

Moving Waters:
The Legacy of Buy-and-Dry and the Challenge of Lease-Following in
Colorado's Arkansas River Basin

by

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Abstract

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Moving Waters:

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Thesis directed by Assistant Professor Deserai A. Crow

Throughout the American West, voluntary transfers of water rights from agricultural users to municipal utilities have become more common as a strategy to meet the water needs of a growing population within a limited supply. These transfers are economically efficient transactions between willing buyers and willing sellers. However, experience suggests that water transfers can have significant local effects on agricultural regions: public and private economic losses, social fracturing, and ecological disasters on dried-up farmlands. In an effort to meet municipal needs while avoiding these undesirable impacts, planners have devised an alternative form of water transfer known as lease-fallowing, where farmland stays in production and farmers stay in business.

This study examines two neighboring cases: one, a traditional water transfer and the other, a lease-fallowing project, in southeastern Colorado, through semi-structured interviews with municipal staffers, farmers, and community leaders in the area. These interviews addressed the impacts of water transfers in the subjects' communities, their motivations for buying, selling and leasing water, and the potential for compensation of undesirable burdens. The results suggest that traditional water transfers can create long-lasting damages in rural areas that are not capable of being adequately compensated by buyers of water, who benefit from the transaction in the form of drought avoidance and economic growth. Meanwhile, motivations for buying and selling water in the region indicate that certain agricultural locales are far more likely to be subject to the practice than others, further exaggerating the undesirable effects and making the future of water reallocation highly concerning. Finally, the study finds that replacing objectionable transfers with leases faces some municipal opposition as well as systemic challenges, and that involving intermediaries in the local leasing market has played an unclear role in facilitating reallocation. The study closes with some broad lessons for the future management of water in the West as population grows and water supplies do not.

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Scholars following up on this research would do well to make the Heritage Center their first stop.

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Chapter One: Introduction

Water in the arid American West must simultaneously meet the demands of various types of water users, the most prominent of which are municipalities and irrigated agriculture. These users hold vested property rights to use quantities of water in a certain place for a certain purpose, and like all private property, these rights may be bought, sold and traded, subject to certain conditions. As the urban West grows in population, municipal utilities must acquire water for their new citizens. Because of the limited nature of Western water supplies and long-established municipal and agricultural uses, there is little water remaining to be developed, and one of the primary tactics municipalities use to augment their water supplies is the acquisition of existing water rights through market mechanisms. These transactions take many forms but are broadly known as *water transfers*. Predominantly, the sellers of water in a water transfer are farmers, irrigation companies and irrigation districts, and the buyers are municipal utilities. Traditionally, water was bought and sold under a model known as “buy-and-dry,” in which irrigated farms are dried up and their entire water allocation is permanently transferred to municipal use (National Research Council, 1992). There have been several high-profile cases of large-scale water transfers that raise questions about their effects and the role played by various geographic, economic, legal and social factors in altering those effects for better or for worse, questions that are worthy of rigorous investigation as the practice becomes more common in the growing arid West. This study attempts such an investigation, as framed by the broad question **“what urban and rural areas have been involved in a water transfer, and what have the effects been?”**

Building from this initial question, this study specifically evaluates evidence gathered from two parallel case studies in the Arkansas Valley of southeast Colorado. The lines of inquiry driving the research arise from academic and policy-oriented literature on water transfers in the fields of economics, sociology, ecology, hydrology and others, as well as the results of some preliminary research into the two case studies. The two cases, one, a permanent “buy-and-dry” water transfer and the other, the beginnings of a transfer under an alternative legal structure, are located in adjacent counties in the common hydrologic and institutional context of the Arkansas River basin in southeastern Colorado (see Figure 1).

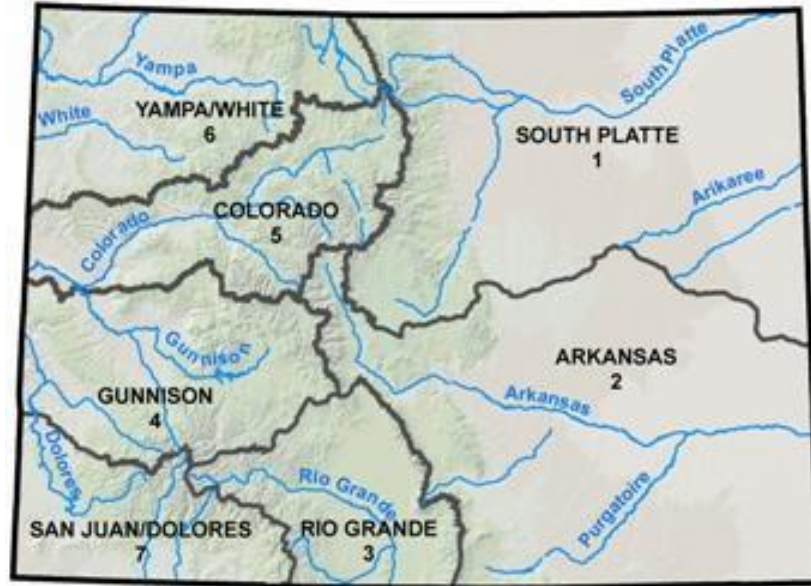


Figure 1: The Arkansas River basin within the State of Colorado (Colorado Division of Water Resources). The Arkansas flows from the high Rocky Mountains at the center of the state to the south and east into the High Plains, before exiting into Kansas.

The first case concerns the “buy-and-dry” acquisition of the **Colorado Canal** and its associated corporate entities by several Colorado cities over the period from 1968 to roughly 1985. Substantially in two phases, farmers and ranchers in Crowley County, operating as the mutual owners of the Colorado Canal Company and dependent on water flowing through that canal, sold their shares in the company to growing cities and special municipal water districts in Pueblo, El Paso and Teller Counties, as well as one city outside the Arkansas Basin. Following the sales, Crowley County sank from one of the preeminent agricultural counties of the state to one of the poorest, and has suffered massive ecological and social consequences (MacDonnell, 1999). It is the classic example of “buy-and-dry” held up in Colorado water circles, and perhaps the best-known acquisition of water by a city since the Owens Valley “water wars” of the early twentieth century.

The second case follows the first chronologically. Beginning in 2002, farmers primarily in Otero County, immediately downstream of Crowley County and with a similar agricultural orientation, organized themselves into two related entities: the Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Valley Super Ditch Company (hereafter, the **Super Ditch** Company). These entities work to keep agriculture viable in the Arkansas basin and to organize the leasing of water to meet municipal needs on a grand scale (McMahon & Smith, 2012). Their potential customers are many of the same municipalities who

purchased the Colorado Canal several decades earlier, they share with Crowley County the technical difficulties inherent in moving water from seller to buyer, and they are under many of the same economic and ecological pressures as the farmers in Crowley County circa 1968. As such, these neighboring cases provide a useful platform for evaluating the effects of both traditional and alternative water transfers, and the influence of geography and legal structures on those effects.

This study investigates the cases primarily through the use of qualitative interviews (Rubin & Rubin, 2011) with key informants in Crowley County, Otero County, and municipal utility organizations. Eleven interview informants drawn from various aspects of water management discussed the informants' experience with water transfers in their communities, the effects those transfers had, efforts to remediate those effects, the reasons the subjects had for participating (buying, selling, leasing, refusing to sell, etc.) and the systemic barriers to market transactions in water. Each interview was recorded and transcribed; the transcriptions were then coded qualitatively according to their relation to the study's lines of inquiry. The interviews are analyzed in relation to their support for or opposition to the suggestions of the existing literature.

Structure of this Study

This study is arranged into chapters following this introduction. Chapter Two presents background information on the practice of water transfers and the hydrologic, economic, demographic and legal context in which they take place, and then presents the suggestions of the existing literature on the effects of water transfers. The chapter concludes by identifying several essential pieces of information that the literature fail to address. Chapter Three follows by introducing in more depth the Colorado Canal and Super Ditch case studies, and justifies them as appropriate venues to investigate the topic. Chapter Four discusses in detail the design of this study, including specific propositions for evaluation, and the interview methods used. Chapter Five presents the results; it does so by examining the evidence collected from the interviews and by deriving some conclusions from them. Chapter Six synthesizes these results into some answers to the research-framing question found at the beginning of this chapter and wraps up with a few lessons for policymakers evaluating the future of water supplies in the West and the role that water transfers will play in it.

Chapter Two: Some Background and a Review of Existing Literature

Context: Water Law, Water Supplies, and Urban Growth

The context that surrounds and brings about water transfers begins with the legal regimes governing water use in the Western states. Though there are, of course, variations from state to state, these regimes center primarily on a system known as “prior appropriation,” a curious historical outgrowth of nineteenth-century law that simultaneously aimed toward four goals: first, putting limited water resources to full “beneficial use;” second, providing certainty and limiting injury to existing users (that is, those water uses already developed should be protected against future developments); third, eliminating speculation in water rights by requiring their use as a condition for ownership; and fourth, allowing use of water by the many rather than the few; that is, defeating monopolies and distributing water access to a wide category of beneficial users (Schorr, 2005). While these principles carry the unmistakable mark of an intention to benefit nascent agriculture, they persist today into governance of a complex, limited, tightly regulated hydrologic system that supplies irrigation water, domestic drinking water, water for industrial processes and energy generation, and water that maintains environmental quality. Put into practical application, prior appropriation regulates the use of water on a particular stream by giving priority to those users, regardless of purpose, who “develop” a water supply first. These users are said to possess “senior rights.” Their temporal followers, possessing “junior rights,” are the first users to be curtailed in times of shortage, for the benefit of those who came first (Hobbs, 1997). Being the first arrival on the vast majority of streams, agricultural users tend to have the most senior (and most reliable) water rights, especially as compared to twentieth-century municipalities.

Supplies of water may be augmented from time to time by importation from neighboring basins and by the construction of storage projects that shunt wet-year excess supplies into the deficits arising in dry years. Indeed, these were the default strategies for the first hundred or so years of settlement of the West by white Americans. However, support for supply augmentation has waned as ideal dam and pipeline sites have been occupied and as the public have become more aware of the monetary and environmental costs of such projects (National Research Council, 1992; Metzger, 1988). As such, it is reasonable to expect that water

supplies in the twentieth century are limited to, at most, their current levels. Furthermore, though the specific impacts of global climate change on the West are not perfectly understood, research suggests that regional precipitation and water availability will decrease rather than increase as the climate warms (Christensen, Wood, Voisin, Lettenmaier, & Palmer, 2004; Revelle & Waggoner, 1983; Barnett, Adam, & Lettenmaier, 2005). Due to the long history of appropriating available supplies, first by agriculture in the late nineteenth century and then by growing cities in the twentieth, many streams across the West are already “fully appropriated.” That is to say, there are as many (or more) water rights on the river as there is water in it. Put another way, anyone developing a new project on such a stream could not have a reasonable expectation of a reliable yield; in most years the water they have claimed is simply not there (Sutherland & Knapp, 1988). All told, there is no reason to believe that additional water supplies will be available to accommodate new users in almost every river basin in the West.

Meanwhile, the Western states grow at a rapid pace. The U.S. Census Bureau projects that the population of the West census region will grow 27% between 2010 and 2030 (United States Census Bureau, 2005). Almost all recent growth has occurred, and almost all future growth is expected, in urban centers and their suburban surroundings (Nichols, Murphy, & Kenney, 2001). These new arrivals, quite plainly, need a reliable, sustainable supply of water, and domestic water providers concern themselves with developing and operating such a supply. Given the constraints of prior appropriation and limited water supply, it is hardly surprising that one of the primary strategies for acquiring municipal water is to purchase senior agricultural water rights. From 1988 to 2009 there were 4,432 water transfers, including one-year leases, in the twelve Western states¹ totaling 36.1 million acre-feet of transferred water (Western Governors' Association, 2012). Legally, the transfer involves permanently or temporarily changing the owner of a water right from a farmer, ditch company or irrigation district to a utility; the location of the right from an agricultural diversion or reservoir to a municipal diversion or reservoir; and the legally decreed type of use from agricultural to municipal (National Research Council, 1992). However, there are at least two legal structures that may be

¹ Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Utah, Colorado, Arizona, New Mexico and Texas, as defined by the Western States Water Council (Western Governors' Association, 2012)

used by the municipal buyer to complete the transaction, and at least two forms the transfer may take in practice.

Water Transfers in Practice: “Buy-and-Dry” and its Alternatives

The traditional form of agriculture-to-municipal water transfers, the one that has predominated in the whole history of water reallocation in the Western states, is the permanent transfer of ownership and use of the agricultural water right to its new municipal owner. As this involves the dry-up of formerly irrigated agricultural land, the practice has acquired the ubiquitous name of “*buy-and-dry*” (McMahon & Smith, 2012). The defining features of this form are that it is a *sale*, not a lease, and that it is *permanent*, not temporary. Buy-and-dry is a voluntary transaction between willing buyers and sellers, and reflects the higher economic value (or willingness-to-pay) of municipal users over agricultural users. Backed by hundreds or thousands of individual customers paying water rates and new tap fees, municipal water utilities have the financial muscle to offer attractive prices to individual farmers or agricultural water providers, who produce less in the economic sense than cities do with the same quantity of water, and for whom water rights are often the major or sole financial asset (National Research Council, 1992). Transfers are therefore an appealing strategy to cities and to state water officials, and are often the “default” supply option in the absence of deliberately constructed alternatives (Nichols, Murphy, & Kenney, 2001). However, the permanent dry-up of irrigated agriculture and the removal of money-generating assets from small rural communities are concerning from a local ecological, economic, and social standpoint and primarily affect third parties that do not consent to the transaction (National Research Council, 1992). It is for these reasons that planners and academics have sought out alternative legal mechanisms for the transfer of water which reduce agricultural dry-up and impacts to rural communities.

While these alternative transfer arrangements take many forms (Michelsen & Young, 1993; Metzger, 1988), one of the most promising mechanisms and the one that is relevant to this study is known as *lease-fallowing*. Under this practice, several farmers or agricultural water institutions *lease* rather than sell some portion of their water rights to an interested municipality, and *rotate* the agricultural dry-up across their

various fields. In other words, some portion of land is taken out of production, but it is not the same land every year, and the farmers or their entities retain legal ownership of the water. Leasing of water has taken place throughout the history of the West, but lease-fallowing is fairly innovative in its use of *long-term* (rather than one-year) leases and its sharing of dry-up burdens across a wider area (Nichols, Murphy, & Kenney, 2001). In this way, lease-fallowing attempts to mimic the reliability of buy-and-dry from the point of view of a thirsty municipality while avoiding the undesirable impacts of permanent dry-up of land and transfer of water. However, it remains to be seen how these impacts compare in a common setting.

Regardless of whether the transfer is “traditional” or “alternative,” a few ground rules must be observed. Water rights holders on the same hydrologic system, including holders of rights junior to those being transferred, are protected from injury caused by the transfer (National Research Council, 1992). This means their right to use water may not be injured in timing, amount or quality of stream flows passing their point of use. To accommodate these users, water transfers generally involve only the *consumptive* portion of the sold water right, that is, the amount of water historically used by evapotranspiration of crops and by evaporation from the land surface. The water that historically returned to the stream, including groundwater percolation that did not immediately return, must be preserved in timing and amount (National Research Council, 1992). Furthermore, many transfers of water, especially upstream transfers of water where the buyer is higher in elevation than the seller, involve *exchanges* of water. In an exchange, the upstream user (here, a city) retains more water than it is entitled to at the upstream location, and releases water from a downstream facility in order to satisfy the water rights holders that would otherwise be injured. Exchanges of “paper water” facilitate transfers that would otherwise require the construction of infrastructure directly connecting buyer and seller (National Research Council, 1992).

Economic Impacts of Traditional Water Transfers

Water transfers are voluntary market transactions, and presumably both buyer and seller benefit from executing one. But like many efficient transactions, there is good reason to believe that “buy-and-dry” creates undesirable economic impacts on third parties. To begin with, transfer payments generally do not create

positive secondary economic effects in rural areas of origin. Rural economies in the arid West depend on irrigated agriculture for purchases of farm equipment, seed, soil amendments, legal services, business services, and the use of intermediate marketing resources like grain elevators and transportation- not to mention household staples (Charney & Woodard, 1990). Farmers undertaking a permanent sale of water receive what they consider to be fair value for themselves, but they rarely reinvest these payments into their communities. Instead, most farmers use the proceeds of their sale to pay off farm debts and to start their retirements (Charney & Woodard, 1990; Weber, 1989). Third parties- the employees and neighbors of those who choose to sell water, and who receive no cut of the sale price- therefore bear most of the economic burdens of water transfers. Removing the primary economic driver from these communities has little to no effect on productivity from a state or national accounting standpoint, but it can have a cascading effect on local capacity (Metzger, 1988).

Furthermore, the decrease in land values between irrigated and dry land reduces rural governments' tax receipts. In 1987, the cost to local governments in La Paz County, Arizona was estimated at \$29,150 (1987 dollars) per 1,000 acres of farmland retired. This cost includes foregone property taxes, sales taxes and assorted fees (Charney & Woodard, 1990). La Paz County expected to lose 13.6% of its employment, 9% of its private income, and 6.4% of its tax revenues from water sales to Phoenix and Tucson (Charney & Woodard, 1990), while the lower Arkansas River basin in Colorado, the setting for this study, lost (in 1982 dollars) over \$5 million in private income and over \$500,000 in government revenues from water sales to several water providers in the Front Range Urban Corridor (Howe, Lazo, & Weber, 1990). There has been no parallel investigation of the effect on urban land values or government revenues; economists have assumed that they increase "substantially" and have pointed out that the benefits include avoiding more expensive developments like new reservoirs and pipelines (Howe, Lazo, & Weber, 1990). In other words, losses are confined locally while from a regional accounting standpoint, water transfers are efficient and represent an overall gain in economic productivity.

Economic research into water transfers has also concerned itself with the geographic proximity of buying and selling regions. As one study points out, when water is transferred within the same "economic

region,” the regional growth it generates provides employment opportunities for those displaced by the transfer. Because of the relative economic value of municipal and agricultural water use, these opportunities will likely be more productive than their pre-transfer employment (Howe & Goemans, 2003). However, many transfers are long-distance and traverse economic regions; these transfers bring about a significant fission of costs and benefits between “areas of origin” and purchasing municipalities (Howe & Goemans, 2003; Howe, Lazo, & Weber, 1990). Effects on areas of origin also depend, naturally, on the price paid by municipalities for their water. Unfortunately, it seems unlikely that water markets, such as they are, accurately value water as a commodity. After all, there are limited numbers of buyers and sellers, with some (like major utilities) acting as dominant market participants; imperfect information about prices and volumes of water; and non-fungible commodities, with senior and junior rights, upstream and downstream rights, high transaction costs inherent in the water-law system, and surface and groundwater rights being used and valued differently (Saliba, Bush, Martin, & Brown, 1987; Squillace, 2012).

Finally, social scientists have asked the question “who will sell their water?” Basic microeconomic theory, and early investigation into water transfers, suggested that farmers will sell roughly in reverse order of the productivity of their land: those farmers who make the least money farming will sell their water rights first, and as the price rises, more productive farmers will see that price begin to make sense for them (Charney & Woodard, 1990). However, empirical research in Crowley County, Colorado, the first case study that will be presented here, countered this suggestion dramatically. In Crowley County, almost everyone chose to sell (Weber, 1989). The farmers in Crowley County faced certain financial pressures simultaneously, not in proportion to their productivity: debts, low commodity prices, local droughts, and, importantly, the opportunity to sell (Weber, 1989). In other words, lands were not retired in order of marginality, but *en masse*, nor were economic consequences spread out over time. Economic impacts of “buy-and-dry” based on previous analyses can therefore be summarized as **significant, concentrated, local, sudden, and not reflective** of the true value of water to rural communities.

Social-Cultural Impacts of Traditional Water Transfers

In rural communities, water is much more than an economic resource. Irrigation is the lifeblood of rural livelihoods, to be sure, but it is also a key strand in the fabric of community identities and the self-determination of rural places. If distant water agencies own a significant portion of the agricultural land in an area and the voting control of an agricultural ditch company, in preparation for transferring the water, this represents a significant transfer of decision-making power to entities with no interest in maintaining the rural community (Metzger, 1988). Outmigration and lost employment, leadership, resources and skills decrease local capacity to undertake projects meaningful to the community (Schaffer & Schaffer, 1984), and drive a wedge down the middle of close-knit towns and counties whose families have often been irrigating side-by-side for generations (Weber, 1992). Farmers who have to seek new employment in distant cities lose the thread of their “life plan” and are often woefully unprepared and underqualified for urban life, in which they may be disvalued for their lack of formal education, and find their paychecks smaller and the cost of living higher when they relocate (Schaffer & Schaffer, 1984).

The social fractures brought about by the decision to sell or hold out are deep and long-lasting. Weber (1990, pp. 13-14) writes that in Crowley County, Colorado, “controversy” does not capture the depth of social strife as farmers received offers to sell:

"Controversy..." is too mild a term for describing local feelings such as when farmers felt obliged to carry firearms with them as they went out to irrigate. Controversy is less than adequate for describing the tension that developed in community meetings, and privately, as the water rights owners determined whether they were going to sell. Controversy inadequately describes the frustration, anxiety, and tension felt by those who chose not to sell as they saw their position eroded by the increasing number who chose to sell. Controversy is inadequate for describing the resulting polarization of communities which previously took pride in their neighborliness, their cooperation, and their kinship ties.

Furthermore, Weber (1989) reports that most of the farmers who chose to sell remained in Crowley County following their decision; most sellers and holdouts, so arrayed against each other in the critical months of transfer activity and so divided by the outcome of those decisions, remained neighbors for some time, perpetuating the social divisions of “one-time” water transfers. Taken together, the literature suggests that the

fracture of rural societies and the transfer of critical decision-making powers and social capacity outside the rural community make water transfers **a cause of major, permanent community decline.**

Environmental Impacts of Traditional Water Transfers

The socioeconomic and ecological aspects of the West are inexorably linked, especially in rural places. Removing the irrigation water from a piece of land whose biological community has come to depend on it means that assemblage will die of thirst. The native precipitation on most dewatered lands beyond the hundredth meridian west longitude is insufficient to maintain ground cover. These lands see increased wind erosion and colonization by non-native species (Sutherland & Knapp, 1988). This further degrades the economic utility of such land, and requires significant investment to be maintained as productive agriculture. While dryland crop production is unlikely in areas with less than fourteen inches of rain per year, it is possible to convert dewatered lands to livestock production by re-establishing native grass species. However, revegetation programs following cropland retirement have failed more times than they have succeeded (Weber, 1989). Dewatered fields that are not successfully revegetated with native species can act as a “seed bank” that allows invasive species to continually infringe upon neighboring still-irrigated fields (Western Governors' Association, 2012). Farmers working amongst dewatered lands also have to deal with the increase in wind erosion as the root mass holding together the fragile topsoil comes apart. On the High Plains, including the Arkansas Valley setting of this study's cases, annual soil loss under irrigation averages between 3 and 6.5 tons per acre. After the removal of irrigation water, that figure rises to more than 15 tons per year (Sutherland & Knapp, 1988). Weeds and dust clog irrigation infrastructure and add to the burdens of farmers who opt to remain and continue production in areas of origin. Existing research predicts that the ecological impacts of buy-and-dry on a large scale can be summarized as **significant nuisances to rural livelihoods and land health.**

Taken together, prior studies suggest that the economic, social and ecological costs of traditional “buy-and-dry” water transfers can be **significant, enduring** and **localized**, and that **they fall almost**

entirely on third parties in the area of origin. This has long been recognized as the major concern for water planners endeavoring to reform, improve, or reduce our reliance on the practice (National Research Council, 1992). It is also clear that even more than the selling farmers, **the primary beneficiaries of water transfers are urban communities:** their utilities pay less for the water than they would have paid for a new supply, their developers have the assurance of a reliable, sustainable supply of water, their residents and business benefit from the economic growth development can provide, and everyone there benefits from the assurance that their water supply is not a drought risk. This has led Colorado, for one, to require that cities who buy water pay for revegetation schemes and compensation to rural counties for the loss of their tax base (Colorado General Assembly, 2003). While the practical effectiveness of revegetation has long been questioned (Sutherland & Knapp, 1988; Weber, 1989), scholars have conducted little research on the efficacy of both revegetation and compensation at actually reducing rural burdens as compared to urban benefits.

What Brings About a Water Transfer, and Where?

The final contribution of existing research to understanding what regions will be involved with a water transfer, and what its effects will be, looks into how cities and farmers decide to engage in water marketing. The assumptions, based primarily on theoretical reasoning with a smattering of empirical support, are that the decisions of both buyer and seller have primarily to do with money. Municipal utilities, so the literature suggests, pursue acquisitions because they are cheaper than the alternatives (Nichols, Murphy, & Kenney, 2001), and presumably this reasoning carries over into the choice of which rights to pursue. Utilities, however, also have a well-won reputation for prizing reliable retail water delivery above all else (Lach, Ingram, & Rayner, 2005). This need for reliability may extend to purchasing more-expensive supplies from better-producing farmers with senior water rights (Charney & Woodard, 1990). This suggestion, it should be noted, is imperfectly reconcilable with the description of farmers selling in reverse order of productivity. Furthermore, utilities seeking a supply of water must be concerned with transaction costs (Squillace, 2012) and transaction risk, that is, the risk that a proposed transfer will be unsuccessful due to political, legal or technical difficulties (Lund, 1993), so they may prefer sources of water that are more reliable in those

additional dimensions. The farmers, meanwhile, have been said to sell because of their debts, their commodity prices, and their low productivity, all fundamentally economic concerns, upon a good opportunity to sell (Weber, 1989; Charney & Woodard, 1990; Taylor & Young, 1995). The existing body of work on the causes and effects of water transfers, with certain valuable exceptions, suggests that they are fundamentally economic concerns with certain social and ecological after-effects that take place in rural communities.

Understanding Water Transfers: Gaps in the Literature

The existing body of work on water transfers has several significant gaps. Most notably, scholars have done almost no research into the effects- economic, social, or ecological- that water transfers have on urban areas. They are merely assumed to be positive based on the higher willingness-to-pay of urban users and the higher economic productivity of urban areas in general as compared to their rural neighbors. However, there has been essentially no effort to connect urban economic and demographic growth to utilities' acquisition of water rights. In fact, it is not even clear that urban growth in the West is water-supply-limited. All in all, the attribution of growth and economic success to water supplies leaves much to be desired. We don't really know how cities make their water planning decisions except at a broad level, we don't really know how they use their acquired or developed water supplies, and we don't really know how (or even if) urban communities change in the wake of a water acquisition.

Building on these notions, the existing literature is remarkably silent on what water rights have been bought and sold, and why those rights and not others. Cost appears to be paramount, or is it seniority, or is it transaction risk, or something else? Understanding how municipalities choose when and what to buy in practice, not according to economic theory, would improve our management of scarce water resources and our long-range water planning. Similarly, researchers rarely look beyond economic theory to explain why and when farmers choose to sell. Ken Weber's research in Crowley County (see above) may be the sole on-the-ground examination of their motivations. A better understanding of what water rights, and especially what ditch systems, will be involved in a water transfer is of paramount importance because existing experience suggests that the impacts of water transfers on areas of origin are strongest, and most objectionable, when

they are concentrated in small areas. This raises a vital question: are future transfers likely to be concentrated because of the buying and selling habits of water users, or distributed?

