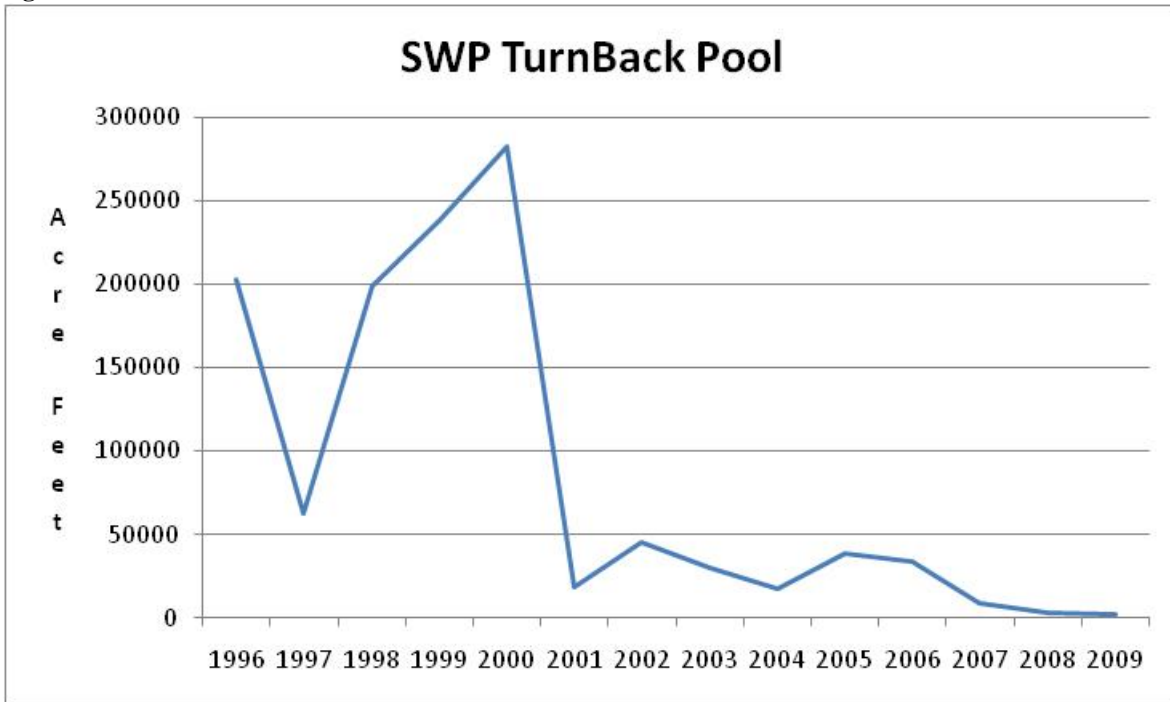


Figure 9 – EWA Transfers

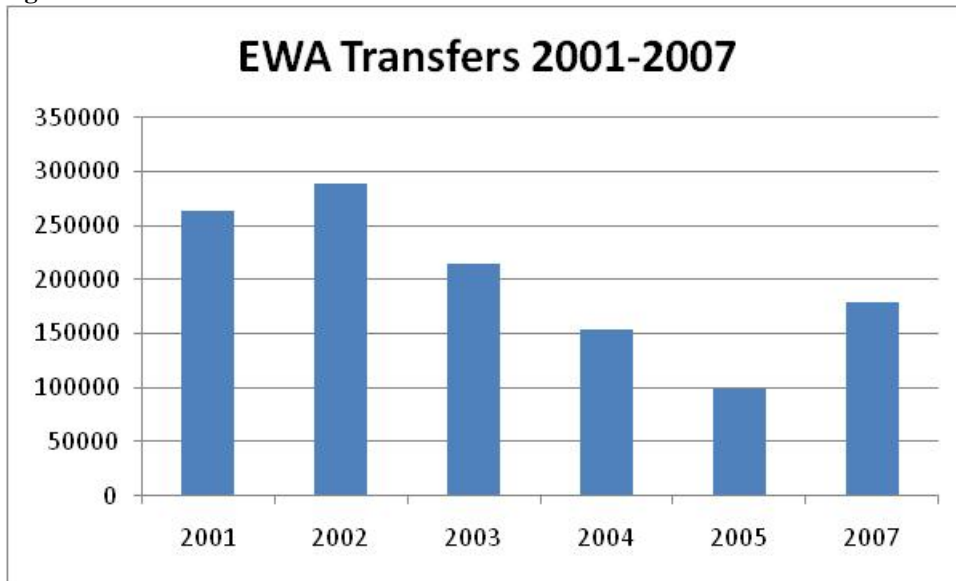


Figure 10 – YCWA Transfers 1985-2009

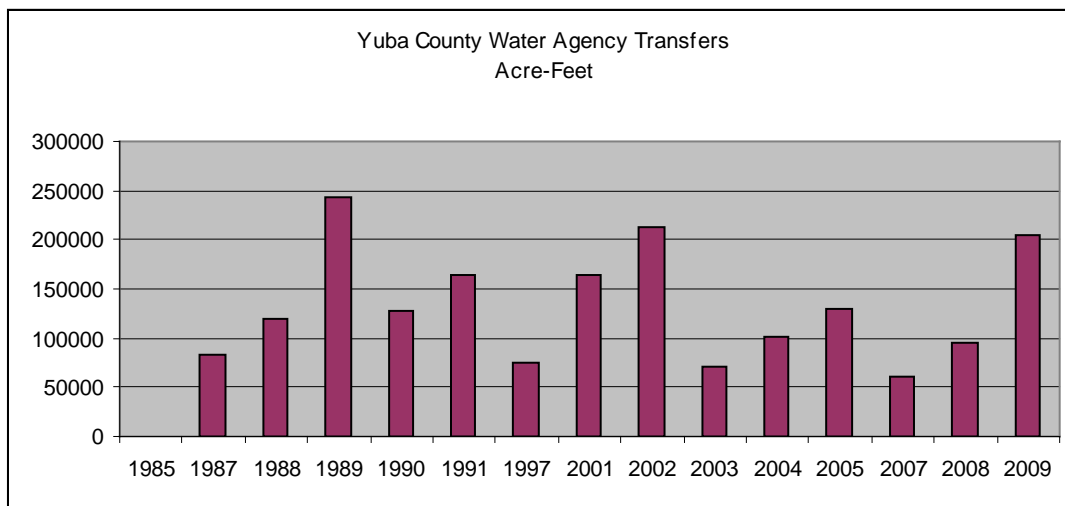


Figure 11

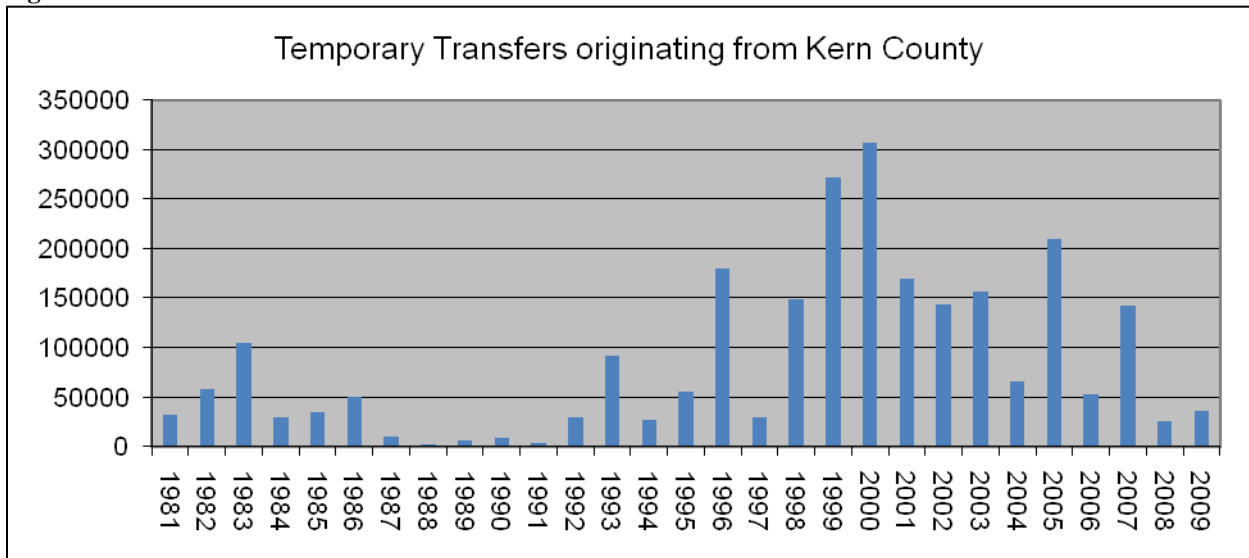


