DISSERTATION

REREGULATING THE FLOWS OF THE ARKANSAS RIVER:

COMPARING FORMS OF COMMON POOL RESOURCE ORGANIZATIONS

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY TROY LEPPER ENTITLED BANKING ON A BETTER DAY BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

REREGULATING THE FLOWS OF THE
ARKANSAS RIVER:
COMPARING FORMS OF COMMON POOL
RESOURCE ORGANIZATIONS

What sociological attributes characterize the form of an enduring social organization that empowers individually rational self-interested actors to provide themselves with a common property resource and collective good?

In order to address this research question, the analyst compared three common property resource and collective goods organizations for water management located in the Arkansas River basin of Colorado to an integrated ideal type model combining the work of David Freeman and Elinor Ostrom. It was the objective of this research to employ empirical observations while giving consideration to existing common property resource theories in an effort to formulate new theory. The three organizations being studied in this research were:

1. The Arkansas River Water Bank Pilot Program,
2. The Lower Arkansas Valley Water Conservancy District,
3. The Lower Arkansas Valley Water Management Association.

A brief overview of the findings were as follows:

1. The Arkansas River Water Bank Pilot Program failed to show the characteristics that the analyst's integrated ideal type model would suggest were important to the creation of a long-enduring organization. The pilot program also failed to generate local interest.
2. The Lower Arkansas Valley Water Conservancy District had some attributes of the integrated ideal type model, and is believed to have been partially successful for this reason. This organization will require further observation in the future to see just how successful it will be.
3. The Lower Arkansas Water Management Association had virtually all the characteristics of the integrated ideal type model. It was the only organization studied that should be considered a success story, success being defined by member support for the organization and the capacity of that organization to re-regulate flows on the Arkansas River.

Implications for policy and theory are also addressed in this dissertation. The conceptual "ideal type" models do identify variables and relationships that can be associated with success and failure of social organizational experiences in the Arkansas Valley. The empirical observations of the three valley organizations do support aspects of the conceptual models found in the literature. Additionally, new theoretical propositions will be advanced.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

Research Question

What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good? Employing conceptual models of organizational form, this research effort will be directed at systematically comparing and contrasting the uses and limits of three organizations in Colorado that are involved in water resource management:

1. The Arkansas River Water Bank Pilot Program;
2. The Lower Arkansas Valley Water Conservancy District;
3. The Lower Arkansas Valley Water Management Association.

Research Context

In 2001, Colorado passed legislation authorizing the creation of the Arkansas River Water Bank Pilot Program in the lower Arkansas River basin for the purpose of preventing further transfers of water out of the basin. In response to this legislation, and more importantly in response to the potentially damaging sale of a significant amount of water shares in the Fort Lyon Canal Company, the communities in the Arkansas Valley responded in 2002 with a counter proposal by creating the Lower Arkansas Valley Water Conservancy District (LAVWCD), which was designed to prevent further water transfers out of the lower Arkansas River basin. Unlike the water bank legislation, the conservancy district was intent on acquiring available water from willing sellers/leasers for the expressed purpose of keeping the rights to the water in the Arkansas River basin, and the conservancy district was not interested in allowing for water transfers out of the valley on a permanent basis.

In 2002, the communities in the Arkansas Valley mobilized to create the conservancy district. Not only was the formation of the conservancy district a response to looming water sales that would take water out of the basin, the creation of the district appeared to represent local dissatisfaction with the State of Colorado's Arkansas River Water Bank Pilot Program. The conservancy district appeared to have been formed to preserve water in the Arkansas Valley for valley water users; what can be considered as a "collective good." Although these two organizations were formed for a similar purpose - to preserve in perpetuity the water rights in the Arkansas River basin for future use - the form of each organization was quite different.

The newly established LAVWCD represented an attempt to provide a collective good by employing public tax money to acquire valley water from a willing seller/leaser to retain water in the Arkansas River basin, as well as a common property resource designed to short- or long-term lease or sell that water back to water users in the Arkansas River basin.

The use of collective goods organizations to secure water for future uses in the valley represented a new perspective on an old idea. In the past, common pool resource organizations, such as mutual irrigation companies, were used in the Arkansas Valley and elsewhere to collectively capture and utilize a resource that no one person could accomplish alone. Common pool resource organizations were used to cooperatively divert water off the Arkansas River and deliver it to agricultural users who would then utilize that private water right to grow crops for production and consumption on the open market. However, with the development of the LAVWCD, we see the creation of a collective goods organization that was designed to protect all the water in the basin not just an individual ditch company's rights to water in the valley; hence, the application of an old idea to a new problem. The conservancy district was initially viewed as mechanism designed to give individual water users and mutual irrigation company members the ability to sell their water shares to a buyer in the valley, the LAVWCD, that was mandated to keep these water shares in the valley, thereby, limiting the damaging impacts of water transfers to the lower Arkansas River basin.

The third organization studied in this research, besides the conservancy district and the pilot water bank, was the Lower Arkansas Water Management Association (LAWMA). This organization was also designed to provide a common property resource, as well as a collective good. Unlike the conservancy district and the pilot water bank, the LAWMA had been operating in the lower Arkansas River basin since the early 1970s. LAWMA was created to provide groundwater management for its organizational shareholders, but in doing so, devoted itself, at least philosophically, to providing a collective good in the form of keeping the water in the lower Arkansas River basin for future use and development.

LAWMA was structured like most traditional common property resource organizations for water management in the State of Colorado. The mutual irrigation company model was a familiar organizational form that had been tried and tested by water users in the lower Arkansas River and elsewhere. It is true that the conservancy district and pilot water bank were designed to operate basin-wide, and were focused on protecting a public good. However, LAWMA differed measurably in being an organization that met the needs of shareholders within a more circumscribed service area.

By bringing collective goods and common pool resource organizational theories to bear on the design of these three organizations, one can systematically examine and advance the understanding of the success or failure of their announced objectives. The creation of these three organizations leads us to our research question: examining each organization's form relative to their stated goals, using common pool resource theory. These three organizations represent the cases that were used to address the primary research question:

What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good?

Definitions: Collective Goods, Private Goods, and Common Property Goods

"A good is said to be private if its benefits can be captured by the investor-owner and denied to those members of the community who do not invest in it" (Freeman 1992; Hanna, Folke et al. 1996: 72). With a private good, the excludability and the rivalness of consumption are high. An example of a private good is the computer used to type this dissertation because others were excluded from the use of this computer and the returns gained from the use of this computer come solely to the author.

A common property good is one where the investor can perhaps capture a significant portion, but not all, of the benefits to their investment. In the case of water being discussed here, the rivalness of consumption is moderate. This is because that part of the investment in the water resource eventually returns to the river basin for use by other water users. Likewise, the excludability is moderate because it might very well be prohibitively costly for the investor to prevent other users from gaining any access to this resource. In fact, a good example of a common property good is irrigation water in a reservoir or ditch. The excludability may well be very moderate due to an irrigator's inability or legal right to prevent return flows back to the basin. The rivalness of consumption is also moderate because it would take a considerable effort to prevent other water users from gaining access to the water that returns to the river basin.

Finally, a collective good, sometimes referred to as a public good, is one where the investor can capture no more of a return on the investment than any non-investor, otherwise referred to as a free-rider.

> "Pure public goods are characterized by two attributes (1) nonrivalness of consumption, meaning that the quantity of a good available to others is not diminished by any one person's consumption of the good; and (2) nonexclusiveness of consumption, meaning that if a good can be consumed by one person it can be consumed by others in the community at no significant marginal cost" (Freeman 1992: 72).

A good example of a collective good provided by an organization would be that provided by the LAVWCD. This organization was designed to keep acquired water in the valley for all water users. Excludability, therefore, was zero because the water was being kept in the valley for all of the water users. The rivalness of consumption was also zero because everyone in the valley potentially benefited from having access to the organization's water through rental or leasing agreements.

Methods

The primary methodology for this research was to construct an integrated ideal type conceptual model (Weber 1947) consisting of organizational variables taken from the models of Elinor Ostrom (Ostrom 1999, Ostrom 1992) and David Freeman (Freeman 1989), and then to compare the integrated model to the observed form and objectives of the three organizations chosen; the state's pilot water bank, the conservancy district and the groundwater association. The intent of this research was to consider the uses and limits of the conceptual model and its organizational variables, along with their policy implications. Information and data on the three organizations were gathered using systematic in-depth interviews of key informants and document collection. This included examining the social and political dynamics by which the water community in the Arkansas River basin reacted to the State of Colorado's Arkansas River Water Bank Pilot Program, and then proceeded to establish an alternative collective goods organization in the form of the LAVWCD. The third organization was already in existence in the valley, and was chosen to assess traditional local knowledge approaches to address the issue that the water bank and conservancy district were to tackle. This research was designed as a hypothesis generating study not a hypothesis testing study. Therefore, the primary impetus of the research was discovery and advancement of hypotheses that could contribute to common pool resource theory building.

Significance

Why should the discipline of Sociology be interested in this case study in the Arkansas Valley? What theoretical significance and insight will this research project bring to the field of common property resource organizational theory? In this case study, the theoretical models will be advanced as they appear in the literature on common property resource and collective goods organizations. They will then be compared to the three organizations found in the lower Arkansas River basin. This will allow the discipline to draw lessons from this case study to examine the uses and limits of the common pool resource models extracted from the literature.

The significance of this research is not only important to the academic universe where theory building and modeling rule the day, but it also brings new insight to the policy and legislative universe. By conducting this research, the discipline of sociology will be enriched by virtue of having carefully applied and evaluated propositions drawn from the literature on common property resource organizational theory and collective goods theory. Those propositions will then be evaluated, assessed, and supplemented. Simultaneously, the policy world of water will be enriched by thick and rich description of: (1) how two different types of organizations were put into place that promised to provide and sustain a collective good in the form of preserving water in the lower Arkansas River basin, and (2) how a third organization already in existence in the valley, and based on more traditional practices, was largely overlooked in this community organizational endeavor.

This organizational research has the potential of reshaping the manner in which water is managed in a strategic Colorado river basin. Policy makers can benefit from gaining a better understanding of new water management strategies, especially in regards to the impacts of small changes in these organizational forms, and how those small changes resulted in different outcomes for the people in the Arkansas Valley. This research is also intended to inform policy makers and students of organizational theory in the use of common property resource organizational forms for protecting and preserving collective goods.

Chapter 2

LITERATURE REVIEW

Research Question

Over the past three decades, literature has emerged in sociology and other academic disciplines centered on the importance of social organization and common property and collective resources. Within this literature, scholars of common property resources and collective goods have asked two primary questions:

1. What organizational form will empower individually self-interested actors to act collectively to advance their common interest and provide sustained common action?
2. What are the relevant factors under which individually rational self-interested actors will mobilize their common resources to protect a collective good?

This dissertation pursues a modest modification to these two questions: What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good?

Environmental and Natural Resource Sociology

In pursuit of this research question on organizational form, this literature review starts with two subfields of sociology: environmental sociology and natural resource sociology. What do these two fields have to say about the creation of long-enduring organizational forms for the purpose of protecting natural resources? Also, what testable variables and relationships, if any, do these two subfields offer researchers interested in studying the impacts of natural resource organizations?

The scale/unit of analysis of natural resource sociology is that of the farm, community, or region tends to focus primarily on nonmetropolitan/rural areas. This perspective is usually driven by middle range theories focused on conservation and the carrying capacity of the local or regional area of study. On the other hand, environmental sociology uses a macro level of analysis in an effort to formulate grand theory to explain how the entire global ecosystem is affected by resource scarcity, pollution, and ecological footprints. The scale/unit of analysis for environmental sociology is the nation-state or global ecosystem and tends to focus on the metropolitan consumption patterns and their impacts on the global ecosystem.

Ever since the formation of environmental sociology as a subfield of study within the discipline of sociology, there has been a debate about whether there should be a division between natural resource sociology and environmental sociology. William Catton and Riley Dunlap are considered the pioneers in the field of environmental sociology, and state, "Natural resource sociology and environmental sociology have different historical roots, organizational identities, institutional bases of support, and scholarly orientations, yet both share a common concern with understanding the environmental bases of human societies" (Dunlap and Catton 2002: 239). These two subfields have been divided along such lines since the early 1970s with the first Earth Day. This celebration started an environmental movement that ultimately redefined the sociological study of the environment from a utilitarian focused natural resource sociology to a more non-utilitarian environmental sociology (Buttel 1996; Belsky 2002; Buttel 2002; Dunlap and Catton 2002; Field, Luloff et al. 2002).

For many social scientists studying the environment, the division of natural resource sociology and environmental sociology is distinct. The differences can be mapped out in regards to subject matters, theories, literatures, institutional locations, scale of analysis, and policy relevance (Buttel 1996; Buttel 2002; Buttel and Field 2002; Dunlap and Catton 2002; Field, Luloff et al. 2002). Belsky raises the question of whether this divide is problematic for the field of environmental studies and concludes that competing theories in environmental studies is a healthy sign of a thriving multiparadigmatic social science and is common across the ecological sciences (Belsky 2002). Belsky goes on to argue that the dualistic division between environmental sociology and natural resources sociology is misleading because it focuses on the two sub-disciplines as the only theoretical perspectives available, but in truth, there are multiple perspectives.

Rosa and Machlis (2002), on the other hand, argue that the divide is artificial and counterproductive. They go on to argue that much of the division is due to trained incapacities where rural sociologists train their graduate students to be rural sociologists and environmental sociologists, thereby, train their graduate students to be environmental sociologists solidifying the division for the next generation of social scientists.

Much like Rosa and Machlis, Freudenburg is also grappling with whether the debate between natural resource sociology and environmental sociology is counterproductive. "I do believe that it is unwise for academics to spend too much time in debating the divides of any sort, but contemporary arguments over natural resource 'versus' environmental sociology strike me as being particularly ill-advised, and particularly ill-timed" (Freudenburg 2002: 230). Finally, it should be recognized that this debate is an artifact of American sociology and is not prevalent in international sociology (Belsky 2002; Rosa and Machlis 2002).

As Dunlap and Catton pointed out throughout their professional careers, environmental and natural resource sociological perspectives have different historical origins and institutional locations. Natural resource sociology was developed by rural sociologists throughout the 20^{th} century with the works of Galpin (1915), Smith (1953) and Zimmerman (1930) to mention a few. This field of study developed as a result of President Theodore Roosevelt's commissioned study on Country Life, which was directed at studying the impacts of rural decline at the beginning of the 20^{th} century. According to Field, Luloff and Krannich, these early rural sociologists used geographic location and communal boundaries to determine how rural farm families were using community centers for social and market exchanges. "Natural resource sociology studies give attention to understanding how environmental/natural resource endowments condition social organization, and how social well-being is linked to and affected by resource conditions and use patterns" (Field, Luloff et al. 2002: 217).