Finally, the existing body of work fails to properly assess the potential for compensation and mitigation attached to “buy-and-dry,” or the potential of alternative transfer arrangements, in part because they are so new. There appears to be an assumption that alternatives like lease-fallowing will yield better outcomes for rural areas than “buy-and-dry” but still be able to provide adequate water for drought insurance and growth in nearby cities (Nichols, Murphy, & Kenney, 2001). This is far from clear. Research is needed to investigate the perspective of farmers and water utilities to alternative transfers: why would they choose to pursue them? What concerns would need to be addressed before they do? What obstacles do leases and other alternatives encounter, and how do these affect their form on the ground? Can they deliver the promised water and the promised benefits at a competitive price, or are we better off looking for another strategy to carry the load for us as our population grows and our water supply does not? These questions have produced this study, which will compare rural and urban outcomes beyond their economic dimension, ask which water rights are likely to be purchased and why, and explain the appeal of and the opposition to lease-fallowing through two parallel case studies: first, the Colorado Canal, and second, the Super Ditch, both on the lower Arkansas River.

Chapter Three: The Arkansas Valley, the Colorado Canal and the Super Ditch

The Arkansas River Context

The Arkansas River basin within Colorado represents about one quarter of the state's land area but produces roughly six percent of the water flowing through this headwaters state. It is a snowmelt-driven hydrologic system, and the bulk of the basin's land area on the High Plains adds essentially no water to the river (MacDonnell, 1999). It passes through Pueblo Reservoir near the city of the same name, then through the agricultural regions of eastern Pueblo, Crowley, Otero and western Bent Counties before entering John Martin Reservoir (see Figure 2).

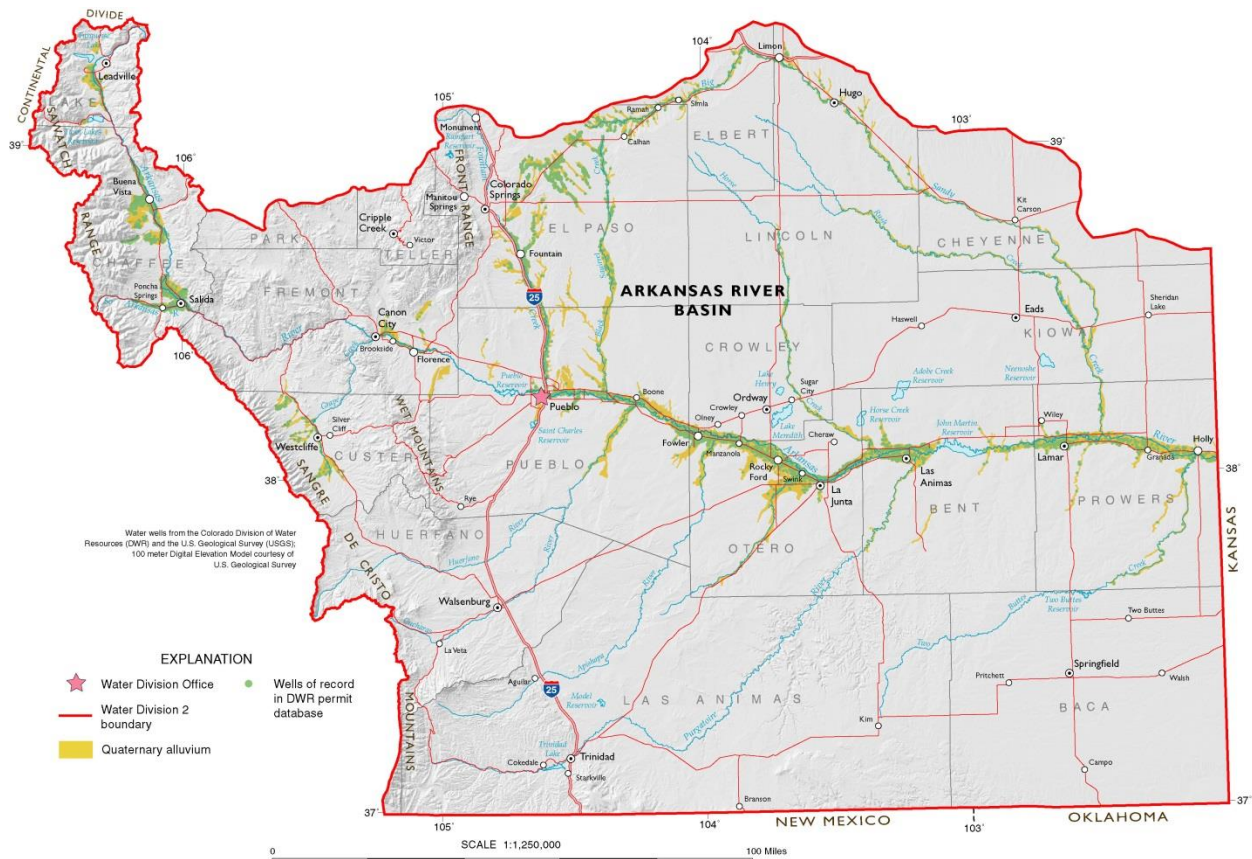


Figure 2: The Arkansas River basin (Colorado Geological Survey). The headwaters are at the top left of the figure.

The river is intensively managed through impoundment in the two reservoirs, diversion for agricultural and municipal use, and importation of water through ten *transbasin diversions* into the headwaters along the Continental Divide. These importations were built between 1880 and 1957 to augment the

inadequate and unreliable streamflow of the Arkansas, at first for agricultural use and eventually for municipal use (Colorado Foundation for Water Education, 2014; MacDonnell, 1999). Even before that, settlers and promoters had been diverting the Arkansas into irrigation ditches, with approximately seventeen ditches springing up between what would eventually become Pueblo and John Martin Reservoirs (see Figure 3). John Martin Reservoir serves flood-control purposes and guarantees that Colorado delivers adequate water to Kansas, while Pueblo Reservoir performs flood control services and stores water for the Southeastern Colorado Water Conservancy District, which provides transbasin water for agriculture and municipalities (MacDonnell, 1999).

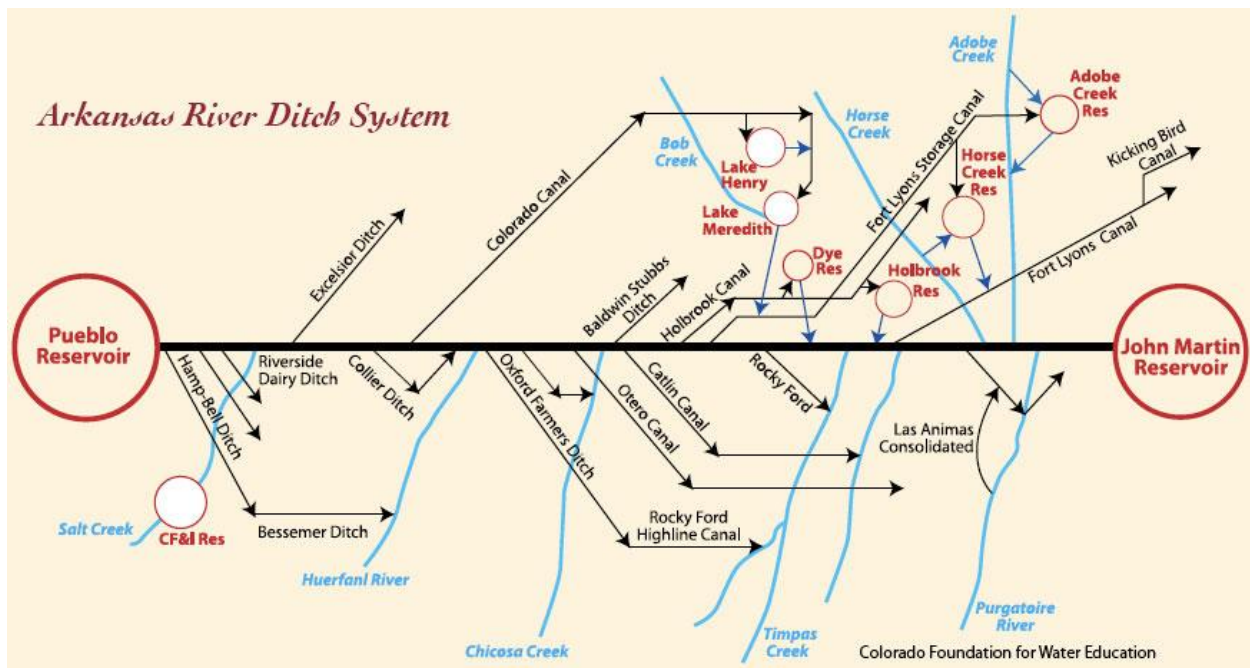


Figure 3: Generalized representation of the Arkansas River ditches between Pueblo Reservoir and John Martin Reservoir (Colorado Foundation for Water Education, 2007)

Even with upstream storage and augmentation through transbasin diversions, the Arkansas River was almost never to meet the demands placed on it. Ditches were chronically water-short from a very early point in time. The cities of Colorado Springs and Pueblo, and the city of Aurora in the neighboring South Platte Basin, which has the infrastructure to transport water out of the Arkansas River system entirely, grew in population and economic strength (MacDonnell, 1999). As demand outstripped supply, the senior water rights on the river came under the eye of the growing cities. As early as 1955, cities bought agricultural water

rights and transferred them legally into municipal use (Howe, Lazo, & Weber, 1990). Transfer activity has continued since then; ten large-scale permanent agriculture-to-municipal water transfers are reported in the basin for the period 1955-2002 (McMahon & Smith, 2012). A simplified table of these transfers is reproduced as Table 1.²

Year	Transfer	Acres of Farmland Lost	Acre-Feet of Water
1955	Otero Ditch (Clear Creek Reservoir system) to Pueblo	5500	9000
1971	Las Animas Town Ditch to Highline Canal	1900	5800
1971	Highline Canal (Busk-Ivanhoe transbasin system) to Pueblo	1200	Unknown
1972	Booth-Orchard Ditch to Pueblo	1432	2894
1973	Hobson Ditch to Pueblo	275	1488
1984	Las Animas Consolidated Ditch & Extension to Public Service Company	5826	13,200
1968-1985	Colorado Canal (including Twin Lakes transbasin system) to Colorado Springs, Pueblo, Pueblo West, Aurora, Woodland Park, Fountain, others	47,373	100,180
1986	Rocky Ford Ditch (majority) to Aurora	4100	11,890
1986	Highline Canal (Busk-Ivanhoe transbasin system) to Aurora	1000	Unknown
2002	Rocky Ford Ditch (remainder) to Aurora	2539	4150
Ongoing	Bessemer Ditch (partial) to Pueblo	Undetermined	Undetermined
Ongoing	Fort Lyon Canal system (partial) to PureCycle	Undetermined	Undetermined
Totals		At least 64,445	At least 148,602

Table 1: History of significant permanent water transfers on the mainstem of the Arkansas River above John Martin Reservoir (McMahon & Smith, 2012)

As the record shows, almost the only buyers of water at a significant scale are municipalities. The exceptions are the 1984 purchase of the Las Animas Consolidated Ditch & Extension by Public Service Company, an electric power plant operator, and the 1971 purchase of the Las Animas Town Ditch by the Highline Canal system as a replacement for the Busk-Ivanhoe transbasin system water it had just sold to the City of Pueblo. PureCycle, the company buying shares in the Fort Lyon Canal, intends to sell water on to Front Range municipalities (Woodka, 2015). By far the largest loss of irrigated farmland and the majority of the water sold came from the Colorado Canal.

² This table, following McMahon and Smith, omits many municipal purchases of individual farms under the major irrigation ditches, as well as purchases on tributaries to the Arkansas River and those above Pueblo Reservoir.

This study looks into the Arkansas Basin by using two cases of water transfer activity and drawing comparisons between them. Case study research is appropriate for in-depth multi-method examination of “complex social phenomena” (Yin, 2002), and given the economic, social-cultural and ecological dimensions of water transfers, they certainly qualify. Using two cases operating within the same Arkansas Valley context allows for distinctions to be made along the lines of the relevant differences between the cases, isolating those variables against the background of what the cases have in common. The study will first look into the **Colorado Canal** (shown in bold in Table 1), by far the largest traditional “buy-and-dry” transfer in the basin. The second case, the **Super Ditch** (see Figure 4, next page), does not appear in Table 1 at all because it is not a traditional water transfer. Rather, it is the first attempt by Arkansas basin farmers to develop a lease-fallowing project as described in Chapter Two. Nonetheless, it involves many of the same municipalities and the same technical and legal challenges as the Colorado Canal, and the farmers involved in the Super Ditch face many of the same economic and social pressures as their counterparts under the Colorado Canal. Each of the cases will now be introduced individually.

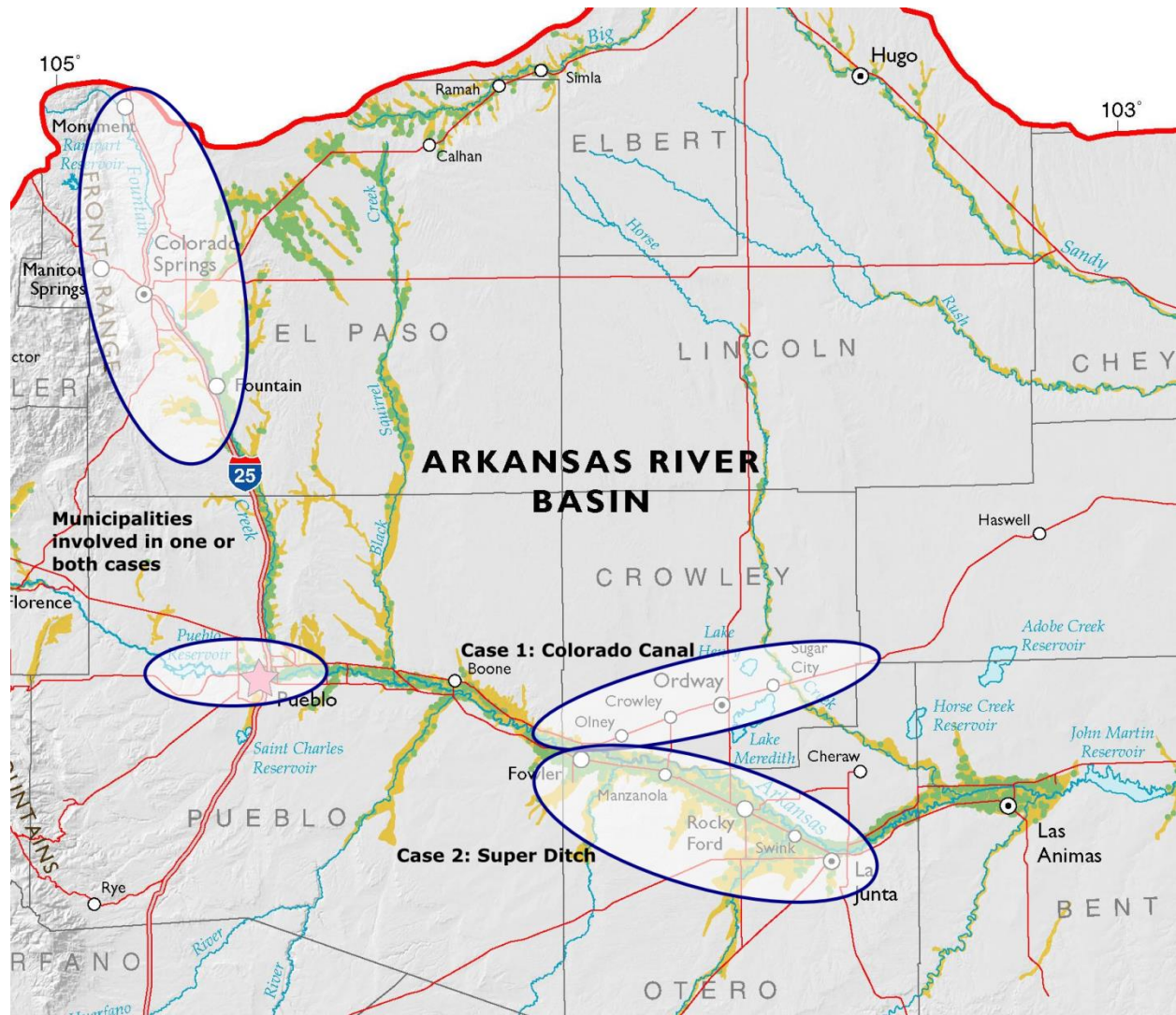


Figure 4: Locations of the Colorado Canal and Super Ditch, and the involved municipalities, within the Arkansas Basin (Colorado Geological Survey)

The Colorado Canal

The Colorado Canal is the prototypical case of “buy-and-dry” in Colorado, it is well-studied as a case in the agricultural economics and agricultural ecology literature, and it is often held up as a “horror story” motivating alternatives to widespread agricultural dry-up (Zaffos, 2015). In less than a generation, farmers sold between 90 and 94 percent of the various companies comprising the Colorado Canal operations and dried up 92.5 percent of the irrigated land in Crowley County (Weber, 1989; Sutherland & Knapp, 1988). This happened in essentially two phases, reflecting the two types of water rights that the Colorado Canal had in its

portfolio (see Table 2 for a full timeline of events). The canal was built in the late nineteenth century by speculators to increase the value of land under the canal, but in the early days there was rarely enough water to make farming profitable. In 1900, the company completed Twin Lakes Reservoir in the Arkansas River headwaters, which stored peak flows and released them downstream to match the needs of irrigators. By 1913, the company was storing water at the end of its canal in Lakes Henry and Meredith, which they used for *exchanges*, releasing water to prevent injury to downstream users in exchange for taking additional water out of the river into the Colorado Canal. In 1935 the company completed a transbasin diversion system feeding Colorado River water into Twin Lakes Reservoir. By that year, therefore, farmers under the Colorado Canal were operating with four distinct water rights: The Colorado Canal itself (usually referred to as “direct-flow” rights), Lake Henry, Lake Meredith, and Twin Lakes (MacDonnell, 1999).

Year	Event
Before 1896	Speculator T.C. Henry begins construction of the Colorado Canal
1896-1900	Construction of Twin Lakes Reservoir
Before 1913	Construction of Lake Henry and Lake Meredith
~1930-1935	Construction of Twin Lakes Tunnel (Independence Pass Transmountain Diversion System)
1950-1957	Severe drought on Colorado’s Eastern Plains
1962	Congress authorizes Fryingpan-Arkansas Project
1967	Sugar City sugar mill closes permanently
1968	CLADCO offers all Twin Lakes shareholders \$380 per acre for their land and water rights
1972	CLADCO gains majority control of Twin Lakes Reservoir and Canal Company
1972-1980	CLADCO and remaining farmers sell 94% of Twin Lakes shares to Colorado Springs, Aurora, Pueblo, Pueblo West, Fountain, Woodland Park, and others
1980	CLADCO ceases to exist
1980-1985	Farmers and Foxley Cattle Company sell more than 90% of the shares of the Colorado Canal direct flow rights, Lake Henry and Lake Meredith storage rights to Colorado Springs, Aurora and Pueblo

Table 2: Timeline of events on the Colorado Canal (MacDonnell, 1999)

At first, all of these rights were held by the same company, but they differed in their appeal to thirsty cities for operational and legal reasons. In Colorado, *transbasin water* (like Twin Lakes) is more flexible than “native” water, can be transferred to new points of diversion and types of use more easily, and can be reused “to extinction,” that is, an unlimited number of times. These make transbasin water rights very valuable on the open market (Squillace, 2012). Twin Lakes rights had the additional advantage of *upstream storage*, wherein one can release water on demand with little cost, rather than use it only when it flows by or need to pump it

uphill from a downstream reservoir. These valuable factors combined to make Twin Lakes water a target for speculators. In Colorado, one cannot simply own a water right; one must put it to beneficial use or risk losing it. With this in mind, a company called the Crowley Land and Development Company (universally known as CLADCO) began purchasing Twin Lakes shares and the land they served for \$380 per acre in 1968, on the heels of a major economic disruption in Crowley County: The mill in Sugar City, which turned Crowley County beets into sugar sent by rail all over the country, closed in 1967 after several hard years. CLADCO told the hard-up farmers that they intended to use the water and land that they purchased to grow Christmas trees or vegetables, and they quickly acquired majority control of the Twin Lakes system (MacDonnell, 1999). Farmers sold their water for a variety of reasons, primarily financial ones: the farmers under the Canal were more indebted and less productive, on average, than farmers under neighboring ditches (Weber, 1992). They were therefore highly susceptible to offers to sell. To accommodate CLADCO, the Colorado Canal company was split into four legal entities, each one in possession of one of the four sets of water rights on the canal: Twin Lakes, Lake Henry, Lake Meredith, and the Colorado Canal itself, though operationally they remained the same.

Upon acquiring two-thirds control of the Twin Lakes Company around 1972, CLADCO unilaterally amended its bylaws to permit water to be separated from the land underneath the canal and transferred to municipal use. Both had been prohibited for the entire history of the canal up to that point. Once successful, they negotiated the sale at secret prices to major municipalities interested in the fully reusable Twin Lakes transbasin water; the primary purchasers in rough order of ownership were Colorado Springs Utilities, Aurora Water, the Pueblo Board of Water Works, the Pueblo West Metropolitan District, the City of Woodland Park, and the City of Fountain (MacDonnell, 1999; Weber, 1989).³ With the writing on the wall, most farmers followed suit and sold their Twin Lakes shares, and some tried to continue farming with their Colorado Canal, Lake Henry and Lake Meredith rights. Less than a decade later, the process was repeated as the Foxley Cattle Company, a major feedlot east of Sugar City, acquired the plurality of shares in the three remaining

³ With the exception of Aurora, all of the purchasers were utilities located in the Colorado Springs and Pueblo metropolitan areas that divert water out of Pueblo Reservoir.

companies and sold them to many of the same cities. Urban interests now own upwards of 90 percent of each company, but remaining farmers retain a voting interest in the ditch operations through the Proxy Group Company, which formed during the sales to represent the interests of agriculture and to extract concessions from the purchasing cities (MacDonnell, 1999). The cities use Lake Henry and Lake Meredith to enable the exchange of water upstream, primarily into Pueblo Reservoir, and dewatered the lands under the canal after some initial attempts to reestablish native prairie grass. The result is as expected: dry lands, weeds, dust storms, population decline, and the radical reorientation of the community: Crowley County is now home to two state prisons and perhaps no more than thirty farms (Weber, 1992; Sutherland & Knapp, 1988).

The Super Ditch

Farmers in Otero County at the turn of the millennium, like their neighbors in Crowley County a generation earlier, came under significant water shortage and financial pressure thanks to a multi-year drought, a crop disease scare, and low prices for farm produce. At this time cities and investors moved to buy out the Rocky Ford Ditch, the most senior ditch in the valley, and the Fort Lyon Canal, the valley's largest (Nichols, 2011); the Rocky Ford was eventually dried up in the last significant buy-and-dry action in the valley, while the Fort Lyon purchase is ongoing, and the whole ditch remains the target of buy-and-dry proposals. The immediate response from valley farmers and community leaders was to unite to keep water in the valley: at the 2002 elections voters in Pueblo, Crowley, Otero, Bent and Prowers Counties formed the Lower Arkansas Valley Water Conservancy District (LAVWCD, ubiquitously known as Lower Ark). Lower Ark is a special-purpose government district funded by property mill levy that uses direct purchases and conservation easements to provide revenues for farmers who might otherwise need to sell their water, in other words, to provide alternatives to buy-and-dry, and to act as a formal opposition in water court to buy-and-dry actions. The District was particularly motivated by saving agriculture-dependent rural towns rather than saving individual farmers (Nichols, 2011).

The District investigated water leasing as early as 2004, had some early negotiations with municipalities, and began intensive engineering studies in 2006 of the ditches between Pueblo and John

Martin Reservoirs, concluding that seven ditches made optimal candidates for a lease-fallowing scheme; others were excluded for technical reasons. It was decided that this scheme would be promulgated through a centralized entity rather than ditch-by-ditch or farmer-by-farmer to increase the negotiating power of the farmers, to give farmers an easy alternative to selling their individual ditch shares, and to prevent cities from exerting pressure on one desirable ditch at a time (Nichols, 2011). The seven chosen ditches (see Table 3) formed the Lower Arkansas Valley Super Ditch Company (Super Ditch) as a for-profit business corporation with unique bylaws that guarantee its only shareholders are farmers who choose to lease their water through the Super Ditch, even though the Board of Directors is chosen by the seven ditch companies (Nichols, 2011).

Ditch	County(ies)	Earliest Appropriation	Associated Storage?
Bessemer Ditch	Pueblo	1861	No
Rocky Ford Highline Canal	Otero	1861	Previously ⁴
Oxford Farmers Ditch	Otero	1867	No
Otero Canal	Otero	1890	Previously
Catlin Canal	Otero	1887	No
Holbrook Canal	Otero	1889	Yes
Fort Lyon Storage Canal and Fort Lyon Canal	Bent, Prowers	1884	Yes

Table 3: The seven ditches that make up the Super Ditch Company (Nichols, 2011). The Bessemer and Fort Lyon systems are under partial municipal ownership with ongoing transfer proceedings.

According to Nichols (2011, p. 50),

The Super Ditch’s *raison d’être* is to negotiate with individual municipalities or other water users the terms and conditions under which they are willing to enter into long-term (i.e., perhaps 40-50 years, with a right to renew) leases for water rights, doing so with a view to maximizing the attractiveness of those leases to irrigators who would become lessors. The water is to be provided by shareholders in any of the named seven Lower Valley ditch companies.

The Super Ditch does not itself own any water or any delivery infrastructure. It is an intermediary between the farmers of the seven ditches, who retain ownership of their water rights, and municipalities interested in acquiring long-term supplies of water. Since its incorporation in 2008, the Super Ditch has attempted three pilot leasing projects, the terms of which specify that farmers may retire 30% of their land on a rotating basis, or may lease water three out of ten years and farm the remaining seven. Water is to be “exchanged” upstream

⁴ The Highline and Otero Canals sold their upstream storage rights in the Busk-Ivanhoe and Clear Creek Reservoir systems, respectively, while continuing to farm with direct-flow rights

into Pueblo Reservoir, where major municipalities in Pueblo and El Paso Counties all have infrastructure connections (Nichols, 2011). Two pilot projects have failed to do so; the first was challenged on strict anti-speculation grounds and the second was withdrawn by the farmers themselves (Woodka, 2013; Woodka, 2014). Between the two pilots, Lower Ark and Super Ditch proposed new legislation, House Bill 13-1248, which would streamline “pilot” leasing processes by removing them from the purview of the existing adversarial transfer process and placing approval under the jurisdiction of the Colorado Water Conservation Board (CWCB), a policymaking body that has promoted alternative transfer arrangements (Colorado General Assembly, 2013). In 2015 CWCB approved the first lease of water through the Super Ditch, which will supply Catlin Canal water to the municipalities of Fountain, Security and Fowler (Woodka, 2015). That pilot project is ongoing as of the writing of this study.

The pairing of these case studies is more than just convenient, it places buy-and-dry and lease-fallowing in a common institutional, physical, and economic context while drawing stark differences in the legal, geographic, financial and social aspects of the transfers. These commonalities and differences provide the basis for the research methods that are set out in detail in the next chapter.