Figure 12 - Average Yearly Transfers, 1980s

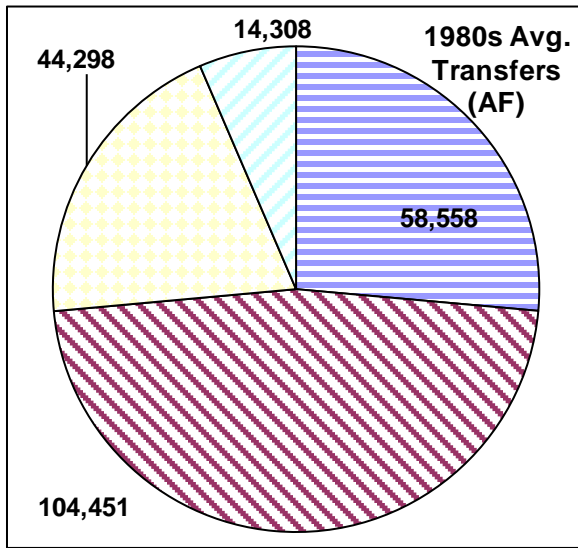


Figure 13 - Average Yearly Transfers, 1990s

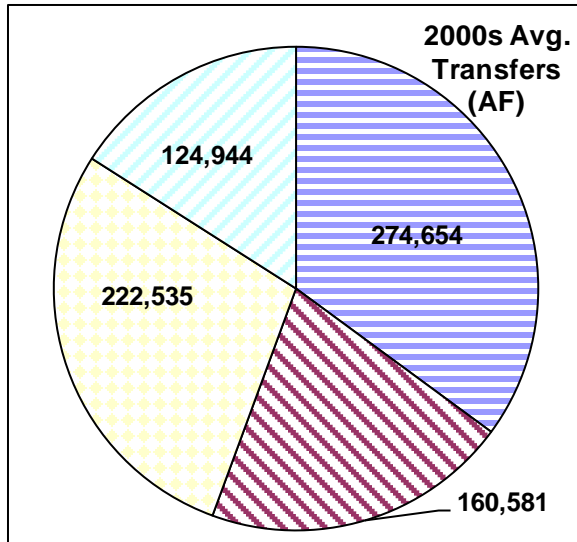
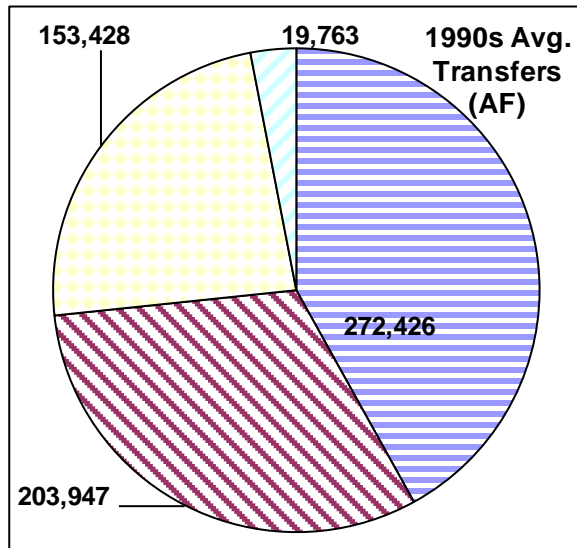