These rural sociologists were located in the newly formed federal land grant universities, and their placement in the colleges of agriculture influenced the types of research they would focus on, especially in relation to the study of rural community development and the land and natural resource use patterns that farm families and farm communities were engaging in. As a field, natural resource sociology was well established by the mid 1960s, and the focus of this perspective was effective resource management, responsive policy making by government agencies, emphasizing the importance of conservation, and after the mid-1970s social impact assessment (Buttel 1996; Buttel 2002). Natural resource sociology was then institutionalized through the Rural Sociological Society in general, and through the Natural Resource Research Group (NRRG) in particular (Buttel 1996; Dunlap and Catton 2002; Field, Luloff et al. 2002).

The theoretical foundation of natural resource sociology was originally influenced by developments in human ecology, community development, geography, and agricultural economics, but eventually broadened its focus to cover the impacts of modernization and urbanization on rural life. Even though natural resource sociology draws its theoretical roots from these traditions, it is still seen by many in the discipline as being light on theory. Natural resource sociology, as practiced by rural sociologists and government agencies, tends to focus more on natural resource management and policy analysis and is applied more empirically and multidisciplinary in nature. According to Rudel, natural resource sociology is more practical in developing countries than is environmental sociology, especially in regards to building sustainable communities (Rudel 2002).

Environmental sociology, on the other hand, did not begin to take form until the early 1970s with the celebration of the first Earth Day. This was joined by the troubling cries of Rachel Carson in her seminal work *The Silent Spring*, and the environmental catastrophes of Love Canal in New York and Times Beach in Missouri (Freudenburg and

Gramling 1989; Buttel 1996; Buttel 2002; Field, Luloff et al. 2002). The participants forming this new field of inquiry were different than those developing the field of natural resource sociology. These former were veterans of the successful social movements of the 1960s (civil rights movement, anti-war movement, feminist movement). These new environmentalists used resource mobilization strategies learned and perfected during their involvement in the social movements of the 1960s to speed up the development of a New Environmental Paradigm (Dunlap and Catton 2002). Catton and Dunlap were instrumental in developing the field of environmental sociology by taking the lead in structuring the debate on the dominant social paradigm (DSP), a concept Dunlap took from Pirages and Ehrlich's 1974 book *Ark II: Social Response to Environmental Imperatives*; which they labeled the Human Exemption Paradigm (HEP) (Freudenburg and Gramling 1989). According to Buttel, Catton and Dunlap were offering a critique of classical sociological inquiry by arguing that humans are not exempt from the biophysical and geographic constraints of the environment, which ran contrary to most of the sociological theorizing in the field to that point. Unlike natural resource sociology, environmental sociology was institutionalized through the American Sociological Association (ASA), especially with the development of the environment and technology section within the ASA in the mid 1970s.

Environmental sociology drew fewer of its theoretical roots from human ecology, geography and economics as compared to natural resource sociology, instead it drew its core connections from general sociology, philosophy, and the humanities (Field, Luloff et al. 2002). One of the clear differences between environmental sociology and natural resource sociology is environmental sociology's heavy reliance on theory.

Three major contributors to environmental sociology as it exists today are Catton, Dunlap, and Alan Shnaiberg (Buttel 1996). Catton and Dunlap put forward a theory of the environment that is predicated on six interrelated notions:

1. Environmental problems and sociology's failure to deal with them is a result of a worldview that fails to recognize the biophysical bases of social structure and social life.
2. Modern societies reliance on fossil fuel and other finite natural resources has rendered them unsustainable and they are using up ecosystems faster than they can replenish themselves.
3. Modern societies are faced with the prospect of ecological vulnerability and collapse.
4. Environmental science has documented the environmental problems of the day and has made a convincing case for major adjustments in society's use of its natural resources.
5. The looming environmental catastrophe is causing paradigmatic shifts in society and in sociology as well.
6. The environmental agenda will be spread through the new ecological paradigm (Catton 1976; Catton and Dunlap 1978; Catton 1980; Buttel 1996).

Schnaiberg on the other hand built his theory on two major principles: the treadmill of production and that this treadmill tends to lead to environmental degradation (Schnaiberg 1980; Schnaiberg 1994; Buttel 1996). According to Schnaiberg, "The treadmill of production holds that modern capitalism and the modern state exhibit a fundamental logic of promoting economic growth and private capital accumulation, and the self-reproducing nature of this process causes it to assume the character of a treadmill…and the treadmill is liked to ecological crisis, since the accumulation process typically requires resource extraction (withdrawals) and contributes to pollution (additions)" (Buttel 1996).

It appears that the state of sociology in relation to the study of the environment is not unified under one theoretical perspective. Catton and Dunlap have identified six major propositions to which sociology should use for understanding human interactions with the environment, and Shnaiberg also mapped out his "treadmill of production." However, both of them tend to focus their sociological analysis at either the nation-state or the global ecosystem level, and by doing so, generally do not provide us with variables or relationships to research these theoretical propositions. Although the sociology of natural resources has been primarily a utilitarian approach to studying how human beings make the most efficient use of the natural resource base, it does offer empirically testable propositions. However, researchers in this tradition are usually aggregating individual preferences through survey data analysis. They too fail to get a hold of the problem, because it is the organizational level of analysis that can offer some of the best insights into how human interactions with the environment can be structured to be more consistent with the sustainability of the natural resource over an extended period of time.

After reviewing the literature on environmental and natural resource sociology, neither of these theoretical strands offers a clear cut specification of independent and dependent variables accompanied by testable relationships. Natural resource sociology has been criticized as being too action oriented (Buttel and Field,2002; Buttel 1996; Field and Luloff 2002) whereas environmental sociology has been questioned for it's over reliance on theory and failure to provide empirically verifiable propositions (Buttel and Field 2002; Buttel 1996; Field and Luloff 2002; Freudenburg and Gramling 1994). Both of these fields offer insightful concepts, but they offer little in the way of theoretical propositions that can be examined empirically, and for the purpose of determining ways to further empower common property organizations. The search for theoretically testable propositions has forced the author to look outside these two theoretical perspectives and toward common property resource and collective goods theories. The roots of this theoretical tradition begins with theories of rational choice.

Rational Choice Theory – Two Traditions

Rational Choice Theory - The Individually Reductionist Path

One way of viewing utility maximization is by thinking about individual actors confronted with a variety of choices, and choosing the path that best serves their objectives (Green and Shapiro 1994). According to Olson, an individual is maximizing their utility through individually rational action when their interests are "pursued by means that are efficient and effective for achieving these objectives" (1965: 65).

The generally accepted assumptions about rational choice theory are founded on five basic premises:

1. Rational action involves utility maximization;
2. Rational action must be consistent in regards to connectedness and transitivity;
3. Rational actors individually maximize the expected value of their own payoff based on a utility scale;
4. Rational actors maximizing their utility are individuals;
5. Rational choice models assume their models apply equally to all parties involved (Green and Shapiro 1994).

Theories of rational choice must meet consistency requirements. "Unless economic units act in conformity with some rational pattern, no general theory about what would follow from certain premises would be possible" (Rothschild 1946: 50). The first prerequisite of consistency is rank ordering. One of the primary assumptions of rational choice theory is connectedness, or that the individual can rank his options from best to worst. Transitivity is another essential element of rational choice theory. Transitivity assumes that if A is preferred to B, and B is preferred to C, then A must be preferred to C. (Green and Shapiro 1994)

The third and fourth tenets of rational choice theory assume that individuals maximize their utility based on some sort of costs-benefit scale, and that the unit of analysis is the individual. Therefore, any collective actions must be seen as the aggregate outcome on individual actors. According to Fishburn, "Expected utility has served for more than a generation as the preeminent model of rational preferences in decision making models under conditions of risk" (Fishburn 1988: 1).

The final assumption of rational choice theory is that all models apply to all individuals equally, and that those individuals make similar decisions, accept similar rules, and have similar tastes; all of which are "stable over time and similar among people" (Stigler 1977: 76).

Jon Elster focuses his research efforts on understanding whether individual rationality can be used to better understand organizational behavior and strategic coalitions (Elster 1979; Elster 1983). Much like Hardin and Olson, Elster assumes first that human action is purposive and intentional and based on a hierarchy of preferences. Elster is also in line with the five premises of rational choice theory offered by Green and Shapiro

(Green and Shapiro 1994) and views actors to be rational if they select their course of action based on utility maximization. Elster, taking a more determined methodologically individualist turn, uses rational choice theory to explain how social outcomes (organizational forms and strategic coalitions) can only be explained through the aggregation of individual action. He argues that altruism may be employed as a tactic to assemble winning coalitions. Consequently, organizations' forms and strategic coalitions may be viewed as a natural by-product of individual rational action (Elster 1982; Elster 1983).

The critique of rational choice theory begins with the recognition of the prisoner's dilemma. "When a prisoner's dilemma exists, conventional rational choice models—which make no allowance for strategic error and stipulate no special utility for 'doing the right thing'—predict that no player will adopt a cooperative strategy" (Ostrom 1992: 77). In the absence of organizational rules of use, as in an open access regime, people have the incentive to betray the other for their own personal benefit, and it is individually rational to do so. However, collective rationality is not a simple aggregation of individual preferences, and what is individually rational turns out to be a collective disaster. This critique of rational choice is built off three classical works: Kenneth Arrow's *Social Choice and Individual Values* (Arrow 1963), Anthony Down's *An Economic Theory of Democracy* (Downs 1957), and Mancur Olson's *Logic of Collective Action* (Olson 1965). All three of these theorists raised questions about whether individually self-interested actors maximizing their own utility can produce an outcome that maximizes both their individual and perhaps joint welfare.

> "In response to Abram Bergson's analysis of social welfare functions (Bergson 1938), which appeared to show that the state could maximize

> social welfare through objective aggregation of individual preferences, Arrow demonstrated that so long as minimal assumptions about rationality and the complexity of choice are granted, no social welfare function exists that is neither imposed nor dictatorial" (Green and Shapiro 1994: 7).

Olson illustrates that "rational individuals will not voluntarily make any sacrifices to help their group attain its political (public or collective) objectives" (Olson 1965: 126). By questioning the logic of collective action, Olson represented a shift towards organizational explanations to social action, although he does not succeed in formalizing this approach, he does sit at the hinge of theoretical change (i.e., he set the stage for organizational theorists to take rational choice theory into the sociological realm).

In summary, the individually reductionist path offers a theoretical perspective which narrowly views rational actors seeking to maximize their utility generally unconnected from the rest of the social world. Consequently, this theoretical tradition has come under fire from a group of researchers utilizing a bounded form of rational action.

A New Turn in Rational Choice Theory: Organizational Form and Escaping from Methodological Reductionism

In 1968, Garret Hardin concluded that human interaction with the natural environment, particularly in the form it takes when extracting natural resources from the commons ultimately leads to "the tragedy of the commons" (Becker and Ostrom 1995; Hanna, Folke et al. 1996; Ostrom 1999; Ostrom, Burger et al. 1999; Ostrom 2003). Hardin's "tragedy" is conditioned by an open access public goods property regime that generally precludes clearly defined property rights. Public goods property regimes are also subject to unfettered individual resource extraction, therefore, making it difficult to enforce sanctions on those individuals "free-riding" on the public goods property regime. Hardin uses a livestock metaphor to explain how individually rational actors can create collective disasters. Hardin argues,

> "(In the public goods property regime)...Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom of the commons brings ruin to all" (Hardin 1968: 1244).

Hardin finds the only solution to the free-riding problem in open access regimes to be the creation of private or state run property rights regimes with built-in sanctioning and enforcement rules that protect the natural resource for continued use.

"Hardin's model has been formalized as a prisoner's dilemma game" (Dawes 1973; Dawes 1975; Ostrom 1992; Ostrom 1999; Ostrom 2003; Ostrom and Ostrom 2004). The "prisoner's dilemma" comes in to play whenever two parties would be better off cooperating, but are given the opportunity to cheat. Prisoner's dilemma can be set up using Hardin's herding metaphor to illustrate how individual herders on an open access pasture will rationally overexploit the resource. When applying the prisoner's dilemma game to Hardin's herding metaphor, there exists an open pasture with an upper limit on the number of animals that can be grazed. When given the choice of cooperating (using the resource in a sustainable way) or defecting (over grazing the resource; therefore, diminishing the returns), the individually rational action is not to cooperate and, therefore, over graze. "The prisoner's dilemma game is conceptualized as a noncooperative game in which all players possess complete information. In noncooperative games, communication among the players is forbidden or impossible or simply irrelevant as long as it is not explicitly modeled as part of the game" (Ostrom 1992; Macy and Flache 1995; Ostrom 1999: 4).

Olson also grappled with the issue of individual rationality leading to collective action through his critique of group theory (Bentley, 1949; Truman, 1958). According to Olson, group theorists are mistaken to assume that,

> "If the members of some group have a common interest or object, and if they would all be better off if that objective were achieved, it has been thought to follow that the individuals in that group would, if they were rational and self-interested, act to achieve that objective" (Olson 1965: 1).

Olson concludes, "Unless the number of individuals is quite small, or unless there is coercion or some other special device to act in their common interest, *rational self-interested individuals will not act to achieve their common or group interests*" (Olson 1965: 2). Much in line with Hardin, Olson argues that if an individual cannot be excluded from the benefits of a public good, then free-riding will be the individually rational action, therefore, limiting the possibility of collective action and resulting in the "tragedy of the commons."

The prisoner's dilemma, the tragedy of the commons, and the logic of collective action are all founded on assumptions about individual rationality and collective action that rule out the possibility of cooperation between the herders. Under these conditions of rational and self-interested action each individual will continue to overexploit the resource base to extinction (Ostrom 1992).

> "Both experimental and field research readily establishes that when those using resources whose legal status is open access are constrained by diverse factors to act independently, the predictions derived from the "tragedy of the commons", the Prisoners' Dilemma game, and the logic of collective action are empirically supported. Where the resources are left to be open access, one can expect conflict, overuse, and the potential for destruction" (Olson 1965; Hardin 1968; Hardin 1982; Becker and Ostrom 1995; Libecap 1995).

At the heart of all three models lies the problem of the free-rider (for more information on the "free-rider problem" refer to Samuelson 1947). Hardin and Olson conclude that free-riding will always take place where an open access resource is being distributed. This is because rational actors will act in a self-interested way by withholding individual investment under the assumption that others will pick up the slack. "Hardin and Olson rule out the possibility of individuals collectively overcoming the "free-rider problem" by establishing rules to govern the resource as a common property resource. Moreover, Hardin may have confused common property regimes, where a community of individuals have enforceable ways of limiting access and may also have rules affecting harvesting strategies, with his description of open access regimes" (Burger 2001: 3).

Hardin's prisoner's dilemma appears to be easily resolved once individually rational actors create organized means to monitor and govern each other. Through such organized means, the prisoner's dilemma is transcended and resolved. For example, if Hardin's herders would have been empowered organizationally to monitor and govern themselves, each could have made individual sacrifices (tempering rational self-interest) knowing that the others were making proportionate sacrifices as well. This approach suggests that the inclusion of organizational forms to the prisoner's dilemma may very well extend the meaning of rational self-interested action to include the pursuit of such organizational arrangements or forms.