Chapter Four: Research Design and Methods

The existing research summarized in Chapter Two presents some theories on the choice to buy or sell water, the variables contained within each water transfer, and what the effects will be on local economies, societies and the environment. Unfortunately, most existing literature looks at these components in isolation: there are many studies of the effects of buy-and-dry (Charney & Woodard, 1990; Howe & Goemans, 2003; Howe, Lazo, & Weber, 1990; Schaffer & Schaffer, 1984; Weber, 1992; Taylor & Young, 1995), at least one forecast of the effects of lease-fallowing (McMahon & Smith, 2012), at least one study of how farmers chose to sell water (Weber, 1989) and a few looking at the variables involved in producing outcomes (Metzger, 1988; Sutherland & Knapp, 1988). However, if we are to properly manage limited water supplies in an era of reallocation, we must understand the interaction between all of these components; the proper unit of analysis is a single transfer as a unit, from initiation to outcomes. Only then can a researcher conclude what aspects of a transfer produce more or less desirable outcomes, and what water marketing is likely to look like in the future. This study asks, broadly speaking, **“What regions have been involved in water transfers, and what have the effects been?”** Based on the existing literature, this study presents six hypotheses for evaluation that tie together decision-making, place-specific variables, attitudes and outcomes across buy-and-dry and lease-fallowing:

The first hypothesis concerns the effects of buy-and-dry, expanding on the established research into the effects in rural areas, which say that traditional water transfers can cause serious economic, social-cultural and ecological consequences in the immediate aftermath of the transfer (Charney & Woodard, 1990; Howe & Goemans, 2003; Howe, Lazo, & Weber, 1990; Schaffer & Schaffer, 1984; Sutherland & Knapp, 1988), but which have not examined the changes in a post-sale community over time:

H1. The economic, social-cultural, and ecological consequences of buy-and-dry water transfers from the Colorado Canal persisted and worsened from 1985 to 2015 in Crowley County

The second hypothesis theorizes that, if cities benefit from acquiring agricultural water (Howe, Lazo, & Weber, 1990; Taylor & Young, 1995; Lach, Ingram, & Rayner, 2005), it is by supplying growth and insulating their customers against risk:

H2. Front Range cities used Colorado Canal water to fuel demographic and economic growth, and to secure themselves against drought

Building on these, the third hypothesis concerns the influence of patterns of buying and selling on water transfers' effects. Existing research suggests that transaction costs, sale prices and reliability, all characteristics that differentiate agricultural water rights from each other, are drivers of municipal buying habits (Charney & Woodard, 1990; Lund, 1993; Squillace, 2012), and that economic concerns, which affect neighboring farmers largely at the same time, drive the farmers' decisions to sell (Weber, 1992). It is therefore theorized that water sales have been clustered rather than distributed evenly across the basin, and that this worsened the economic, social and ecological response in the involved areas:

H3. Front Range cities focused their water acquisitions on the Colorado Canal, which exacerbated the consequences there, while exempting other ditches

The fourth hypothesis suggests that, given the observed severity of traditional water transfers and the theorized impact of geographic clustering, there is little opportunity for compensation to make rural communities whole:

H4. The primary "losers" of the Colorado Canal case were third parties in Crowley County; the primary beneficiaries were urban water utilities, residents and property developers; these losers were not well-compensated by revegetation and monetary payments

The fifth and sixth hypotheses concern the potential use of lease-fallowing as a replacement of the buy-and-dry model and the use of multiple ditches for lease-fallowing schemes. Policy-oriented research suggests that lease-fallowing is likely to improve rural outcomes compared to buy-and-dry (Nichols, Murphy, & Kenney, 2001; McMahan & Smith, 2012) but that municipal utilities are fundamentally conservative organizations who value the certainty of owning and controlling their water rights (Lach, Ingram, & Rayner, 2005). The fifth hypothesis combines these suggestions into a theory that applies to both ends of the proposed lease arrangement:

H5. Farmers and rural residents have pursued the Super Ditch concept as a way to avoid the impacts of buy and dry and retain their communities' health, but urban water utilities are skeptical because of their insistence on certainty, reliability, and low costs

The final hypothesis concerns the role of the Super Ditch Company, a somewhat novel entity that functions as an intermediary between farmers and municipalities. Little research has been done on these types of entities, but existing research does carve out a role for “water markets,” “water banks” or “brokers” that might improve the efficiency of leasing by linking several potential buyers and sellers (Metzger, 1988; Squillace, 2012). It is theorized that the Super Ditch does this while ameliorate the effects of geographic concentration presented in **H3**.

H6. The Super Ditch Company has facilitated a leasing market, while distributing benefits and burdens over a wider area

The evaluation of all six hypotheses is necessary to understand the effects of water transfers and the role played by geography, economics and legal structures.

Water transfers take place all over the Western states, and have for several decades. In order to gain insight into these six proposed hypotheses, a researcher could choose a number of different approaches. However, water transfers' context and effects are highly place-dependent (National Research Council, 1992), and a survey of many transactions from Washington to Texas would probably introduce as much confusion as it does clarity. Case study research, the selection of representative or extreme examples of a complex phenomenon, allows for the unpacking of context from attributes common to all examples, and the selection of multiple cases in a common context allows for comparisons across the cases that isolate particular factors of interest (Yin, 2002). Fortunately, there are two opposite extremes side by side in the Arkansas basin. It is appropriate to examine extreme rather than representative examples of water transfers because of the stark contrast that they may provide: the transfers are permanent in one case, and temporary in the other; the water rights are owned by cities in one case and by farmers in the other; farming is retired on a large scale, or only briefly and in a rotating fashion; finally, investment is removed from the community in one case and reinvigorated in the other. Looking at these two cases together, rather than a single “representative” water transfer, allows the research to examine what specific geographic and decision-making factors create desirable

and undesirable outcomes- not to mention that, as place-based as water transfers are, it is unlikely that there is truly a case that “represents” the phenomenon in all its forms around the American West.

At the same time, the Colorado Canal and the Super Ditch share a common local context: the delivery and storage infrastructure up and down the river upon which all water management depends, the economic headwinds of farming in a worldwide market in eastern Colorado, the dependence of Crowley and Otero County communities on irrigated agriculture as a primary economic driver and social tie, frequent severe droughts, and the growth and vitality of El Paso and Pueblo County cities and suburbs. This shared local context improves the comparison of cases, whereas, for example, comparing the Colorado Canal and the leasing of massive quantities of water to southern California’s Metropolitan Water District does not. Situating two extreme cases within a common physical, institutional, economic and legal setting allows for a more direct comparison of the relevant geographic and decision-making process variables while eliminating concerns that might confound the analysis in a comparison between cases in separate basins, in separate states, on opposite sides of the arid West.

The relevant comparison, then, is between certain aspects of the Colorado Canal and Super Ditch cases that are not common to both of them. The most obvious and most relevant is the legal structure of the transfers themselves: permanent acquisition and transfer to municipal use, versus retained agricultural ownership and long-term leasing. Because not enough time has passed to measure the ecological, social and ecological outcomes of the Super Ditch, the second obvious comparison between permanent dry-up and rotational fallowing of irrigated farmland cannot yet be made. However, a researcher can use these cases to investigate urban and rural decision-making around buy-and-dry and around lease-fallowing. Because many of the same actors are involved in both cases, this permits a robust if not universally generalizable discussion of the water management choices they make. Looking at water transfers, from initiation through the variable factors they encompass, to their outcomes, as a single unit of analysis (rather than just analyzing their effects or the decision process) allows research into all aspects of the transfer, and into which variables create which outcomes in both urban and rural settings. The research design is summarized in Figure 5 on the next page.

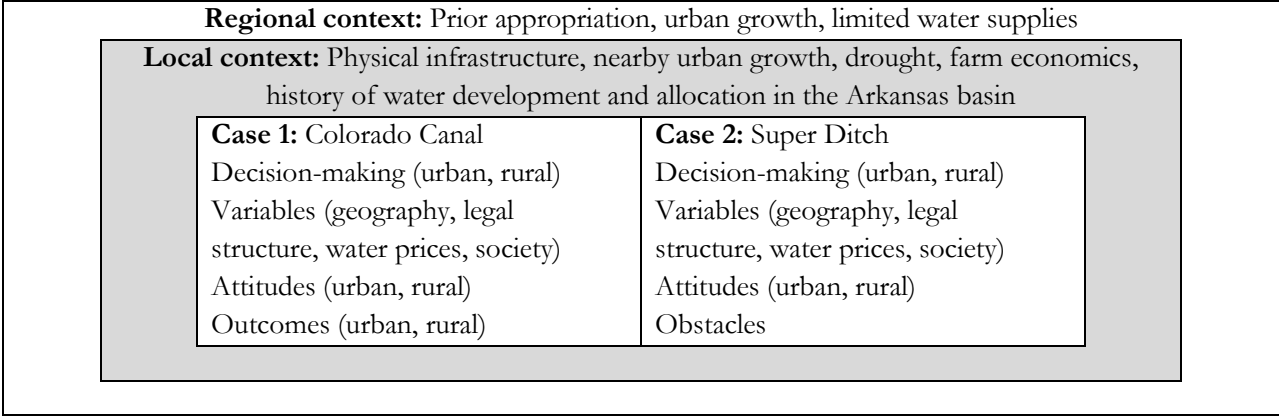


Figure 5: Research design

Case-study research permits the use of multiple quantitative and qualitative methods to paint a complete picture of a complex phenomenon (Yin, 2002). This study will primarily use qualitative interviews with key informants in the Arkansas basin. This study includes semi-structured responsive interviews (Rubin & Rubin, 2011) with eleven persons heavily involved in either the Colorado Canal transfer, or the Super Ditch process, or both, or whose organization was heavily involved, who could offer evidence pertaining to the accuracy of the hypotheses from a wide set of viewpoints. These interviews are an appropriate method to investigate the six hypotheses because they refer to a wide set of qualitative indicators, such as attitudes and decision-making processes, that could not be captured in depth from a quantitative survey of farmers and water managers or from records of water rights transactions, local economics and land use; and because interviewees were encouraged to expound on the details of their answers, providing rich additional information not foreseen by the literature.

The interviewees were chosen at first through publicly available contact information drawn from the websites of organizations involved in water management in the Arkansas basin, and then through snowball sampling, in which informants were asked if there were anyone else in the valley that the study should include. In the end, eleven persons were interviewed from El Paso, Pueblo, Crowley and Otero Counties. Two persons participated together in a single interview, for a total of ten interviews. Rural participants were deliberately chosen to include a variety of perspectives: some sold water, some chose not to, some are potential lessors of water and some hold leadership or organizing roles in their communities or in the Super Ditch process. Urban participants included representatives of buyers of Colorado Canal water, lessees of

Super Ditch water, and those who have declined to participate in Super Ditch for various reasons. Interviewees were guaranteed anonymity in exchange for their participation, but a redacted table of their roles in water marketing appears as Table 4.

In this table and throughout the rest of the study, the interview informants are referred to by an alphanumeric reference system that identifies their role in the basin: Colorado Canal shareholders are referred to with the prefix **C**, Super Ditch participants with the prefix **S**, and municipal representatives (who cross both cases as buyers of Colorado Canal water and potential lessees of Super Ditch water) with the prefix **M**. The number that follows each prefix refers solely to the order in which the informants were interviewed, and implies no hierarchical relationship. In the results that follow, quotes and references from the interviews will be cited solely with these alphanumeric identifiers to preserve anonymity, and where necessary, names of persons and places in the quotations have been eliminated or changed.

Identifier	Role of Interview Subject in Case Study
C-1	Farmer under Colorado Canal, family sold no water to cities; shareholder and board member, Colorado Canal companies; former county commissioner, Crowley County
C-2	Former farmer under Colorado Canal, sold all owned water to cities; active in community affairs through non-profit organizations and municipal politics
C-3	Farmer under Colorado Canal, sold some water to cities; shareholder and board member, Colorado Canal companies; co-founder, Proxy Group company; board member, Crowley County Water Authority
M-1	Water resources staff of Arkansas basin utility; utility purchased shares in Colorado Canal companies as well as several other regional ditches and is potential Super Ditch lessee
M-2	Water resources staff of Arkansas basin utility; utility purchased shares in Colorado Canal companies and is potential Super Ditch lessee
M-3	<i>(Two interviewees participated)</i> Water resources staff of Arkansas basin utility; utility purchased shares in Colorado Canal companies and is potential Super Ditch lessee; one interviewee is on the board of Colorado Canal companies
M-4	Water resources staff of Arkansas basin utility; utility purchased shares in Colorado Canal companies and is a lessee of the ongoing Super Ditch pilot project
S-1	Staff of Lower Arkansas Valley Water Conservancy District and early organizer of Super Ditch Company
S-2	Farmer in Otero County; shareholder, Super Ditch member ditch; early organizer and current board member, Super Ditch Company
S-3	Water attorney counseling Lower Arkansas Valley Water Conservancy District and Super Ditch Company since their formation

Table 4: Redacted table of interview informants

Each interview was conducted in-person, at the informant's office or residence, and each was recorded, with the informants' permission, on a digital audio recorder. Questions were chosen to be specifically relevant to the six hypotheses, such that the answers might serve as evidence of their truth or falsehood, and such that elaboration through follow-up questions would provide rich detail on the interviewee's experiences and decisions. The complete interview protocol is reproduced as Appendix A: Interview Protocol; however, no two interviews proceeded exactly the same way through the protocol. The interviewer asked questions in various orders to follow up on topics raised by the informants and to maintain a comfortable, responsive setting for the interview, added clarifactory questions where necessary, and omitted follow-up questions where the interviewee had answered them in his or her main answer.

Following the interviews, the interviewer transcribed the recordings verbatim, except for the omission of filler words. Pauses and incomplete thoughts remain in the transcripts to maintain the conversational setting of the interviews and to indicate some non-verbalized hesitations where they appear. These transcripts were then coded qualitatively (Miles & Huberman, 2014) using the Nvivo 10 software package, and using a hierarchy of code groups and individual codes that is reproduced in its entirety as Appendix B: Interview Codebook. The code groups and individual codes arise from the six research hypotheses, and include specific references that are intended to mark where informants agreed or disagreed with what they propose. While the set of code groups (i.e. how do cities choose what water rights to buy?) did not change during the study, certain individual codes (i.e. they choose water rights based on expected reliability) were added as the coding process progressed. This allowed for certain references in the interviews to first be marked as a reference within a code group (i.e. here the informant lists an unexpected reason for buying a water right) and then transferred to a novel individual code at the completion of the coding exercise. This hierarchical process allowed for new answers to emerge to the questions posed by the research propositions in addition to those suggested by the literature, for which individual codes pre-existed. The table of code groups, organized by research proposition, appears on the next page:

- H1.** The economic, social-cultural, and ecological consequences of buy-and-dry water transfers from the Colorado Canal persisted and worsened from 1985 to 2015 in Crowley County
 - a. *RURECON* – mentions of economic changes in rural communities after buy and dry
 - b. *RURSOC* – mentions of social/cultural changes in rural communities after buy and dry
 - c. *RURENV* – mentions of environmental changes in rural communities after buy and dry
- H2.** Front Range cities used Colorado Canal water to fuel demographic and economic growth, and to secure themselves against drought
 - a. *URBCHG* – mentions of changes in urban communities after acquiring water
- H3.** Front Range cities focused their water acquisitions on the Colorado Canal, which exacerbated the consequences there, while exempting other ditches
 - a. *WHYBUY* – mentions of motivations for municipalities buying agricultural water
 - b. *WHYSELL* – mentions of factors motivating farmers to sell water
- H4.** The primary “losers” of the Colorado Canal case were third parties in Crowley County; the primary beneficiaries were urban water utilities, residents and property developers; these losers were not well-compensated by revegetation and monetary payments
 - a. *3PCOMP* – mentions of third-party compensation attached to buy and dry
 - b. *REVEG* – mentions of revegetation after buy and dry
- H5.** Farmers and rural residents have pursued the Super Ditch concept as a way to avoid the impacts of buy and dry and retain their communities’ health, but urban water utilities are skeptical because of their insistence on certainty, reliability, and low costs
 - a. *WHYLF* – mentions of motivations for leasing-fallowing or other alternative transfers
 - b. *ANTILF* – mentions of opposition to leasing-fallowing or Super Ditch
 - c. *LFCHALL* – mentions of systemic challenges to leasing-fallowing
- H6.** The Super Ditch Company has facilitated a leasing market, while distributing benefits and burdens over a wider area
 - a. *SDCROLE* – mentions of the role of the Super Ditch Company or of pooling multiple ditches

Following the completion of coding, the researcher generated a summary report in NVivo 10 associated with each code group and individual code (Miles & Huberman, 2014). These results were analyzed for trends, patterns, and common references, which built support for the hypotheses, refined them, suggested alternative explanations, and in some cases, contradicted aspects of the hypotheses directly. The results of this analysis are presented, in order from **H1** to **H6**, in the next chapter.

Chapter Five: Results and Analysis

The Colorado Canal: Rural Outcomes Thirty Years On

H1. The economic, social-cultural, and ecological consequences of buy-and-dry water transfers from the Colorado Canal persisted and worsened from 1985 to 2015 in Crowley County

If this hypothesis is true, interviewees would be expected to report that the significant economic (code group *RURECON*), social (code group *RURSOC*) and environmental (code group *RURENV*) burdens persist into 2015. They would describe these burdens using both the past and present tenses, and would refer to recent events that have happened as a result of a water transfer that is now thirty years in the past. Interviewees did just that. Interestingly, it was not only Colorado Canal shareholders who mentioned negative consequences of the Colorado Canal sales, but rather, all informant groups are aware of how severe they were and many informants wished to avoid repeating the process.

To begin with, if **H1** is true, then interviewees should report that their county has not recovered economically from the shock of water sales and farm retirement. This was generally confirmed, and interview responses break down into essentially four categories: secondary private effects, secondary public effects, inadequate sale proceeds, and a sudden pivot to (and over-reliance on) the prison industry. In the first category, as first suggested by Weber (1989), interviewees confirmed that very little of the sale proceeds were reinvested into the Crowley County community and the region has lost tremendous amounts of agriculture-related business:

A lot of it got put in the mattress and if any was left the great-niece who lives in Louisiana got the money, because there's no investment, there's nothing to show for it. There's nothing to show for it, literally. A couple of people, you got a new pickup. A couple of people, you got nice houses. But there's no new school, there's no- nothing built- nothing was refurbished in our downtown commercial area, it took us, god we had to pull teeth- it took us years to even put in a decent library, so there was no civic investment back in the community. I think everybody just- a lot of people just said "I'm done..." (C-1)

Informant C-2 brought up the closure of the sugar beet plant in Sugar City to explain that not all the secondary economic effects should be attributed solely to the water sales. Informant C-3 confirmed that Crowley County had lost a good deal of agriculture-related business "before the water even sold."

Nonetheless, the interview results confirmed that buy-and-dry does not represent a net benefit in the economic sense from the standpoint of an area of origin, and that these consequences are not undone in the years after a transfer. While such a transaction might be efficient from the standpoint of the nation, or from the standpoint of a purchasing city who saves the cost of acquiring a more expensive junior supply, or from the standpoint of a seller who must sell to stay afloat, it is not a net benefit to the selling community due to a lack of reinvestment and money circulation. Interviewees confirmed that most proceeds went to pay down debts or to pay medical or educational bills (all C interviews).

In addition, there have been persistent secondary effects on public coffers in Crowley County that supports the findings of Howe, Lazo and Weber (1990), and the suggestions of Charney and Woodard (1990) in La Paz County, Arizona. The Crowley County tax base was severely eroded by the retirement of irrigated lands, to an extent that even motivates people outside the community to avoid repeating widespread dry-up:

But as far as what it does do- our tax base for the county has really dropped. Because land with water on it, the tax base is a lot higher ... (C-3)

These impacts, too, are not compensated for by the circulation of money from the sale proceeds. Crowley County leaders, desperate for economic and public-finance support, sought out any remotely viable economic activity.

We'll do anything to get a company in here. You could bring in whatever you want; they even talked about a mustard factory. (C-3)

After trying out agricultural and residential developments to no avail, they settled on the business of incarceration. The State of Colorado directed two new correctional facilities, one public and one privately operated under contract, to Crowley County and now the county depends overwhelmingly on them for tax payments, employment, and the payment of public utilities services to the Crowley County Water Authority, which provides domestic drinking water to the towns of Crowley, Olney Springs, Ordway and Sugar City:

So the private prison we have pays a lot of taxes. It pays a lot of taxes. (C-3)

We was just growing a little all the time, the way we were, but when the two prisons come in, it really helped us, because we only had to have one [water] meter for one prison and one meter for another one, and it was a big one, and we charge the same as we do for everybody else. We have no maintenance there, we have hardly nothing, don't have to anything. Just turn that sucker on and let

them guys take their baths and whatever they want to do, and the two prisons actually use almost as much water as all the residents. And that includes using the water for our lawns, too. (C-3)

While the prisons essentially subsidize the rest of the county's domestic water supply, and the private prison props up their property tax base, one might find a saving grace in the story of the Colorado Canal if sellers were able to take fair value from their sale proceeds and make a prosperous life for themselves- either in the purchasing cities, as some of the economics literature has suggested (Howe & Goemans, 2003; Young, 1984), or in Crowley County. If **H1** is true, however, these potential benefits should be minimal. In fact, interviewees reported that while most sellers did remain in Crowley County, at least at first (Weber, 1989), sellers of water found that their proceeds did not last as long as they'd hoped, and found it difficult to find new work after their water was gone given their lack of formal education:

Some of the people, you know we have a very technical society these days, I mean somebody that's been in the farming industry for 30 years who's 55 years old, what type of job are they going to get? Minimum wage? Are they going to go to work at McDonalds? I mean, McDonalds isn't going to hire them because, well, I've already given you the example, [he became] the Wal-Mart greeter. (S-1)

Informant S-1 told of several water sellers he knows personally who struggled to find work in Pueblo or Colorado Springs, and who brought families with them. They found they were unsuited to the requirements of the urban job market, and that their new surroundings came with higher home prices and property taxation. In essence, when the Front Range cities bought Crowley County's water, they also purchased many of the county's social problems. This runs counter to the proposition of Howe and Goemans (2003) that disaffected rural residents will be able to find more productive employment in cities within their "economic region," and supports the propositions of Schaffer and Schaffer (1984) about the social dislocation of moving to a productive city.

The failures of economic theory to capture all the relevant impacts of water transfers are nothing new. Some brief attention has been paid to the social damages done to rural areas by the decision to sell. Weber (1989, 1992) remains the definitive authority on this subject, suggesting that water sales have left a subtle but persistent fracture point in the community between sellers and non-sellers, most of whom remained residents in the community. If **H1** is correct, and the social dislocation that followed the Colorado Canal sales has persisted and been made worse over time, we would expect to see interviewees refer to

ongoing conflicts with their retired neighbors. However, given upwards of thirty years to come to terms with what happened, informants report that the fracture is not now overwhelming:

Oh yeah, there's a few that were [mad about water sales]; that wasn't very many... maybe less than five percent about it, then there was about 20 percent who thought "well..." – they didn't like it but they knew it was gonna happen, and 20-30 percent said "I'm sort of glad, I got some money, and I can still stay here," then there's probably another thirty percent that said "hey, I'm gonna get out no matter what the heck. I'm gonna get my money and go." (C-3)

So there was no... angry thoughts by other people other than in general, to say, a large group of people that sold. (C-2)

And it's uncomfortable, it's terribly uncomfortable, in certain situations, to sit down with a person that sold water, or water shares, and you think you know, you don't know everything, you think quite frankly that there was no reason to sell the water shares because they were doing good, and they had family, and... you know they're right next to me, so they must have been making- they're not that bad of farmers, they made some money. Why? Why? (C-1)

For me at this point in time there's no sense in begrudging or being angry. You can have some feeling once in a while of, wow, this really could have been different, but this is how it is. (C-1)

Nonetheless, the fracture point remains between the sellers and those that held out and continued farming; the sales are rarely spoken of except in homogenous groups:

And I've actually, I've only had very few conversations that have ever even gone that deep.

Interviewer: Is it just not talked about around here?

We talk about it amongst ourselves, between the sellers, the non-sellers talk about it.

Interviewer: With other non-sellers.

With other non-sellers. Because we still- even though we want to respect each other's rights to do a sale if we have to, we still- and now we're down to the nitty-gritty, there's only about 10 or 12 of us families left. Yeah, we kind of have those conversations amongst ourselves. (C-1)

Social consequences extend beyond changing relationships among Crowley County residents. For the shareholders of the Colorado Canal, the business of farming and the communal effort of operating the canal for mutual benefit were the defining element of their community identity. Farming, and especially the canal's water supply, formed the centerpiece of conversations and how the farmers constructed their own lives together.

When you do have a nice rain, that's the subject around town for the whole day, how much rain did you get? (C-2)

...the whole county was consumed with when's the ditch gonna be in, what's the weather forecast, and are we gonna grow a crop this year? That was what surprised me when I came here, I said "God I'd never heard so many people talk about the weather in my life." ... You talk about it [now] but there's no meaning to the talk. How much rain- It was like you'd drive around... if it rained some place, they would go in the car and take a look at the rain. "Oh it rained over by Numa, let's go take a look!" They were obsessed, it was totally their culture. Totally. It's mind-blowing, really. (C-1)

When some members of the community sold their water, many people exited that construction while remaining "in the neighborhood." As the canal became more difficult to operate and deliveries became more and more rare, the communal spirit and organizing attribute disappeared:

Because irrigated farming the way we do it, it's very communal. We're not an *acequia*,⁵ but everybody got together to burn the ditch in the spring, which you had to do, clean it out, make it- somebody had to be in charge of the divide boxes,⁶ that's the majordomo under the *acequia* system, but somebody had to be responsible and had to basically you can't put the brick there, you're cheating, you asshole, and make it work. So like I said, everybody was fascinated and everybody was so tied to the irrigation of the land that it was their entire being, right? You don't want to do something to jeopardize the ditch. (C-1)

In other words, farmers under the Colorado Canal were never operating in a vacuum. The livelihood of all depended on the participation of all, and the fair value received by a seller from a city, or from an intermediary like CLADCO, could never have replaced the value of the social network and formal or informal co-dependence being harmed by the action of the buyer and seller. Holdouts lost their relationships with their neighbors, their sense of belonging to a great agricultural project, and their communal effort to make a living irrigating the erstwhile semidesert of the eastern plains.

The experience of the Twin Lakes and Colorado Canal sales, however, provided an opportunity for a narrower form of community organizing that may be underappreciated, and is not suggested by **H1**. Several non-sellers in Crowley County formed the Proxy Group Company to protect their interests and reclaim some control over events from parties outside the community:

There was some people, there was obviously a group, they obviously coalesced at one point and called themselves the Proxy Group Company, they wanted to protect their rights, they still wanted to

⁵ An *acequia* is a traditional form of communal irrigation in Spanish-derived communities in the southwestern states, associated with democratic decision-making, communal maintenance and operation, and volunteer management and enforcement of rules (Rivero, 1998)

⁶ Divide boxes are irrigation structures meant to ensure that every ditch member gets his/her proper share of water

farm here, they thought it was worth saving, they put their own treasure on the table and they did the best they could. (C-1)

...we still are an entity, we still are a group, we still have money put away and our main- the Proxy Group's main mission is to protect our water rights, so any time we see something that could affect our water rights we either file an objection or whatever. (C-3)

And now you've got here the Proxy Group, which I'm part of, we sit here and we just didn't have enough strength to do anything. We were outvoted because Foxley had three members on the Board, and there was two of us; now Colorado Springs has three on the board and there's two of us, and so we basically are at the mercy, at some point, of being outvoted every time on everything. (C-3)

Water sales presented an opportunity for non-sellers to organize and better protect themselves than they could alone. They enlisted the help of a high-powered water attorney⁷ and acted as a formal opposition in water court to the transfer of water; their objective was to ensure that those remaining under the Colorado Canal could continue farming and not see their shares sapped away in canal operation (C-3). This is a promising tale of community reinvestment and organization, but it is telling that one of the first things the Proxy Group did was ensure that, if the time came, they could easily sell their own shares in the canal:

...but the non-sellers did agree that when the sellers changed the water from ag to [municipal and industrial], these people, their shares were included.