Figure 14 - Average Yearly Transfers, 2000s

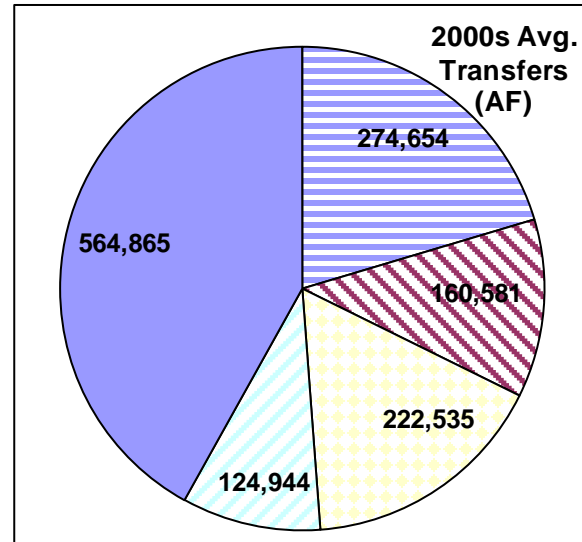


Figure 15 - Average Yearly Transfers, 2000s
Previous Commitments Included

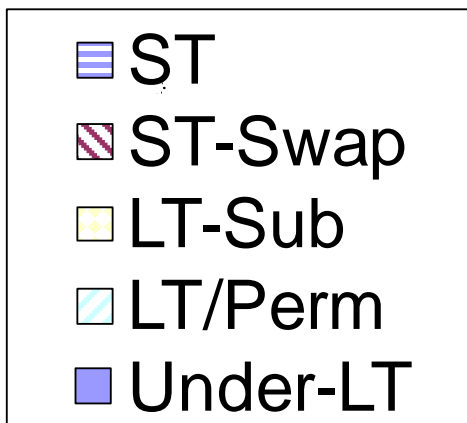


Figure 16
Transfer Time Trends, in Acre-Feet

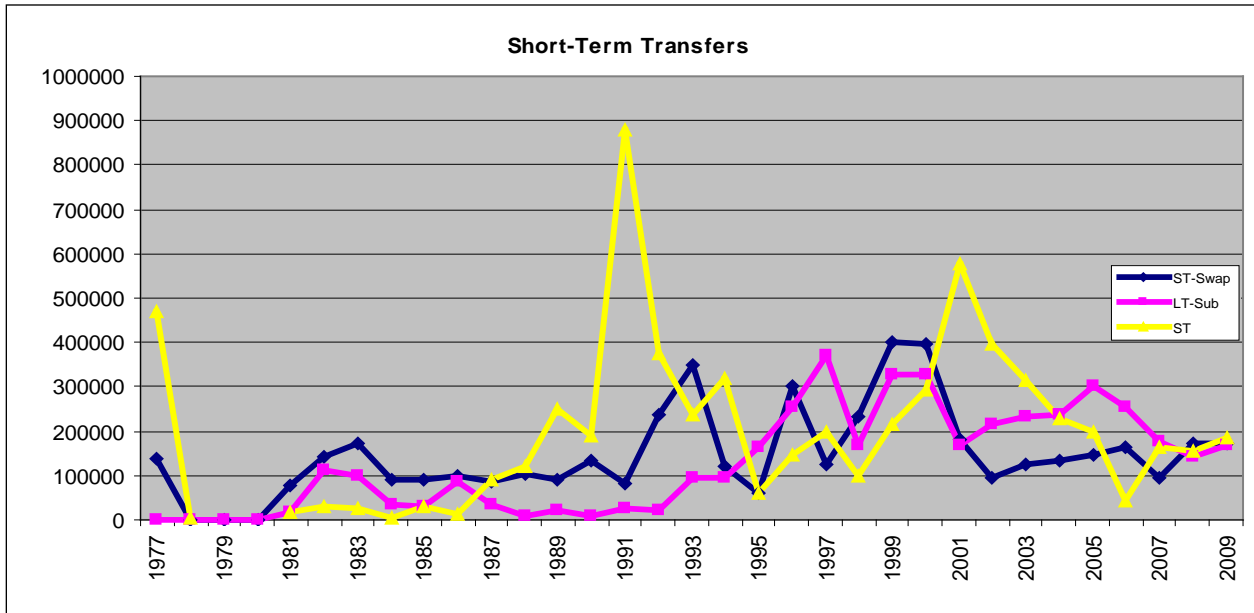


Figure 17 - Historical CVP Allocations

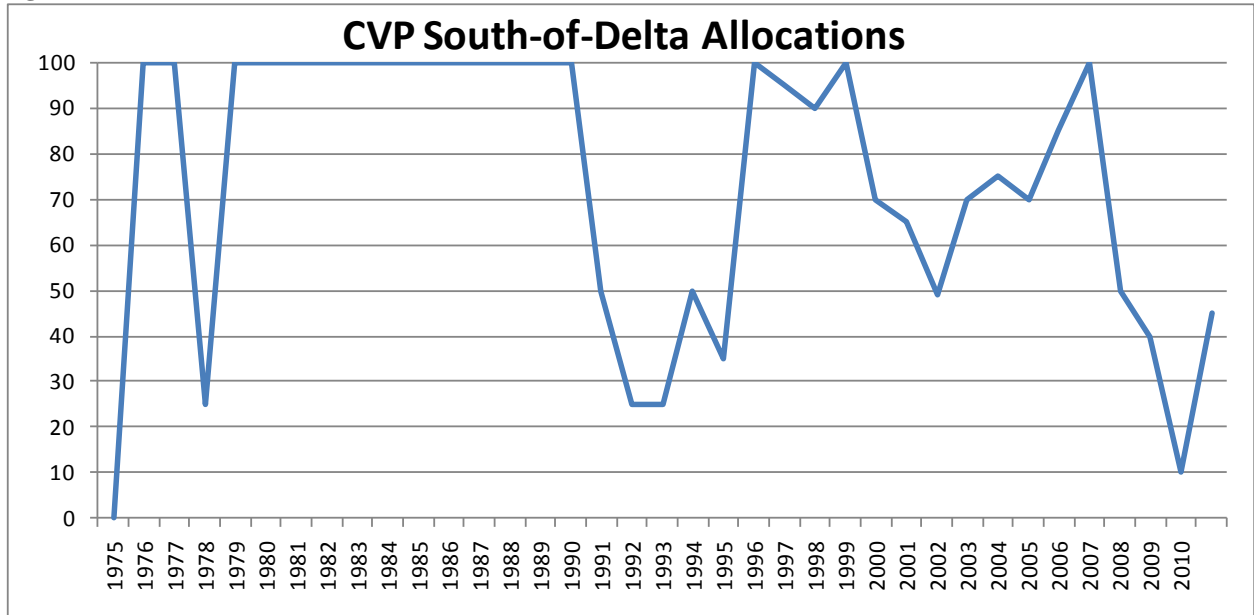
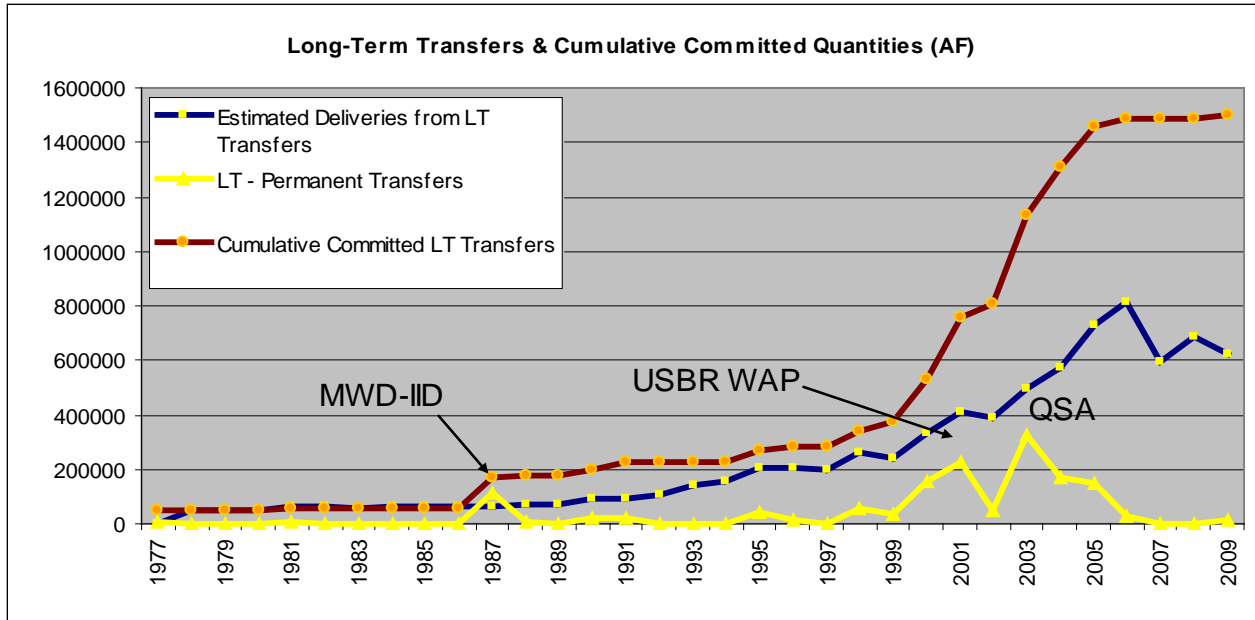


Figure 18

Transfer Time Trends – The middle line is an estimate of the cumulative amount reallocated on paper (the top line)



Note - The USBR WAP is the Water Acquisition Program, resulting from the CVPIA (discussed later with MWD-IID). The QSA is the Colorado River Quantification Settlement Agreement.