The social theories of James Coleman represent a shift in rational choice theory. Coleman moves away from Elster's methodological individualism when he recognizes the importance of collective organizations in the formation of social solidarity (Coleman 1986; Coleman 1990). Coleman's work focused on much more than just a critique of methodological individualism. He set his sights on the grand retooling of the sociological discipline. "Coleman's *Frontiers in Social Theory* represents his principal theoretical project which aspires toward a transdiciplinary theory of the functioning of social systems that allow social science to aid in the designing of improved social organizations" (Coleman 1990; Marsden 2005: 12). Coleman, like his theoretical predecessors, Durkheim and Parson, was trying to bridge the gap between theory and method in order to provide a unified theory for the discipline of sociology. "Freeman's history of network analysis points to Coleman as an influential bridge between a cluster of sociologists and an 'eclectic hodgepodge' of scholars in other disciplines as well" (Freeman and Breiger 2004; Marsden 2005). Coleman's impacts on public policy were just as significant as well. Coleman's theoretical project was directed at bringing organizational theory to bear on public policy problems. He felt that a new sociology, and the sociologists that practice it, could become social architects helping to create purposive social organizations with informal rules by tapping into the existing social capital to empower people to act. The Coleman Report published in 1966 was one of the first scientific studies commissioned by the U.S. Congress in order to inform the public of policy initiatives.

According to Jonathan Turner, Coleman's key theoretical questions, which served as the foundation for his understanding of social solidarity, were focused on two questions:

1. What conditions within larger collectives of individuals create the climate for rational actors to give up a portion of their rights over resources, or rights to act, in order to pursue normative rules and sanctions;

2. What conditions allow for the realization of effective control by these norms and sanctions (Coleman 1990; Turner 1997)?

Coleman believed that individuals shared a common need to limit negative externalities, and it was negative externalities that were the driving force for individually rational actors to subject themselves to social norms and sanctions. "Ultimately, negative externalities give actors an interest in elaborating social structure and cultural systems. They begin to see that by giving up some of their rights of control over their resources, they can reduce negative externalities and, thereby, increase their (individual) utility" (Turner 1997: 313). Therefore, the creation of proscriptive norms prohibiting certain behavior and negative sanctions enforcing those proscriptive norms represent the solution to the first order free-riding problem; to limit those who do not contribute to sustaining the resource from gaining access to that resource and its benefits.

> "Coleman's theory of effective norms stresses three conditions: that beneficiary actors demand control over the target action owing to its external effects on them; that they cannot attain such control via exchanges; and that social organization can supply a sanctioning system sufficient to enforce conformity" (Marsden 2005: 14).

Coleman's solution of proscriptive norms to monitor and sanction individual behavior creates a second order free-riding problem related to the cost associated with monitoring and sanctioning. Monitoring and sanctioning can be expensive and time consuming, creating a whole new set of negative externalities (Turner 1997).

Social Capital and Collective Rationality

Social capital first arrived in the literature in the early the 1900s when Lyda Judson Hanifan made reference to it in regards to rural community centers (Hanifan 1916; Hanifan 1920). But it really took off as an important sociological concept with the publication of Robert Putnam's "Bowling Alone: America's Declining Social Capital," and has since become a central concept in the social science literature (Bourdieu 1983; Coleman 1988; Putnam 1995). According to Putnam:

> "Physical capital refers to physical objects and human capital refers to the properties of individuals, whereas social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them. In that sense social capital is closely related to what some have called 'civic virtue.' The difference is that 'social capital' calls attention to the fact that civic virtue is most powerful when embedded in a network of reciprocal social relations. A society of many virtuous but isolated individuals is not necessarily rich in social capital" (Putnam 2000: 19).

Cohen and Prusack define social capital by stating, "Social capital consists of the stock of active connections among people: the trust, mutual understanding, and shared values and behaviors that bind the members of human networks and communities and make cooperative action possible" (Cohen and Prusak 2001: 4). According to the World Bank, "Social capital refers to the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions... Social capital is not just the sum of the institutions which underpin a society – it is the glue that holds them together" (Bank 1999).

In common property resource organizations, the free-rider problem is always at play; therefore, the presence of social capital is necessary to suppress an individual's inclination to gain access to the organizational benefits without participating in the organization maintenance.

> "For Coleman, social capital refers to features of social structure that facilitate action. Among these are systems of trust and obligations, networks disseminating information, norms accompanied by sanctioning systems, centralized authority structures arising through transfers of control and appropriable social organization that may be used for purposes distinct from those that led to establishing it" (Coleman 1988; Marsden 2005: 14).

Marsden goes on to say that Coleman's use of social capital was more of an umbrella concept for describing "useful social organization," and he did not intend to use social capital as an independent variable used to predict whether "useful social organizations" would form (Marsden 2005).

In this section of the literature review, we are taking a subset of the literature on social capital in an effort examine how social capital as a form of organization can be utilized as a common property resource management strategy as well as controlling the threat of the free-rider. We review this literature to discover what forms of social capital are utilized in common property and collective goods organizations.

Bounded Rationality and the Organizational Provision of Common Property Resource and Collective Goods

Complete rationality is just one among many theories of rational action (Ostrom 1998). The classical economic argument that individuals are self-maximizing, norm free, rational actors pursuing their own benefit and gains is not supported in empirical studies

(Macy and Flache 1995; Ostrom 1999; Ostrom, Burger et al. 1999; Ostrom 2003). In order to theoretically explain these empirical findings Ostrom and many other social theorists sought to place boundaries on rational action, which in turn allowed them to understand why individuals would give up short-term gains for long-term sustainability.

> "Consistent with all rational choice models is a general theory of human behavior that views all humans as complex, fallible learners who seek to do the best they can given the constraints they face, and who are able to learn rules, norms and heuristics and how to craft rules to improve achieved outcomes" (Ostrom 1998: 9).

The origin and effectiveness of rules and norms aside, bounded rational resource users are perhaps not able to construct a rationally complete set of strategies for every situation they face. They can only hope to do the best they can with the constraints that bind them.

Ostrom defines trust as the expectations individuals have about other peoples' behavior, whereas reciprocity is equivalent to the norms of cooperation individuals learn from socialization and life experience (Ostrom 1998). When engaged in a Prisoners' Dilemma game each player finds it irrational to trust the other and to cooperate; therefore, both individuals defect producing the worst outcome for each party.

A Brief Look at Social Ecological Systems and Sustainable Resource Use

Before examining the intricacies of common property resource theory, it is important to give recognition to the concepts of sustainability and social ecological systems and their applicability to natural resource use. This section of the literature is represented by a group of scholars who examine organizations that manage dynamic systems in sustainable ways. These scholars focus their research on the characteristics of organizations that can enable rapid adaptation in dynamic social ecological systems. According to Costanza and Patten, "A sustainable system is one which survives or persists" (Costanza 1995: 19). Biological sustainability refers to the ability of the environment to reproduce itself while avoiding extinction, whereas economic sustainability refers to the avoidance of major disruptions and collapse of the natural resource base due to human interaction and extraction of the natural resource in question (Costanza 1996).

How do human beings interact with the environment? According to Holling and Sanderson, "The eventual success of the management of the environment, and the degree to which it allows adaptive flexibility depend on the convergence of human and natural systems" (Hollings 1996; Folke, Hahn et al. 2005: 57). Another way of viewing this distinction is to study social-ecological systems (SES) in regards to robustness and resilience. An SES is an ecological system intricately linked with and affected by one or more social systems (Anderies, Janssen et al. 2004). Two concepts, robustness and resilience, are often used to measure the degree to which an SES adapts to change. Robust systems do not always produce the most efficient use of the resource, especially in comparison to non-robust systems because they are designed with built-in buffers to lessen the ecological destruction due to external disturbances in the environment (Anderies, Janssen et al. 2004). Resilience is used to measure the amount of change and disruption necessary in an SES to force an adaptive change in the way the SES is structured and managed (Hollings 1973; Anderies, Janssen et al. 2004). According to Anderies robustness is a better concept to use than is resilience because it emphasizes the costs and benefits associated with how well a particular design of an SES deals with uncertainty.

One of the first assumptions that must be made about ecological and economic systems is that they are not static, they are actually quite turbulent. In regards to ecological systems, we know that the environment is not constant and that change is episodic. We also know that the spatial organization in ecological systems is not uniform, and that there is no single state of equilibrium to be attained. Humans in the modern management paradigm tend to manage their social-economic systems with questionable assumptions about ecological systems. Many of these management schemes are based on relatively short time frames, ecologically speaking, and assume that changes in ecological systems are continuous and predictable (Hollings 1996).

Rational Choice Theory, Social Organization, and the Social Construction of Property: Open Access, Collective Goods, Private Goods, and Common Property Goods

In the common pool resource perspective, there are various forms of property, each of which represents different implications for human organization. As briefly discussed earlier, according to the individually reductionist rational choice theorists, in an open access system where no organizational regime is created, the researcher can expect to find the tragedy of the commons and the prevalence of the free-rider. However, Coleman, Putnam, Ostrom, Freeman and others show that people can seemingly move past the tragedy of the commons by organizing in certain ways.

We now turn to a theoretical perspective that views property as a social construction and its role in the choice of organizational forms. By viewing property through the lens of three different property types - collective goods, private goods and common property goods - we can tease out these organizational forms and their impacts on human interaction and the management of natural resources.

Social Construction of Property

Property is the claim to a benefit stream, and a property right is a claim that is protected by some institutional body, most characteristically the state (Coward 1980; Bromley 1992). Alfred Hallowell describes property as a triadic social relation defined by benefit streams, rights holders and duty bearers (Hallowell 1943; Bromley 1992). Therefore, we must understand property not as an object, but as a social relation governed by institutional rules backed by the state. If one person has a right, then another person must recognize the legitimacy of that right or suffer the ramifications of failing to do so. Most economic theories classify private property rights in relation to their rights of alienability, but this may not be a sufficient enough distinction when one is looking at problems associated with common pool resources. Edella Schlager and Ostrom expand on this narrow definition of private property rights by identifying five aspects of property rights that influence the management of common-pool resources: access, withdrawal, management, exclusion and alienation (Schlager 2001; Ostrom 2003: 249). In addition, property rights can change over time depending on the institutional rules governing the use of the resource. Even though these rules can change over time, Malinowski (1961) and Runge (1992) warn us about the tenacity of such rules. "While it may seem easy to replace a custom here and there or transform a technical device, such a change of detail very often upsets an institution without reforming it" (Malinowski 1961: 52).

Table 1 provides a useful analytical model for understanding the differences between collective, common property and private goods is to compare the property types in question on two dimensions—exclusiveness and subtractability (Samuelson 1954; Musgrave 1959; Ostrom 1999; Ostrom 2003).

Table 1: Properties of Collective, Common Property and Private Goods

		Properties			
		Exclusiveness	Non-Exclusive	Rivalness	Non-rivalness
Type of Property	Collective		X		X
	CPR	X	X	X	X
	Private	X		X	

These two concepts of excludability and subtractability and their relationship to providing for the management of collective goods were hotly debated by Paul Samuelson and Richard Musgrave back in the 1950s. Samuelson's primary research variable was that of jointness of consumption, which he separated into private and public consumption. Jointness is related to whether the consumption of a particular resource subtracts from the overall resource and prevents others from using the resource. Collective goods are seen as being characterized by their non-subtractive nature, or perhaps lack of jointness (Samuelson 1954). Musgrave on the other hand, believed that it was excludability that was the key variable in protecting collective goods. Musgrave believed that exclusion by itself was a sufficient strategy to divide the world into public and private goods (1959). Both of these theorists were focusing their efforts on the same problem, which was predicting when markets would succeed or fail at sustaining the natural resource, and both theorists' predictions failed because they refused to listen to the other (Ostrom 2003).

A collective good is one type of property where the investor can capture no more of a return on the investment than someone who is not investing, otherwise known as a free-rider (For more on this topic refer to the original discussion in Samuelson 1947).

> "Pure public goods are characterized by two attributes (1) nonrivalness of consumption, meaning that the quantity of a good available to others is not diminished by any one person's consumption of the good; and (2) nonexclusiveness of consumption, meaning that if a good can be consumed by one person it can be consumed by others in the community at no significant marginal cost" (Samuelson 1954; Olson 1965; Freeman 1992: 72).

Samuelson goes on to say that nonrivalness refers to the extent to which, "each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good" (1954: 387). And nonexcludability refers to the fact that if the resource is available to anyone, it must be available to everyone (Olson 1965: 14). An example of a collective good would be that for which the LAVWCD was created; an organization designed to keep acquired water in the valley for all water users. In this example, the excludability is zero because the water is being kept in the valley for all of the water users, and the rivalness of consumption is also zero because everyone in the valley benefits from having the acquired water available for continued use in the valley.

Turning to private goods, "a good is said to be private if its benefits can be captured by the investor-owner and denied to those members of the community who do not invest in it" (Freeman 1992; Hanna, Folke et al. 1996). C. Ford Runge defines private rights as "individual rights to exclude others where these rights are based on a clear definition and assignment in connection with the thing owned, together with a mechanism to adjudicate disputes when they arise" (Runge 1992: 18). "The 'exclusion principle,' also used by economists to differentiate private goods from public goods, (Musgrave 1959) ordinarily refers to the ability of sellers to exclude potential buyers from goods and services unless they pay a stipulated price" (Oakerson 1992: 45). With a private good, the excludability and the rivalness of consumption are high. An example of a private good is the computer used to type this dissertation, because the author is able to exclude others from the use of this computer and the returns gained from the use of this computer come solely to the author.

Finally, a common property good is one where the rivalness of consumption and excludability are moderate. To take the Arkansas Valley example again, the rivalness of consumption is moderate because part of the investment in the control and use of the water resource effectively returns to the river basin for use by other water users. The excludability is moderate because it is generally very costly for the investor to prevent other users from gaining some access to the resource. Return flows to the river, seepage from earthen canal flows and the overall management of water moderates excludability.

Hannah and Jentoft remind us that resources managed under common property regimes may not be available to everyone, but are nevertheless to be seen as "property in common," and the rights to this "property in common" are determined by the community of users,\ and not the state or individual property owners (Ciracry-Wantrup and Bishop 1975; McKay 1987; Berkes 1989; Hanna and Jentoft 1996).

According to Daniel Bromley,

> "Irrigation systems represent the essence of a common property regime. There is a well-defined group whose membership is restricted; an asset to be managed (the physical distribution system); an annual stream of benefits (the water that constitutes a valuable agricultural input) and a need for a group management of both the capital stock and the annual flow (necessary maintenance of the system and a process for allocating the water among members of the group of irrigators), to make sure that the system continues to yield benefits to the group" (Bromley 1992: 11-12).

We have now recognized three general categories of property rights regimes: collective goods, common property goods and private goods. Open access to a resource does not exemplify a property rights regime, but rather a resource base that has no well-defined property rights, and the resource itself is often free to anyone with limited restrictions on use and access. Collective goods are characterized by low levels of excludability as well as low levels of rivalness of consumption. In contrast to collective goods, common property resources are characterized by moderate levels of exclusion and rivalness of consumption. A private property right on the other hand is where the individual holds an exclusive property right to the resource. This gives them a high level of excludability, and they can sell or rent a portion or the entirety of their right to others giving them a high level of rivalness of consumption as well (Bromley 1989; Feeney 1990; Bromley 1991).