Interviewer: ...So that they could then more easily sell in the future?

So we wouldn't have to go through our own change case, we piggybacked [off of theirs]. (C-1)

Despite their efforts, when it comes to their goal of preserving water delivery and canal operations for the benefit of those who wanted to continue irrigated farming, the Proxy Group was generally unsuccessful. Theoretically, and in policy circles around the Western states, it is assumed that water transfers will not be permitted to harm third parties with water rights (see Chapter Two). The water court process, or administrative process as the case may be by state, allows for "opposers" to make the case that they will be injured in the timing, amount or quality of the water they will receive after a transfer is finalized. In theory, the principles of historic consumptive use and non-injury should protect other water users on the stream and other water users on the ditch system. It is clear from the interviews done in Crowley County that things are not always so simple in practice. Buy-and-dry complicated water deliveries to non-sellers on the Colorado

⁷ Ironically, he was from the Front Range and usually represented municipalities against West Slope agriculture!

Canal because there is often not enough water in the system to physically “carry” deliveries to end users, and users’ rights on the Colorado Canal are measured only at the ditch headgate on the Arkansas River, not at their farms. These concerns were not adequately addressed by the non-injury rule and calculations for water lost in the ditch and on the laterals that deliver water to individual farms:

Every ditch is different. And in our ditch we measure everything from the headgate at the main canal, which means that it’s great if you’re a mile from the canal or half a mile from the canal. It’s not so great if you’re several miles from the canal. And even though there were allotments made in some of the transfers for transit losses in the canal and transit losses in the laterals, it’s not the same... It’s still a big ass lateral that requires all kinds of water to soak it up, you know, and you have bank storage and seepage and everything like that. (C-1)

In other words, the physical lack of water in the Colorado Canal system, post-sales, makes it near-impossible to deliver the water to which remaining farmers are legally entitled. The calculations of water loss during delivery, as made in the transfer proceedings, did not adequately address this problem.

Furthermore, even when deliveries might be possible, all things considered, the canal is still operated primarily for the benefit of its municipal owners, who control a majority of the several Boards of Directors and hire the canal’s management personnel. If **H1** is correct, one would expect this transfer of decision-making authority outside the community to make water deliveries and land health even worse over time, but to their credit, the municipalities appear to be doing their best to overcome the physical limitations of the canal to deliver water by “bunching” deliveries together:

But here’s where Colorado Springs has been of help and they know that. We try to piggyback our water on top of theirs or they try to piggyback it on ours. But the bad thing is the cities don’t always need to run or want to run when you want to run, because ours is for farming and theirs is for to get the maximum use out of the water so they can either transfer it or use it, see what I’m saying? So we try to work together and say okay, we need the water in July, about July 15th, is there any way you can figure out a run that you can run to the lakes so that we can run our farming water, and they do the best they can. So we have a little bit of help there. But it isn’t like it used to be. (C-3)

Quite simply, the needs of municipalities and the needs of farmers differ in the timing of flows through the canal to Lake Henry and Lake Meredith. The cities want to maximize their exchange potential: as a reminder, they release water from the lakes to satisfy downstream users who would otherwise be injured when they keep water in municipal reservoirs higher up in the system, generally in Pueblo Reservoir. The farmers want their “runs,” or deliveries, when their crops are in need of water. Sometimes the cities can accommodate the

farmers, sometimes they cannot. The cities, however, have invested in the canal itself to improve its operation (from which their upstream exchanges benefit):

...you know, some of the ditches are run really, really well and some not so well. If you bring- if the cities come in and put some money into it, you have professionals maintaining and managing the ditch, you can squeeze more efficiency, more yield out of that operation. (M-3)

For a long time, farmers under the Colorado Canal were able to make up for some of the deficiency of canal deliveries by leasing water on the open market. In Colorado, one-year leases are a good deal easier to acquire and get approved by the state than long-term transfers, and during wet years the cities had water to spare, often the very same Colorado Canal water they had previously purchased. However, from 2000 to 2002 the state endured one of the most severe droughts in its history. Several interviewees brought up 2002 in response to various questions; it clearly impacted a great deal of the municipal and agricultural thinking in the Arkansas valley. However, perhaps its most immediate effect was the closing of the spot market and the end of municipalities allowing excess water to which they were entitled pass downstream to the benefit of farmers in Crowley and Otero Counties:

...many of our previous purchases, we've leased the water we purchased back to the agricultural users for quite a number of years. An example was the Twin Lakes Reservoir and Canal Company; we leased that water back from when we bought it in the 70s until I think 2002 is when we quit that practice. (M-1)

...for years and years, Pueblo and other entities, especially Pueblo, wouldn't take their allotment [of federal transbasin diversions]. Now they take it and they remarket their [non-federal] transmountain water and they make money out of it. So we're actually- that market is probably closed to us for supplemental water. (C-1)

I think 2-0-2 was a game changer. Not only did it change people's attitudes, especially it changed municipal attitudes, and municipal attitudes quite frankly drive the valley a lot, because there's a lot of water that's held by municipalities, a lot of it was leased back, a lot of it was put into the free market at relatively inexpensive prices and that all lubricated the system and- it's gonna take a tremendous flooding event or flooding events to unwind that a little bit, but I think from now on everybody's gonna just watch their butt. (C-1)

The unavailability of a spot market is not specifically theorized by **H1**, but it is relevant that while municipalities and some policymakers will point to the potential of "lease-back" to ease, or at least draw out, the burdens of buy-and-dry, it is clear that in the Arkansas basin, this is no longer realistic. It makes sense that

cities, especially after a supply shock, will choose to save their surplus water or remarket it to the highest bidder, who is likely a neighboring municipality, rather than simply to the farmers that sold it to them.

H1 suggests that the enormous land health problems created by dewatering, which may be the most-frequently cited objection to traditional water transfers, should persist rather than disappear over time. Interviews confirmed that, thirty years on from the Colorado Canal sales, the alteration of the landscape still weighs heavily on their minds. Crowley County now suffers from serious invasive weeds and frequent dust storms primarily originating from retired lands and spreading to active lands and active irrigation channels:

But now we're islands of irrigated farm ground surrounded essentially by abandoned lands that for most- all practical purposes are kind of nuisances, right? Because they- not only do they make weeds but under severe conditions, depending on what's going on, they also become the focal point for dirt storms. (C-1)

...when the weeds aren't so high, you can see the cement ditches they've abandoned, the dirt ditches they've abandoned. You drive down the country road and you see this farmstead with a broken down house or somebody's moved the broken down house, or a set of trailer houses there and they're working at the prison. All the trees are dead because there's no water to water 'em, you know? And the dirt's blown, covered the fence up. Mile after mile after mile after mile, it's just sickening! (S-2)

As first reported by Sutherland and Knapp (1988), it was no simple matter to reestablish native grasses:

Well, it'd probably be about 110 years ago, you think of what this land was. It was grazing grass that was knee-high, maybe a little higher. A lot of buffalo in the area, and a lot of the Indians still lived here. And I think when our water was sold, we had the idea that this grass would go back, go back a hundred years, it would be the same. But when you have irrigated land for a hundred years, and then decide "well, I'm gonna put it all back in grass and it'll be just fine, like it was a hundred years ago," the land doesn't let you do that. I mean, it... [pause] it just doesn't let you do that, because it was used to that water, and it doesn't happen that way. (C-2)

That being said, weeds are an ever-present problem even on actively managed lands:

Well, it's everybody. I'm making weeds too. Even where I'm planting and cultivating I'm making some weeds. (C-1)

Weeds and dust create more than just an aesthetic problem; they create real difficulties for the continuation of farming and for public safety:

And then we have to clean [the ditches] out or carefully burn them; we lost two firemen back several years ago in Crowley County, we had a wildland fire that was essentially aided by the amount of debris that collected in our large drains and on fencerows, and we burned up a pretty good part of eastern Crowley County. (C-1)

While it is undeniable that the sale of Twin Lakes and Colorado Canal water was the primary cause of agricultural dry-up and of land degradation in Crowley County, interviewees reported that it is necessary to attribute some of it to poor land management decisions following the sales. Some lands on the Colorado Canal were made worse by overgrazing in the aftermath of water sales as people, some of them new to the area or to livestock management, brought in horses to their properties:

And our problems really weren't out in the dryland, they were in the 40-80-acre patches, 60-acre patches that had been denuded by grazing primarily, and they were just whipping up dirt like you couldn't believe. (C-1)

So you have people that- and a lot of them did come- some of them did come in the early 90s when it was- everything looked pretty lush and even if it looked green it was weeds, they still turned their cows out or their horses, they were happy, they didn't have to buy hay, but after a while it didn't work, it doesn't work. And we have thousands of acres like that. Thousands. (C-1)

Of course, it is unlikely that career farmers would have switched to grazing in the absence of water sales, or would have sold property without water rights to new arrivals without first selling water to municipalities. But it is clear that the sales did not cause the land to degrade overnight once the checks were signed. The ground was always unsuited for intensive grazing, and many people, new to the area or simply new to ranching, overburdened their land and made Crowley County's problems worse.

As a reminder, this subchapter examined the evidence for and against **H1: The economic, social-cultural and ecological consequences of buy-and-dry water transfers persist and worsen over multi-decade time scales**. All in all, Crowley County interviewees and the people that are familiar with the county report that the undesirable outcomes of the water sales have not ameliorated over time, with one or two exceptions: the social fracture between sellers and holdouts remains, but with less conflict, and there is some new business in the county in the form of a public and private prison. The interview results for **H1** concerning the impacts of the Colorado Canal water sales, as felt thirty years after the sales were completed, appear summarized in Table 5.

Findings	Interviews Mentioned	Groups Mentioned	Relevant Quotations	
Economic effects	Private secondary losses/ persistent lack of reinvestment	3	C	“There’s nothing to show for it, literally. ...there was no civic investment back in the community.” (C-1)
	Public secondary losses/ tax base erosion	4	C, M, S	“Our tax base for the county has really dropped. Because land with water on it, the tax base is a lot higher ...we almost got a mushroom plant, I now that sounds sort of stupid, but everybody’s trying to find something to get in here to keep the county tax base up.” (C-3)
	Reliance on replacement industries (here, prisons)	2	C	“So the private prison we have pays a lot of taxes. It pays a lot of taxes.” (C-3)
	Inadequate proceeds/ lack of post-sale opportunities	2	C, S	“[W]e have a very technical society these days, I mean somebody that’s been in the farming industry for 30 years who’s 55 years old, what type of job are they going to get? Minimum wage? Are they going to go to work at McDonalds?” (S-1)
Social effects	Social fracture/ relationship changes lessened over time	3	C	“For me at this point in time there’s no sense in begrudging or being angry. You can have some feeling once in a while of, wow, this really could have been different, but this is how it is.” (C-1)
	Loss of identity centered around irrigation	3	C	“When you do have a nice rain, that’s the subject around town for the whole day, how much rain did you get?” (C-2)
	Loss of communal purpose/ spirit	3	C	“...irrigated farming the way we do it, it’s very communal... You don’t want to do something to jeopardize the ditch. (C-1)
	Organization of Proxy Group of non-sellers	2	C	“...the Proxy Group’s main mission is to protect our water rights, so any time we see something that could affect our water rights we either file an objection or whatever.” (C-3)
Environmental effects	Difficult water deliveries due to inadequate “carrying” water	4	C, M, S	“...when you talk to Colorado Canal farmers you’re gonna find some of them who didn’t sell, you know, they’ll probably, they’re still getting legally what they’re entitled to, but it is very difficult especially if you’re the last two guys left, operationally to keep doing it.” (M-1)
	Some improved deliveries through agricultural-municipal cooperation	3	C, M	“We try to piggyback our water on top of theirs or they try to piggyback it on ours. But the bad thing is the cities don’t always need to run or want to run when you want to run, because ours is for farming and theirs is for to get the maximum use out of the water so they can either transfer it or use it, see what I’m saying?” (C-3)
	Weeds and dust storms remain hazards to water delivery and public safety	4	C, S	“...we have this pattern now of dry, dry, little rain, fields, acres, thousands of acres with thistles and other weeds that will break off and then blow, which then fill our windbreaks, our buildings, our driveways, our fencerows, our ditches.” (C-1)
	Overgrazing contributed to land degradation	3	C	“So you have people that... still turned their cows out or their horses, they were happy, they didn’t have to buy hay, but after a while it didn’t work, it doesn’t work. And we have thousands of acres like that. Thousands.” (C-1)

Table 5: Summarized findings for H1, persistent effects of the Colorado Canal water sales in Crowley County

H2.Front Range cities used Colorado Canal water to fuel demographic and economic growth, and to secure themselves against drought

If this hypothesis is true, interviewees will report that acquiring Colorado Canal water allowed their cities to expand and develop new economic opportunities while reducing the risk of drought shortage (code group *URBCHG*). The interviews in this study confirm this theory while adding some nuance: growth is reported as, depending on circumstances, dependent or not dependent on water availability, and water acquisitions reduce drought risk in two ways: they add both *diversity* and *reliability* to urban water supply portfolios. All told, it is clear that growth expectations do drive acquisitions, but municipal thinking in the Arkansas basin uses a framework of drought avoidance rather than direct growth supply.

To begin with, three of four municipal planners interviewed reported that they expect demographic growth to be independent of the robustness or firmness of their water supply portfolios and of the annexations that are sometimes theorized as connected to water acquisitions; the fourth indicated no thoughts one way or the other. This feeling is common to fast-growing and slow-growing municipalities:

But it's interesting, we talk to our econometric modelers and we've confirmed this with the state demographer too, it's not a function of necessarily land, you will grow regardless. And the market will adapt, the housing market will adapt, the commercial market will adapt, as you- you'll grow whether you had enough- I always said "if you didn't have [municipal annexation] you wouldn't have to do all this stuff." Well the reality is you're gonna grow either way... (M-3)

The driver for us to have to get more water is growth, period. It's not speculative growth, it is growth. As the utility director my job is not to determine what should happen with growth, my job is to make sure we have the utilities and utility services that we need to support growth. (M-4)

[My city] has had a history since the late '70s of little or no growth, so I don't know that I believe or senior management here believes we're gonna suddenly explode with growth, but... you know, I think we have a sense that we need to be prepared for it. (M-1)

Nevertheless, at least one municipality sought out water acquisitions, including the Twin Lakes system, at least partially in response to specific economic growth opportunities, but not generalized demographic growth expectations:

...they decided to locate a coal fired power plant down here in the early '70s and came to us for water supply. It's a very significant demand, the old, the original two units that were built, as I recall,

used around seven or eight thousand acre-feet a year, so at that time, [we] started purchasing other supplies to supplement its... [pause]... partially to serve [the power plant] and also we had had a couple of economic development prospects in the '60s that considered locating in [this city] and ended up locating elsewhere; one of the reasons they gave was they were concerned whether we had adequate water supply. (M-1)

Others reported that they felt economic growth pressures more broadly, in tandem with “uncoupled” demographic growth, and this drove the need to acquire reliable water:

Well, keep in mind that [this city] in the '70s into the '80s and the '90s, huge growth curve... Huge growth. Those days it was one of the go-go growth cities in the US, at that time frame. (M-3)

Interviewer: It sounds like just about everything that goes on in [your city] has been enabled by acquiring agricultural rights, is that correct?

Absolutely. (M-2)

In other words, municipalities in the Arkansas basin feel that demographic growth will occur regardless of their water supply situations, and procure water supplies in the hope of keeping up with growth. Analysts might therefore conclude that it is appropriate to define the “benefits” of traditional water transfers accruing to purchasing municipalities as the very growth that they “supply.” But it is certainly not that simple. To begin with, cities do not think of water acquisitions as a growth measure, but as a *drought avoidance* measure. Municipalities’ acquisitions add diversity and reliability to their water supply portfolios; both factors reduce utilities’ vulnerability to drought extremes:

We’ve really been working hard to develop a more diverse portfolio of water supply to really help our city through the lean times when you’ll have one part of the area or the other of the state of Colorado in drought, and that typically is the case, that some part of Colorado is in drought. (M-4)

But the other thing that really hit, too, was the drought of the mid-'70s. That showed us that, gosh, we really have a vulnerability. Kind of the combination of not having that supply and then the drought kind of put us on notice that, yeah, you’ve got a lot of water in general, but things can get bad, you may need more. (M-3)

Growth or no growth, cities have realized over time that they need a geographically diverse water supply to buffer against local drought, and a reliable water supply that is senior enough to deliver water in lean years and well-located to deliver the promised quantity of water into the municipality’s infrastructure system. The Twin Lakes system, with its transmountain component, upstream storage, and connection to Pueblo Reservoir, fit these categories perfectly. Later on, the Colorado Canal- Lake Henry- Lake Meredith purchases

met these criteria to a lesser but still useful degree. Even if the cities had not grown in the aftermath of these purchases, they would have accrued the benefits of reliable delivery and avoided hardships to their customer base, hardships like rate increases and watering restrictions that municipalities are committed to avoiding (Lach, Ingram, & Rayner, 2005).

Perhaps it is difficult to measure this benefit in economic terms, but it is drought avoidance that is the most accurate benefit on the urban side of the ledger of traditional water transfers. Unlike on the rural ledger, no municipal representatives reported environmental or social changes in their communities following the Colorado Canal experience. Therefore the evidence gathered from the Colorado Canal acquisitions indicates that municipal thinking is less tied to specific growth than it is to drought avoidance, but otherwise largely confirms **H2. Front Range cities used Colorado Canal water to fuel demographic and economic growth, and to secure themselves against drought.** The interview results for **H2** concerning the effects of the Colorado Canal sales on the purchasing cities appear summarized in Table 6.

Findings	Interviews Mentioned	Groups Mentioned	Relevant Quotations
Planners operate under assumptions of “uncoupled” demographic growth, and acquire water to keep up	3	M	“The driver for us to have to get more water is growth, period. It’s not speculative growth, it is growth.” (M-4)
Some municipalities pursued water in response to <i>specific</i> growth opportunities	1	M	“[W]e had had a couple of economic development prospects in the ‘60s that considered locating in [our city] and ended up locating elsewhere; one of the reasons they gave was they were concerned whether we had adequate water supply.” (M-1)
Other municipalities felt growth pressures more broadly	3	M	“Huge growth. Those days it was one of the go-go growth cities in the US, at that time frame. You had all the big names in tech were here, all the big names- a lot of the big names in aerospace were still here, you had a lot going on...” (M-3)
The primary benefit of acquiring agricultural water supplies is <i>drought avoidance</i> through diverse, senior, reliable supply	3	M	<p>“We’ve really been working hard to develop a more diverse portfolio of water supply to really help our city through the lean times when you’ll have one part of the area or the other of the state of Colorado in drought, and that typically is the case, that some part of Colorado is in drought.” (M-4)</p> <p>“Today, yes, we are secure. We have a robust portfolio, a diverse portfolio, that will serve us well for now and the foreseeable future. But our job is not to just take care of today. We’re in the middle of our Integrated Resource Planning process, and looking out 50-60 years in the future, we see lots of different scenarios where we’re going to need more water.” (M-3)</p>

Table 6: Summarized findings for H2, effects of the Colorado Canal water sales on urban areas

H3. Front Range cities focused their water acquisitions on the Colorado Canal, which exacerbated the consequences there, while exempting other ditches

If **H3** accurately reflects patterns of buying and selling, then we would see municipal interviewees confirm that costs, transaction risk, and reliability push them to pursue the Colorado Canal while rejecting others (code group *WHYBUY*), and we would expect to see farmers report selling water for reasons that affected the Colorado Canal differently from other ditches: poor productivity, local economic shocks, and operational concerns, among others (code group *WHYSELL*). Interviewees largely confirmed this theory, while adding a few mitigating circumstances which explain which water rights get bought and sold. This finding is important because it has long been understood that Western agriculture as a whole is not at risk from water transfers, if only because there is so much of it. It is often proposed that drying up ten percent of the West's irrigated agriculture could meet all foreseeable municipal needs (Metzger, 1988). If this would dry up one out of every ten farms in every irrigating community, life would likely continue largely as before in these places. But if instead we lose nearly all the farms in ten percent of the West's rural counties, as has happened in Crowley County, water reallocation starts to look less like an adjustment in productivity and more like a seismic shift with persistent consequences. It is vitally important that policymakers and water users understand which water rights are likely to be bought and sold, and therefore how concentrated or distributed the effects will be.

Interview results reveal that Arkansas basin cities *do* cluster their water rights purchases, but *not only* to reduce transaction costs. Certain water rights are simply more attractive due to higher expected reliability. Utilities define reliability as expected delivery of the promised yield of water, into the existing municipal treatment system, even in times of drought:

You know, certain water rights are obviously going to be more attractive to us than others, for the reliability reasons. (M-3)

I would say the most significant factor is minimizing the risk around being able to get the yield out of it that you think is there. (M-4)

Reliability of delivery is measured by several attributes of a water right, including its seniority, location, compatibility with existing infrastructure, and the quality of historic record-keeping:

Interviewer: And how do you define reliability, what does that mean?

Subject 1: It's the seniority of the water right-

Subject 2: Seniority, the ability to get it where we need it-

Subject 1: The location, where that water right actually is designated to be, and then how do you get that water right [to your existing delivery system]- (M-3)

Looking at it strictly from a water supply standpoint, I'd rather have the senior, the senior water rights... sometimes it'll be a very junior water right or a water right that hasn't been used in 20 or 30 years so, those are pretty easy to dismiss... (M-1)

...there's plenty of people that call up and go "I've got all this water," they don't have a clue what they're talking about; they don't have records, so if you're gonna have to go to court, you need records. You need some proof that there really was some water... (M-2)

The importance of record-keeping fits with the suggestions of Lund (1993) that municipalities avoid transaction risk, the risk that a transfer will be unsuccessful, in this case because there are inadequate records to establish the historic consumptive use of the water right for the purposes of transferring that amount to the new municipal use. Senior water rights are, of course, preferred for drought avoidance, but these are also preferred by agricultural users (C-1, C-3, S-2), which drives up the price. In any case, however, the willingness-to-pay of the municipalities is higher than that of agriculture with respect to any particular water right (C-1, C-3, M-1, M-3, all S interviews), so the increased desire to retain senior rights in agriculture does not correspond with increased success in doing so. Location, meanwhile, is important because distant water rights will "lose" more water in transit to the municipal infrastructure, via streambed losses and evaporation (M-3). These risk-avoidance attributes mean that, fundamentally, water rights are not substitutable in the sense of an efficient market.

One component of reliability with specific implications is the importance of a water right's compatibility with existing infrastructure. Put bluntly, cities would be foolish to buy water rights, at any price, if they cannot physically move the water into their storage and treatment system or use it for exchange. A right's decreed location is part of this attribute, but so are the operational characteristics of a water right, such as attached storage and exchange potential:

...well if I buy water down valley it's not always gonna be available to me. I have to find a place to put it. I'm gonna need to be able to exchange it up, so now you're gonna be junior to... a whole lot of people, you're gonna be in the back of the line wanting to exchange water upriver. And so your days are gonna be limited, the amount of days that you can move this water. So, there's a cost that you can associate with all of that. An expectation and a cost, how much water you can possibly get back up the river. (M-2)

...actually, the bigger problem in my mind is not so much the water right; you could go down and buy a water right at a headgate with relative ease... it's really not so much getting the water, it's getting it from point A to point B to point C. It's being able to move it, store it, and probably move it again until you can get it to where the demand is. (M-3)

Snowmelt makes water available in the spring, and it flows past water supply infrastructure on its own schedule, except where modified by human intervention. Municipal demand, unlike supply and unlike agricultural demand, is less seasonally variable. This means that municipalities benefit from storing and releasing water throughout the year. The storage associated with the Colorado Canal system, upstream at Twin Lakes and downstream at Lake Henry and Lake Meredith, makes it possible to exchange and move water into Pueblo Reservoir, where it gets pumped to municipal treatment plants, without harming other users:

Even though [the Colorado Canal is] not a great water right, [municipalities] got winter water⁸ and they got storage in two lakes which they can exchange all the way up to Twin Lakes and up to Turquoise [Lake] with. That's what they wanted, they wanted our exchange and our lakes, they didn't care a rat's ass about the water right. (C-1)

Given the primacy of storage and exchange potential, it is unsurprising that the majority, measured by acre-feet, of large water rights purchases by municipalities in the basin have involved storage (see Table 7, next page). The majority has also included attractive fully reusable transbasin water.

⁸ "Winter water" is storage available to the ditches located above John Martin Reservoir in the irrigation offseason; those storage accounts are in Pueblo Reservoir itself.

Year	Transfer	Acre-Feet	Reusable Transbasin Water?	Storage (other than winter water)?
1955	Otero Ditch to Pueblo	5500	No	Upstream
1971	Highline Canal (partial) to Pueblo	1200	Yes	Upstream
1972	Booth-Orchard Ditch to Pueblo	1432	No	None
1973	Hobson Ditch to Pueblo	275	No	None
1968-1985	Colorado Canal to Colorado Springs, Aurora, Pueblo, others	47,373	Yes	Upstream and Downstream
1986	Rocky Ford Ditch (majority) to Aurora	4100	No	None
1986	Highline Canal (partial) to Aurora	1000	Yes	Upstream
2002	Rocky Ford Ditch (remainder) to Aurora	2539	No	None
Ongoing	Bessemer Ditch (partial) to Pueblo	Undetermined	No	None

Table 7: Arkansas Valley ditches purchased by municipalities and associated storage

According to municipal interviewees, the insistence on low cost water supplies only extends so far. Given the non-substitutability of water rights in reliability and compatibility terms, utilities do not “play the market” to keep their costs low:

But if the water right itself is attractive enough you’re willing to pay for it, and if it’s not attractive, then you’re not. What are you offering me for what I have to pay for it? (M-3)

They are concerned about climbing engineering and legal costs, and they would prefer to minimize transaction costs by consolidating their purchases, but in any event, they expect agricultural water sources to be cheaper than other water sources:

In those cases [buying from multiple ditches] you end up with more lawyers’ fees, more engineering fees, more time by internal staff because you’ve got a lot more little pieces to manage and not one big block. (M-3)

It’s all risk-based right now. What do you think the potential legal costs will be, who do you think the potential opposers will be? (M-4)

But right now there’s more agricultural capacity than there’s need, and so... ag water can usually be purchased relatively cheap because of that. (M-1)

These results suggest that the purchase price and transaction costs of a water acquisition are not determinative, and that other attributes like reliability and compatibility are likely to drive which regions are involved in a water transfer and which are not.