Figure 19 - Non-Project / Non-Environmental Transfers

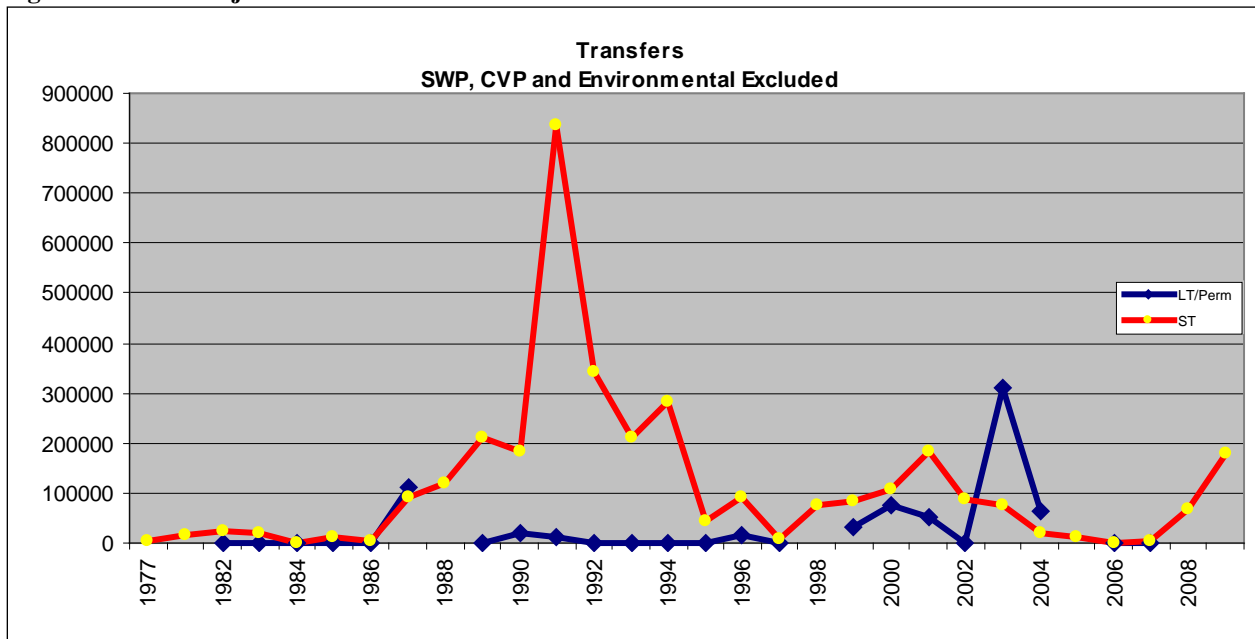


Figure 20 – Scarcity Trends

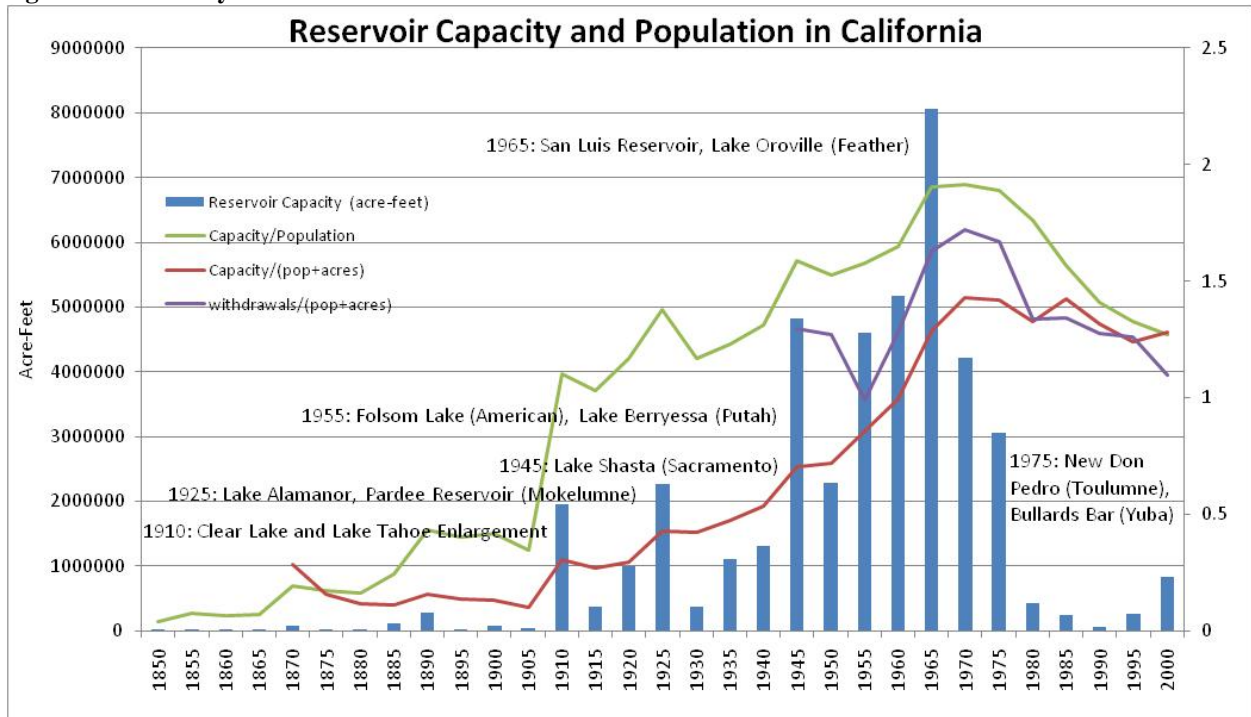


Figure 21 - LT Transfer Counts

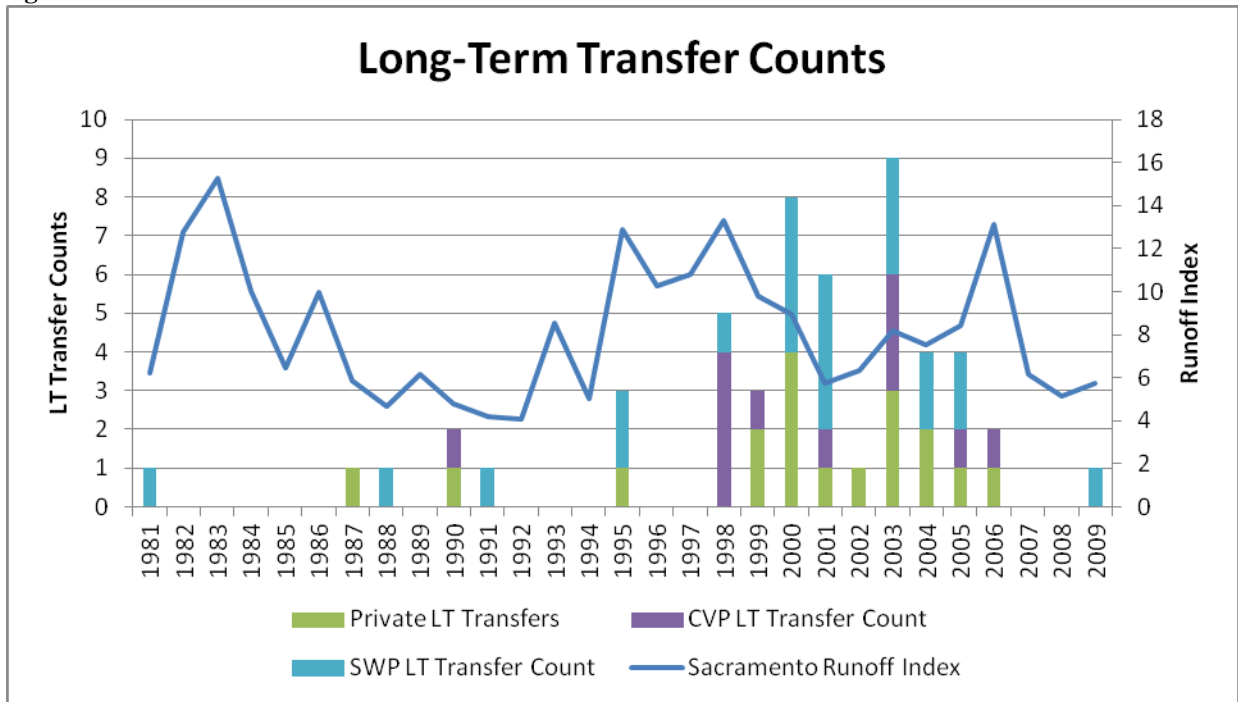
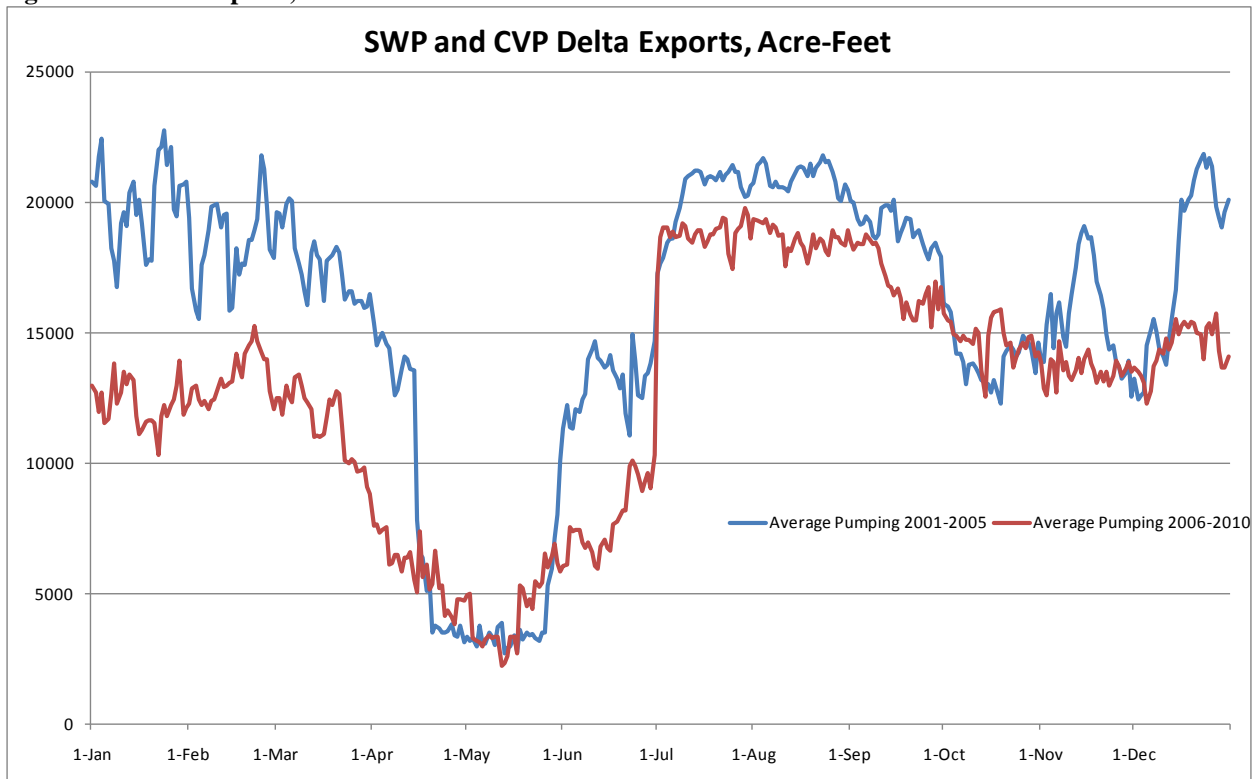