Organizational Forms for Overcoming the Tragedy of the Commons: Developing Conceptual Models

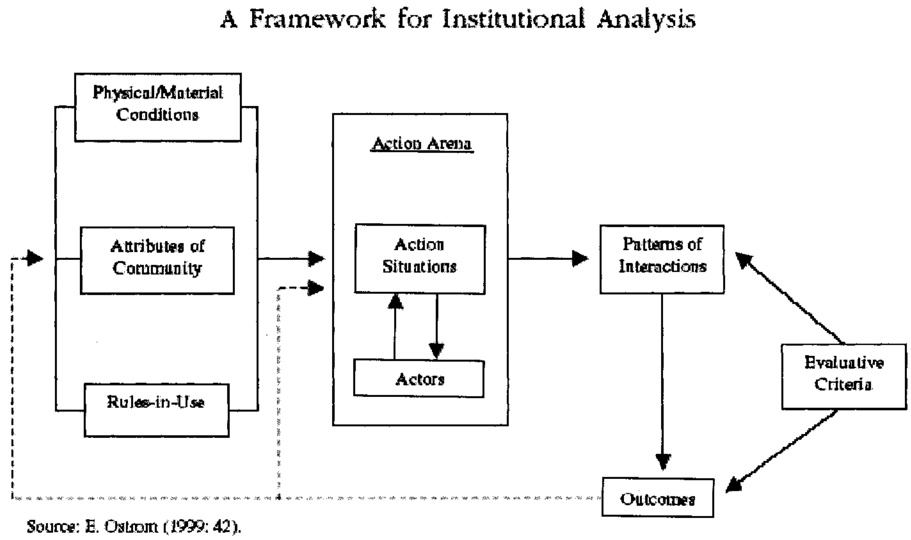
A group of theorists have built upon the traditions of rational choice, environmentalism, natural resource sociology, a new turn in rational choice theory, social ecological systems and social capital. These theorists have advanced particular conceptual models that inform the topic of this dissertation research.

Elinor Ostrom and other common pool resource theorists have advanced design principals to characterize the form of an organization that will empower individually rational actors to provide themselves with a common property or collective good. These researchers have organized principals into a conceptual framework that provides a larger context within which the design principals are seen to be operating. When developing a general framework for analysis the researcher is trying to identify all the important elements that must be consider if they are going to conduct a thorough analysis of the issues they are researching.

In the context of this research, frameworks provide the most general list of categories of phenomenon that are used to analyze types of organizational arrangements. These frameworks focus on mapping out the universal elements that any theory must deal with if they are going to adequately cover the phenomenon under study. Frameworks include a wide variety of differing theories of explanation, and they are used as the starting point for diagnostic and prescriptive inquiry. Frameworks provide the researcher with a tool to conduct a preliminary look at the problem, which is then narrowed down further in regards to theoretical preference and finally a choice of an analytical model to conduct the analysis.

This research will be using the Institutional Analysis and Development framework developed by Ostrom and other common pool resource theorists (Kiser and Ostrom 1982; Freeman 1989; Oakerson 1992; Ostrom, Gardner et al. 1994). Ostrom uses the term common pool resource to refer to both common property resources as well as collective goods (Ostrom, Gardner et al. 1994; Ostrom 2003). "Common-pool resources are characterized by difficulty of exclusion and subtractability of resource units and are threatened by overuse leading to congestion or even destruction of the resource" (Ostrom 2003: 239-270). Ostrom breaks down this framework into steps. The first step is focused on the action arena and is directed at analyzing the problem as a conceptual unit. "An action arena refers to the social space where individuals interact, exchange goods and services, solve problems, dominate one another, or fight" (Ostrom and Ostrom 2004: 116). As shown in Figure 1, the action arena is then broken down into two subunits: the action situation and the actor. The action situation is comprised of seven clusters of variables: participants, positions, outcomes, action-outcome linkages, the control that participants exercise, information and the costs and benefits related to the outcomes. An actor on the other hand is characterized by four different sets of variables: the resources an actor brings to the table, the values that the actor assigns different outcomes, how individual actors gain access to—and utilize—information and knowledge and strategies actors use to select a plan of attack (Ostrom and Ostrom 2004). Both the action situation and the actor are necessary in predicting and diagnosing the outcomes.

Figure 1: Institutional Analysis and Development Framework



There are three additional variables affecting the action arena: rules of the game, the physical environment and the structure of the community of resource users. When dealing with the rules of the game, the researcher must first define the rules of the game then focus on the origin of the rules. The next step is to determine how the rules impact the action situation. "Ostrom identifies seven types of rules that structure an action situation: entry and exit rules, position rules, scope rules, authority rules, aggregation rules, information rules, and payoff rules" (Ostrom and Ostrom 2004: 127) . "The IAD framework is thus a general language about how rules, physical and material conditions, and attributes of community affect the structure of action arenas, the incentives that individuals face, and the resulting outcomes" (Ostrom and Ostrom 2004: 133).

Common Pool Resource Models

Ostrom, in her seminal work, *Governing the Commons,* gives us a model for designing common pool resource organizations that is based on long-enduring common pool resource institutions. This model is based on eight nomothetic propositions: clearly defined boundaries, congruence, collective-choice arrangements, monitoring, graduated sanctions, conflict-resolution mechanisms, minimal recognition of rights to organize and nested enterprises. By analyzing the results of case studies done on a variety of common property resource management organizations (forest management in Switzerland (Netting 1981) and Japan (McKean 1992), and irrigation systems in Spain (Maass and Anderson 1986) and the Philippines (Siy 1982)), Ostrom builds her model on these eight nomothetic principles.

1. *Clearly Defined Boundaries*
The boundaries of the resource system (e.g., irrigation system or fishery) and the individuals or households with rights to harvest resource units are clearly defined.

2. *Proportional Equivalence between Benefits and Costs*
This principle refers to Ostrom's appropriation and provision rules. Rules specifying the amount of resource products that a user is allocated are related to local conditions and to rules requiring labor, materials, and/or money inputs.

3. *Collective-Choice Arrangements*
Most individuals affected by harvesting and protection rules are included in the group who can modify these rules.

4. *Monitoring*
Monitors, who actively audit biophysical conditions and user behavior, are at least partially accountable to the users or are the users themselves.

5. *Graduated Sanctions*
Users who violate rules-in-use are likely to receive graduated sanctions (depending on the seriousness and context of the offense) from other users, from officials accountable to these users, or from both.

6. *Conflict-Resolution Mechanisms*
Users and their officials have rapid access to low-cost, local arenas to resolve conflict among users or between users and officials.

7. *Minimal Recognition of Rights to Organize*
The rights of users to devise their own institutions are not challenged by external governmental authorities, and users have long-term tenure rights to the resource.

For resources that are parts of larger systems:

8. *Nested Enterprises*
Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises[1] (Ostrom 1992; Becker and Ostrom 1995; Anderies, Janssen et al. 2004).

> "Therefore, for any users to have a minimal interest in coordinating patterns of appropriation and provision, some set of users has to be able to exclude others from access and use rights. If there are substantial numbers of potential users and the demand for the resource units is high, the destructive potential of all users freely withdrawing from a CPR could lead to the destruction of a resource and of the organization that is trying to manage it" (Ostrom 1999: 493-535).

For Ostrom, "Appropriation rules are rules restricting the time, place, type of technology and/or quantity of the resource that can be appropriated. Provision rules determine whether labor, materials or money are required to receive part of the benefit stream" (Ostrom 1992: 92). Ostrom illustrates through empirical studies that most long-enduring common pool resource organizations survive because their organizational rules ensure congruence between the appropriation and provision of that resource. "In long-surviving irrigation systems, for example, subtly different rules are used in each system for assessing water fees used to pay for water guards and for maintenance activities, but in all

[1] Even though Ostrom listed eight variables in her model, it is only the first five that are used in the analysis of organizations. Ostrom lists variables six, seven and eight as important categories, but does not offer analytic variables to determine their impacts. This research follows Ostrom's lead by relying on the first five variables for the analysis while using the final three variables for discussion.

instances, those who receive the highest proportion of the water also pay approximately the highest proportion of the fees" (Ostrom 1999). According to Ostrom,

> "For these design principles to constitute a credible explanation for the persistence of these CPR's and their related institutions, she needs to show that they can affect incentives in such a way that appropriators will be willing to commit themselves to conform to operational rules devised in such systems, to monitor each other's conformance, and to replicate the CPR institutions across generational boundaries" (Ostrom 1992: 91).

In Ostrom's model, clearly defined boundaries determine who has the right to use the resource, and they also formally demarcate the boundaries of the common pool resource. Congruence refers to the distribution of benefits being roughly equal to the costs received from the use of the resource, and it also ensures that the rules and technology are grounded in the local conditions. Collective-choice arrangements refer to the ability of the resource users to participate in the formulation of the rules that govern the use of the common pool resource. Monitoring establishes a mechanism that allows the users themselves to ensure that everyone gets the resource for which they paid. Graduated sanctions represent the idea that the punishment must fit the crime. For example, if a person were to catch a child stealing a piece of candy, it would not be appropriate to chop the child's hand off. This would not represent a graduated sanction. Organizations that successfully control free-riders usually possess a variety of sanctions to address various gradations of problems.

Conflict-resolution mechanisms allow common pool resource organizations access to inexpensive arenas to deal with differences among appropriators or between appropriators and officials. The last two variables, minimal recognition of rights to organize and nested enterprises, are intimately tied together. Minimal recognition of rights to organize rests on the fact that external government authorities will allow individuals to organize themselves independently into common pool organizations, which illustrates that these organizations themselves are often nested in multiple layers of governance. In summary, each of these seven variables must be seen in light of the objective of the common pool resource organization, as well as the larger system in which it is imbedded (Ostrom 1992; Ostrom, Burger et al. 1999).

Ostrom's first three variables form a cluster that focuses on exclusion and subtractability. If these three rules are designed well, the organization can also limit free-riding. The next four variables form a cluster that focuses on monitoring and enforcement. Establishing rules and regulations are not enough to guarantee everyone will comply with the new arrangement. Therefore, monitoring coupled with effective enforcement of the rules when they are broken is essential to the success of any organization (Becker and Ostrom 1995).

Drawing from the insights of Max Weber (1947) and his methodological use of ideal types, David Freeman (1989) illustrates how a conceptual model can be used as a benchmark for comparing real world organizations to conceptual models formulated as ideal type conceptual models. Freeman focuses on how small farmers in south and southeast Asia organized, or failed to organize, local common property resource organizations to manage water flows (1989). Freeman takes this conceptual model of analysis to the State of Colorado to research how local communities throughout Colorado have organized local common property resource organizations, otherwise known as mutual ditch companies, to manage their water (2000). With the help of state and federal agencies, these mutual ditch companies develop and administer water in a manner that is both ecologically sustainable and economically productive.

Freeman argues, "Properties of local organizations, mediating between the agendas and resources of state bureaucracies and those of the local community, have everything to do with the ultimate productivity of the state supplied, and locally managed resources" (Freeman, 1989: 4). "Property rights defining who has access, how much can be harvested, who can mange, and how rights are transferred are a necessary but not sufficient condition for avoiding overexploitation of a resource" (Ostrom 1992; Schlager and Ostrom 1992; Ostrom 1999; Ostrom, Burger et al. 1999; Ostrom 2003: 293) This perspective reminds us that different organizational forms will produce different organizational outcomes. Freeman contributes to this theoretical debate with his own analytical model for explaining the development of collective goods organizations.

Figure 2 represents Freeman's ideal type conceptual model. In Freeman's ideal type conceptual model, there are a variety of intervening variables that ultimately condition the type of organizational rules a group of resource users would agree with to govern themselves. "Local irrigation organizations are assemblies of joint agreements between farmers and main system managers which make it possible to produce, through provision and use of physical structures, a collective good not available through individual effort" (Freeman 1989: 24). These joint agreements can be seen as intervening variables that lay the foundation for whether a group of farmers will support or fail to support a particular organization. These intervening variables include source of recruitment, staff responsibility, distributional share system, maintenance structures, and farmer water control. Freeman's thesis is "that many recurrent problems in large-scale gravity flow irrigation systems stem from the failure to couple social rules with physical tools in local farmer irrigation organizations…the design of a middle-level interface between farmers and the bureaucracy is a strategic determinant of farmers' water control and, therefore, of their productivity" (Freeman and Lowdermilk 1985: 113).

The first intervening variable, source of recruitment, refers to whether the staff hired is local or cosmopolitan. "Cosmopolitans are staff recruited from outside the local command area, and they are hired based on educational background and experience with nomothetic discipline specific knowledge, where locals are hired on the local labor market and are hired based on local experience and social connections" (Freeman 1989: 26).

The next set of joint agreements determines how the shares in the organization will be distributed to its members. The heart of Freeman's distributional share system is comprised of two components: resource allocation and resource acquisition. For Freeman, "a water share is a two-sided concept: 1. it confers legitimate access to the water resource within certain pre-arranged rules, and 2. it imposes on the user a specified obligation to share in paying the water management costs" (Freeman 1989: 27).

It is important to refer to the arguments made by Maas and Anderson (Maass and Anderson 1986) especially considering that Freeman draws heavily off of their insights when developing his distributional share system (Maass and Anderson 1986; Freeman 1989: 27). According to Maass, Anderson and Freeman, "Middle-level organizations can specify water shares according to some combination of the following principles:

1. "Distributional shares may be organized by fixed percentage allotments:
    a. by volume (e.g., a percentage of the total acre-feet or cubic meters estimated to be available).
    b. by time period rotation (e.g., a percentage of a day or week).
2. Distributional shares may be organized by a priority system:
    a. priority by location (e.g., head to tail of a channel).

    b. priority by farm characteristic (e.g., time of settlement).
    c. priority by crop (e.g., market or subsistence value).
3. Distributional shares may be organized by user demand:
    a. demand placed upon storage in a surface reservoir.
    b. demand placed upon storage of groundwater" (Freeman 1989, 27-28).