Further results indicate that a primary driver of which water rights will be bought is even simpler: Arkansas Valley cities bought the water rights that were made available to them by sellers. While some deliberately sought out water rights in response to growth pressures, the primary reason that the Colorado Canal came to their attention was the marketing efforts of farmers and intermediaries:

In the early 70s for the Twin Lakes water, yes, there was pressure. There was a need for water at that time, but the Twin Lakes kind of set us up for quite a long time. I think the Colorado Canal was more of an opportunistic approach. At that very time, that's right when Fry-Ark was coming online.⁹ So [the utility] had already purchased the Twin Lakes, we were in pretty good shape, and then Fry-Ark was coming online, we had a decent share of that, so I don't think that it was such that we were desperate for water at that point, but it was more of "well here's another opportunity," kind of the same system we're already invested in, to a degree. It seemed like an opportunity. (M-3)

... the Twin Lakes sale, that was one that they came to us; a group that had formed under Foxley and CLADCO and some groups and bought a bunch of Twin Lakes shares and Colorado Canal shares with the idea of being able to sell them and make some money, and so... they came to us and said, you know, "we've got these Twin Lakes shares, are you interested..." (M-1)

[CLADCO] did market the Twin Lakes water, and at that point that's when they approached Colorado Springs and Pueblo and some of the other municipalities. What do you do? You get offered a really good water right, you're gonna buy it if you have any brain in your head. (M-3)

I'm not the evil municipality driving down into the valley looking for water. Any of the water rights that we've acquired have been brought to us. They've come to us, they've knocked on our door and they want to know if we're interested. Then I start to develop a list of what is out there, what's being marketed. (M-4)

When you talk to people about what happened [on the Colorado Canal], it's almost like when these announcements came for the sale, people were running over each other to get to the door, I mean literally running over each other. (C-1)

The theme of these and other responses is that farmers were aware that cities were interested in purchasing water, and cities did not have to seek out individual ditches or farmers. Every municipal interviewee reported getting regular inquiries from farmers and intermediaries about engaging in a water transfer. They then evaluate the opportunities presented and pursue those that satisfy them on reliability, compatibility and cost grounds:

⁹ The Fryingpan-Arkansas Project (Fry-Ark) is a federal transbasin diversion project that imports water into the Arkansas Basin headwaters. At the outset, the allocation of project water was split 50-50 between municipal and agricultural users. This project included the construction of Pueblo Reservoir (Southeastern Colorado Water Conservancy District, 2014).

...we get calls all the time. Good water rights, bad water rights, but every once in a while there will be a good water right that comes by, and it's actually our policy directive from our Board to actually pursue those if we think there's a good opportunity there. When a good one comes by, if you miss it, it's gone, pretty much forever. (M-3)

There is one additional consideration reported by municipal staff. While several of them mentioned the "politics" surrounding water transfers, interviewee M-1 explicitly stated that local politics partially motivated his organization's purchase of a nearby ditch (not the Colorado Canal):

There's political things, like I mentioned, the [nearby ditch] purchase I would not categorize as being strictly about, "Okay, we needed additional water supply, this was the best option," it had some other things with it, about wanting to protect a larger asset for the community beyond simply how much water can we get into the city. I think there was some political pressure for us to step up and make sure the [ditch] didn't sell outside the local area. (M-1)

However, no interviewees reported that the controversy surrounding "buy-and-dry" motivated their boards or upper management to direct them *not* to buy agricultural water rights or to rely on another source of additional supply. In fact, it appears from interview results that most utility boards in the basin are either unaware or uncaring of the effects of their buy-and-dry actions on neighboring rural communities: boards turn over frequently (M-3, M-4) and see their responsibilities as directed toward the city's water supply. That being said, at least one municipal board seems to dislike buy-and-dry actions taken by *other* municipalities, especially the transfer of water outside the Arkansas basin (M-1, M-2, M-3), while not subjecting their own to the same kind of scrutiny. Municipal staffers who control water rights portfolios and interact with their neighboring entities on a day-to-day basis are far more aware of the secondary effects of their strategic choices, but are directed to continue pursuing reliable, useful water rights when they are available.

Taken together, the municipal preference for senior, nearby, operationally compatible, storage-associated water rights at low transaction costs tells a convincing story: in the Arkansas basin, municipal buying habits have tended and will tend to concentrate rather than disperse the water rights that are transferred, and thus the lands that are dried up, and thus the economic, social and environmental consequences, confirming the first part of **H3**. But this might be counterbalanced by farmers' selling habits: if farmers sell one-by-one according to escalating marginal costs, as suggested by Young (1984), it would lessen the suddenness and perhaps concentration of agricultural dry-up. If **H3** is to be true in its entirety, this cannot

be so. The experience of the Colorado Canal generally confirms **H3** because farmers under the canal were faced with serious financial challenges substantially at the same time, and in greater proportions than on neighboring ditches. These challenges included overleveraging, the closure of the Sugar City mill, which served essentially only Crowley County farmers, inadequate water in proportion to the land under the canal, and poor soil productivity (Weber, 1989; MacDonnell, 1999). Financial considerations reported by interviewees included all of these challenges:

And I said well, the best reason, the only reason that I know of they done it, they had some tough years, they had some short water years, they'd borrowed money from the bank, and they were in debt, and it didn't look like they were going to get out of debt very easy. A lot of them were about to lose their farms. (S-2)

There were some who sold, probably didn't want to, but felt like they were in a financial position that they had to sell. (M-1)

I think that's the story of the Colorado Canal, is that the economics didn't work out for the canal system, and everybody that had been beating their head against that wall for however many years, many of them just- when the sugar beet factory closed in '67, I believe it was, over in Sugar City, they just threw in the towel and said "we're done. We can't make a living on this." (M-3)

It's notable that the Colorado Canal, like several but not all ditches in the Arkansas Valley, is almost certainly over-extended in terms of the land available for irrigation and the lack of seniority of the water right (C-1, C-3, M-3). In that sense, the financial pressures to sell water are not evenly distributed across the landscape, but rather are similar for farmers on the same ditch system. Furthermore, poor soils under parts of the Colorado Canal reduced productivity and profits (C-1, C-2). Because of the storage and transbasin components of the system, it was attractive to CLADCO as a speculative venture, and their offers in 1968 were substantially more than anyone was paying for Crowley County land:

They couldn't wait to sell. And maybe if I was on one of those farms and I was starving to death and no one wanted to- I mean, the first offer was like 350 or 390 an acre for everything, and land, you couldn't get 200 dollars for an acre of land in Crowley County that had both the Twin Lakes, the [Lake] Meredith, or Lake Henry and [direct-flow] Canal on it. That's how bad it was. (C-1)

The situation was largely repeated for the direct-flow and storage rights decades later. Of course, more conventional financial pressures played a role in the decision to sell; these are probably not concentrated under particular ditches:

And... over the years, especially in the late 1960s and early 70s, farm prices were not good. They- that's when I think the people began to think, when the idea came and when- that they could sell their water, they did. (C-2)

And so it was an opportunity- we had a loan at that time on our farm, it was an opportunity to pay that off, to send our children to school and have money that we could put in savings. (C-2)

I sold a little bit to get out of debt. I really wasn't in debt that much but I took a few shares and said "well it'd be nice not to pay any interest" so I... got everything paid for. (C-3)

...but there are people- they need money, they're usually frantic, they shop around, they come to all of us, "we want to sell, we got a medical bill." (M-2)

Just the same, it seems that financial considerations aggravated rather than mitigated the concentration of municipal purchases, at least in the case of the Colorado Canal.

There were several non-monetary motivations for farmers who chose to sell water. Many farmers had no children interested in taking over the farm operation, and many wished to give them more formal education:

...we encouraged our son to go to college and our daughter was already in college. It was a way that we could pay for their education and get them started in life and we used money for that. (C-2)

...you had quite a few who don't have children interested in farming, and so I think for some that was a big driver, is "I'm getting up there in years, nobody in the family wants to take this thing over, and so maybe it makes sense to cash out." (M-1)

But people that don't have anybody that wants to continue farming, don't have any family that's interested and the neighbor can't buy it, they're looking for a place to sell. (S-2)

While surely these worries are common to every agricultural area as society urbanizes, providing some evidence against **H3**, it is also true that some farmers on the Colorado Canal sold because they thought their operations would be harmed by the mass sale of canal shares by others and the lack of sufficient water in the canal, or that the cities would make their operations impossible once they had control of the canal:

...I think some sold because they felt like once their neighbor does if they don't sell it's gonna be the end of the world for them.... Basically that they'll, in the end they'll get run over by the city and they won't get their water if they choose not to sell, things like that. So I think there were a few who really didn't want to sell but just felt like it was inevitable at that point and they, you know, didn't really have a choice in it. (M-1)

This feeling was aggravated by the overextension of the canal to serve too much land:

...the Colorado Canal may always have been doomed for failure... because the water right was so junior and because there was so much land that was under cultivation for such a poor right in terms of how much water produced on an annual basis. (C-1)

This is strong evidence in favor of the concentration of dry-up. If farmers sell because others are selling already, and they are concerned about the future operation of the canal (perhaps rightly, as the evidence for **H1** suggests), then small sales of water that would have minor consequences can quickly balloon into system-wide sell-offs, exactly as happened under the Colorado Canal.

Interestingly, interviewees also reported that they and their neighbors often hoped for continued farming in the area after the water sales. This hope took two forms: first, CLADCO's assertion that they were buying the water in order to operate Christmas tree or vegetable farms may have persuaded some shareholders that selling to CLADCO would not be damaging to the valley:

I think they did [think the water sold would be used locally], especially the ones that sold their farms and their water together to CLADCO. They came in and bought a lot of farms that way. (C-2)

This feeling, for some, persists today:

And I think some of them would even sell their water a bit less if they had to, to keep it here [in Crowley County], because there are some people that had to sell, they were really good farmers and they hate to sell, so they come to us all the time and we [Crowley County Water Authority] buy anything they got, now... (C-3)

Far more important, and an underappreciated motivation for water sales on the Colorado Canal, was the coming of the federal Fryingpan-Arkansas (Fry-Ark) Project, which imports transbasin water into the headwaters of the Arkansas River not far from Twin Lakes. The Project was authorized in 1962 and begun in 1964, just four years before the first sales (Southeastern Colorado Water Conservancy District, 2014). The Project's authorizing legislation specified that 50% of the water brought into the basin would be dedicated to the agricultural ditches between Pueblo and John Martin Reservoirs, and as a federally subsidized project, the water was expected to be cheap:

So you have some guys either thinking or saying "well, crap, I don't need the Twin [Lakes water]. Twin's a transmountain water right. I'm part of the Fry-Ark. I'm gonna get transmountain water. Why should I hold on to an asset that I can get 1000 dollars for, and when I buy water from the [Fry-Ark] Project it's gonna cost me 3 bucks?" ...I'd argue that there's an influence of the Project and its timing and what the promises were. (C-1)

Importantly, the Fry-Ark's initial scope was far more grandiose than its eventual completed realization in 1981. Colorado River interests concerned about losing more water under the Continental Divide secured half of the Project's developed water for themselves and reduced its overall size. By the time it was finalized, and after half of the Arkansas deliveries were taken by cities, there was too little water spread over the many ditches below Pueblo Reservoir to be of any use at all replacing what was sold (C-1, M-1, S-1).

In summary, the involvement of the Colorado Canal in a transfer proceeding was determined by a combination of municipal needs and agricultural pressures. Many of these, like the occurrence of low commodity prices, are shared by most or all agricultural areas in the modern West. However, many of them, and in the case of the Colorado Canal, enough of them, tend to focus attention on certain ditches that are senior enough for municipal purposes, in the right place, have operational benefits like associated storage, are overextended or junior enough to stress farming, have poor soils, or have local economic shocks. The interviewees' experiences strongly suggest **H3. Front Range cities focused their water acquisitions on the Colorado Canal, which exacerbated the consequences there, while exempting other ditches.** The reasons reported for buying water under the Colorado Canal are summarized as Table 8 and the reasons reported for selling water under the Colorado Canal are summarized as Table 9 on the following pages. In both tables, results in shaded cells contribute to the concentration rather than the distribution of transfer activity.

Findings		Interviews Mentioned	Groups Mentioned	Relevant Quotations
Why buy a water right?	Reliability in times of drought	4	M	“It’s the seniority of the water right... The location, where that water right actually is designated to be, and then how do you get that water right-” (M-3)
	Operational compatibility	5	C, M	“But it’s really not so much getting the water, it’s getting it from point A to point B to point C. It’s being able to move it, store it, and probably move it again until you can get it to where the demand is.” (M-3)
	Operational benefits (especially storage)	5	C, M	“That’s what they wanted, they wanted our exchange and our lakes, they didn’t care a rat’s ass about the water right.” (C-1)
	Lower costs, including transaction costs	4	M	“In those cases [buying from multiple ditches] you end up with more lawyers’ fees, more engineering fees, more time by internal staff because you’ve got a lot more little pieces to manage and not one big block.” (M-3)
				“But if the water right itself is attractive enough you’re willing to pay for it, and if it’s not attractive, then you’re not. What are you offering me for what I have to pay for it?” (M-3)
	Immediate need	3	C, M	“...we had had a couple of economic development prospects in the ‘60s that considered locating in [the city] and ended up locating elsewhere; one of the reasons they gave was they were concerned whether we had adequate water supply.” (M-1)
	Buy what is being marketed	6	C, M	“I’m not the evil municipality driving down into the valley looking for water. Any of the water rights that we’ve acquired have been brought to us. They’ve come to us, they’ve knocked on our door and they want to know if we’re interested. Then I start to develop a list of what is out there, what’s being marketed.” (M-4)
Keep nearby water rights as benefit to community	1	M	“...it had some other things with it, about wanting to protect a larger asset for the community beyond simply how much water can we get into the city. I think there was some political pressure for us to step up and make sure the [nearby ditch] didn’t sell outside the local area.” (M-1)	

Table 8: Findings for H3, motivations for buying shares in the Colorado Canal. Reasons with gray backgrounds tend toward the geographic concentration of transfer activity.

Findings	Interviews Mentioned	Groups Mentioned	Relevant Quotations	
Why sell a water right?	Debt or bill pressures, made worse by local economic shocks and low commodity prices	9	C, M, S	“And... over the years, especially in the late 1960s and early 70s, farm prices were not good. They- that’s when I think the people began to think, when the idea came and when- that they could sell their water, they did.” (C-2)
	Family considerations	6	C, M, S	“But people that don’t have anybody [family or neighbors] that wants to continue farming, ...they’re looking for a place to sell.” (S-2)
	Ditch or land inadequacy	3	C, M	“...the Colorado Canal may always have been doomed for failure... because the water right was so junior and because there was so much land that was under cultivation for such a poor right in terms of how much water produced on an annual basis.” (C-1)
	Continue farming with a cheaper water source	5	C, M, S	“...maybe it makes sense to sell off these expensive to operate systems and we can replace that water with Fry-Ark water.” (M-1)
	Keep water rights within rural community or in farming	2	C	“And I think some of them would even sell their water a bit less if they had to, to keep it here [in Crowley County]” (C-3)
	Fear of future operational difficulties as a holdout	4	C, M	“And so I think there was probably some folks who thought they were going to end up like that, they were going to be the last guy left who can’t, can no longer operate, and so they didn’t want to be that guy so they sold.” (M-1)

Table 9: Findings for H3, motivations for selling shares in the Colorado Canal. Reasons with gray backgrounds tend toward the concentration of transfer activity.

Burdens and Compensation

H4. The primary “losers” of the Colorado Canal case were third parties in Crowley County; the primary beneficiaries were urban water utilities, residents and property developers; these losers were not well-compensated by revegetation and monetary payments

If **H4** is supported by the evidence of interviewees, we would find them speaking skeptically about the revegetation (code group *REVEG*) and compensation (code group *3PCOMP*) schemes that took place in the aftermath of the Colorado Canal water sales. Because the burdens of the Colorado Canal sales fell, and continue to fall, almost exclusively on third parties in the areas of origin, as found in the research into **H1**, and because these outcomes were made worse by their concentration in a small area, by the attributes of the Colorado Canal system, as found in the research into **H3**, and because the benefits accrued to municipal providers, their customers and developers, as found in research into **H2**, it is tempting to think that, as with many otherwise efficient transactions with easily identifiable suffering third parties, the beneficiaries could simply provide compensation, make all parties “whole,” and still benefit from the transaction. In Colorado, this principle is embodied through two requirements of traditional water transfers that involve more than 1000 acre-feet of water: first, municipalities or other buyers may be required to replenish the lost taxable value of the retired land (Senate Bill 03-115) (Colorado General Assembly, 2013); and second, they may be required to revegetate the retired lands with native grasses (Senate Bill 92-92) (Colorado General Assembly, 1992). These requirements did not exist, in their current form, on the Colorado Canal sales, but there were substantial revegetation efforts and payments to Crowley County by municipalities anyway. Interview results generally confirm **H4** and show that these “compensation and mitigation” efforts do not adequately represent or replace the value of what is lost in the transfer. This skepticism is shared by all interview groups.

To begin with, revegetation under the Colorado Canal, as in many other places, was largely unsuccessful due to the lack of water committed to the effort, overgrazing, and insufficient attention:

I seen enough of Crowley County and then the Rocky Ford [Ditch] when they sold out, they had to supposedly revegetate it, ha-ha-ha. Some of it’s good and some of it isn’t worth a darn. (S-2)

What had happened prior to that law [SB 92-92] were fairly unsuccessful efforts because what would happen is... the landowner would be responsible for the revegetation and they may or may not be all that interested in putting a lot of effort into it, and if they no longer had the water, it was difficult to

get the grass established, I mean unless you got lucky with rains at the right time you end up buying a lot of seed and it never germinating... (M-1)

Another issue is there was not water attached to that [offer of free seed for revegetation]. Now they could have leased water from the cities. (M-3)

On the revegetation, when they sold the water, we had an agreement that they were supposed to revegetate. They had two years to revegetate. And they put in there two words. They said they had to revegetate and take that water that they had for two years and use it on the land, and to revegetate whatever was “economically viable.” They took that- what’s economical? You know, what’s economically viable? How do you understand that when you’re planting grass? (C-3)

So we had people from the city come down with their two or three horses, and they’d put it on the 40 acres of ground that was revegetated, and thought they really had something, and put 4 or 5 horses on, and pretty soon, a year or two, they don’t want to buy the hay for ten dollars a bale like last year, so let the horses eat it in the ground, and they destroyed everything that we did to get it back to where it was. (C-3)

After the Crowley County experience, municipalities began reserving water for their revegetation projects and must now establish vegetation before they can even move the water to municipal use, if the transfer is more than 1000 acre-feet (S-1, S-2, M-1, M-3). Super Ditch participants pointed out that this requirement is no panacea: the Rocky Ford Ditch has been under intensive revegetation management for well over a decade (S-1, S-2), often with little concrete progress.

Given these outcomes, it is unsurprising that municipal and rural attitudes toward revegetation are skeptical or begrudging. However, both groups reported that they felt utilities, not remaining landowners, are the proper stewards of any revegetation project and the most likely to be successful:

I don’t know about fairness, but I think it’s the most workable solution, because if you say that the water can’t be used for the new use until the reveg is complete then you have a motivated party to do it, and so you know obviously that’s going to fall to the municipality because we’re the ones who want to make the change. I don’t know so much fairness but that’s the party that’s got to be motivated to do it, so I think the law’s a good law. (M-1)

I think [revegetation requirements are fair], because somebody who is there, who has an asset, is gonna be somebody who has an interest in maintaining that. (M-3)

Typically it’s gonna be a part of what happens through the change case process. You’re gonna have opposers that are gonna require [revegetation].

Interviewer: And you’re okay with that?

Yes. Of course.

Interviewer: You think that's a fair requirement for someone buying water?

Yes. (M-4)

Utilities have an ongoing interest in the retired land, especially if grass establishment is required as a condition of completing the transfer. They also have the staff and the resources to reestablish grasses. Nevertheless, given their subpar track record in the Arkansas basin and the many other things that are lost in a transfer, revegetation alone is unlikely to make rural communities whole, even if municipalities have committed to the practice either as a gesture of fairness (M-4) or the “cost of doing business” (M-3, M-4).

Parties to a transaction try to make up for some of “the other things lost” through compensation of public coffers (“PILC payments”), and there are suggestions of extending that to affected businesses in rural towns. However, both rural residents and utilities in the Arkansas Valley are skeptical of third-party compensation’s ability to restore losses in rural areas:

But PILC payments, they don’t make up the true economic decline of when the water leaves. Because those PILC payments, they mean paying the taxes. But that farmer, like on the Rocky Ford Ditch, you have farmers who are buying trucks, tractors, fertilizer, seed; when they’re buying that they’re paying taxes on it and creating jobs, and jobs and you have taxes from jobs; those guys are going out to restaurants, spending money on the restaurants. So PILC payments aren’t about the- it’s about the county getting some property tax revenue, but it really doesn’t make up for the total loss. I mean, in a farming community, there’s a study done [that] said a dollar will circulate 19 times in a farming community, and the one dollar that you’re losing from this guy buying seed and fertilizer, that dollar’s not circulating throughout the economy. (S-1)

Furthermore, all interviewees who expressed an opinion on third-party compensation objected to the very idea of municipalities replacing lost public or private revenues simply because they engaged in a market transaction:

I can see the counties wanting that. And I can understand their logic behind it, I don’t begrudge them asking for it, but on the other hand that gets into a whole different area of social engineering, that- do we want to... again, does the city has a responsibility to maintain a certain lifestyle in a county simply because we’ve bought one of their products? I don’t personally, having grown up there and I still have a lot of family down there, I don’t think that’s a legitimate claim. (M-3)

My personal opinion is if that land’s not being used for ag, why would I pay for it for being used for ag? I understand it has an impact on the government of that area, but... if they need revenue, don’t they assess taxes? They can assess taxes. (M-3)

...our attorney likes to say there'll be some level of "how many fire trucks are you going to be buying?" as part of the process. (M-1)

Interestingly, even Super Ditch participants, who have the objective of keeping rural communities whole, don't believe that compensation is a reasonable way to do so:

[No,] I think what they need to do is keep agriculture here and partner with agriculture and not dry up agriculture. (S-1)

This last comment is revealing: for rural stakeholders who followed the Crowley County situation closely, as did this interviewee, *there is no good (or even "better") way to dry up agriculture*. Instead, it must be avoided through the pursuit of alternative models. All in all, despite the gap between a municipality's willingness-to-pay, backed by hundreds to thousands of rate-payers and developers' new tap fees, and a farmer's willingness-to-accept, exploiting that gap through more substantial compensation or mitigation is unlikely to truly replace what is lost, or to be accepted by the relevant stakeholder groups. The interview results strongly confirm **H4**. **The primary "losers" of the Colorado Canal case were third parties in Crowley County; the primary beneficiaries were urban water utilities, residents and property developers; these losers were not well-compensated by revegetation and monetary payments.** Summarized interview results about compensating affected communities and mitigating buy-and-dry damages, are summarized in Table 10 on the next page.

Findings	Interviews Mentioned	Groups Mentioned	Relevant Quotations
Revegetation on the Colorado Canal, as in other places, was largely unsuccessful due to lack of attention, mismanagement or lack of water	8	C, M, S	“...when your land has been irrigated for so many years, it’s really hard to leave it dormant like that without any water and then try to get grass to grow.” (C-2)
All user groups think municipalities are the appropriate responsible party for revegetation	5	C, M, S	“But reveg was done, it wasn’t done well, and there was- the lesson learned was it probably needs to be somebody who has an ongoing interest that would be responsible to see that done, as well as covenants.” (M-3)
All user groups are skeptical that third-party compensation can or should replace value of water and land	4	M, S	<p>“[Y]ou have farmers who are buying trucks, tractors, fertilizer, seed; when they’re buying that they’re paying taxes on it and creating jobs and jobs and you have taxes from jobs; those guys are going out to restaurants, spending money on the restaurants. So PILC payments aren’t about the- it’s about the county getting some property tax revenue, but it really doesn’t make up for the total loss.” (S-3)</p> <p>“Well, the guy who is selling implements, now he doesn’t have as many... so do I need to supplement his income? What about the lady that was selling him his lunch, do I need to... where does it end? Where does it end?” (M-3)</p>

Table 10: Findings for H4, potential for compensation and mitigation of damages of “buy-and-dry” on the Colorado Canal

H5. Farmers and rural residents have pursued the Super Ditch concept as a way to avoid the impacts of buy and dry and retain their communities' health, but urban water utilities are skeptical because of their insistence on certainty, reliability, and low costs

If the evidence supports **H5**, then there will be a stark difference of opinion on the prospect of leasing between rural residents and urban planners. Super Ditch participants and Colorado Canal shareholders would report that they support the Super Ditch effort as a way to avoid the worst impacts of buy-and-dry seen in Crowley County, and municipal interviewees would report their opposition on financial and operational grounds. The interview results reveal that these theories are only part of the story. Farmers and Super Ditch leaders think about more than just avoiding buy-and-dry when planning leases (code group *WHYLF*), municipalities showed a range of opinions on the prospects of leasing water long-term (code groups *WHYLF* and *ANTILF*), and there remain persistent systemic challenges (code group *LFCHALL*) to instituting a leasing scheme separate from municipal opposition.

To begin with, the specter of the Colorado Canal is indeed prominent in the minds of Super Ditch participants:

And that's what we're trying to do is make sure that this part of the Arkansas Valley doesn't get dried up like what happened in Crowley County. (S-1)

I don't know if you drove through Sugar City or Ordway or someplace like that.... You just- that's, we don't want to see any more of those. (S-3)

Otero County will talk about "we don't want to do what Crowley County done," and have all of our water leave, and that's the big issue, you know, of all southeast Colorado. Don't do what Crowley County done. (C-2)

Not only that, but it looms large in the thinking of certain municipal planners:

It would be nice to have a different route. Because when you look at what's happened down in the valley, that's not a very good future, and I get that. Like I said, I get it that there's a farmer down there, his most valuable asset is his water. And he's saying that's it, I just want to part with it. But boy, if we can develop something that makes it better, where we can say well, you know, I think I can make this thing work. (M-4)

[Some urban community leaders] hate the idea of any ag land being dried up whether permanently or temporarily to feed the thirst of municipalities to the north, but it's probably inevitable and we'd sure rather it be rotational and temporary rather than permanent. (M-1)

...the most attractive part [of Super Ditch is] that farming is viable. (M-4)

Even Colorado Canal farmers lament that leasing was not an option for them in 1968 or 1980; the idea had not yet broached the discussion around water planning, perhaps simply because the impacts of the traditional route had not yet been fully observed:

I would've [leased water]. I would've if they would've done that but... they haven't done that until they seen all the damage. (C-3)

...surely there would have been a way for us to come up with some kind of reasonable way of leasing that [Colorado Canal] water to municipalities that needed it. (C-1)

This sense of “giving farmers an option” is vital to the mission of the Super Ditch (all S interviews, M-4). If farmers, susceptible to an offer to cash out of the business, can instead receive a guaranteed income stream while reducing their workload, it turns selling from a practical necessity into one of several choices and reduces their vulnerability to economic and environmental pressures that, as of now, might cost them their farms. It may even attract new farmers to the area who can't commit to the risk of farming year-in, year-out, thus also reducing the family pressure to sell water as retirement nears (S-1, S-2). It is important to recognize that even though the choice to sell or lease is always voluntary in the strictest sense, the reality in practice is that they often have had no choice but to take a municipal offer and walk away. This vulnerability to external pressure is reported by all of the Super Ditch participants and all of the Colorado Canal shareholders that were interviewed.