Figure 22 - Delta Exports, 2001-2010⁷⁵⁰



⁷⁵⁰ Central Valley Operations Office, "Water Accounting Reports" (U.S. Bureau of Reclamation, Mid-Pacific Region, 2011 2000), http://www.usbr.gov/mp/cvo/Mo_Rpts_Prev.html.

Figure 23 - Sacramento Runoff, 1906-1930

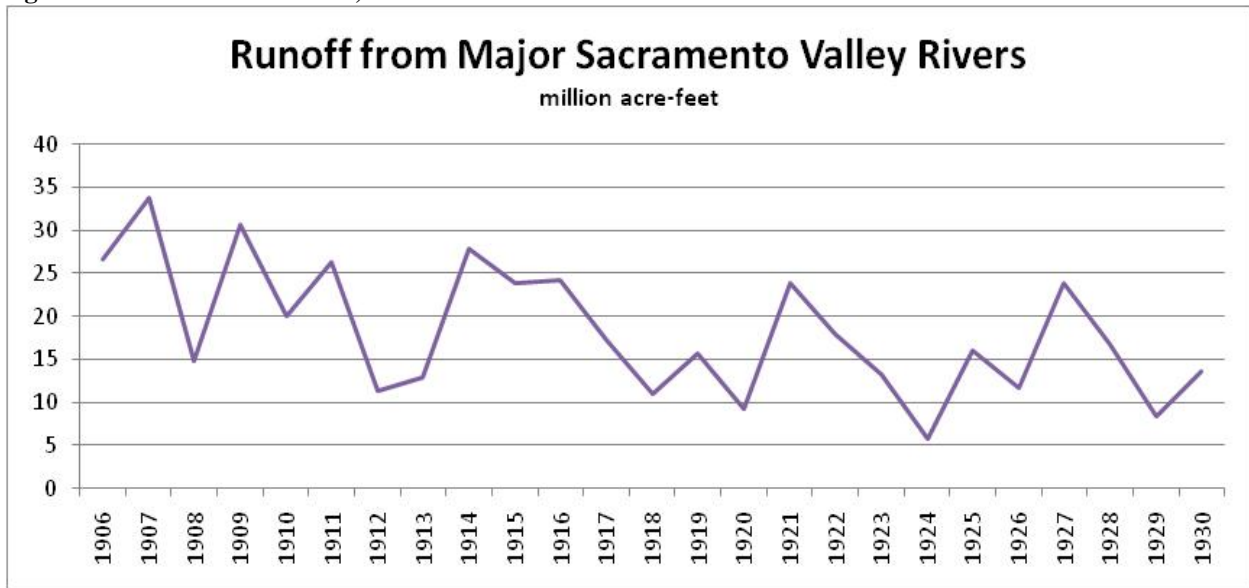


Figure 24- Increasing Rice Acreage, 1910-1920

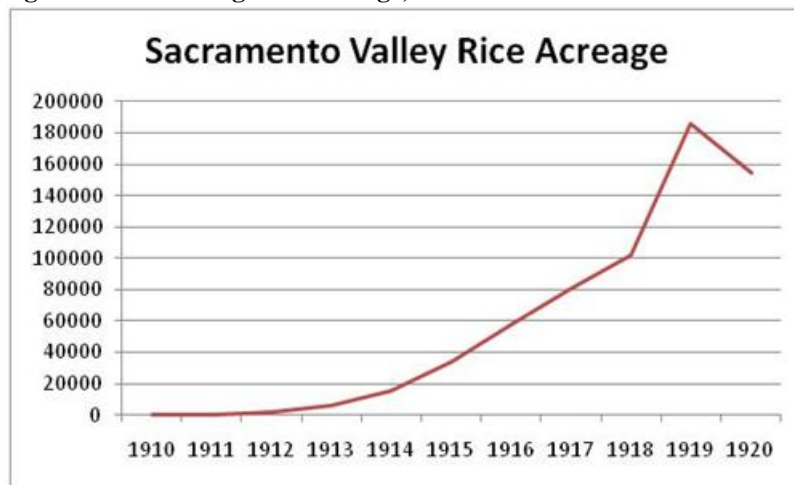


Figure 25 - WY Transfer Size Histogram

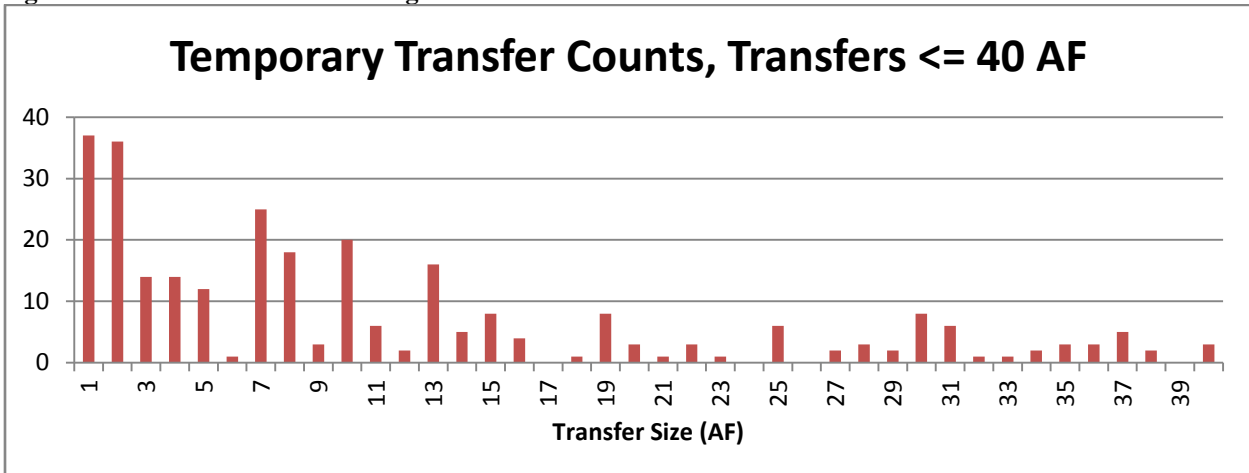