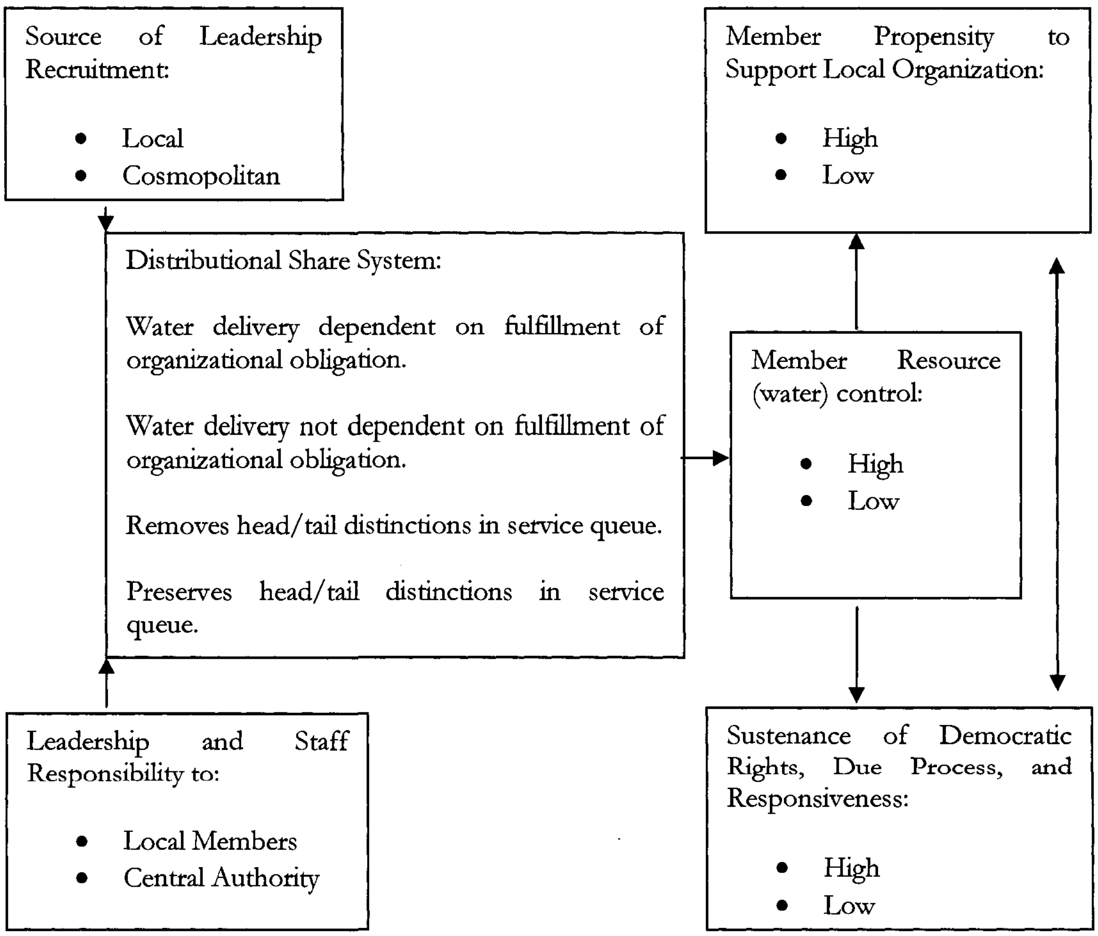
Freeman then argues that human beings have been clever in using these rules individually or in combination, and when they do so, they tend to create long-enduring organizations that govern the common property resource in a sustainable manner.

By tying water delivery to the fulfillment of an obligation to purchase shares in the organization, the organization forces the water users to pay into the organization in order to gain access to the benefit stream, thereby limiting the possibility of free-riding. In order for the organization to equitably provide a natural resource to its members, it must also deal with head/tail distinctions where users at the beginning of the ditch do not receive better service than users at the end of a ditch. If an organization is able to address these two components of the distributional share system, they are more likely to gain the support of its members.

Another variable is the type of maintenance agreements that a particular organization employs in the rules of operation. "The first option is to perform routine maintenance by a hired staff paid for by resources mobilized by member water share obligations. The other option is for the tasks to be performed periodically by mobilizing farmers to do it themselves" (Freeman 1989: 33).

"The essential purpose of construction or rehabilitation, allocation, maintenance, and conflict management at all levels of any irrigation system is to provide ultimate control over the water to its users" (Freeman and Lowdermilk, 1985: 115). Therefore, the measure of any irrigation organization's effectiveness is directly tied to the degree of water control that they provide to their users. With that said, water control must be understood from three perspectives: the main system management, the middle-level organization management and the level of the individual farm unit. "Main system water supply managers approach water control with a fundamentally different set of interests than do farmers. The difference in interest, knowledge and perspective necessitates an intermediate organizational level which can reconcile the farmer's water demand with central management's supply" (Freeman and Lowdermilk, 1985: 115).

Figure 2: Freeman's Local Organization Model



Source: (Freeman 1989: 25)

> "In summary, the more the middle-level organization is staffed by locals who look to the authority of farmers, the more the organization provides continuous maintenance performed by employees, and the more the system of water shares denies water to free-riders and distributes the water loss to all members without regard to location, the greater will be the water supply and control afforded across the system, and the better will be the opportunity for farmer involvement and investment. Farmers will display a higher propensity to support such an organization" (Freeman 1989: 35).

Freeman and Ostrom are independently grappling with the issues integral to the development of common pool organizations. Although, originally, they did not enjoy the benefit of each others' work, they arrived at much of the same perspective on the requirements of long-enduring common pool resource organizations. Ostrom's focus has been on the management of timber and grazing lands, fisheries and a variety of groundwater issues both in the continental United States and abroad. Freeman, on the other hand, focused his research primarily on irrigation systems in the State of Colorado, even though much of his earlier research was done on irrigated systems in India, Pakistan and Sri Lanka. Both of these theorists created analytical models to deal with the development of long enduring common property resource organizations, and for the most part, they agree on the uses and limits of the models but do not always agree on the variables that belong in these models. Both Ostrom and Freeman lay the foundations of their models on the congruence between provision and allocation rules governing the resource, where those receiving the majority of the benefit also must pay the majority of the costs.

Freeman and Ostrom part ways in other aspects of their models. Freeman emphasizes the nested nature of middle-level organizations in larger state and federal nexuses. Ostrom gives recognition to nested systems in her model, but does not routinely utilize it as a variable in her empirical work. Ostrom, on the other hand uses clearly defined boundaries as a way of limiting the existence of free-riders, where Freeman uses the distributional share system variable to limit free-riding by creating organizational rules that determine insiders and outsiders. Ostrom's proportional equivalence between benefits and costs and collective choice agreements are the equivalent of Freemans's distributional share system. Freeman compresses many of Ostrom's variables into his distributional share system, whereas Ostrom leaves them as independent variables in their own right. Finally, Freeman deals with conflict resolution through enforcement of the rules that govern the organization, whereas Ostrom tends to emphasize the need for rapid access to inexpensive local arenas to resolve conflicts among and between appropriators (Ostrom 1992: 90).

History of Water Banks in the West

Any conceptual model must be applied to empirical referents. In the case of the Arkansas River basin, the organizations to which the models will be applied are in one form or another water banks. According to Larry MacDonnell, "A water bank is an institutionalized process specifically designed to facilitate the transfer of developed water to new uses." Water banks are a popular solution to the changing water use patterns in the West. The states of Idaho and California have led the way in the use of water banks, and now it seems that the State of Colorado is following suit.

Water banking was largely instituted throughout the West as a new water management strategy to deal with the changing demographics due to urban growth, drought protection, habitat protection and agricultural retraction. A water bank facilitates the transfer of water from economically low-valued use to economically higher-valued uses by bringing buyers and sellers together. As advanced by Clifford and Landry, the transfer of banked water performs a multitude of objectives:

- "Creating reliability in water supply during dry years.
- Creating seasonal water reliability
- Ensuring a future water supply for people, farms, and fish.
- Promoting water conservation by encouraging water-rights holders to conserve and deposit water rights into the bank.
- Acting as market mechanism.
- Resolving issues of inequity between groundwater and surface-water users.
- Ensuring compliance with intrastate agreements of instream flow"

(Clifford, Landry et al. 2004; MacDonnell and Howe 1994: 3).

Water banks usually fall into one of three categories: institutional banks, surface storage banks and groundwater banks. Institutional banks, also referred to as paper exchanges, established a legal institutional framework that permits the exchange of water entitlement rights. "Institutional banks were developed for areas where physical water storage was limited or for large geographic areas. In addition, these banks were commonly used for natural flow water rights (or a combination of storage and flow rights) where the supply and delivery of water was subject to hydrologic and regulatory variations" (Clifford, Landry et al. 2004: 4). The Idaho State Water Supply Bank is an example of an institutional bank.

Surface storage banks are generally found in geographic areas with a reservoir or a system of reservoirs that provide an opportunity to bank and exchange excess water. "Generally surface storage banks operate on an annualized basis where deposits and exchanges were limited to a single year. Some surface storage banks allowed limited carry-over of deposits to subsequent years" (Clifford, Landry et al. 2004: 5). The California Drought Water Bank was an example of a surface storage bank, and there are many other examples throughout the west, including the Arkansas River Water Bank Pilot Program that will be discussed in more detail later in this dissertation.

Groundwater banking may be the newest form of water banking in the west, and it also may be the format that offers the most potential for addressing water management problems in the 21st century. "Groundwater banking programs provided a mechanism for exchanging credits or entitlements for water withdrawals within an underlying aquifer" (Clifford, Landry et al. 2004: 5). Conjunctive use groundwater banks are designed to take surface water and inject it into the aquifer to recharge it when irrigation or other types of wells deplete the aquifer. Groundwater banks can also be used as a mitigation strategy to replace stream or river depletions due to nearby well pumping. "An effective groundwater banking program requires a defined allocation system to specify the quantity available for transfer to buyers" (Clifford, Landry et al. 2004: 5).

Groundwater banking was also referred to as groundwater recharge/augmentation in the State of Colorado. In 1969, Colorado passed the Water Right Determination and Administration Act where groundwater pumping, which up to this time was not recognized under the Doctrine of Prior Appropriations, was now made subject to this doctrine. Well users would slowly be required to pump surface water into sandy recharge pits during the winter months to replenish extractions from the groundwater basin during the irrigation season. This was needed because the depletion of groundwater was now recognized as potentially negatively affecting surface water flows in the river or its tributaries. These groundwater augmentation plans allow water users relying on wells to continue to operate their wells out of priority. They are in effect protecting more senior surface water users by paying back the river through their water bank and recharge program. Groundwater recharge can be used to address a wide variety of problems in a river basin.

> "In addition to storing water for future use, artificial groundwater recharge is used to: counteract saltwater intrusion in coastal areas, and for salinity control in areas with naturally occurring poor quality water; maintain or restore declining groundwater tables, thus preventing land subsistence or the necessity of drilling deeper wells; and improve water quality through the natural filtration that occurs as water percolates from the surface downward" (MacDonnell and Howe 1994: 3-2).

Each bank must have an administrative agent that is given the responsibility of governing over the transactions processed through the bank establishing the rules and regulations for operating the bank and monitoring the amount of water extracted and returned to the basin. Water banking organizations must decide what their role will be in the market. Will their role be one of a broker, a clearinghouse, or a market-maker? "As a broker the bank connects or solicits buyers and sellers to create sales. In a clearinghouse, the bank serves mainly as a repository for bid and information and facilitates the regulatory requirements for trades. And as a market-maker, the bank creates liquidity in the market by standing ready to purchase surplus water or sell reserve water within predetermined price ranges" (Clifford, Landry et al. 2004: 6). Landry (2004) provides a list of water banking projects in the western United States shown in Table 2.

Table 2: Water Banking Projects in the Western United States

State	Primary Banks	Initial Bank Activity
Arizona	Central Arizona Project Water Banking Program	1996
California	Drought Water Bank	1991
	Dry-Year Purchasing Program	2001
	Multiple Groundwater Banks	
Colorado	Arkansas River Basin Bank	2002
Idaho	State Water Supply Bank	1979
	6 Rental Pools	1932
Montana	No Banks	-
Nevada	Interstate Water Bank with Arizona	2002
	Truckee Meadows Groundwater Bank	2000
New Mexico	Pecos River Basin Water Bank	2002
	Pecos River Acquisition Program	1991
	ESA Mitigation on Pecos river	Proposed
Oregon	Deschutes Water Exchange – Groundwater Mitigation Bank	2003
Texas	Texas Water Bank	1993
	Edwards Aquifer Authority Groundwater Trust	2001
Utah	No Banks	-
Washington	Yakima Basin Emergency Water Bank	2001
Wyoming	No Banks	-

Source: (Clifford, Landry et al. 2004: 2)

There is a diverse history of water banks in the west dating back to the creation of the first water bank in the Idaho during the drought of the early 1930s. This water bank was finally put into law when the Idaho State Legislature formalized annual leases of storage water in 1979. The purpose of the Idaho water bank is to encourage the highest beneficial use of water, provide an adequate water supply to benefit new and supplemental water uses, and to provide a source of funding for improving water user facilities and their efficiencies. The Idaho Water Supply Bank is a water exchange market operated by the board to assist marketing water rights to natural flow or stored water in Idaho reservoirs. Like many water banks, the Idaho Water Supply Bank was created for "the purpose of acquiring water rights or water entitlements from willing sellers for reallocation by sale or lease to other new or existing uses."[2]

California is another state that has experimented with water banks. In 1991, California was entering its fifth year of a drought cycle, the winter precipitation totals were down, and the reservoir levels were at historic lows. In 1991, 1992 and 1994, the California State Legislature passed legislation to create emergency drought water banks in an effort to stimulate the development of a water rental market in order to allow for the transfer of water rights during the drought to other beneficial uses with junior priority rights in the California system.

> "The expected impacts of the low-water conditions were very unevenly distributed. Rapidly growing urban centers, particularly in the southern portion of the state, as well as agricultural users served by the federal Central Valley Project and the State Water Project were anticipating severe cutbacks in supplies.[3] At the same time, other agricultural water users with riparian rights, senior appropriative rights or access to storage outside of the SWP or CVP had full or nearly full supplies at their disposal" (MacDonnell and Howe 1994: 2-23).

The purpose of a water bank is to shift water rights from those in excess to those in need. California needed a water banking mechanism that would allow the transfer of water between users, without having to enter into the adjudication process, which was costly and

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[2] This quote was taken from the Idaho Water Resource Board Website: www.idwr.state.id.us/planpol/watplan/planning/history.htm.

[3] The SWP had announced complete suspension of deliveries to agricultural users and deliveries of only 10 percent of contractual entitlements to municipalities. The CVP had declared that supplies would be 50 percent of entitlements for urban users and 25 percent for agricultural customers, except for holders of Sacramento River water rights and San Joaquin exchange contractors, who would receive 75 percent. Howitt, R., Moore, N., and Smith, R.T., 1992. *A Retrospective on California's 1991 Emergency Drought Water Bank*, Report prepared for the California Department of Water Resources.

complicated. "California continued to have a reputation as a state in which the administrative requirements of the water transfer were cumbersome and fraught with uncertainties" (MacDonnell and Howe 1994: 2-23). Therefore, during the drought years, they used the California Drought Water Bank to reduce the transaction costs of transferring a water right to other beneficial uses, but only on a year-to-year basis.