While “don't do what Crowley County done” is perhaps the most important motivation behind organizing the Super Ditch, it is not the only one, especially for farmers. Many farmers pursue leasing for direct benefits to their operation and their communities. The most obvious of these is additional income and monetary circulation:

More than three years, and you can only do 30 percent of it at a time. So we're still farming 70 percent of the land, we're still here farming, we're still here buying fuel, we're still buying seed, we're still buying fertilizer, we're still going to town to buy groceries and whatever. The community continues to thrive... (S-2)

Coming out of that drought a lot of those guys [on the Highline Canal] were in pretty bad shape financially, and being able to do that lease for a couple of years sort of let them get above water,

whereas they might not have been able, farming, to get themselves back into a good financial position. (M-1)

Subject 1: ...we leased water; that was the woman I referred to earlier who squeezed my arm and said "I really enjoyed my trip to Hawaii, thank you very much." And with the proceeds that they got from not farming and the cash they had in the door, got them a trip to Hawaii, which... good for them!

Subject 2: Yeah, they made a lot more... money that year than they ever would have farming. (M-3)

The two key things were, make sure the water rights ownership continues to be with the farmers and ranchers in the valley so they can realize the appreciating value of the water, and second of all, water can be considered an extra crop. (S-3)

Arkansas Valley water rights, especially Twin Lakes shares, have exploded in value since 1968 (all C interviews, all M interviews), often in the hands of municipal owners. The Super Ditch attempts to retain the extremely valuable appreciating asset in rural communities, and to provide farmers with direct income that, unlike following the Colorado Canal sales, they are expected to reinvest in their community because they are still farming.

The "fallowing" part of lease-fallowing gives farmers a chance to rest land, and the income available for reinvestment gives a chance to make on-farm improvements:

And it's just like selling crops, you're gonna get money for leasing it, and you can rest your- the dry up land, you can either rest it, you can level it to make it better to farm when you put the water back on it, or whatever it takes, but you still own the water! (S-2)

He's an organic farmer, so when you're doing that you're not putting all the artificial fertilizers, you actually need to fallow it, it's an important part of keeping the land healthy... (M-1)

Yeah, you know, if you've got a field that needs leveling, you're gonna get paid just like you had a crop, you get time in the summer time you go out and work on it. (S-2)

Just as importantly, however, setting up and running a leasing scheme gives the Arkansas valley ownership of its own problems and the chance to collaborate for mutual benefit:

...but at the end of the day, and this is what's going to get your wheels turning, at the end of the day, lease-fallowing will not be about moving water to the city. It will be about the farmers solving their own problem. (S-1)

Most notably, this might manifest in the form of agriculture-to-agriculture leasing, keeping water in the valley and making its production more viable in short years:

[Farmers] will realize that what they're going to have to do is lease and fallow to each other... is it better to have seven ditches in 2012 kind of farming? Or is it better to have four ditches farming and three ditches fallowing their land and leasing their water back to other farmers. That what lease-fallowing is going to end up with is farmers solving their own problem... And hopefully you do that, with a combination of leasing to a city, it should make agriculture very sustainable and very viable in the Ark basin. (S-1)

The Lower Arkansas Valley, virtually all the ditches are water-short, which means in an average year they don't have enough water to grow the crops. So maybe the ditches get together and sort of rotate amongst themselves and say well, we look at this year, our ditch is not gonna do well, we'll forgo our diversions and we'll let this other ditch have all of our water so everybody gets plenty of water to finish their crops, and then next year we'll get it. Something like that. (S-3)

The suggestion of "ag-to-ag" leasing leads into a broader attraction of lease-fallowing, one unexpectedly shared by several of the municipalities and not predicted by **H5**. Many interviewees, both urban and rural, like the operational flexibility of the practice, especially in the face of variable water supplies and the prospect of drought recovery:

Now I think where leases really fit in well is to meet drought conditions. So it's not your base supply but it's a supply you go to, let's say you've got a drought that's drawn your storage down and you want to get it refilled, so maybe 3 or 4 years of leasing from ag to refill your storage reserves, I think that makes a lot more sense than just saying "we're gonna grow on this water supply." (M-1)

But I really like the way that you could manage the Super Ditch concept. Where you go into a dry year, farmers saying this isn't going to work, and instead they would be willing to lease a larger amount of that water or whatever the yield would be- the yield won't be as much- but it's a win for them in a dry year where they can't economically do it, they can still have some money coming in to keep them economically viable. (M-4)

This flexibility, however, only works if it meets the essential attribute of operational compatibility. The Super Ditch has to be able to deliver leased water into Pueblo Reservoir in order to benefit the municipalities. Going one step further, if the Super Ditch can move the water on their own initiative, without the involvement of municipal exchanges and storage, then cities become, essentially, a customer of a water wholesaler, and that role is attractive to municipal planners:

Yeah, I think the concept of the Super Ditch as you were describing it, that's an ideal world for us. If they were able to produce a block of water at the right location for us at a price we're willing to pay, why wouldn't we? (M-3)

With Super Ditch it's their responsibility. We have a contract with them for a set amount at a set price, and then they work on making it happen. (M-4)

That is precisely the role the Super Ditch is trying to prove it can perform in the pilot leasing project that is ongoing as of 2015. Furthermore, as a “client” of Super Ditch, cities may be able to avoid some of the substantial costs of changing a water right in court: This potential benefit is, as of yet, totally unproven:

What we’re trying to do is cut the transaction costs down, which are a big headache. And the transaction costs for this pilot project are high, and the transaction costs for long-term leasing-fallowing are high. We’ve got to figure out how to get those down, or else we’ve got to figure out how to share them, because right now the Lower Arkansas Valley Water Conservancy District is subsidizing it. They’re paying for all of it. The money goes directly from the municipalities to the farmers. Nobody’s having to take a hit on the transaction costs, because we’re trying to prove it, but ultimately there’s gonna have to be some sort of agreements as to how that happens. (S-3)

As the impacts of the Colorado Canal sales have become more widely known, and as the prospect of wide-scale agricultural dry-up was deemed unacceptable, political rhetoric and new planning processes organized to avoid future buy-and-dry at the state level. Exactly how that has filtered down to municipal operations is unclear, but two municipalities mentioned political pressure to avoid buy-and-dry and to pursue leasing, as did one individual involved with Super Ditch:

And [a local newspaper has] sort of gone back and forth editorially on support for Super Ditch, they’ve had some editorials in opposition, I think from what I can tell they’re now in favor of it, although very cautiously, “we’re worried about it but we think it may beat the alternative.” (M-1)

The other thing, and you mentioned it already, that politically this is good. This is something that we want to support not just because we feel like we need a pat on the back for supporting it; I want to support it because it’s a good idea. (M-4)

I think that the editorial board at the [newspaper] has moderated a bit over time, and I think that, you know, they’ve decided we aren’t all crazy. This has been a keystone issue of the basin, of the Arkansas basin plan, so that’s important and I think [a newspaper official] is on the basin roundtable¹⁰ down there... (S-3)

As a minor final note, one municipal planner mentioned that lease-fallowing could potentially avoid incurring revegetation costs, which the Rocky Ford Ditch experience has shown can be long-lasting and intense:

¹⁰ The Arkansas Basin Roundtable brings together municipal, agricultural and other water users to produce planning documents for the future development of water resources within the basin (Koebele, 2014). Whether these plans will alter the management of the Arkansas River is as yet unclear.

...if people can control the weeds and control soil erosion during those periods of fallowing I think that's going to be something cities will look at in the future and say, okay, financially are we better off doing a temporary fallow with no permanent reveg requirement? (M-1)

In summary, respondents from all three interview groups, including the municipal planners supposedly stridently opposed to leasing water, had good things to say about the Super Ditch proposal. This begins to cast doubt on the comprehensiveness of **H5**. Of course, there still exists substantial opposition to lease-fallowing and to the Super Ditch in particular. **H5** assumes that municipalities will not pursue the practice, simply because they prefer owning, and having ultimate control over, their water portfolios. In these interviews, only one municipality mentioned an outright preference for owning water, and that only in the context of transaction costs. Even that one municipality mentioned a willingness to lease water if reliable, long-term, and appropriately priced. It was, however, a uniform belief among Super Ditch participants that utilities would prefer to own water outright, and would have to be convinced to lease water:

You can go to Enterprise and rent a car for a couple of weeks, you can go lease a car for a couple of years, or you can buy a car and have it for ten years. Or forever. (M-3)

Your utilities, they're still that way, we want to own the water. We want the surety of owning water as opposed to leasing water, because if it's leasing water we're not in control. Utilities, your major big utilities, they want to be in control. (S-1)

And they don't want to lease it, because it's not that sure of a thing. They have to negotiate once in a while to get the price up to where we'll be willing to lease it, then they might have to come back next year and do the same thing. They don't want to do that. They want to buy the water so it's theirs forever. (S-2)

...the cities still hold out the hope that this will fail. They're more comfortable owning the water and leasing it back... (S-3)

Cities, however, did express reservations about operational difficulties of leasing. These difficulties include the question of what happens after the lease expires:

If it's on a lease, if in 30 years the farmer decides "you know, I don't want to do this anymore," then you could find yourself in quite a predicament if you've come to rely on that as a base supply. (M-1)

We don't have to think about it again for a while, but now it's gonna become integral to your system. At the end of that system you say I want to renew another 20 [years], they say "oh no, these other people are actually buying it and they're going to take it," and it's called a springing interest in that

right, and without a right of refusal to actually buy that, someone could come in and buy the right out from under you at the end of your lease. (M-3)

Although they are phrased in terms of operational difficulties, it is clear that these worries constitute a weak preference for ownership over leasing. Given the correct legal and operational mechanisms, Arkansas Valley cities would feel comfortable with relying on a base supply of leased water, but as of yet the Super Ditch has not provided those. Cities were also somewhat skeptical of the potential of leasing across multiple ditches, because of the difficulties of calculating and managing return flow obligations from multiple farms or ditches:

The concern is the return flows, you just can't do it without interfering with the return flows. (M-2)

However, on principle none of the municipal planners were concerned about having a water supply sourced from multiple ditches, so long as it could be delivered into Pueblo Reservoir (M-1, M-3, M-4). Finally, some cities indicated they were opposed to leasing at this time simply because they had enough water already (M-1, M-2) but that they would consider the Super Ditch if their operational needs dictated a search for additional water.

In addition, the Super Ditch participants all mentioned the opposition from downstream users, which have an operational flavor:

The ditches are not super-efficient in their use of water, and so any slop in the system upstream in John Martin Reservoir benefits those people downstream of John Martin Reservoir. What they see the Super Ditch as doing is really doing a much better job of using the water rights that are available to the various ditches, and therefore there's going to be less slop, and they're going to get less gratuitous- water that they have been getting historically but they're not legally entitled to. (S-3)

Yes, as people up here go through change cases, they get to pick away at the water right. And they could turn a very bad water right into a very good water right. (S-1)

They've been the biggest objector, I mean, anything that happens to water up here, they're up there objecting to it because they think that anytime they can object, we have to turn a little more water loose, they're the ones that are gonna pick it up. (S-2)

Interviewee S-3 stated bluntly that "they don't have legitimate concerns." Nonetheless, the water court system gives these users the right to object on grounds of injury to existing water rights, and regardless of legitimacy, the hydrologic connection between the users above and below John Martin Reservoir gives the downstream

users reasons to be concerned for their own operations in the event of widespread lease-fallowing, and goes beyond **H5** by suggesting that municipalities are not the only parties opposed to lease-fallowing.

Beyond their operational and reliability concerns, one municipality did mention that they expected lease-fallowing to be more expensive than purchasing water rights, and that the price for water promised by the Super Ditch, prior to the first pilot leasing attempt in 2012, had gone up:

If it costs just as much to go through all the trouble to do a change case and an exchange, to lease water for 3 years...I do that 2 or 3 years in a row, I might as well own it. (M-3)

They, number one, almost immediately jettisoned the idea of providing it to us in Pueblo Reservoir. And then, the price sheets we all kind of had, and talk to [another city] about this, they basically signed a price sheet with the Super Ditch for 500 dollars an acre-foot. Super Ditch just thumbed their nose at them and said no, it's really more like 1500 dollars an acre-foot or 1200, or whatever it came to. (M-3)

One Super Ditch participant agreed that the economics of his venture were not advantageous at this time:

The process of leasing even for a pilot project is not that much better, not that much cheaper at least, on a per-acre-foot basis when you're dealing with small amounts of water. If we do large amounts of water it might be. (S-3)

The costs of lease-fallowing to a municipality, including transaction costs that they bear, and the reliability of the water delivery into municipal systems must be commensurate with buying agricultural supplies permanently in order for the Super Ditch to succeed.

H5 theorizes that opposition to the practice of lease-fallowing in both urban areas and in the area of origin arises because of practical concerns like costs, operations and outcomes. However, interviewees revealed that there are persistent interpersonal conflicts between the member ditches of Super Ditch and between the Super Ditch Company and staff of major utilities, both of which provide a barrier to leasing arrangements:

I think conceptually... [Super Ditch] probably makes a lot of sense. [Long pause] I don't know that the... that there's the right leadership in place right now to make it happen. (M-1)

They burned their bridges very deeply. (M-3)

It's a challenge, and what makes it a challenge is that you have very senior water rights and it kind of gets to bragging points- mine's better than yours... (S-1)

Some of the ditches way down there got upset because they weren't included. So now they're against us instead of- they can't join us, so they're against us. (S-2)

The bigger complication is [the ditches] don't necessarily get along with each other and they're sort of competitive. (S-3)

Part of the animus between the staff behind the Super Ditch and the staff of their potential customers is likely a product of the complicated relationship between the municipalities, the Super Ditch Company, and its benefactor, the Lower Arkansas Valley Water Conservancy District. The Lower Ark has funded the engineering and legal costs of the Super Ditch pilot project, all while fiercely opposing the purchase of water rights in the Valley by potential municipal customers, through the purchase of conservation easements and by acting as an opposer to permanent change cases in water court (S-1, S-3). Objections to municipal purchases and negotiations for leasing projects are done by the same staff, and multiple municipalities referred to the Lower Ark and the Super Ditch as a single entity (M-1, M-3, M-4) despite their substantially different purposes and despite local care to distinguish them (all S interviews).

Beyond hesitant attitudes from municipal planners, the Super Ditch effort also faces several systemic challenges. These were coded separately in the analysis stage of this study because they do not necessarily reflect a particular *reason* for opposing or supporting lease-fallowing, but rather a particular *process* that lease-fallowing proposals must undergo in order to be approved, a distinction that goes beyond the motivation-based theory of **H5**. These processes represent two types of obstacles: technical and legal. Moving leased water into municipal systems, especially from multiple ditches, without injuring other users is a serious technical challenge, and leasing is as dependent on storage and exchange potential as buy-and-dry is:

...it's very difficult from a technical point of view to exchange water upstream from the headgates into Pueblo Reservoir where you can actually deliver it to the municipalities... (S-3)

The flexibility of lease-fallowing across multiple ditches adds two additional complexities; first, these technical challenges must be confronted anew each year, with different amounts of water needing to be exchanged:

In a dry year they might be saying "whatever yield I get, you can have it," but then we would look at it and say "yeah, but the call on the river doesn't allow us to utilize it." So, that may have us start to look to try to do some different things to manage dry-year. (M-4)

The second added complexity is calculating and delivering return flow obligations to preserve non-injury from seven ditches rather than one:

The amount, the complexity of the technology- of the technical issues involving more than one ditch in terms of where the return flows are owed and when, and there's probably a hundred, 120 different water rights in the seven ditches. It's complex enough to deal with a dozen on any one given ditch, trying to deal with all of them just makes it much more difficult for everybody. (S-3)

Resolving these technical challenges is difficult given that users in the Arkansas basin use competing technical models to evaluate deliveries and return flows, rather than a single model:

I think what you've got to have is a common technical platform. You've got to have one set of rules to the game. And with the number of different models that you have out there you have different sets of rules to the game. I can play by the rules; just tell me what the rules are. (S-1)

Reconciling their projections during a water rights change case is a major transaction cost (S-1, S-3). The Super Ditch pilot project of 2015 was developed under a common platform called the "lease-fallowing tool." Potential opposers can challenge the assumptions of this model only when it is created, not when it is applied to a proposed transfer:

And the other thing we're trying to do is develop a standardized engineering approach, the lease-fallowing tool, which you've probably heard about. And that way reduces the cost of everyone doing this. And it leaves water in the river, which sort of greases the skids to let people know, you know, we're not gonna get injured, we'll leave 5 to 20 percent of extra water in the river than there was before. (S-3)

While these return flow calculations are made conservatively, they are setting out into uncharted territory:

...when you just do a permanent transfer where you say it's going to municipal use now, it will never be used for irrigation again, then you don't have to take into account soil moisture voids and that sort of thing, because you just cease irrigating, you take the historic consumptive use, you've got the new use. When you're moving it back and forth, after a farm's been fallowed for a few years it's probably going to have a soil moisture deficit. So initially when you first start to apply irrigation water to it again, it's going to, I don't know if I'd say consume more, but less of its gonna come back as return flow because it's gonna fill that soil moisture void, and so that impacts then the water flow downstream, the other water rights... (M-1)

These sorts of technical challenges are a major motivation for doing the first leasing scheme as a small-scale "pilot project," in order to evaluate things like soil moisture loss, delivery into Pueblo Reservoir and the

response of the land fallowed (all S interviews). The pilot project of 2015, however, only involves one ditch, the Catlin Canal, and involves no exchanges to make delivery into Pueblo Reservoir (M-3).

While Super Ditch participants originally believed that the full potential of their scheme can be realized without major changes to Colorado water law, the water court process provides a barrier to lease approval given the number of opposers on the Arkansas River, the strict definition of material injury, and the new and uncertain nature of leasing. This means that long-term temporary transfers are no easier than permanent ones, which creates an incentive to pursue permanent ownership of water rights:

I think we can push it pretty far, but ultimately it's gonna have to be... to really make this work, we're gonna have to make some fundamental changes to Colorado water law which make permanent buy and dry very difficult and leasing relatively easy. (S-3)

The original pilot leasing project ran afoul of then-existing water law, at first on anti-speculation grounds and then through excessive conditions placed on the lease by objection of opposing entities:

We tried to do a pilot project in 2012 under current law, and even though the State Engineer put, I don't know, 35 or 45 terms and conditions that were basically impossible to meet on his approval, both the state and the Super Ditch got sued the next day by the principal objectors, who basically got everything they wanted in the terms and conditions anyway. (S-3)

We took a run at actually trying to get it going but then there was significant opposition through the Substitute Water Supply Plan process,¹¹ so the State Engineer's office hit a brick wall and then the contract that we had in place with the Lower District couldn't be met, through no fault- they tried. (M-4)

Colorado's strict definition of "material injury," when combined with the proliferation of sophisticated hydrologic models, made it incredibly onerous to approve the 2012 pilot leasing project; an opposer's calculations determined that the proposal would leave a single water right short of water by just 23 gallons, and only in the last month of a proposed six-year lease-fallowing scheme:

What has happened when it comes to material injuries, computers have gotten so sophisticated. I mean, 1 acre-foot of water is 325,000 gallons. I mean, 23 gallons down there? And that was all computer modeling and I think somebody said they took they took it out to like the seventeenth decimal point to get to the 23 gallons of water. So, people will still continue to fight over this, and we've got to have a change on material injury and what people say are material injury. (S-1)

¹¹ Substitute Water Supply Plans are the usual mechanism for approving one-year leases of water, and the mechanism for approving the 2012 Super Ditch multiyear lease pilot.

Municipalities, too, are wary of the potential for a lease to be challenged on material injury grounds:

Interviewer: Do you worry that any change case that involves some kind of rotation or temporariness to it, is just sort of hanging out there for somebody to attack in court, and make it more complicated for you and make it take longer?

Yeah.

Interviewer: Just something that they can oppose?

[Nodding] (M-1)

Given these very serious technical and legal obstacles to overcome, the Lower Ark and the Super Ditch proposed legislation that eventually passed the Colorado General Assembly as House Bill 1248 (Colorado General Assembly, 2013). This removed the authority for up to ten lease-fallowing pilot projects from the water court system, and the Substitute Water Supply Plan mechanism that covered the first leasing pilot, to the Colorado Water Conservation Board (CWCB), a state policymaking body that had been promoting alternatives to buy-and-dry. This process and the associated lease-fallowing tool have been essential to approving the 2015 Catlin Canal pilot leasing project:

So what we did is we ran a piece of legislation, HB 1248, which has pilot projects for leasing-fallowing, and the final decision is no longer on the State Engineer's office, who is the regulatory arm of the state, it is on the Colorado Water Conservation Board, who is the policy arm of the state. So we decided to go to the policy arm of the state and say "guys, do you want us to do this or don't you want us to do that?" (S-1)

But the process under the CWCB pilot program involved people commenting on the application, and then a conference of all of the engineers, with the State Engineer's office to try to work out terms and conditions to deal with injury. That was successful in terms of coming to agreement and compromising and working through all the parties rather than having the State Engineer just unilaterally say these are your terms and conditions. What we ended up with was negotiated terms and conditions. (S-3)

The 1248 process integrates the suggested responses to technical and legal barriers to lease-fallowing: a common engineering platform (the aforementioned lease-fallowing tool) and an administrative approval process which replaces the adversarial nature of water court:

That's why we're trying to do this sort of alternative administrative method, to avoid the whole cost of water court, which is really substantial. (S-3)

But it was... the idea was get it worked out amongst the people who understand this stuff, the engineers, rather than the people like me, the lawyers, who just will fight about it. And I think it

worked- I think everybody thinks it worked quite well, and nobody's gotten sued over it, which is, you know, a major step in the right direction. (S-3)

It would have been nice if it was not needed, but unfortunately it took a bit of a push and some legislation... (M-4)

It is telling that, despite the prevalence of one-year leases up and down the Arkansas River for decades (C-1, M-1, M-3, S-1, S-3), and despite the support for alternative transfer mechanisms in the rhetoric of state water leaders (M-1, M-3, M-4, all S interviews), it still took a legislative change to be able to execute a ten-year pilot leasing project involving just 500 acre-feet of water from a single ditch.

While HB 1248 was critical to move the project forward, numerous interviewees expressed the belief that the single change that would most drive progress toward leasing is drought pressure:

You know maybe someday down the road all this'll work itself out. Crisis is how we'll get there. Serious drought will drive a lot of changes. School of hard knocks. (M-2)

We keep hoping [laughter] that it'll catch on better, but a drought- quickest way in the world to get it to work. I mean a real bad drought like 2002, 2003 was, because the cities really need the water and the farmers really need the money, because they're not gonna raise a crop anyway. They can raise part of a crop because they're gonna have some water, but they're not gonna be able to plant their whole farm to crop because they won't have the water to water it. So a drought would be the best way to really get it going. That and low prices, low commodity prices. Back when they was getting 8 dollars a bushel for corn, they was raising 200 bushels of corn, and they was getting 250-300 dollars a ton for the hay, and 7-8 tons to the acre... why would you want to lease water for 3 or 500 dollars an acre? (S-2)

So another thing that would really help would be a good drought. The cities have their reservoirs full right now. (S-3)

Given time, successful demonstration leases, supply shock, and obstruction of purchases from the Lower Ark District, it is likely that many major cities would engage with Super Ditch, but there is obviously a long way to go.

This subchapter presented the evidence for and against **H5. Farmers and rural residents have pursued the Super Ditch concept as a way to avoid the impacts of buy and dry and retain their communities' health, but urban water utilities are skeptical because of their insistence on certainty, reliability, and low costs.** This study found that attitudes toward the Super Ditch project are much more complicated than this theory suggests. There is both opposition and support for Super Ditch from both

urban and rural quarters. Furthermore, support is as concerned with direct and indirect benefits to the participants as it is with avoiding the undesirable outcome seen under the Colorado Canal. Likewise, opposition exists on grounds more complex than the suggested drivers of conservative municipal behavior: operational, financial and interpersonal concerns are all present. Meanwhile, **H5** suggested that Super Ditch's struggle to engage with municipalities was primarily the result of attitudes, not of systemic challenges, but Super Ditch and municipal interviewees alike reported the legal and technical difficulties of moving leased water, difficulties extensive enough to prompt an entirely new legal-technical process for approving the 2015 pilot project. Clearly, **H5** fails to capture all of the relevant considerations around this leasing opportunity. The results of interviews concerning **H5** are summarized in Table 11 (attitudes and motivations) and Table 12 (systemic barriers and routes to overcome them) on the following pages.

Findings		Interviews Mentioned	Groups Mentioned	Relevant Quotations
Motivations for pursuing lease-fallowing	Avoid the impacts of buy-and-dry	8	C, M, S	“And that’s what we’re trying to do is make sure that this part of the Arkansas Valley doesn’t get dried up like what happened in Crowley County.” (S-1)
	Direct benefits for farmers and their communities	8	C, M, S	“So we’re still farming 70 percent of the land, we’re still here farming, we’re still here buying fuel, we’re still buying seed, we’re still buying fertilizer, we’re still going to town to buy groceries and whatever. The community continues to thrive...” (S-2)
	Local ownership of problems and generation of solutions	3	S	“[B]ut at the end of the day, and this is what’s going to get your wheels turning, at the end of the day, lease-fallowing will not be about moving water to the city. It will be about the farmers solving their own problem.” (S-1)
	Operational flexibility, especially during drought recovery	7	C, M, S	“... let’s say you’ve got a drought that’s drawn your storage down and you want to get it refilled, so maybe 3 or 4 years of leasing from ag to refill your storage reserves” (M-1)
	Potential for “wholesale” delivery	5	M, S	“If they were able to produce a block of water at the right location for us at a price we’re willing to pay, why wouldn’t we?” (M-3)
	Public pressure to avoid buy-and-dry	3	M, S	“The other thing, and you mentioned it already, that politically this is good. This is something that we want to support not just because we feel like we need a pat on the back for supporting it, I want to support it because it’s a good idea.” (M-4)
	Weak outright preference for owning water	4	M, S	“You can go to Enterprise and rent a car for a couple of weeks, you can go lease a car for a couple of years, or you can buy a car and have it for ten years. Or forever.” (M-3)
Motivations for opposing lease-fallowing	Potential to lose water supply at expiration of lease term	5	M, S	“If it’s on a lease, if in 30 years the farmer decides “you know, I don’t want to do this anymore,” then you could find yourself in quite a predicament if you’ve come to rely on that as a base supply.” (M-1)
	Rising costs of leasing	2	M, S	“If it costs just as much to go through all the trouble to do a change case and an exchange, to lease water for 3 years...I do that 2 or 3 years in a row, I might as well own it.” (M-3)
	Interpersonal conflicts	5	M, S	“I don’t know that the... that there’s the right leadership in place right now to make it happen.” (M-1) “The bigger complication is they [the ditches] don’t necessarily get along with each other and they’re sort of competitive.” (S-3)

Table 11: Findings for H5, motivations for and against the Super Ditch effort

Findings		Interviews Mentioned	Groups Mentioned	Relevant Quotations
Systemic obstacles to lease-following	Strict definition of material injury	4	M, S	“I think there’s gonna have to be some changes to law, especially when it comes to material injury and the definition of material injury.” (S-1)
	Need for storage and exchange, especially in dry years	6	C, M, S	“[I]t’s very difficult from a technical point of view to exchange water upstream from the headgates into Pueblo Reservoir where you can actually deliver it to the municipalities...” (S-3)
	Integrating water and return flow obligations from multiple ditches	4	M, S	“[T]here’s probably a hundred, 120 different water rights in the seven ditches. It’s complex enough to deal with a dozen on any one given ditch, trying to deal with all of them just makes it much more difficult for everybody.” (S-3)
Resolutions to these obstacles	Common technical platform to evaluate leases	3	M, S	“[T]he idea was get it worked out amongst the people who understand this stuff, the engineers, rather than the people like me, the lawyers, who just will fight about it.” (S-3)
	Administrative approval of leases	3	M, S	“So we decided to go to the policy arm of the state and say ‘guys, do you want us to do this or don’t you want us to do that?’” (S-1)
	Drought pressure	3	M, S	“You know, maybe someday down the road all this’ll work itself out. Crisis is how we’ll get there. Serious drought will drive a lot of changes. School of hard knocks.” (M-2)

Table 12: Findings for H5, systemic obstacles to lease-following through the Super Ditch and efforts done to overcome them

H6. The Super Ditch Company has facilitated a leasing market, while distributing benefits and burdens over a wider area

If this hypothesis is true, interviewees would report that the Super Ditch Company, as an intermediary combining several available water rights, has improved prospects for leasing in the Arkansas basin, and the participants will report that involving multiple ditches, despite the technical complications found in research into **H5**, allows for the benefits of leasing and the burdens of fallowing to be shared across the entire Lower Arkansas Valley. Instead, interview results confirmed this proposition only to an extent (code group *SDCROLE*): the distributive component appears to be true, but Super Ditch participants saw the Company's primary purpose as the strengthening of the ditches' negotiating position, and opinions are strongly divided over whether the Super Ditch has eased or hindered leasing in the Arkansas Valley. All things considered, at this time the Super Ditch effort has not progressed far enough to determine whether this hypothesis is true. The success or failure of the ongoing pilot project (and, probably, a larger future project) will resolve the uncertainties of the company's role and performance. Until then, we may conclude only a few things with certainty.