Figure 26 – Adjudicated Streams (bold) in California

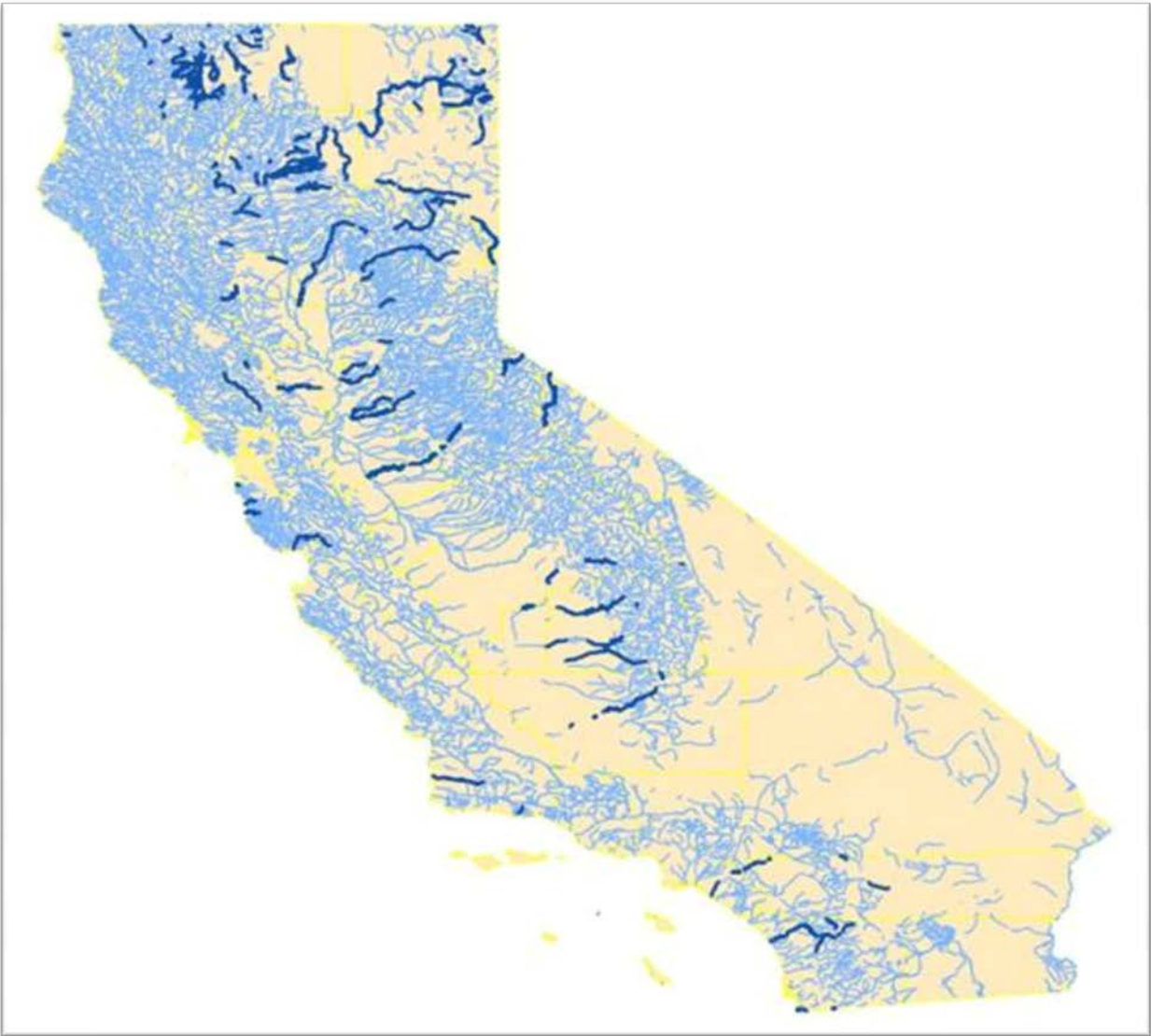


Figure 27 – City of Tracy and Centinella, Widren and Westlands Water Districts

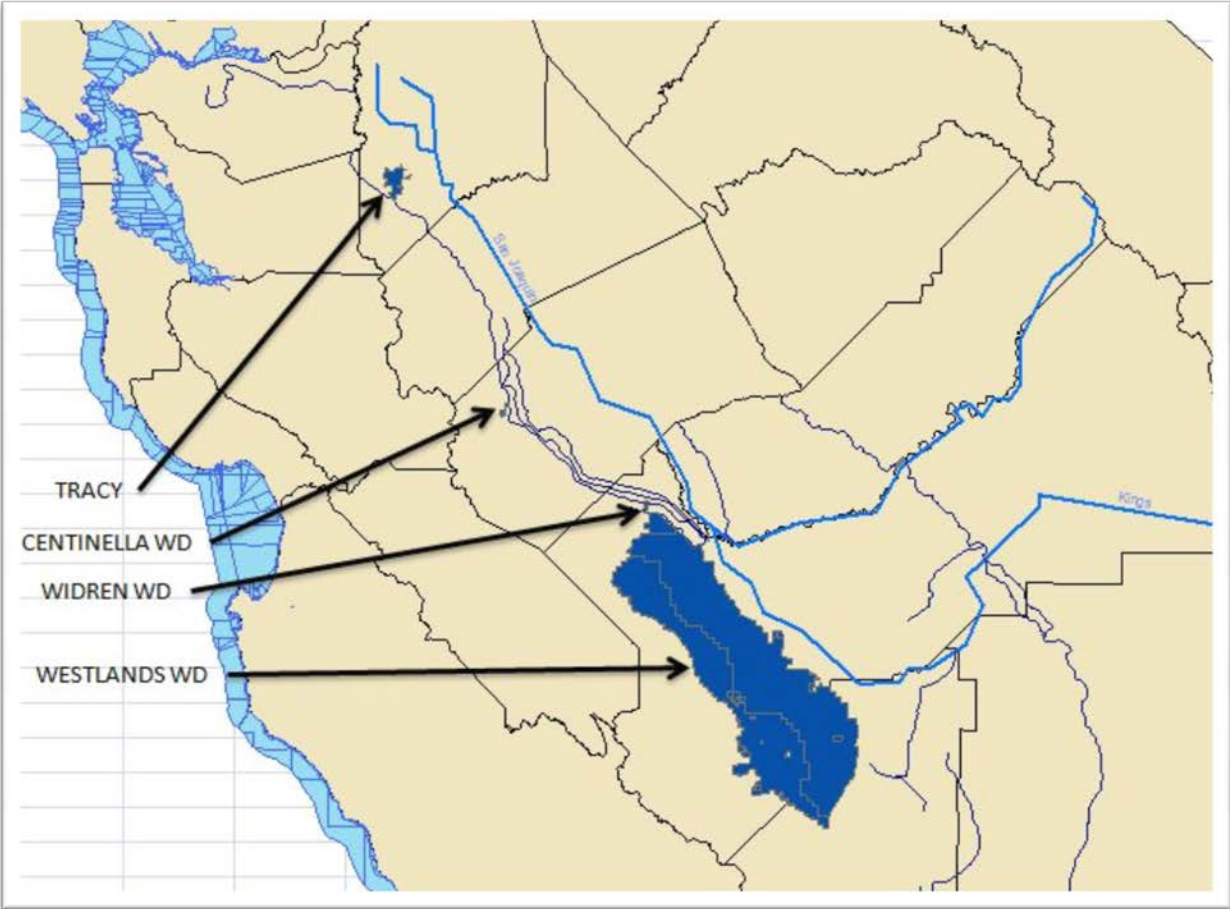


Figure 28 – Central CA ID and MWD



Figure 29 - Cadiz stock price during MWD negotiations.



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Appendix

In this appendix, I describe how California estimates water right usage numbers and the extent of our knowledge on older transfers before 1980.