Finally, the State of Colorado entertained the idea of creating a water bank in the lower Arkansas River basin as an alternative to water transfers that have been wrecking havoc on the water system in the valley. "A 1991 proposal to purchase a majority of shares in the Fort Lyon Canal Company for permanent transfer of the associated water to urban users in the Front Range of Colorado prompted the State of Colorado to sponsor a study of 'alternatives'" (MacDonnell and Howe 1994: 2-23). The Fort Lyon Plan, which was a result of this study, recommended the creation of a water bank by emulating the organizational structure of the mutual ditch company. The 1991 proposed water bank in the Arkansas Valley would be operated by a not-for-profit organization with a full-time manager and a board of directors. However, this recommendation was ultimately not followed by the State of Colorado when it formed the Arkansas River Water Bank Pilot Program; one of the three organizations being analyzed in this dissertation.

Unlike the Idaho Water Supply Bank, the Arkansas River Water Bank Pilot Program would only allow winter water to be traded in the market. According to Hal Simpson, the Colorado State Engineer, "We're trying to create a mechanism for farmers to lease stored water through a water bank, rather than have to sell it off the land permanently" (Flannagan 2002). It was anticipated that these leases would be agreed to for a specific amount of time. However, during the pilot years of the program, water leases would only be authorized for one year. The Colorado State Engineer goes on to clarify that the Arkansas River Water Bank Pilot Program was intended to establish an exchange market where farmers can engage in water exchanges with others in the lower Arkansas River basin while still holding on to their water right.

In 2001, the State of Colorado passed HB 1354 authorizing the development of a pilot water bank for the Arkansas River basin. It would be designed with a well developed set of administrative rules and procedures that were in compliance with existing state and federal water laws designed to protect senior water rights from third party injury, as well as developing a state-of-the-art computer website to operate the bank. Coinciding with this state initiative was the passage of a local valley public referendum to create another entity. This new entity would be called the Lower Arkansas Valley Water Conservancy District. This new conservancy district was developed with a similar goal of preserving the valley's water supplies by keeping water rights in the hands of the farmers in the valley. Since its formation in 2002, it has been working on creative alternatives for in-basin water marketing in the lower Arkansas River basin.

In addition to these two water marketing programs, there was another long-enduring water marketing program developed through local initiative. This is the Lower Arkansas Water Management Association (LAWMA). Unlike the previous two organizations, the Lower Arkansas Water Management Association had been in existence since the early 1970s and had been operating an adaptive groundwater management association since 1985.

Each of these three organizations was designed around different attributes and characteristics. This dissertation is focused on understanding which arrangement of these attributes and characteristics were more likely to lead to long-enduring water user organizations, and one that effectively and efficiently addressed the needs of the valley water users. Unlike a water market where the buyer and the seller, or those interested in a water exchange, find each other and deal directly with each other, a water banking system might be considered as a system that utilizes a middle level organization acting as a third party. This middle level organization is designed to act as a third party by getting those who have excess water to deposit it in the water bank for leasing, exchanging or transferring that excess water to other uses. This is very similar to Ostrom's and Freeman's common pool resource model, particularly Freeman's concept of the role of middle level organization between the state and the direct resource beneficiary. The middle level organizational task is to provide a temporary or permanent change in the use of a water right, but in a way that protects the common property resource for the community of local water users; in this case, the lower Arkansas River basin.

The Doctrine of Prior Appropriation and Its Role in the Development of Water Banks and Water Markets

The Doctrine of Prior Appropriation was founded on the idea that water in the State of Colorado (and elsewhere in the west for that matter) is not specifically tied to the land. Water can be moved around the landscape in accordance with the rule of "first in time, first in right" and the water user putting that right to an appropriate beneficial use. This established the foundation for a water market to form in the State of Colorado. Consequently, "Colorado has one of the most active water markets in the world, with tens of thousands of acre-feet of water traded each year through private, voluntary transactions...During the last few years, the market has grown considerably, providing a reliable source of water for farmers as well as thirsty residents of Denver, Fort Collins, and Colorado Springs" (Landry 2002: 1).

> "In a water market, irrigators with surplus water make their water available for sale to water users who are water-short." This market then allows for the connection between willing buyers and sellers who negotiate to an acceptable price. By allowing water to move from people who have water to people who need water, a water market can promote water use efficiency" (Schuck, E. 2002, 7).

As they developed, water markets in Colorado drew heavily on three different types of water transactions: water exchanges, water transfers, and groundwater augmentation plans.

> "A water exchange may be defined as voluntary, temporary and generally localized (intra-basin) transfers of water between closely neighboring water supply entities. Generally, a change of ownership in water does not occur as a result of a water exchange. A water exchange can occur simultaneously between two or more entities, but more often than not occurs over a short time delay. Exchanging entities may include canal companies, reservoir companies, irrigation districts, other special water districts and even municipalities" (Wilkins-Wells, et. Al. 2003: 2).

Traditionally water exchanges have been carried out for irrigation purposes. Water exchanges have relatively low transaction costs, because the parties involved in the exchange are not infringing on the original integrity of the beneficial use assigned to that particular water right from the state water court, and they are tapping into social capital that is founded on longstanding market relationships built on trust and reciprocity. Water transfers, on the other hand, have high transaction costs, due to legal and engineering restrictions that require the parties involved in the transaction to submit their request for transfers to the state water court. This can be a costly process, requiring engineering costs for reconfiguring the physical water control structures involved in such a transfer. Water transfers appear to be the main reason for the development of water banks in the West. "Water districts and ditch companies long have facilitated 'rotation' of water among users within their system. The important difference of modern water banks is that they act to facilitate transfers to uses outside of their original delivery system and for uses other than irrigation" (MacDonnell and Howe 1994: 1-4).

Historically, the main beneficial uses for Colorado water were irrigation, municipal and commercial uses. Recently hydropower, flood control, fish and wildlife preservation, and recreation have been added to the list. One of the Colorado's Supreme Court Justices reminds us that it is citizen demand that drives water law and policy.

> "The list of recognized beneficial uses now includes irrigation, stock watering, domestic, municipal, commercial, industrial, power generation, fire protection, flood control, residential environment, recreation, fish and wildlife culture, release from storage for boating and fishing flows, snowmaking, dust suppression, mined land reclamation, boat chutes, fish ladders, nature centers, augmentation of depletions for out-of priority diversions, and minimum stream flows for preservation of the environment to a reasonable degree" (Hobbs 2002: 37).

Water banks are being proposed as a solution to the high costs of transferring water rights from one beneficial use to another. This was certainly the case for the proposed water bank in the Arkansas Valley. HOUSE BILL 01-1354 stated:

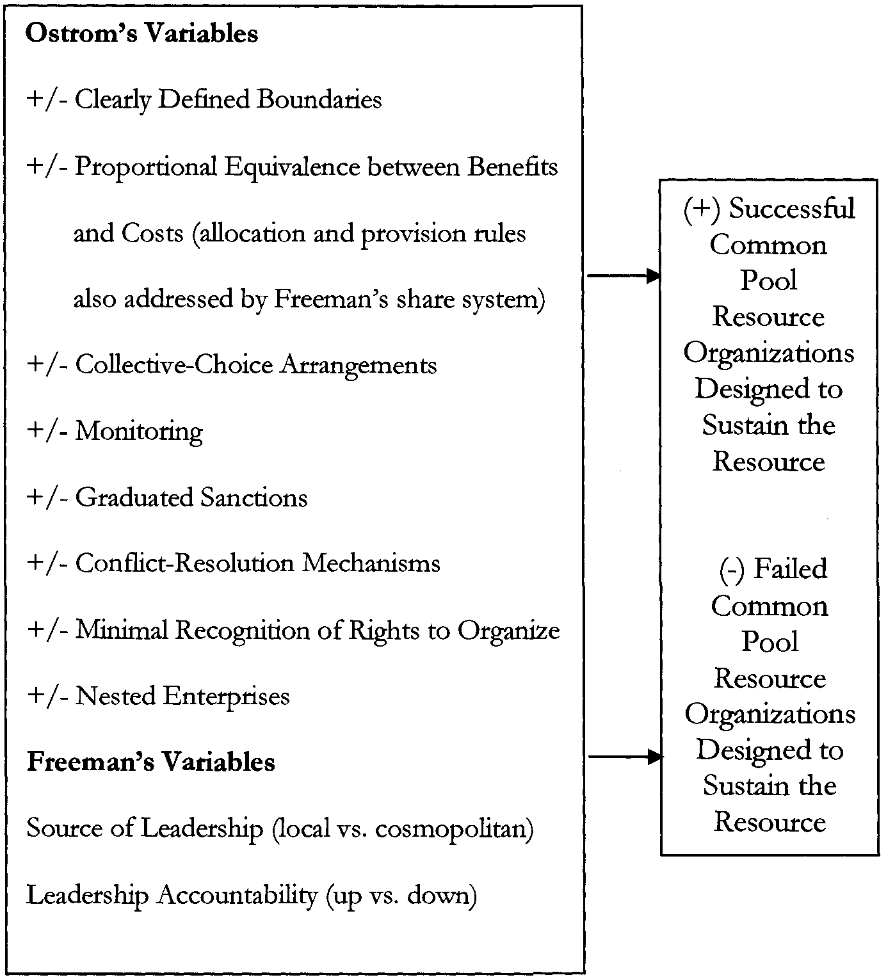
> "The pilot water bank program created by this article is intended to simplify and improve the approval of water leases, loans, and exchanges, including interruptible supply agreements, of stored water within the Arkansas River basin, reduce the costs associated with such transactions...It is also the purpose of this pilot water bank to assist farmers and ranchers by developing a mechanism to realize the value of their water rights asset

without forcing the permanent severance of those water rights from the land" (HB 01-1354).

Integrating a Model

So, what do these models have to offer in an analysis of the three organizations chosen from the Arkansas Valley? Before bringing these models to bear on this particular case study, some common elements from all of the models should be found in order to focus on certain overarching themes. What kind of synthesis of the literature can guide this research project? After examining the theories of Ostrom and Freeman, propositions to guide the direction of this dissertation can be determined.

Figure 3: Integrating Ostrom and Freeman's Models



These conceptual models are not to be seen as deterministic in the same sense of some formal mathematical and economic models. Ostrom, Freeman and Oakerson agree that these models are conceptual guides. They are used to predict whether a particular organizational strategy is going to: (1) produce a common pool resource organization that distributes the benefits of the common pool resource, while (2) equitably distributing the costs of appropriating and delivering the resource in the most efficient manner, and (3) in distributing these costs in accordance with the organizational rules drafted and ratified by all the users in the organization.

> "It will not be possible to relate all structural variables in one large causal theory, given that they are so numerous and that many depend for their effect on the values of other variables. What is possible is the development of coherent, cumulative, theoretical scenarios that start with relatively simple baseline models and then proceed to change one variable at a time" (Ostrom 1998: 1-22).

With the review of literature on common pool resource organizations and the initial the attempt to relate this literature to a specific natural resource problem in the State of Colorado, attention can be paid to the methods that will be used in this research project. As alluded to in this chapter, the research used an integrated ideal type conceptual model drawing off the insights of Ostrom and Freeman. The purpose was to examine site specific phenomenon and common property resource needs surrounding a particular case study. The goal was to make theoretical contributions to the general scientific community.

Chapter 3

METHODS

Introduction

What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good?

This discussion now turns to the methodological choices made while conducting this research. The general methodology for this research can be summed up with three steps:

1. The first step is to specify the ideal types/conceptual model which will be used in the analysis.
2. The second step is to construct carefully observed studies of three organizational cases (each of which has engaged in producing a common property resource or collective good or a combination of both) located in the Arkansas River basin:
    a. The Arkansas River Bank Pilot Program,
    b. The Lower Arkansas Valley Water Conservancy District, and
    c. The Lower Arkansas Valley Water Management Association.
3. The final step consists of comparing the site specific case to the ideal type model for the purpose of analyzing the uses and limits of the models used in the research by:

a. Evaluating the success of common property resource and collective goods produced by these three organizations.

b. Comparing the attributes of each organization to those specified in the conceptual models.

c. Employing insights to consider improvements to the conceptual models. This project, at its core, is a theory building exercise.

Ideal Types

One of Max Weber's most significant contributions to social science methodology was the ideal type as a tool for inquiry (Weber 1947). For Weber, "The concept of the ideal type can direct judgment in matters of imputation, it is not a 'hypothesis', but seeks to guide the formation of hypotheses. It is not a representation of the real, but seeks to provide representation with unambiguous means of expression" (Whimster 2004: 387). Weber was intent on sociology, as well as the rest of the social sciences following in the empirical footsteps of the natural sciences. However, Weber realized that the social world was characterized by infinite complexity that presented real problems for using the scientific method as a general method of inquiry.

Weber used the ideal type to construct a theoretically rational ideal to compare to the real world. This allows the researcher to learn about how that world ultimately works. Weber used ideal types to prepare the descriptive materials of the real world for comparative analysis to the ideal type (Gerth and Mills 1946). Gould and Kolb remind us that an ideal type is ideal in the logical sense, not the ethical sense. Nor is an ideal type to be confused with a statistical average (Gould and Kolb 1964). For Gould and Kolb, ideal type constructs perform two basic functions: (1) they provide a limiting case to compare a real world structures or actions, and (2) they constitute a framework for generalizations that ultimately are used as causal explanations of historical events. Weber believed that ideal types were created by determining the aspects of social organizations that would be logically necessary for the organization to function if there were no outside interferences from other organizations. An ideal type, therefore, is somewhat bounded. "The ideal type in its conceptual purity can never be found in reality... Historical research has the task of determining in each case how close to, or far from, reality such an ideal type is" (Whimster 2004: 388). Therefore, the use of ideal type constructs can shed light on how organizations operating in the real world are doing in comparison to one another. Weber used ideal types as heuristic devices for learning about the real world. According to Whimster:

> "Weber explicitly says they have nothing to do with empirical reality, they are not created through a process of induction from experience. Instead they are purely mental constructs...Ideal types are necessarily relatively empty of contents as compared with the concrete reality of the historical. We need them, Weber argues, to enhance our conceptual precision about meaningful action" (Whimster 2004: 305).

"Methodologically, one very often has only a choice between imprecise terminology, on the one hand, and on the other terminology which though precise, is unreal and 'ideal typical'. In such a case the latter are scientifically preferable" (Whimster 2004: 327).