To begin with, the Super Ditch Company fortifies the negotiating position of Arkansas Valley ditches in three ways. The first two are closely related: it provides farmers a revenue-generating option other than buy-and-dry, and second, negotiating together reduces the likelihood of cities pressuring individual ditches or farmers one at a time:

So the thinking was that you can either sit back in the Lower Arkansas Valley and municipalities will come down and pick off the senior ditches one by one when the economic conditions are ripe, because that's what they typically did in the past, waited until commodity prices are bad, farmers were having trouble paying their bills, and then came down and either directly or through an intermediary... bought up the ditches... (S-3)

...you've got to get those guys down there to start working together and speaking with one voice. Because when they're divided, the big cities come down and pick them off, that's what they do. (S-1)

So I see it- certainly collaboration makes it work and makes them much stronger. They have more to offer. (M-4)

Of course, there is nothing legally standing in the way of a Super Ditch farmer selling his or her water to a city; they all retain that property right. The company therefore remains in the precarious position of negotiating leases on behalf of its members, any of whom could choose to undercut the lease opportunity with a permanent water sale rather than participate. The third component of negotiating strength is the commitment of professional staff to the cause of leasing:

...the ditch companies totally lack the expertise to do this on their own. You've got ditch companies down there that are probably ten or hundred million dollar corporations that are run by people with high school educations. It's not that they're not smart; it's just that they just don't think that way. (S-3)

Considering the expertise and economic muscle of the Front Range cities, the risk of an unbalanced negotiation is a real one, and the introduction of the Super Ditch Company into the midst has already had a substantive effect: the City of Aurora, which has substantial experience both buying and leasing water in the Valley, signed an intergovernmental agreement with the Super Ditch shortly after its formation to acquire Arkansas Valley water solely through the company (S-1, S-3).

Theoretically, if and when they do so, the city will be acquiring water that comes off of more than one ditch. **H6** suggests that the inclusion of multiple ditches in the Super Ditch scheme was deliberate from the very beginning, but not only for negotiating purposes; the founders also wanted to distribute the benefits of lease-fallowing and the chance to participate across the widest viable area. This proposition was borne out by interviewees:

...we're gonna do this equally, we're gonna give everybody an opportunity, and that's another thing I think is nothing but fair about it, the fact that it gives everybody and equal chance. If enough water is leased, every ditch in the valley can participate and anybody that wants to lease has a chance to lease some of his water. It's not one ditch getting all the gravy and everybody else- in fact, after we started Super Ditch and some of the guys from the Fort Lyon [a more junior ditch], we have a meeting or something, they said "we was really upset when the Highline [a more senior ditch] leased their water, because we didn't have that chance." (S-2)

Not only that, but participants recognize the importance of sharing costs across the ditches:

...why not have one organization do all that work, instead of each ditch trying to do it? To do that, you're gonna have to have a set of attorneys, you're gonna have a bunch of engineer work. ...why would the Catlin want to hire their set of engineers and attorneys and the Highline want to their set of engineers and attorneys to do the same thing, or come to the same conclusion? (S-2)

Finally, there are technical reasons for including multiple ditches, despite the headaches that it causes in terms of return flow obligations and exchanges:

...some of the ditches have really high yields in dry years, some have really high yields in wet years, some in average years, so it would be good to have a bunch of ditches involved so you could match the ditch with the kind of hydrologic year that you had, which would maximize the amount of water available for lease but also maximize the amount of water available to continue agricultural production at a given point in time in the valley. (S-3)

There is an important nuance in this last statement: while priority of appropriation essentially determines the seniority of the water right, many of the junior ditches (including, before its sale, the Colorado Canal) are decreed large quantities of water to divert (C-1, C-3, S-3). While they may rarely be in priority and legally able to do so, when the river is flooding, they are able to take much more of the water than the senior, smaller ditches. This means a combination of ditches is likely to provide more water on an annualized basis than even a senior ditch. Of course, when the year is wet, most cities are unlikely to need to acquire water from the Super Ditch. Nevertheless, the value of the Super Ditch Company as an “exchange” of water rights (Squillace, 2012) goes beyond the reduction of transaction costs, to the point of making more water available in any particular year. This is not explicitly theorized by **H6**, but it is suggestive of a contribution to the ease of leasing water.

The Super Ditch unquestionably has these roles as strong negotiator and facilitator of farmer participation, as suggested by **H6**, but the hypothesis also suggests that combining ditch rights and acting as a negotiator should facilitate actual leasing activity. This remains an open question. The company has not produced leased water, despite both municipalities and agricultural participants hoping that it would do so, with the exception of the 2015 pilot project. If **H6** is true in its entirety, both participants and non-participants in the pilot project should report that leasing is now easier because of Super Ditch. In reality, participants in the 2015 pilot view the Super Ditch Company as a helper while non-participating cities, which have their own experience negotiating leases, do not:

Certainly what we’re doing with the Super Ditch concept is easier for us because we are just a customer, so it’s their job to put the water in Pueblo Reservoir. It’s their job to obtain all the approvals necessary from the State Engineer’s office; it’s their job to figure out how to make it work

from a water rights perspective. I am just their customer. They do all the heavy lifting... (M-4, a participant in the 2015 pilot project)

I believe, quote me on this, I think they've been more of a hindrance to leases than a help. (M-3, a non-participant who has negotiated leases with individual ditches previously)

...when you do these lease-following programs, you have to manage the following, you have to manage the ditches, you have to disperse the money, there's a lot of little details. You have to do a lot of measurement, all that kind of stuff. There's a lot of legwork that has to be done. So there's a little bit of sweat equity you've got to put into this, and somebody should charge a fair price for actually doing that work. That's not an issue. They simply haven't stepped up to take that on. It's kind of strange. (M-3)

Perhaps the question of help or hindrance cannot truly be answered until after the 2015 pilot project is complete, or perhaps after another project beyond that. Several municipalities mentioned needing to see concrete results before committing to leasing as a source of supply (M-1, M-2, M-3). But at the moment, participants in the Super Ditch process view it as anything from essential to merely useful, and non-participants look at it with cautious curiosity, skepticism, frustration and sometimes derision.

Much remains to be seen about the role and performance of the Super Ditch, but it is clear that it is far from a mere "exchange" connecting buyers and sellers. At times it functions much more like a cartel preventing market competition and driving up the price of water, and at times it functions like a water wholesaler. Regardless, it is clear that the company's role is much more complicated than is suggested by **H6**, **The Super Ditch Company has facilitated a leasing market, while distributing benefits and burdens over a wider area.** It is unclear what effect the Super Ditch has had on the ease of leasing water, and its primary role in the eyes of many is to strengthen the farmers' position vis-à-vis cities, but in any case it does serve a distributive function. The interview results for **H6**, concerning the role and effect of the Super Ditch as a "centralizing water rights entity," for lack of a better comprehensive term, appear summarized in Table 13 on the next page.

Findings	Interviews Mentioned	Groups Mentioned	Relevant Quotations
Super Ditch serves to strengthen the negotiating position of farmers and ditches vis-à-vis cities	5	M, S	“[We] know the cities have the demand, we know they’re going to get their water because they have the economic muscle to get it, can we change the rules of the game so they can get it on our terms instead of on their terms?” (S-3)
Super Ditch spreads the opportunity to participate in leasing, and the benefits and costs, across more farmers and ditches	3	M, S	“If enough water is leased, every ditch in the valley can participate and anybody that wants to lease has a chance to lease some of his water. It’s not one ditch getting all the gravy...” (S-2) “...why would the Catlin want to hire their set of engineers and attorneys and the Highline want to their set of engineers and attorneys to do the same thing, or come to the same conclusion?” (S-2)
Super Ditch participants view the company as a facilitator of leasing, while non-participants view it neutrally or as a hindrance to leasing	5	M, S	“Certainly what we’re doing with the Super Ditch concept is easier for us because we are just a customer, so it’s their job to put the water in Pueblo Reservoir. It’s their job to obtain all the approvals necessary from the State Engineer’s office; it’s their job to figure out how to make it work from a water rights perspective. I am just their customer. They do all the heavy lifting...” (M-4) “I believe, quote me on this, I think they’ve been more of a hindrance to leases than a help.” (M-3)

Table 13: Interview results for H6, role and effect of the Super Ditch Company

Chapter Six: Some Conclusions, Caveats and Lessons Learned

Summary of Propositions and Results

This research aimed to evaluate six propositions concerning agricultural-to-municipal water transfers. This study was framed by the question **“What areas have been involved in water transfers, and what have the effects been?”** and designed lines of inquiry around six hypotheses arising from the literature related to that question and to the circumstances of the two Arkansas Valley cases. The time has come to present briefly some conclusions about the accuracy of those propositions based on the results of the interviews in the Arkansas basin, and then to suggest which if these findings are specific to these cases and what sorts of hypotheses might be generalizable to water transfers across the West.

H1. The economic, social-cultural, and ecological consequences of buy-and-dry water transfers from the Colorado Canal persisted and worsened from 1985 to 2015 in Crowley County

The severity of consequences is well-established in the literature, and this study can merely add that the economic and ecological consequences of buy-and-dry under the Colorado Canal have been very persistent, most likely permanent. In the twenty-five or so years since researchers attempted to understand the outcomes of the Colorado Canal sales (Howe, Lazo, & Weber, 1990; Weber, 1989; Weber, 1992; Sutherland & Knapp, 1988), Crowley County remains largely the same: poor, far from vibrant, largely empty, and filled with weeds and choking dust. The social strife reported by Ken Weber has ameliorated over time, and the crisis of the water sales provided an opportunity for community organization among the non-sellers, but the community they were organizing is a fraction of its former size. That a county that once produced sugar beets, corn, alfalfa and melons, that once had multiple grocery stores and movie theatres (C-2), now produces little but incarceration revenues, and that getting two prisons in the county represented a real triumph for the remaining farmers and community leaders, speaks volumes about the permanence of buy-and-dry.

It is difficult to draw a line between the outcomes seen only under the Colorado Canal and those that can be expected in most or all buy-and-dry water transfers. La Paz County, Arizona, saw similar impacts to

Crowley County as a consequence of farm purchases by utilities in the Phoenix metropolitan area (Charney & Woodard, 1990), but the completed dry-up of the Rocky Ford Ditch in Otero County has not put the town of Rocky Ford out of business, though it has created a serious invasive weed problem (M-1, M-3, S-1, S-2). The Colorado Canal is famous in Colorado water circles for a reason: it is such an extreme example of buy-and-dry that it motivates widespread opposition to the practice in the agricultural community, as seen in the interview results for **H5**, and in state-level planning. However, it is rarely recognized as a contributing factor that the Canal was the only ditch servicing the entire economic region of Crowley County, and because the sugar mill in Sugar City closed in 1967, prompting widespread sale pressure and a lack of economic alternatives. It is reasonable to conclude that the severity of losses in Crowley County is not because of buy-and-dry *per se*, but because of its extent. A more generalizable hypothesis might be **H1a: The undesirable consequences of buy-and-dry in rural communities are in rough proportion to the percentage of farmland in an economic region that is permanently retired.** This formulation of the hypothesis is well-supported by the evidence of the Colorado Canal and the other permanent transfers in the Arkansas Basin that, because their damages were not as extensive, are not as well-known.

H2.Front Range cities used Colorado Canal water to fuel demographic and economic growth, and to secure themselves against drought

Research has focused so much on the rural impacts of buy-and-dry, for obvious reasons, that the corresponding effect on cities is usually taken for granted: they get a cheap supply of water to grow on. However, Arkansas Valley municipal interviewees revealed that drought security is at the forefront of their minds. They operate under the assumption that population growth is decoupled from water supply planning and land use planning. Therefore, they act not to “supply” growth, except in a handful of specific situations, but to acquire diverse and reliable water rights that will carry their usually-expanding customer base through drought with a minimum of risk. When making a comparison of water transfer outcomes in urban and rural places, it is perhaps more relevant to list drought security as the urban benefit than any economic growth that such a transfer “enabled.” A more generalizable hypothesis for testing around the West might read **H2a: Acquiring agricultural water sources improves the reliability and diversity of municipal water**

sources, but is uncoupled from demographic growth. Such a hypothesis, if confirmed, would secure well the proper “benefit” to be charged to cities that buy agricultural water.

H3.Front Range cities focused their water acquisitions on the Colorado Canal, which exacerbated the consequences there, while exempting other ditches

Similarly to our lack of focus on **H2**, there has been little treatment of the issue of concentration, and the question of which water rights are likely to be bought and sold. Transaction costs and transaction risk feature prominently in discussions of water marketing (Squillace, 2012; Lund, 1993). Interviews revealed that Arkansas Valley municipalities do indeed cluster their water rights purchases. Several ditches have been purchased almost in their entirety, while other ditches remain mostly exempt from municipal ownership. Their buying patterns reflect much more than the size of transaction costs, however. Cities buy water rights that are reliable and compatible with their existing infrastructure. They also prefer water rights with certain operational benefits like associated storage. Furthermore, water rights holders under the Colorado Canal sold, in large part, for reasons that affected them together rather than one-by-one: debts, poor productivity, inadequate water supplies, and the closure of the Sugar City plant. Taken together, these findings imply that water transfers are very likely to be concentrated in particular areas rather than evenly distributed across agricultural regions. This is worrying, as the Colorado Canal experience shows that concentrating dry-up and the mass exit of farmers from the community can be very bad for environmental, social and economic outcomes. It also implies that treating water transfers as a “non-issue” because agriculture has so much water to give dangerously misses the point.

Because the Colorado Canal represents the vast majority of the volume of permanently transferred water in the Arkansas Basin, it is risky to conclude that it represents all of the attributes that make a ditch attractive for municipal purchases. Many of the factors presented in Table 8 may simply be incidental attributes of the Canal that do not motivate sales elsewhere. However, it is clear from the interview results that water rights are not created equal: they differ in seniority, location, associated storage, and other critical ways. Furthermore, it is reasonable to think that the differentiated pressures affecting farmers on different ditches that are unequally productive or reliable will continue to motivate large blocks of interested sellers at

once. Without assuming that any of the attributes or motivations are determinative, or that there is a particular “formula” for the involvement of particular water sources over others, the fact that they are not substitutable and that many sellers are likely to be involved in any particular sale suggests the following reasonable generalized hypothesis: **H3a: Cities cluster their water rights purchases geographically, which exacerbates the consequences in particular communities while exempting others, and makes regionally insignificant transfer amounts highly consequential.** This proposition is general enough to be tested in various river basins without specifying the exact reasons for purchasing or selling one water right over another.

H4. The primary “losers” of the Colorado Canal case were third parties in Crowley County; the primary beneficiaries were urban water utilities, residents and property developers; these losers were not well-compensated by revegetation and monetary payments

It has long been recognized that third parties are the primary cause of concern when it comes to water transfers (National Research Council, 1992). Frequently, the policy-related literature divides potential solutions to this concern into two camps: alternative transfer mechanisms and the potential for compensation and mitigation. The experience of Crowley County and the responses of interviewees on both the rural and urban side of the ledger suggest that the latter response is inadequate. Revegetation under the Colorado Canal was almost completely ineffective, and both municipal planners and rural leaders have objections to compensation of third parties on philosophical grounds or grounds of efficacy. These results suggest that avoiding the worst of water reallocation must rely not on adding obligations owed to rural communities, but rather on changing fundamental aspects of the transfer itself: its geographic concentration, or its legal structure, and suggests a more general **H4a: Burdens of water transfers fall on third parties in areas of origin and are not well-compensated by mitigation or payments contributed by urban areas.** This proposition is well-supported by the Colorado Canal experience but could use evaluation in other well-known cases of traditional water transfers.

H5. Farmers and rural residents have pursued the Super Ditch concept as a way to avoid the impacts of buy and dry and retain their communities’ health, but urban water utilities are skeptical because of their insistence on certainty, reliability, and low costs

Leasing itself is nothing new in the Arkansas Valley, but only now has it been attempted in multiyear time frames and with a rotational fallowing component. Lease-fallowing exists primarily in the policy-related literature as a way to avoid buy-and-dry (Nichols, Murphy, & Kenney, 2001). Super Ditch participants agreed that avoiding “doing what Crowley County done” is the biggest driving factor behind the process. However, they also recognize the direct monetary and operational benefits lease-fallowing can provide them. While they openly assume that cities have an outright preference for owning and controlling water rights, municipal planners phrased their opposition to Super Ditch in a weaker way: they worry about the expiration of a lease that they rely on for a base water supply, and they would prefer to go through the process of acquiring water once rather than renegotiating it every ten, or thirty, or even fifty years. This suggests that there is room for Super Ditch and its potential customers to make a deal: if the farmers can deliver a perpetual water supply into Pueblo Reservoir (or, in the future, where other cities need it) at a reasonable cost, the cities will be receptive. The best cure for the disagreement and miscommunication surrounding Super Ditch would be the success of the currently-ongoing pilot project, followed by successful delivery of a larger quantity of water that involves more than one ditch and the exchange of water upstream. If Super Ditch can accomplish that, more cities and farmers will be persuaded that it is a realistic alternative to the status quo. It is also telling that these pilot projects go through an administrative approval process submitted to the legislature by the Super Ditch itself and used, as yet, nowhere else in Colorado. There is little doubt that some movement on the legal and technical obstacles facing lease-fallowing will be required before Super Ditch is replicated in other basins.

Some of these findings are no doubt specific to the Arkansas River basin: the role of technically complicated upstream exchange will not carry over to downstream water transfers to coastal cities, and the interaction between the property-tax-funded Lower Ark District and the for-profit Super Ditch Company that probably contributes to some cities’ antipathy to the Super Ditch effort is a novel relationship in Western water management. But the systemic obstacles to leasing are no doubt generalizable to many Western states, as are the general attitudes of farmers who have seen buy-and-dry and municipalities that have track records purchasing water. Perhaps there are two generalizable theories to be tested in other cases: first, **H5a: Farmers want the opportunity to lease water as well as sell it, but cities will only participate in**

leasing if the reliability and costs are guaranteed to fall at similar levels to their historic purchases of water, and second, **H5b: Placing identical legal and technical barriers in front of leasing and buying water depresses leasing activity relative to local interest.** These hypotheses reflect the variables understood to be involved in rural and municipal decision-making and an assessment of the calculus of leasing rather than buying water which probably apply across the West.

H6. The Super Ditch Company has facilitated a leasing market, while distributing benefits and burdens over a wider area

The Super Ditch Company is the first of its kind in the American West, and nowhere does the existing literature examine the potential role of these “centralizing water rights entities” – a gap that means the Super Ditch and its future brethren have no single appealing name. At times, the Super Ditch acts like a cartel of ditches, at times it acts like a water wholesaler, and at times it acts like a broker or water rights exchange. Comfortably placing the company into a theoretical framework that includes its role in the institutional landscape and its performance toward its stated goals is not possible at this time. In its multitude of roles towards a multitude of stakeholders, it has divided Valley opinions. Those who are on board see the company as a facilitator of leasing, and those who are not see it neutrally or as a hindrance. This is unsurprising considering its lack of successful projects up to 2015, and its explicit role as a strong negotiator on behalf of agriculture. It is unquestionable that it has done strengthened the ditches’ position and spread the opportunity to participate in water marketing more widely, but to act in its role as a supplier of water it needs a few successful pilot projects. Until then, Super Ditch will remain in the tenuous position between ditches who know how to sell (and sometimes lease) water and cities that know how to buy (and sometimes lease) water directly from them.

Generalizing from the Super Ditch case is difficult. First of all, the legacy of buy-and-dry under the Colorado Canal and the Rocky Ford Ditch colors everything in the case from the intentions of farmers and rural organizers to the corporate design of the Company itself. This will not be the case in other basins interested in market flexibility of water rights without the push of history behind them. More importantly, though, at the moment there are no other cases on which to test any hypothesis about “centralizing water

rights entities” that resemble the Super Ditch Company. However, some observations of interviewees inform discussion of all “water marketing” activity- that is, of the entities that involve themselves in the voluntary reallocation of water. A very general hypothesis might be **H6a: The role and effect of water marketing entities depend both on their legal design and the intentions of those that create, operate and interact with them.** This is certainly true in the Super Ditch case and it is reasonable to think it applies across the West.

Some General Conclusions and the Limitations of this Study

This research was framed by the question **what urban and rural areas have been involved in a water transfer, and what have the effects been?** At this time, however, it is perhaps better to ask the question in the future tense: **What urban and rural areas will be involved in a water transfer, and what will the effects be?** After all, the findings of this research are relevant to the development of water policies, expectations of what rural and urban areas will look like in an era of limited water supplies and population growth, and the potential for new lease-fallowing schemes to operate in this coming space. The conclusions that this study can draw are in five general areas: the importance of infrastructure, the likelihood and role of geographic concentration, the likely role that lease-fallowing will play in meeting future water needs, the importance of long-term lease agreements, and the representativeness of the Colorado Canal and the Super Ditch.

To begin with, the theme of physical infrastructure permeates the interviews in both cases. Whether it’s the appeal of the Colorado Canal’s associated storage, the necessity of exchanging water (leased *or* bought) into Pueblo Reservoir where cities can take delivery, or the role of storage in managing leased water between wet and dry years, the management of water in the Arkansas basin revolves around the physical realities of water delivery. This conclusion would surprise no-one in the basin, or probably in any basin in the West, but it might be surprising to the scholars that investigate water management and especially water reallocation. Moving water out of agriculture does not take place solely in the realm of economic theory, or even in “water governance,” it requires cities to actually *move* it! The regions involved in water transfers, full stop, must be

physically connected. This has serious implications for what water reallocation will look like in practice: farmers in some regions, distant from growing suburbs or separated from them by the West's great mountain ranges, are unlikely to find receptive utility managers if they seek to sell them water. Their counterparts nearby to cities will instead probably have no problem making a deal, and the result will be highly unbalanced dry-up.

None of the interviewees in this study explicitly mentioned the concentration of the impacts of buy-and-dry. Rather, they think of the Colorado Canal as fairly standard as far as dry-up goes, and some of them want desperately to avoid it visiting their own communities. But the weeds, dust, water delivery problems, closed stores, lost taxes, social disruption and radical reorientation seen in Crowley County is surely made worse by the *extent* of the dry-up, not just that it happened. If the cities that now own the Colorado Canal had instead found it reasonable to buy only one-quarter of the system, it is likely that life in Crowley County would continue largely as normal. There would still be a weed and dust problem, especially if the dry-up were all in one area with the canal's service range, but there would be hundreds of farmers buying supplies in Ordway and paying county taxes on irrigated land, rather than a few dozen at most. Of course, because of the operational benefits of the canal system, and the wide availability of its shares at a low price, they did find it reasonable to buy almost the entire canal. Spreading their purchases around would have added to their transaction costs and made them operate three or four systems rather than just one. It is likely that these results will continue in basins experiencing urban growth: cities will buy few agricultural systems rather than many, because of their superior reliability and operational compatibility, as well as to keep costs low, and the burdens of buy-and-dry will fall hard on the third parties in those few areas in a way not suggested by a 10,000-foot view of how much water, and money, will be moved out of agriculture as a whole.

This situation cries out for an alternative to buy-and-dry, but such an alternative will not arrive without deliberate effort. Water rights will always be out there to be bought, and they will be often cheaper and almost always more reliable than constructing new reservoirs and canals. Lease-fallowing is just one such alternative, and the effect of switching from sales to leases is as yet unclear in terms of the economic returns and ecological impacts. Nonetheless, there is good reason to believe that the Super Ditch will be a

component of maintaining viable agricultural communities in the Arkansas Valley: it represents local ownership of the problem of water scarcity and urban growth, keeps land in production and in the hands of farmers with an interest in maintaining its quality, and improves the economic situation of farmers and their suppliers. The challenge of the Super Ditch is not proving that it can do all that. Rather, its challenge, and the challenge of all alternatives to buy-and-dry, is proving to cities that it can deliver water as promised, reliably enough to be more than a drought recovery mechanism. If Super Ditch can do that, more cities will become interested customers, more farmers will become interested participants, and the improvements in rural outcomes will surely follow. If it cannot, the role of leasing will be much more limited, probably to times of drought recovery, and permanent acquisition of agricultural water rights will remain the default strategy for thirsty municipalities' base supply requirements.

A second conclusion about the role of “water marketing” by farmers can also be drawn: a “market” in the conventional sense, connecting buyers and sellers based on real-time willingness-to-pay and willingness-to-accept, will have tremendous obstacles to overcome if it ever seeks to provide cities with a comfortable base water supply. This study has found that certain water rights are more attractive than others, whether for purchase or lease. It has also found that municipal infrastructure and municipal operations come to revolve around the supply they already have; this is reflected in the insistence on operational compatibility. Relying on a new leased water right every year, with different delivery potential, different reliability, and different losses in transit, will be extremely uncomfortable for municipalities. It is much more promising to negotiate long-term leases with options to renew in perpetuity that include a “wholesale” delivery obligation. As cities grow, they will have to build new infrastructure and rules of reservoir and pipeline operation that depend on particular supplies of water delivered to particular places at particular times. The spot market does not deliver supplies in that regular way. Many scholars, especially economists, see legal and engineering costs as the primary barrier to instituting robust, efficient water markets. However, this study has shown that municipal reluctance to utilize annual water marketing extends beyond these obstacles, and justifiably so.

The final comment to make about these cases is that they are just two cases in the whole landscape of water reallocation across the West, deliberately chosen to represent extremes of outcomes, geographic

distribution and legal approaches. Case study researchers must be careful not to over-generalize their findings. While the above conclusions (the importance of infrastructure, the role of concentration, the need for proof of leasing) can be safely said to apply to most if not all growing Western cities in need of water, many of the other results of this study cannot, at least not as broadly or as safely. There are several examples of factors that are essential in the Arkansas basin that will not apply elsewhere: for example, as mentioned in the previous section, in the Arkansas the senior agricultural water rights are downstream of the urban corridor, and exchange of water is vital in order to move it into municipal supplies. In other basins, such as California's Central Valley, the opposite is true: a city that buys agricultural water can expect it to flow down to them; though they will still need to store it, there is no need to be concerned about exchange. As a second example, lease-fallowing is underway in southern California under a contract between the Palo Verde Irrigation District and the Metropolitan Water District (MWD) (Western Governors' Association, 2012). In this case, Palo Verde land is rotationally fallowed on a large scale, larger than the Super Ditch, and the irrigation district acts as the negotiator. But it is very easy to move water from Palo Verde to MWD and despite its massive scale there is no need to "integrate" the water rights of several ditches in the way that Super Ditch must. Palo Verde's role as a "centralizing water rights entity" will therefore be quite different from that of Super Ditch. A third example is the complication of the Lower Ark District opposing sales while subsidizing lease-fallowing using the same staff and funding sources. The Lower Ark is the unique sort of public water entity that does not own water rights or work to develop and supply water for beneficial use. There will not be analogues in many other basins. The variables and outcomes of water transfers remain as place-specific as ever (National Research Council, 1992).