Measuring Water Use and Water Rights Accounting in CA

There are data on California water rights holders' water use, but they are often unreliable and incomplete. Most water rights holders are supposed to report their diversion data, but for different reasons this requirement does not translate into good data.

Historical Origins of Reporting Requirements

The legislature granted broad authority⁷⁵¹ to the Board to require reporting on all riparian and pre-1914 water use except for diversions in an area governed by a watermaster. This requirement was amended in 1967⁷⁵² to provide exceptions for springs that don't run off the property, groundwater extraction covered by other areas of the water code reporting requirements, and for water use within areas for which the Department of Water Resources filed hydrologic data reports, which includes the Delta lowlands. However, at the time, the state's Department of Water Resources was actively involved in determining the feasibility of the State Water Project, and was collecting consumptive use data for the Delta as well as other areas. Hence, it made sense to exclude these areas from having to report their consumptive use to the Board. Since 1967, the Department has gradually collected less detailed data, to the point where now they collect cropping data only infrequently.

The Department of Water Resources produces estimates of water use in California, and from those estimates, I can attempt to figure out approximate water right usages in California. DWR presents data on applied water use for urban and agricultural sectors, and their sum over the 1998-2005 period averages 42.02 million acre-feet (maf).⁷⁵³ This water comes from a number of sources, and DWR presents estimates of water use from the following sources

- Colorado River
- Groundwater extraction
- State Water Project
- Central Valley Project service for Water Service Contractors
- Central Valley Project service for Settlement Contractors (Base Supply)
- Other federal deliveries (e.g. the Solano Project, Army Corps Projects)
- Local imports (consisting mainly of East Bay MUD's Mokelumne supply, SFPUC's Hetch Hetchy supply and LADWP's Owens Valley supply)
- Local deliveries – includes the many users that draw directly from a local stream or reservoir (e.g. Merced ID, riparian users, Yuba County WA).

This data is helpful in determining how much water appropriators, riparians and groundwater users use. Most of the data is **not** estimated but rather collected from different

⁷⁵¹ See 1965 Statutes, ch 1430 (SB 1196, Cobey) passed by unanimous vote.

⁷⁵² AB 195 (Porter), also unanimous.

⁷⁵³ California Department of Water Resources, *California Water Plan Update 2005*, Bulletin 160 (Sacramento, Calif: California Dept. of Water Resources, 2005), <http://www.waterplan.water.ca.gov/previous/cwpu2005/index.cfm>.

agencies throughout California. The large exception to this is groundwater, and DWR treats groundwater usage as a residual claimant. DWR estimates cropping patterns and water requirements, and if local surface water is not sufficient to provide for these needs, the *balance is assumed to be groundwater*.

Local Deliveries

The local deliveries category is problematic for determining water right usage. The amount given in DWR's Water Supply Portfolios includes urban and agriculture usage *as well as* instream flow uses. Therefore, to calculate how much of the category is used for urban and agricultural uses, I subtract the other categories from 42.02 maf. This yields 10.79 maf, the portion used for non-environmental uses and therefore the portion which is used by someone with a water right.

Most of the categories come clearly from one type of water right, either post-1914 appropriative, Colorado or groundwater. The local import category is a mix of pre and post 1914 water rights (SFPUC is pre-1914, EBMUD is post-1914, LADWP has both). However, the "local deliveries" category represents a combination of riparian and pre and post-1914 appropriative water rights, and assigning more precision to that number is difficult.

Riparian Usage Estimation

One method of assigning more precision is to use historical estimates. For example, the irrigation census in the early 20th century inquired about the type of water right used to irrigate land. Although they discontinued this question in the 1950 census, the earlier estimates may still provide a useful figure. There were 425,844 acres irrigated from riparian sources in 1939.⁷⁵⁴ This number had been steadily growing since 1909, and represents a doubling over 1909 riparian acres. Using 2.6 af/acre as the average delivered to farmers from irrigation enterprises, there would be approximately 1.1 maf of riparian use. In addition, 105,371 acres were irrigated with both riparian and underground sources in 1939, and 778,908 acres were irrigated with appropriative and riparian rights. In each case, it is likely that riparian rights represent the smaller share and are indicative only that there are still landowners in a district with valid riparian claims. 1.1 million acre-feet of riparian rights therefore is a reasonable lower bound.

Because most of the riparian acreage is in California's Delta, tracking irrigated acreage there may reveal estimates for riparian usage as well. Delta irrigated acreage as of 2007 was 387,419 acres.⁷⁵⁵ This figure is lower than in the past, and does not include 80,336 non-irrigated agricultural land.⁷⁵⁶ In-delta consumptive use, ranges from 1 to 1.6 maf, but averages close to 1.2 maf for most of the past century and rarely exceeded 1.4 maf. Recently, however, the average has been closer to 1 maf. Given about 400,000 irrigated acres, this number seems quite reasonable. The Department of Water Resources also estimates applied water in the Delta, more indicative of the total rights, at 1.426 maf in 2001, the latest available figures.⁷⁵⁷ Consumptive use was very close to 1 maf in 2001, indicating that farmers achieve 70% efficiency. Therefore, in wet years when Delta consumptive use tops out around 1.4 maf, total

⁷⁵⁴ United States, *16th Census of the United States, 1940. Land in Drainage Enterprises, Capital Invested and Drainage Works with Statistics for Counties*.

⁷⁵⁵ California Department of Water Resources, *California Water Plan Update 2009*, v3, Delta, D-4.

⁷⁵⁶ *Ibid.*, v3, Delta, Table DB-1.

⁷⁵⁷ Department of Water Resources, *Irrigated Crop Acres and Water Use - Detailed Analysis Unit*, 2001, <http://www.water.ca.gov/landwateruse/anaglwu.cfm>.

applied water may be closer to 2 maf. Not all of this acreage is riparian – many divert out of appropriative rights as well, and so 2 maf is an overly-generous upper bound for in-Delta riparian rights.

To get an upper bound on riparian usage in the entire state, the census provides estimates of on-farm surface usage. On-farm surface supply is “water from a surface source not controlled by a water supply organization.”⁷⁵⁸ In the 2008 census, 1,425,715 acres were irrigated with on-farm sources, using 2,651,880 acre-feet of water.⁷⁵⁹ Not all on-farm sources are riparian – personal reservoirs (which are appropriations) also count as on-farm sources. On the other hand, it is possible that off-farm sources deliver riparian water. Mutual water companies, which allow users to pool their original rights, can deliver the water to riparian land and still act under the riparian rights of the original owners even though the company does not own the irrigated land.⁷⁶⁰ However, the number of companies using riparian rights this way is likely very small. Considering that there are a significant number of appropriations among the on-farm sources, and that the on-farm sources likely represent the vast majority of riparian usage in California, 2,651,880 acre-feet is an upper bound on riparian rights, and likely an overly-generous one. The following table shows the on-farm water usage estimated by the most recent agricultural censuses. The numbers fluctuate based on the year-type in California, although not perfectly.

Year	On-Farm Water	SacYearType
1969	2136175	Wet
1979	1356944	Below Normal
1988	1499879	Critical
1998	1781818	Wet
2003	2998094	Above Normal
2008	2651880	Critical

Governor’s Commission Estimate

In addition, the Governor’s Commission to Review California Water Rights Law offers riparian estimates, likely based on census reports as well as other information.⁷⁶¹ The Governor’s Commission indicates that half of the net water use of 31 maf in 1977 is used under an appropriative right. A quarter of this use (12.5% of the total) is from pre-1914 appropriative rights. The rest is from post-1914 appropriative rights of course, and the Governor’s Commission authors estimate that half of these rights are held by a state or federal agency (SWP, CVP) and the remaining chunk is held by others. They also claim that riparian rights account for 10% of the 31 maf net water use. In making this claim, they acknowledge that San Joaquin riparian rights were exchanged for federal contract rights, and that most of the riparian use is in the Delta and along the Sacramento River.⁷⁶² Since then, due to land subdivision, this amount

⁷⁵⁸ United States, *2008 Census of Agriculture*, Appendix B, 6.