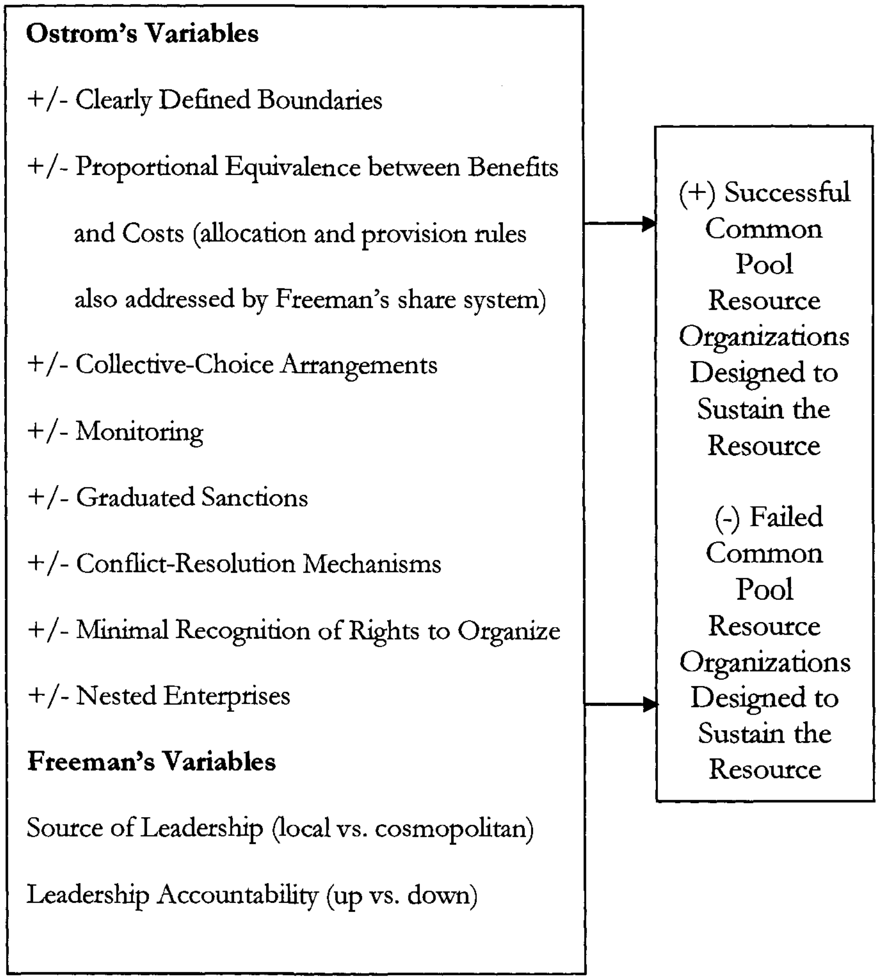
One of the most influential ideal type/models used in governing the commons is the one based on Ostrom's design principles. Ostrom's model parts ways with the traditional economic models in favor of a model that places boundaries on rational behavior. In the model of complete rationality, resource users are viewed as "norm-free maximizers of immediate gains, who will not cooperate to overcome the perverse incentives of dilemma situations in order to increase their own and others' long-term benefits unless coerced by external authorities" (Ostrom 1999: 496). Ostrom, Simon and others have put forth an alternative organizational model about individual behavior based on a theory of bounded rationality. In this model, individuals are self-interested maximizers, but they are bound by the social networks in which they are imbedded. These individuals are willing to give up some of their short-term gain for long-term yields in order to protect the sustainability of the resource.

> "The assumption that individuals are able to engage in problem solving to increase long-term payoffs, to make promises, to build reputations for trustworthiness, to reciprocate trustworthiness with trust, and to punish those who are not trustworthy, leads to a different type of policy analysis than the assumption that individuals seek their own short-term, narrow interests even when presented with situations where everyone's joint returns could be substantially increase" (Ostrom 1999: 507).

This research is using an integrated conceptual model to compare three different organizational approaches used to facilitate the development of water banks in the lower Arkansas River basin:

1. The Arkansas River Water Bank Pilot Program;
2. The Lower Arkansas Valley Water Conservancy District; and
3. The Lower Arkansas Water Management Association.

Figure 4: Integrating a Model Drawing from Ostrom and Freeman's Models



Nomothetic and Idiographic Knowledge

Social scientists have distinguished nomothetic from idiographic knowledge (Freeman 1992).

> "Knowledge of the local and specific must inform applications of the universal, general, and nomothetic. Policy assessment for social development must combine the positivist emphasis upon knowing about nomothetic relationships 'out there' with the postpositivist emphasis of knowing 'with the other.' People possessing idiographic knowledge must,

> in turn, effectively participate in the application and interpretation of nomothetic policy assessment processes" (Freeman 1992: 23).

According to Max Weber, "Sociology constructs concepts of types and seeks general rules in events" (Whimster 2004, 325: 325). Nomothetic knowledge focuses on the generalized principles. The institution of science is in pursuit of general nomothetic principles that can be utilized in a variety of natural and social situations, and this dissertation is following in that tradition. For Freeman, the problem for the social sciences in general, and the discipline of sociology in particular, is clear. "We must extract nomothetic order from the flux of human existence, and we must apply nomothetic principles for policy assessment in real socio-ecological units, each with its unique properties—and must do so with sensitivity to site-specific considerations" (Freeman 1992: 23).

Weber noted, "As with any generalizing science, abstractions are necessarily relatively empty of content as compared with the concrete reality of the historical" (Whimster 2004: 325). "Idiographic knowledge consists of documenting—in proper names—the unique and particular in a unit of study" (Freeman 1992: 18). Idiographic knowledge consists of unique aspects of particular cases by exploring a case in order to discover what happened in that particular place, at that particular time. "Nomothetic knowledge, on the other hand, consists of statements asserting general form of relationships among phenomena that do not require reference to specific objects, events, dates, or places" (Freeman 1992: 19). This nomothetic concept tends to blend well with Weber's ideal type, although the former is more of a description of knowledge content while the latter more specifically to modeling and hypothesis testing.

By having adopted an integrated ideal type conceptual model, using nomothetic principles, the researcher can then analyze the differences between the three organizational forms that were found in the lower Arkansas River basin. This is accomplished by comparing each organization to the integrated conceptual model and searching for empirical and conceptual insight.

This dissertation is focused on answering the research question by using improved conceptual models that are applied to site specific cases. This is done not only to answer questions about each unique case, but also to critically consider the usefulness of the Ostrom and Freeman conceptual models in other social settings, and to make suggestions for improving these nomothetic model formulations where necessary.

Data Collection

This research is designed as a hypothesis generating study not a hypothesis testing study. The use of ideal type conceptual models combined with a case study approach is an appropriate research methodology for this goal, especially since there is very little knowledge or research concerning the organizational development of the Arkansas River Water Bank Pilot Program, the creation of the Lower Arkansas Valley Water Conservancy District or the development of the Lower Arkansas Water Management Association. By using a case study approach, the interviewer was able to solicit information from key stakeholders that would not have been accessible through survey methods using random sampling techniques. This research used a snowball sampling technique that was based on initially identifying a few key informants for interviewing and then asking those key informants to identify other key informants who would be essential to creating a thick, rich description of what is happening in the lower Arkansas River basin in regards to the creation of the organizations designed to protect the water in the lower basin. A multi-method data collection strategy was used to gain access to this information, which includes participant observation, archival research and interviewing.

Case Study Method

The standard external critiques of using qualitative methods in general and case studies in particular, are that qualitative methods are not scientific, objective or reliable. They do not quantitatively test hypotheses, or lead to generalizable propositions, and therefore, the findings are not valid (Kvale 1996). Many qualitative researchers have argued that it is unfair for qualitative studies to be judged by the methodological principles that guide quantitative research, and in response to this critique, they have offered their own principals to guide qualitative case studies. Lincoln and Guba (1985) and Creswell (2003 and 1998) believe that alternative terms must be established and utilized if qualitative research is going to establish itself as a legitimate methodological strategy. To establish "trustworthiness" of a study they use terms like "credibility," "transferability," "dependability" and "confirmability" as natural equivalents to "internal validity," "external validity," "reliability" and "objectivity."

According to Creswell and Assmussen, a case study is a detailed study of a specific unit (a group, locality, organization) involving open-ended questioning and the preparation of "histories." (Assmussen 1995) Case study is the primary method for this research project. Lincoln and Guba have put forward a series of steps for researching public policy issues through case studies:

1. The analyst identifies a case for study;
2. The case is bounded in regard to time and space;
3. Multiple sources of data collection are then used to provide detailed in-depth description of the area of study;
4. A considerable time is then spent on describing the context/setting for the case and exploring the issues;
5. The analyst brings the case study results back to theory for interpretation and lessons learned. (Lincoln and Guba 1985)

"Case studies are extremely important, but case-study authors tend to identify different variables to study, therefore making comparable findings from case studies extremely difficult" (Poteete and Ostrom 2004: 216). All types of empirical research suffer from problems related to concept and data comparability, but these problems tend to be compounded when the research is being conducted with a multi-disciplinary approach. This is especially problematic in case-study research on issues of collective action. (Poteete and Ostrom 2004) In response to this problem of multi-disciplinary comparability, "members of the International Forestry Resources and Institutions (IFRI) research network collect data on a common set of set of variables use the same methods for data collection, and share data in a growing international database, thereby maintaining the comparability required for cross-national analysis" (Poteete and Ostrom 2004: 220).

The primary method for this research will use a case study approach, which in turn utilizes participant observation, systematic interviewing and document collection to construct a detailed case study. By using the case study method, a thick and rich description of what happened in the lower Arkansas River basin is developed. This effort will examine the social and political dynamics by which the water community in the Arkansas River basin assessed the State of Colorado's Arkansas River Water Bank Pilot Program and then proceeded to establish an alternative collective goods organization in the form of the newly established LAVWCD. The researcher will also examine a third organization, the Lower Arkansas Water Management Association.

The point of doing a case study is to search for variables and relationships that can contribute to the overall building and testing of theoretical propositions.

Participant Observation

Participant observation as a method of inquiry in the field of Sociology originated out of the Chicago School of Sociology (Denzin and Lincoln 1998), especially through William Foote Whyte *Street Corner Society* (1955) and Laud Humprhey's *Tea Room Trade* (1970). This method of inquiry is characterized by the use of a variety of methods, which include interviewing, document collection, direct observation and participation in group activities. (Denzin and Lincoln 1998; Marshall 1998) Participant observation is a straightforward technique where the researcher immerses him/herself in the subject being studied. With this technique, the researcher is presumed to gain a better understanding of the subject, perhaps more deeply than could be obtained, for example, by questionnaire items on a survey. Arguments in favor of this method include reliance on first-hand information, high face validity of data, and reliance on relatively simple and inexpensive methods. The downside of participant observation as a data-gathering technique is increased threat to the objectivity of the researcher, unsystematic gathering of data, reliance on subjective measurement and possible observer effects.

The central critique to the use of participant observation as a method of inquiry is the loss of objectivity due to the researcher's involvement in the subjective worlds of those being researched. Qualitative researchers like Denzin and Lincoln see the researcher as a "bricoleur," and the "bricoleur" "understands that research is an interactive process shaped by his or her personal history, biography, gender, race, social class, and ethnicity, as well as that of the people they are studying in a particular setting" (Denzin and Lincoln 1998: 4). Creswell and others lists four limitations to this type of data collection: "The researcher may be seen as intrusive, private information may be kept from the researcher, researcher may not be attentive while observing, and certain participants may present problems for rapport building" (Bogdon and Biklen 1992; Merriam 1998; Creswell 2003: 186-187). With this said, Creswell also lists four advantages to this type of data collection: "The researcher has firsthand experience with the participants, the researcher can record information as it is revealed, the unusual aspects can be noticed during observations, and it is useful for exploring topics that may be difficult for the participants to discuss" (Bogdon and Biklen 1992; Merriam 1998; Creswell 2003: 186-187). In many respects, participant observation is the umbrella method that covers all the methods discussed above, but it also is in reference to the semi-structured observation methodology used to collect research in public and private meetings.

While in the Arkansas Valley, the researcher attended a variety of public meetings dealing with water issues in the Arkansas Valley. Participant observation in public meetings in the Arkansas Valley helped frame the public side of the debate and also gave insight into the conflicts that exist between the individual groups with a vested interest in protecting their water rights. These meetings were conducted by a variety of groups and organizations, which included the Lower Arkansas Valley Water Conservancy District, the Colorado State University Sociology Water Lab, the Colorado State Engineer's Office, the Southeastern Water Conservancy District, the Arkansas Valley Preservation and Land Trust, and a variety of mutual ditch companies in the valley including the Fort Lyon Canal Company, Catlin Canal Company and the Highline Canal Company. The meetings primarily took place over the summers of 2003 and 2004, but also continued through the summer of 2006. The meetings ranged from short meetings that lasted approximately one hour to long meetings that were conducted over a period of two days. The meetings also ranged in their structure from formal proceedings to meetings that were much more relaxed in nature.

Archival Research

There are certain drawbacks to document research, especially when the researcher has a difficulty locating research materials, obtaining permission to use the materials once they are found, and then determining the usefulness and value of the archive once it has been analyzed. Since there is rarely a systematic approach to collecting materials for an archive, it makes it difficult to find things that are potentially important to research, especially if the archive is large. There is also the issue of bias that must be addressed when document collection is used. Each key informant that provides the researcher with access to an archive has a particular view they are trying to convey; therefore, the researcher must be careful to balance the differing views amongst the key informants and their respective organizations. Creswell lists five limitations to archival research: "Documents may be protected and unavailable for public or private use, documents are hard to find, documents require optical scanning for computer entry which may not always be an option, documents may be lost or incomplete, and the documents may not be authentic" (Bogdon and Biklen 1992; Merriam 1998; Creswell 2003: 186-187). Once again, Creswell offers the advantages to this form of data collection:

> "Document collection allows the researcher to obtain the language and words of the participants, documents can be accessed at the researcher convenience and is unobtrusive, archives also represent data that are thoughtful about how the documents were collected, and it is evidence already in written form, so the researcher does not have to transcribe them" (Bogdon and Biklen 1992; Merriam 1998; Creswell 2003: 186-187).

Archival research is one of the primary methods of data collection for this research project. The plan was to collect data from a variety of archives, including the State of Colorado Division II Engineer's Office, The Southeastern Water Conservancy District, the Lower Arkansas Valley Water Conservancy District, the Pueblo Chieftan, the Rocky Ford Gazette, the Ag Journal in La Junta, the Bent County Democrat, the Lamar Daily News, the La Junta Tribune-Democrat, the Water Works Commission in La Junta, and a variety of other archives that surface during the course of the research. This research helped develop the setting and served as an external check on what the researcher was discovering through in-depth interviews. The downside of archival research was the inherent bias of the archive itself and those who created it. Most archives have a particular focus and perspective that may not be representative of the generally accepted view of things, but with that said, they also bring many unique documents as well.

Interviews

One weakness with using interviews is the inherent bias of the person conducting the interview (Kvale 1996). The researcher must be aware of their own biases when it comes to the how they conduct the interview and how they interpret the findings once the data is collected. "Because of the central role they play in data collection, interviewers have a great deal of potential for influencing the quality of the data they collect. The management of interviewers is a difficult task, particularly in personal interviewer studies" (Fowler 1993: 105). Kvale draws our attention to the overall qualifications of the interviewers as one potential way to control their bias. Interviewers must be knowledgeable on the subject, able to structure the interview process, able to steer the interview, be critical of the knowledge produced, and, finally, they must remember what has been said in the interview. If an interviewer is weak in any of these areas, then they open up the research findings to problems with credibility. Creswell offers four limitations to the use of interviews for data collection: "Interviews provide indirect information tempered by the perspectives of the interviewers, interviews provide information in a designated area that is usually not the natural field setting, the researchers presence may bias the responses, and people are not equally articulate and perceptive" (Bogdon and Biklen 1992; Merriam 1998; Creswell 2003: 186-187). Creswell offers the other side of this argument by giving four advantages to interviewing as a data collection technique: "Interviews are useful when the participants cannot be observed directly, participants can provide historical information during the interview, and interviewing allows the researcher to control the line of questioning" (Bogdon and Biklen 1992; Merriam 1998; Creswell 2003: 186-187) (Refer to Appendix 4).