In fact, it is risky to read too much into the story of the Colorado Canal. What happened in Crowley County is perhaps the most obvious example of buy-and-dry since the Owens Valley "water wars" of the 1920s, and it is a powerful motivator of rural behavior in the Valley, some municipal behavior upstream, and of state-level policy rhetoric. But the Colorado Canal probably also represents the extreme end of the spectrum. At some level, one can say that a "perfect storm" of factors led to the mass sell-off of shares in the canal system: the overextension of the ditch, the relatively junior direct-flow water right, the poor quality of

some of its soils, its dependence on a single crop (sugar beets) and processing facility (in Sugar City), the failure of that same sugar plant, the appeal of its transbasin water, the appeal of its upstream and terminal storage, and its location nearby to growing cities. Of course, one must be careful about concluding that the canal was the only system that exhibited all these motivating qualities right after determining the qualities that motivate from a study of that same system, but it is obvious that it was a very attractive water right and that the farmers there were in more pressure than their counterparts. They sold off in droves, and the community quickly suffered. This could easily happen under the Otero County ditches. However, the Colorado Canal is also unique in the Arkansas Valley for being the only appreciable ditch in its county; the counties above and below Crowley have multiple ditch systems, and if they were to lose one, the rest would continue to operate. In Crowley County, there was nothing else to fall back on; the sales removed not just one ditch and its farmers from the community, but the entire potential for irrigated agriculture. There are plenty of good reasons to oppose the buy-and-dry of entire ditch systems: the burdening of third parties, the proliferation of weeds and dust, the challenges of water delivery, the unbalanced negotiations that often produce buy-and-dry, and no doubt others. But the disappearance of entire communities that is frequently cited, following Crowley's example, is probably an extreme case. Nowhere else did an economic and social unit depend so wholly on a single ditch system that was also so attractive to municipalities.

Opportunities for Further Research

The Super Ditch and Colorado Canal are but two cases of water transfers across the Western states, and there can be no doubt that transfer activity will increase in every state as population continues to grow (Western Governors' Association, 2012). The lessons of the Arkansas Valley inform directions for other researchers interested in determining the effects of water transfer arrangements on society, the landscape, the hydrologic system, and the regional economy, perhaps beginning with the seven more general hypotheses **H1a** through **H6a** formulated in the first section of this chapter. When it comes to research design, case studies will remain a valuable component of future inquiry on this topic. The results of this study suggest that place-specific variables like storage, exchange, existing institutions and specific state water laws have a

relevant impact on determining the outcomes of water transfers. It would be valuable to see new case studies in other regions of the West, especially those trying alternative transfer arrangements (not just lease-fallowing), which keep these factors in mind. Research design should incorporate the role of these place-specific variables, and comparisons of water transfers should, wherever possible, be done within a common hydrologic and institutional context. In these new case studies, the seven proposed hypotheses **H1a** through **H6a** could be reformulated into whatever local equivalents make sense in context.

Scholarship around water reallocation will benefit from more than just case studies, however. This study suggests that a number of factors drove buying, selling and leasing activity in the Arkansas basin. These include operational, economic, legal, technical and interpersonal concerns. In order to understand which of these are specific to the Arkansas Valley context and how well **H1a** through **H6a** describe transfer activity generally, researchers could conduct a survey of the major agriculture-to-municipal water transfers around the Western states asking the following questions, and no doubt many others:

- Did the acquisition include storage?
- Does the transfer involve upstream exchange?
- Was new infrastructure required?
- What is the distance between agricultural and municipal points of use?
- What percentage of the ditch company or other irrigation entity was acquired?
- How did the costs compare to developing new water supplies, or conserving water?
- Were their local economic shocks like drought, crop failure, transportation or processing facility failure in the area of origin?
- Under what legal structure did the transfer take place?
- What approval process was required?
- Who opposed the transfer and why?
- How (relatively) senior are the rights acquired?
- What environmental and demographic effects have occurred in the area of origin?
- Has the city grown in the aftermath of the transfer, and how does that compare to the amount of water acquired?
- How does the acquired water compare in terms of reliability and location to the city's pre-existing supply?

Discovering which attributes appear in the most completed transfers, and what effects tend to be observed, would expand the conclusions of this case study to a more general level without losing the place-based considerations like infrastructure and institutions that seem to truly affect observed outcomes. Truly

answering the question “What regions will be involved in a water transfer, and what will the effects be?” requires surveying which place-based attributes appear in the most transfers, where future transfers are likely to occur, and what they will most likely look like.

Finally, this study can only brush the surface of the Super Ditch project. As of this writing, Catlin Canal water is being delivered to three cities via Pueblo Reservoir and wells along the Arkansas River. 500 acres of land have been fallowed for only a few months, and the cities have yet to make their payments to the participating farmers. Completing the comparison of the Colorado Canal and the Super Ditch will require study of the next several years in Otero County, especially if Super Ditch successfully creates a larger pilot program involving multiple ditches. Study of the Super Ditch going forward should be multi-disciplinary, tracking at least these variables derived from a suggested **H7a: Outcomes of the Super Ditch in Otero County are preferable to outcomes of the Colorado Canal in Crowley County, without jeopardizing the security of municipal supply**, as well as variables necessary to fully understand the attitudes projected by **H5**:

- Economic reinvestment in the Lower Valley
- Shifting social attitudes toward leasing and between ditch companies
- Farmer participation in future pilot projects
- Response of fallowed land
- Delivery of water to municipalities
- Delivery of water to non-participating farmers
- Growth and water security of participating cities
- Participation of new cities and ditches
- Technical approaches to utilizing multiple ditches
- Technical approaches to supplying water in differentially dry years

The 2015 pilot project and, hopefully, future, larger leasing projects out of the seven ditches must be tracked on similar terms to the existing research on the Colorado Canal in order to draw apt comparisons that highlight the effect of “switching” from buy-and-dry to lease-fallowing. Recording the particular challenges that they face and the ways they overcome them will inform design of future alternative water transfer projects. If future research can identify leasing outcomes, identify the attributes that appear in the most transfers, and identify additional comparisons of alternative and traditional transfers in a shared context,

scholars will have contributed to our understanding of this phenomenon and to the development of policies that avoid the worst outcomes while promoting equity, efficiency and sustainability in the allocation of water.

Some Lessons for Policymakers

Keeping in mind the limitations of generalizing case-study research and the novelty of the Super Ditch as an entity that follows land and delivers water, rather than just proposes to do so, there are some relevant lessons for policymakers that confront the massive water crisis facing the Western states. The time to scrutinize water transfers is critical: rhetoric in some states (including Colorado) turns against the practice of buy-and-dry (State of Colorado, 2014) while rhetoric in others emphasizes water marketing as a solution to inefficient allocations of water resources (Moore, 2015). Absent deliberate planning and certain policy actions, permanent agriculture-to-municipal water transfers will remain the default strategy for cities confronting the twin specters of drought and growth (Nichols, Murphy, & Kenney, 2001). The Crowley County case demonstrates that dry-up will occur primarily in certain communities to the exclusion of others, and the impacts in those places will be more severe than a broad view indicates. Fortunately, there are certain steps that states, municipalities and irrigators could take to maximize the likelihood that drying up agriculture is done in a smarter, less damaging way within the existing water rights framework.

The first step for states that truly wish to promote alternative water transfers would be to **make it easier to lease water for long periods than it is to buy water permanently**. That action could take many forms; adopting a common technical platform for determining return flow obligations, moving to a less adversarial legal transfer process, and loosening the definition of material injury and speculation in the case of leases would all make good steps. Perpetual leases must be permitted in states where leases are currently limited in duration. Cities that are committed to acquiring title to their water rights could still go through a more intensive legal and technical process to establish that, while cities willing to lease could more easily arrange it with their own staff, or, even better, serve as customers of rural entities with a delivery obligation. It will take several demonstration projects to establish that these entities can reliably deliver water to their municipal partners and convince a critical mass of cities to sign up. But legal changes, properly applied, could

speed the shift to long-term leasing. This study suggests that absent such differentiation in transaction costs, many cities (though not all) will choose to acquire water permanently rather than revisit the issue several years apart, especially if they already have experience purchasing water. Of course, lease-fallowing is not the only model of alternative transfer that might be made less legally onerous; where institutionally and hydrologically appropriate, the beneficiary of such adjustments could be water banks, option contracts, salvaged water, or wholly novel arrangements (Metzger, 1988; Nichols, Murphy, & Kenney, 2001).

The second step that would prove helpful is for states to **incentivize the construction of small storage and conveyance projects whose capacity is shared by urban and rural users** (Pueblo Reservoir serves this purpose in the Arkansas basin, albeit on a much larger scale). In basins dependent on exchange, this will be especially crucial, but all rivers would benefit from the operational flexibility that strategic capture and release of water provides, including leasing from agriculture to agriculture and from cities to other cities. Storage helps guard against downstream injury and is essential for municipalities moving water from its long-time point of diversion to a new one at a municipal treatment plant. Conveyance infrastructure that improves flexibility by tying together multiple ditches, cities and rivers will play a similar role: a city that can take water from only one intake can only buy water it can move to that intake. It may sound paradoxical, given what we know about the worst of buy-and-dry, to recommend that more areas be exposed to it through physical infrastructure improvements. But it is likely that absent these investments, a lot of buy-and-dry will happen anyway, and it will happen only in particular areas, and new infrastructure can facilitate the flexible annual management of water regardless of the prevalence of buy-and-dry or the future success of lease-fallowing. States that are serious about avoiding this should not focus on legal reforms or institutional development, the usual suggestions, to the exclusion of the physical side of the equation.

It is too early to draw any specific policy-related conclusions from the experience of the Super Ditch as a company. It is tempting to recommend that more Super Ditches be created across the West to improve farmers' bargaining positions and act as a wholesaler to growing municipalities, especially the younger ones that have no experience leasing water but are capable of buying water permanently in a real estate transaction. The potential to integrate water rights from multiple ditches and deliver it to multiple cities, according to

annual supply and demand, is perhaps the most promising development in avoiding the worst of buy-and-dry and keeping agriculture viable across large swaths of the West. The enormous legal and technical challenges currently inherent in doing so should give us pause, and the result of the 2015 Catlin Canal pilot project will inform recommendations on this point. However, it does seem that **any “centralizing water rights entity” should operate as independently as possible from other institutions in its watershed that stand between cities and ditch companies.** When cities get sued by rural entities, and soon thereafter a nearly-indistinguishable entity petitions them to engage in a lease contract, it is little wonder that some hesitate. Water management is still, on some level, interpersonal in character, and repeated interactions build relationships and attitudes for better or for worse. Having the same people involved is inevitable to a point, but this study suggests that Super Ditch would be more successful if it were more determinedly separated from the Lower Ark District. While exact equivalents to the Lower Ark are rare, given that it exists to oppose water development rather than promote it, ditches who wish to lease water to municipalities should keep the existing relationships between institutions in their basin at the forefront of their mind when designing a leasing scheme.

The demands on water west of the hundredth meridian, that mythical line that divides arid West from verdant East, will always be severe. It will continue to be that most contradictory of natural resources – so abundant as to be nearly free to use, so scarce as to create discord and violence as well as million dollar transactions, critical to our very survival but wasted in so many ways. In an era of growth and limited supplies, a few realities are apparent: the urban West – the New West of sprawling Las Vegas, the canal-fed desert that is Phoenix and the countless teenage developments between Denver and Colorado Springs – is going to continue growing, and they will continue to buy agricultural supplies as they grow. Broadly speaking, those purchases do not threaten the survival of the rural West – the Old West of Idaho potatoes, California vineyards and Washington apples. Agriculture uses so much water so inefficiently that the industry itself, from a regional standpoint, will survive. But the practices of cities during and after the Colorado Canal case dictate that many communities will not. The wholesale removal of irrigation water from the Colorado Canal

took away Crowley County's economic driver, its capacity for self-determination, its sense of self-identity, its topsoil and its greenery to benefit a handful of distant cities. Fortunately, we know that this need not repeat itself. It is inevitable that water must be moved from agricultural to municipal uses, but we can choose the places where and methods by which this happens. Doing so will take conscious choices by states, municipalities and farmers, but those choices can improve the viability of the Western agricultural enterprise, improve flexibility of water management and reduce environmental damage. As we transition from Old West to New, our water management decisions- thoughtful or brazen, devastating or measured- reflect our own judgements as a water-dependent society and serve as a marker for how the West chooses to live.

References

- Barnett, T. P., Adam, J. C., & Lettenmaier, D. P. (2005). Potential impacts of a warming climate on water availability in snow-dominated regions. *Nature*, 303-309.
- Charney, A. H., & Woodard, G. C. (1990). Socioeconomic Impacts of Water Farming on Rural Areas of Origin in Arizona. *American Journal of Agricultural Economics*, 1193-1199.
- Christensen, N. S., Wood, A. W., Voisin, N., Lettenmaier, D. P., & Palmer, R. N. (2004). The Effects of Climate Change on the Hydrology and Water Resources of the Colorado River Basin. *Climatic Change*, 337-363.
- Colorado Division of Water Resources. (n.d.). *Division Offices by Major River Basin(s)*. Retrieved June 1, 2015, from <http://water.state.co.us/DivisionsOffices/Pages/default.aspx>
- Colorado Foundation for Water Education. (2007, Fall). Just One Chance. *Headwaters Magazine*, pp. 24-26.
- Colorado Foundation for Water Education. (2014). *Citizen's Guide to Colorado's Transbasin Diversions*. Denver.
- Colorado General Assembly. (1992). Senate Bill 92-92.
- Colorado General Assembly. (2003). Senate Bill 03-115.
- Colorado General Assembly. (2013). House Bill 13-1248.
- Colorado General Assembly. (2013). Senate Bill 03-115.
- Colorado Geological Survey. (n.d.). *Major Alluvial Aquifers: Arkansas River basin*. Retrieved June 2, 2015, from http://coloradogeologicalsurvey.org/apps/wateratlas/chapter5_2page1.html
- Hobbs, G. J. (1997). Colorado Water Law: An Historical Overview. *Water Law Review*, 1-74.
- Howe, C. W., & Goemans, C. (2003). Water Transfers and their Impacts: Lessons from Three Colorado Water Markets. *Journal of the American Water Resources Association*, 1055-1065.
- Howe, C. W., Lazo, J. K., & Weber, K. R. (1990). The Economic Impacts of Agriculture-to-Urban Water Transfers on the Area of Origin: A Case Study of the Arkansas River Valley in Colorado. *American Journal of Agricultural Economics*, 1200-1204.
- Koebele, E. (2014). *Stakeholder Beliefs, Collaboration, and Policy Outcomes: An Analysis of Colorado's Basin Roundtable Process*. M.S. Thesis, University of Colorado - Boulder.
- Lach, D., Ingram, H., & Rayner, S. (2005). Maintaining the Status Quo: How Institutional Norms and Practices Create Conservative Water Organizations. *Texas Law Review*, 2027-2053.

- Lund, J. (1993). Transaction Risk versus Transaction Cost in Water Transfers. *Water Resources Research*, 3103-3107.
- MacDonnell, L. (1999). *From Reclamation to Sustainability: Water Agriculture and the Environment in the American West*. Niwot: University Press of Colorado.
- McMahon, T. G., & Smith, M. G. (2012). The Arkansas Valley "Super Ditch" - An Analysis of Potential Economic Impacts. *Journal of the American Water Resources Association*, 151-162.
- Metzger, P. C. (1988). Protecting Social Values in Western Water Transfers. *Journal of the American Water Works Association*, 58-65.
- Michelsen, A. M., & Young, R. A. (1993). Optioning Agricultural Water Rights for Urban Water Supplies During Drought. *American Journal of Agricultural Economics*, 1010-1020.
- Miles, M. B., & Huberman, A. M. (2014). *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oaks: SAGE Publications.
- Moore, S. (2015, April 1). Water Pricing, Not Engineering, Will Ease Looming Water Shortages. *The New York Times*.
- National Research Council. (1992). *Water Transfers in the West: Efficiency, Equity and the Environment*. Washington: National Academy Press.
- Nichols, P. D. (2011). *Development of Land Fallowing- Water Leasing in the Arkansas Valley (2002 through mid-2011)*. Report to the Colorado Water Conservation Board.
- Nichols, P. D., Murphy, M. K., & Kenney, D. S. (2001). *Water and Growth in Colorado*. Boulder: Natural Resources Law Center.
- Revelle, R. R., & Waggoner, P. E. (1983). Effects of a Carbon-Dioxide Induced Climatic Change on Water Supplies in the Western States. In National Research Council, *Changing Climate: Report of the Carbon Dioxide Assessment Committee* (pp. 419-432). Washington: National Academies.
- Rivero, J. A. (1998). *Acequia Culture: Water, Land and Community in the Southwest*. Albuquerque: University of New Mexico Press.
- Rubin, H. J., & Rubin, I. S. (2011). *Qualitative Interviewing: The Art of Hearing Data*. SAGE Publications.
- Saliba, B. C., Bush, D. B., Martin, W. E., & Brown, T. C. (1987). Do Water Market Prices Appropriately Measure Water Values? *Natural Resources Journal*, 617-651.
- Schaffer, A., & Schaffer, R. C. (1984). Social Impacts on Rural Communities. In E. A. Engelbert, *Water Scarcity: Impacts on Western Agriculture* (pp. 309-330). Berkeley: University of California Press.
- Schorr, D. B. (2005). Appropriation as Agrarianism: Distributive Justice in the Creation of Property Rights. *Ecology Law Quarterly*, 3-71.

- Southeastern Colorado Water Conservancy District. (2014). *Fryingpan-Arkansas Project History*. Retrieved June 11, 2015, from <https://www.secwcd.org/content/fryingpan-arkansas-project-history>
- Squillace, M. (2012). The Water Marketing Solution. *Environmental Law Reporter*.
- State of Colorado. (2014). *Draft Colorado Water Plan*.
- Sutherland, P. L., & Knapp, J. A. (1988). The impacts of limited water: A Colorado case study. *Journal of Soil and Water Conservation*, 294-298.
- Taylor, R. G., & Young, R. A. (1995). Rural-to-Urban Water Transfers: Measuring Direct Foregone Benefits of Irrigation Water under Uncertain Water Supplies. *Journal of Agricultural and Resource Economics*, 247-262.
- United States Census Bureau. (2005). *2005 Interim State Population Projections*. Washington: Government Printing Office.
- Weber, K. R. (1989). *What Becomes of Farmers Who Sell Their Irrigation Water: The Case of Water Sales in Crowley County, Colorado*. The Ford Foundation.
- Weber, K. R. (1990). Effects of Water Transfers on Rural Areas: A Response to Shupe, Weatherford, and Checchio. *Natural Resources Journal*, 13-19.
- Weber, K. R. (1992). *An Offer I Can't Refuse: Social Consequences of Water Transfers to the Transferring Area*.
- Western Governors' Association. (2012). *Water Transfers in the West: Projects, Trends and Practices in Voluntary Water Trading*.
- Woodka, C. (2013, June 14). Super Ditch 'speculative'. *The Pueblo Chieftain*.
- Woodka, C. (2014, March 11). Super Ditch scuttles pilot program. *The Pueblo Chieftain*.
- Woodka, C. (2015, January 28). Catlin lease gets state's blessing. *The Pueblo Chieftain*.
- Woodka, C. (2015, March 20). Fort Lyon sale: State of shock. *The Pueblo Chieftain*.
- Yin, R. K. (2002). *Case Study Research: Design and Methods* (3rd ed.). SAGE Publications.
- Young, R. A. (1984). Local and Regional Economic Impacts. In E. A. Engelbert, *Water Scarcity: Impacts on Western Agriculture* (pp. 244-272). Berkeley: University of California Press.
- Zaffos, J. (2015, June 8). Last-Ditch Effort. *High Country News*.

Appendix A: Interview Protocol

Semi-Structured Interview Questions for Lower Arkansas Valley Agricultural Producers, Ditch Company Officers, and Super Ditch Organizers

Lower-case letters designate possible follow-up questions; the actual questions asked will depend on participants' answers to the main questions designated by numbers. The interviewer may also follow up on unexpected responses, and ask clarifactory questions seeking detail, examples and definitions (see Rubin & Rubin, 2005).

1. Can you please tell me your first and last name, where you live, and how long you've lived there?
2. Could you tell me what you saw change in this area when large numbers of people started to sell water to cities on the Front Range?
 - a. Have there been changes on the land since the big water transfers?
 - b. What was farming like here beforehand? How does that compare to today?
 - c. How has your livelihood changed since the water transfers?
 - d. Have your relationships with other people in this community changed?
3. (if interviewee is/was a ditch shareholder) Why did you decide to sell/not sell your shares?
 - a. Did you talk to a city directly or to an intermediary?
 - b. How much did the city/ intermediary offer you?
 - c. What was it like here when people were deciding whether or not to sell?
 - d. What's your attitude toward people who did not/ did sell their shares?
4. Do you think things would have gone differently if the cities had wanted to lease water, or take water some years but not others?
 - a. (If interviewee is/was a ditch shareholder) Would that have affected your decision?
 - b. Is there anything else the cities might have done differently?
5. The other thing I want to talk to you about is the Super Ditch proposal. What results do you expect to see from the project?
 - a. What do you think is different about the Super Ditch as it relates to your community?
 - b. Have the last few years, as the Super Ditch proposal has come together, changed your attitudes toward other water users in this area? What about toward the cities?
6. Is there anyone else you can think of that we should contact about this study?
 - a. Can we use your name as a reference if we contact them?

Semi-Structured Interview Questions for Front Range Water Utility Staff

1. Can you please tell me your first and last name, your position, and how long you have been here?
2. Could you tell me how your office or your city has changed since acquiring so many agricultural water rights from the Colorado Canal and other places?
 - a. How do you think things would be different if you hadn't purchased those rights?
 - b. How have these rights changed your water supply or planning situation?
 - c. Do you think people in your city know that they rely on agricultural transfers for some of their supply?
3. How much do you typically pay for agricultural water rights?
 - a. How do you come up with an acceptable price? Is there a ceiling or a floor?
4. How do you choose what sources of water to pursue?
 - a. Are there differences between agricultural and other sources in terms of what they enable you to do?
 - b. Do you seek out individual rights holders or do they approach you?
5. I've heard it suggested that you prefer to buy water from a single ditch company rather than several. Is this true? Why or why not?
6. The other thing I'd like to talk about is the Super Ditch proposal, or water leasing and rotational fallowing more generally. Do you expect to have any involvement with the Super Ditch, or other alternatives to buy-and-dry?
 - a. Would your city consider leasing large amounts of agricultural water going forward?
 - b. Are there obstacles to entering leasing arrangements that you don't have to deal with in a traditional transfer? Is anything easier?
 - c. Has the Super Ditch proposal changed the way you go about water planning?
7. Is there anyone else you can think of that we should contact about this study?
 - a. Can we use your name as a reference if we contact them?

Appendix B: Interview Codebook

H1. The economic, social-cultural and ecological consequences of buy-and-try water transfers persist and worsen over multi-decade time scales

- RURECON – mentions of economic changes in rural communities after buy and dry
 - PROCEEDS – mentions of how sale proceeds were spent
 - SECEFFEC – mentions of secondary economic effects (public and private)
 - DIREFFEC – mentions of direct economic effects on people who sold or did not sell
- RURSO – mentions of social/cultural changes in rural communities after buy and dry
 - SOCCHG – mentions of changes in social/cultural interactions/identities
 - PROXYGP – mentions of the Proxy Group which consolidated non-sellers
- RURENV – mentions of environmental changes in rural communities after buy and dry
 - RURLAND – mentions of changes to rural landscapes
 - RURWATER – mentions of changes to rural water delivery or availability

H2. Cities use water acquisitions to fuel demographic and economic growth, and to secure themselves against drought

- URBCHG – mentions of changes in urban communities after acquiring water
 - URBGROWTH – mentions of urban economic or demographic growth
 - URBSUPPLY – mentions of changes to urban water supply portfolios

H3. Cities cluster their water rights purchases geographically, which exacerbates the consequences in particular communities while exempting others, and makes regionally insignificant transfer amounts highly consequential

- WHYBUY – mentions of motivations for municipalities buying agricultural water
 - BUYAVAIL – mentions of buying water that was made available/ put up for sale
 - BUYCOST – mentions of buying water based on cost
 - BUYOPNL – mentions of buying water based on operational concerns
 - RELIABLE – mentions of buying water that is reliable
 - BUYNEED – mentions of seeking water rights to meet specific growth needs
 - BUYPOL – mentions of political or tactical considerations for buying water rights
- WHYSELL – mentions of factors motivating farmers to sell water
 - SELLMONEY – mentions of financial motivations for selling
 - SELLFAM – mentions of family motivations for selling
 - SELLCONT – mentions of selling motivated by expectation of continued farming

H4. The primary “losers” of water transfers are third parties in areas of origin; the primary beneficiaries are urban water utilities, residents and property developers; these losers are not well-compensated by revegetation and monetary payments

- 3PCOMP – mentions of third-party compensation attached to buy and dry
- REVEG – mentions of revegetation after buy and dry
 - RVATT – mentions of attitudes toward revegetation requirements
 - RVOUTCOME – mentions of outcomes of revegetation projects

H5. Farmers and rural residents prefer leasing water as a way to avoid the impacts of buy and dry and retain their communities' health, but urban water utilities are skeptical because of their insistence on certainty, reliability, and low costs

- WHYLF – mentions of motivations for leasing-fallowing or other alternative transfers
 - AVOIDBD – mentions of avoiding duplicating Crowley County or “buy and dry” impacts
 - AGBENS – mentions of benefits to agriculture or rural communities from LF
 - PROLEGLOPNL – mentions of legal or operational benefits of leased water
 - PROPOL – mentions of political motivations for pursuing lease-fallowing
- ANTILF - mentions of opposition to leasing-fallowing or Super Ditch
 - WANTOWN – mentions of preference for owning over leasing
 - LFCOST – mentions of higher costs of leasing water
 - LFPRSNL – mentions of interpersonal opposition to leasing
 - ANTIOPNL – mentions of technical or operational opposition to leasing
- LFCHALL – mentions of technical or legal challenges to leasing-fallowing
 - LEGCHAL – mentions of legal challenges
 - TECHCHAL – mentions of technical or operational challenges
 - 1248 – mentions of HB 1248 or its role in LF process

H6. Entities that combine the assets of several agricultural ditches facilitate a leasing market, while distributing benefits and burdens over a wider area

- SDCROLE – mentions of the role of the Super Ditch Company or of pooling multiple ditches
 - SDSTRONG – mentions of SDC as strong negotiator
 - SDSPREAD – mentions of SDC spreading benefits, burdens, participation over wider area
 - SDEFFECT – mentions of SDC making leasing harder, easier, more attractive, less attractive