⁷⁵⁹ *Ibid.*, Table 11, pg 26. Within this total, 293,402 acres averaging 3.8 acre-feet per acre (1,114,928 acre-feet) relied exclusively on on-farm sources.

⁷⁶⁰ Michael Brandman Associates, “September Ranch Subdivision Project Recirculated Draft REIR”, February 2006, 7.3.1, http://www.co.monterey.ca.us/planning/docs/eirs/september/sept2/21370002_intro_toc.pdf. See also discussion in *City of Glendale v. Crescenta Mutual Water Co.* 135 Cal. App. 2d 784 (1955).

⁷⁶¹ Governor’s Commission to Review California Water Rights Law., *Governor’s commission to review California water rights law*, 11.

⁷⁶² The Sacramento River Settlement Contractors, unlike the San Joaquin River Exchange Contractors, still retain their original rights. In 1964, they agreed with the Bureau on a delivery schedule and place of use for their Sacramento water diversions for the next 40 years, but with the expressed idea that none of the factual studies done

has likely decreased. However, the quoted figure of 31 maf is net water use, not applied use. The actual applied water use figure in 1972 was 36.74 maf⁷⁶³ (applied water use in 1980 was 42.199 maf⁷⁶⁴). If riparians reuse water at the same rates as other users, then the Governor's Commission estimate could mean that up to 3.67 maf of rights are riparian. Given the other data above, this seems too high.

The best estimate is that riparian rights range between 1.1 million acre-feet and 2.6 million acre-feet, with more likely estimates between 1.5 and 2 million.

Pre-1914 Water Rights

Pre-1914 water right quantities are similarly difficult to estimate. The only estimates are from the Governor's Commission, which indicates that about 12.5% of the total 31 maf net use is used under a pre-1914 water right, and from the agricultural census at the time of the Water Commission Act. 12.5% of the applied water in 1972 equals 4.59 maf. The census reports detail the type of water rights used, and in 1919 and 1929, they break down appropriative use into that which is established from the new Water Commission Act and that which is not, in addition to underground, adjudicated and unreported sources. In 1919, 2.17 million acres were using a pre-1914 appropriative right, falling to 1.90 million in 1929.⁷⁶⁵ Using 3 acre-feet per acre, pre-1914 appropriative rights could be near 5.7 maf. As mentioned above in footnote 762, the Sacramento Settlement Contractors had significant pre-1914 appropriative rights, and these are now consolidated into the USBR's CVP water rights (1.8 maf). Not all were pre-1914 rights, and therefore the Governor's Commission Report estimate of 4.59 maf seems quite reasonable.

Bad Data

Besides difficulty in riparian estimation, the data in the Water Supply Portfolios are often wrong. The DWR data for the Sacramento Valley Hydrologic Region lists CVP Base Supplies as varying between 1.5 and 4 million acre-feet, despite the fact that the Settlement Contractors only have contracts for 1.8 million acre-feet (2.2 maf if their project supplies are added) and recent delivery data from the CVP typically reveals deliveries, even in years with a 100% allocation, that are about 80% of their water right supply (Exchange Contractors average 90%). The more recent CVP numbers are much lower than the actual numbers from 1998-2005 period

or contracts signed would in any way be a legal basis for their water rights. Should an adjudication or other proceeding arise to determine the rights on the river, the parties were not bound by the contracts and were free to assert their full claim of right. See Wanger, *NRDC v. Kemphorne* 1:05-CV-01207 OWW, pt. H (2009). Therefore, while the Sacramento River Settlement Contractors have a mix of pre and post-1914 appropriative water rights, riparian rights and other rights, (Ibid., pt. D.) for all intents and purposes, they receive their water from the USBR like any other Water Service Contractor, and ought to be included within the post-1914 appropriative right category (at least for the time being). If the Settlement Contractors were to assert their original claims, most of the rights would remain appropriative. There are 1.83 maf in base supply contracts for 137 Settlement Contractors. 1.62 maf belong to the large diverters (Glenn Colusa ID, Reclamation District 108, Anderson-Cottonwood ID, Sutter MWC, etc.). Those diverters all had large appropriative rights. Some of their users did have riparian rights, but these are small in comparison. Therefore, in 1977, the Governor's Commission claim of about 3 maf of riparian rights likely excludes Sacramento River Settlement Contractors.

⁷⁶³ California, *The California Water Plan: Outlook in 1974: Summary Report*, Bulletin 160 (Sacramento: The Department, 1974), 39-40.

⁷⁶⁴ *The California Water Plan: Projected Use and Available Water Supplies to 2010* (Sacramento, Calif: Dept. of Water Resources, 1983), 84.

⁷⁶⁵ There are 346,504 acres reporting other rights or mixed sources, a decrease from 396,703 in 1919.

too. For this reason, I present two charts, one with the original 1998-2005 DWR data, and then the same chart adjusted for the more recent, lower CVP deliveries.

Figure 3 – Avg Water Use in CA – 1998-2005

Figure 4 – Avg Water Use in CA – 2004-2009

Older Data on Water Transfers:

Water transfers fall into a few major groups, and although this analysis focuses on 1980 to the present for practical reasons, it is useful to describe the early history and accuracy of the data within these groups.

CVP:

Data exist back to 1981. Gray mentions that Central Valley Project transfers occurred before 1981, but that the Bureau routinely deleted the data.⁷⁶⁶ Only by chance did they actually end up keeping the older data which we are lucky to have. One written reference refers to 1977 activity, but I have been unable to find any other published work documenting pre-1981 transfer levels.⁷⁶⁷

SWP:

The Department of Water Resources keeps good data on all deliveries within their aqueduct system, labeling all water as entitlement, surplus or transfer/exchange water. There were drought exchanges in the late 1970s as well as storage problems in San Luis Reservoir in 1982 which led to a couple major transfers and exchanges, and these have been recorded from the Bulletin 132 series. For the most part, however, little activity is occurring among contractors because of the large amounts of surplus water available to agricultural contractors during the early stages of the project.

Post-1914 Water Rights:

The SWRCB has jurisdiction over these transfers, and Gray⁷⁶⁸ reports that the SWRCB did not receive any petitions for transfer between 1975 and 1982. Meyers and Posner go back even farther, mentioning that between 1959 and 1969, there were no transfer records before the SWRCB.⁷⁶⁹

Other:

For all other rights, we may be missing data on transfers, but that is still the case today – that is, if we are missing data, we are consistently missing it over time. Ronald Robie, water law expert and California DWR Director, writing about California water markets in 1982, claimed that “there is essentially no private market for water”⁷⁷⁰ so although there were infrequent transfers before this dataset starts, assigning a 0 to these years is not far from the truth.

⁷⁶⁶ Gray, *Water Transfers in California, 1981-1989*.

⁷⁶⁷ DWR and UCLA, *Buying and Selling Water in California*, 42.

⁷⁶⁸ Gray, *Water Transfers in California, 1981-1989*.

⁷⁶⁹ Meyers and Posner, “Market Transfers of Water Rights,” 8.

⁷⁷⁰ E. A. Engelbert and A. F. Scheuring, *Water Scarcity: Impacts on Western Agriculture* (University of California Press Berkeley (USA), 1984).

Internal Markets

Internal markets are not included because there is no aggregator for their information. There are districts where active internal markets exist (Westlands WD, Arvin-Edison WSD, Berrenda Mesa WD, others), and in speaking to those districts, they mentioned that activity is down compared to 1990s levels due to increasing scarcity.

Missing Data for Internal Markets

I estimated some of the missing data for transfers within districts and other wholesalers. Most of this information came from conversations with the districts, and then I calculated annual averages. Westlands WD and Arvin-Edison WSD have active internal markets and have had these for years (Arvin's dates back more than 30 years). Kern County Water Agency is likely similar. From my crude estimates, I suspect that there are close to 200,000 acre-feet of intra-district transfers. See Table 22