This researcher used a particular type of interviewing strategy known as key informant interviewing. Key informant interviewing is usually associated with ethnographic studies, but is also found in the use of case study analysis. "The ethnographer is sensitive to fieldwork issues such as gaining access to the group through gatekeepers, individuals who can provide entrance to the research site. The ethnographer then located the key informants, individuals who provide useful insights into the group and can steer the researcher to information and contacts" (Creswell 1998: 60). In this study, the researcher repeatedly returned to the people interviewed over the time period of the research. Key informants were those individuals that were identified as being especially knowledgeable in the subject area of study. By learning about the topic of study from key informants who were seen as insiders on the issues at hand, the researcher gained a better understanding of the issues that were most affecting the formation of the two organizations under study. Key informant research must be seen in contrast to the regular interview process associated with random sampling with the expressed purpose of generalizability of the findings from a probability sample.

The first phase of the interviewing schedule for this project was carried out over the summers of 2003 and 2004. Travel to the Arkansas Valley occurred several times during these time periods for a length of one week at a time. By spreading the visits out over two summers, the researcher was able to gain access to a larger number of farmers, whose work schedules do not sync well with the academic research timeframe. It also allowed for the use of this time to explore archives and conduct participant observation.

Information gained from these interviews was then checked and substantiated with a process referred to as triangulation of data sources. Newspapers, public meetings, journal articles, books and other archival research were used to triangulate the data. These documents were collected from a variety of sources which included the Morgan Library at Colorado State University, The Rocky Ford Gazette, The La Junta Tribune, participants interviewed, as well as a variety of other archives owned by individuals in the Arkansas Valley.

Protection of Research Respondents

Interview protocols utilized a format of informed consent and voluntary participation (refer to Appendix 2). Interviews were conducted in compliance with the requirements of the Human Subjects Board at Colorado State University, where the initial contact of potential participants was done using a semi-structured telephone script that informed the subjects of the general nature of the study (refer to Appendix 1). Participants were assured the information shared in the interview would be held in the strictest of confidence and would not be shared with anyone, and their identity would not be revealed in the write-up of the research project.

This research used a multi-method approach for making observations with the purpose of comparing three different water banking organizations in the lower Arkansas

River basin with the integrated conceptual model for the purpose of considering the uses and limits of this particular model. The Arkansas Valley provided a unique case study that allowed the researcher to bring nomothetic constructs to bear on the idiographic case specific organizational characteristics of the Arkansas River Water Bank Pilot Program, the Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Water Management Association in an effort to provide thick, rich descriptions of how each of these organization formed in an effort to test the overall applicability of the integrated model.

Chapter 4

BACKGROUND

What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good?

To address this question, the research was conducted in Colorado's lower Arkansas River basin. The history of the lower Arkansas River basin is one of discovery, prosperity and tragedy. When the first settlers arrived in the valley, they were confronted by a harsh, arid environment that produced less than twenty inches of precipitation a year. This environment was vastly different than the humid environments from where the settlers traveled; therefore, the settlers were forced to either adapt to the environment or die. The main source of water in the Arkansas Valley was the Arkansas River. The annual flows of the Arkansas River were seasonal and dependent on snow melt in the mountains making the rivers flow quite unpredictable. One way settlers in the Arkansas Valley adapted to the environment was to develop lateral ditches off the Arkansas River for irrigation. By diverting the Arkansas River flows for irrigation, the settlers in the lower Arkansas River basin transformed the barren desert into a productive agricultural valley, and for close to one hundred years, this land of plenty produced crops for an agricultural economy that sustained communities throughout the valley. These agricultural communities were founded on the success of mutual ditch companies made up of irrigators in the valley who needed to organize collectively to accomplish a task they could not do individually.

Arkansas River Basin Overview

The Arkansas River is a major tributary river of the Mississippi River flowing east and southeast though Colorado, Kansas, Oklahoma and Arkansas.

> "Beginning near Leadville, Colorado, the river grows gradually as it makes its way through Salida, Colorado and Canon City, Colorado. It picks up speed as it travels through the Royal Gorge then flows through Pueblo before being joined by the St. Charles River. The Arkansas River continues past Las Animas, Colorado and Pikes Peak. Rolling into Kansas, the river flows past Cimarron, Dodge City and Wichita before entering Oklahoma. In Oklahoma, the river passes through Tulsa, Ft. Gibson and Muskogee, crossing into Arkansas near Fort Smith. It crosses the State of Arkansas and empties into the Mississippi River about 600 miles North of New Orleans."[4]

The river drops more than 10,000 feet over a stretch from the headwaters at 14,125 feet on Mount Democrat in Leadville leveling out at 4,600 feet at Pueblo Reservoir located on the plains just south of Pueblo, and finally leveling out at around 3,400 feet at the Colorado/Kansas border. This represents an elevation drop of 10,725 feet over a 350 mile stretch of the river from Leadville to the Colorado/Kansas state line. This stretch of the river's flow provides for a variety of outdoor activities - such as white water rafting, kayaking, hiking and camping - which fuels a booming tourist industry in the Upper Arkansas Valley River basin.

According to the Colorado Water Conservation Board, the river basin created by the Arkansas River and its major tributaries (Fountain, Timpas and Grape Creeks; and St.

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4 This quote was taken from the Arkansas Post National Monument website http://www.scsc.k12.ar.us/2003outwest/RoarkJ/Arkansas%20River.htm from the section on the history of the Arkansas River from 1541-2000.

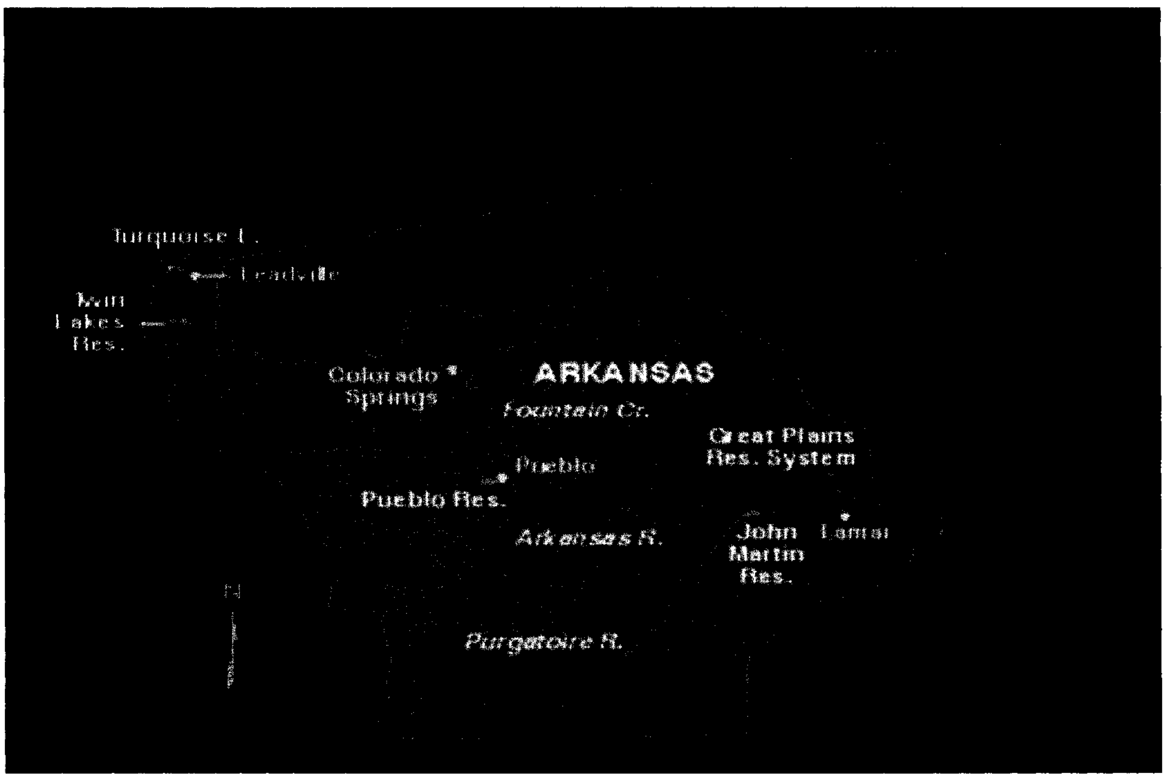
Charles, Huerfano, Apishapa and Purgatoire Rivers) makes up the Arkansas River basin. The basin is comprised of 19 counties with irrigation representing the primary water use in the region of which 2 million of the 3.7 million acre feet of water is diverted annually from the Arkansas River. Other surface water deliveries in the basin include storage, municipal, industrial, commercial, domestic, stock, recreation, fish, augmentation and recharge.

The climate in the Arkansas River basin varies greatly from the upper basin to the lower basin. "Basinwide average annual precipitation ranges from less than 10 inches per year in the plains to over 30 inches per year in the high mountain regions" (CWCB 2006: 17). Daily average temperatures vary about 10°F with the upper basin averaging 46°F and the lower basin averaging 56°F annually. Temperatures in the lower basin range from 100°F in the mid-summer's heat to 0°F in the coldest part of the winter. Geographically located in the southeastern part of the state, the Arkansas River basin is the largest river basin in the Colorado covering 27 percent of the state, or an area of 28,268 square miles. The largest cities in the basin are Colorado Springs (population 373,328) and Pueblo (population 103,846) (DOLA 2003; CWCB 2006: 17). The topography of the basin is also quite diverse ranging from spiraling peeks in the upper basin to the flats of the plains in the lower basin.

Growth in the region is also an issue. Between 1990 and 2000, the population in the Arkansas River basin increased 22 percent, with Colorado Springs accounting for the majority of this growth (CWCB 2006). To offset new growth, the Southeastern Water Conservancy District predicted that the Arkansas River basin will need approximately 173,000 more acre-feet of water per year by the year 2004. The Colorado Statewide Water Supply Initiative (SWSI) projected growth in the Arkansas River basin to increase from

835,130 in the year 2000 to 1,292,985 in the year 2030 growing at an annual rate of 1.5 percent and resulting in an increase in the overall population of the river basin by 55 percent (SWSI 2004). The total gross demand for the river basin in 2000 was 256,900 acre-feet, and that number will increase to 354,900 in 2030 resulting in an increase of 98,000 acre-feet. Of that 98,000 acre-feet, 81,600 acre-feet are accounted for with future water projects and conservation efforts, leaving 16,800 acre-feet of water to account for still. This excess will be attained from the agricultural sector through lease or permanent transfer of water rights unless new water projects are brought to the table in the Arkansas River basin.

Figure 5: Map of the Arkansas Valley in Southeastern Colorado



Source: (Colorado Water Knowledge 2007)
http://waterknowledge.colostate.edu/ark_map.htm

The Arkansas River basin is served by a series of major storage points, which include John Martin Reservoir, Pueblo Reservoir, Great Plains Reservoir, Twin Lakes and the Turquoise Reservoir, just to mention a few. The major winter calls on the river come from the John Martin Reservoir, the Winter Water Storage Program, and the Pueblo Reservoir. The irrigation season, on the other hand, operates on priority with senior rights, which include the Colorado Canal (1890), Fort Lyon Nos. 2 (1887) and 3 (1893), Holbrook (1889), Catlin (1887), Highline (1890), Otero (1890), Consolidated (1888) and Amity (1887) having first call. There are also a variety of major water imports into the basin coming from the Upper Arkansas River and its tributaries, which accounts for the majority of the transmountain diversions to the Arkansas River basin.

Table 3: Major Yearly Water Imports into the Arkansas Valley River Basin and its Tributaries

Name	Recipient Stream	Acre Feet Delivered
Boustead Tunnel	Lake Fork Creek	53,971
Twin Lakes Tunnel	Lake Creek	46,930
Homestake Tunnel	Lake Fork Creek	24,520
Hoosier Tunnel	Fountain Creek	9,330
Busk-Ivanhoe Tunnel	Busk Creek	4,123
Wurtz Ditch	Tennessee Creek	2,070
Columbine Ditch	Arkansas River	1,699
Medano Ditch	Huerfano River	834
Ewing Ditch	Tennessee Creek	775
Larkspur Ditch	Poncha Creek	66

Source: (Colorado Water Conservation Board Arkansas River Basin Facts 2002)

Canal and Ditch Building – Local Efforts 1840s-1890s

The first step in harnessing the river's flow was build canals and ditches. The first canal was dug in 1839 near Old Bent's Fort in southeastern Colorado. The Arkansas River's flows were much different in the pre-canal building era than they were after the canals, ditches and dams were installed on the river. The river channel was much deeper and the banks were shaded and protected from erosion with large trees, bushes and thick grasses. The river banks were also approximately five feet higher than they are today. The river channel was flushed out periodically due to sudden storms washing silt and debris down the river. "Before 1870 people had recorded the peculiar habits of the Arkansas River. Observers most familiar with it noted that it flowed intermittently. The river simply served as a great drainage system for the melting snowpack on the eastern slopes of the Greenhorn, Sangre de Cristo, and Rocky mountains" (Sherow 1990: 9). With the construction of canals, ditches and dams, the channel became more regulated and sudden storms no longer flushed the river bed as they once did. The trees, bushes and tall grasses no longer dominated the growth along the river banks resulting in bank erosion. Both of these factors caused a gradual filling of the river channel resulting in severe flooding of farmland as well as the local economic and social centers surrounding this farmland.

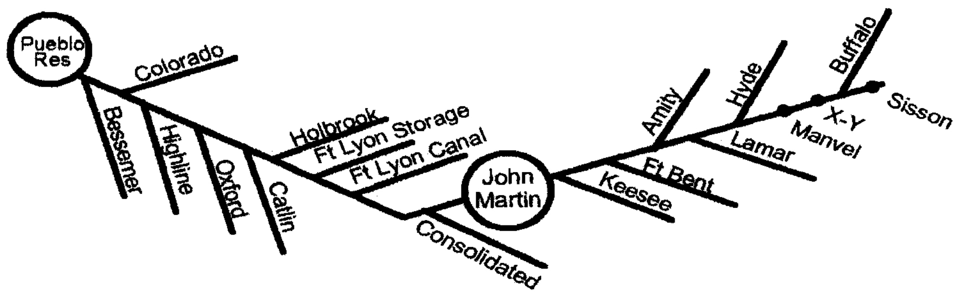
> "Colorado irrigators built their ditch systems in a land of climatic extremes, a general condition unevenly affecting the operations of every irrigation system in the valley. On average, depending on locale, between fourteen and twenty inches of precipitation fell annually, but wide variations marked these averages. The rain or snow might come at any time of the year, or not at all. Sometimes searing drought withered flora and parched fauna, and at other times high precipitation nourished a lush growth of grasses, notably buffalo grass. Sudden torrential thunderstorms might interrupt dry summer days by pounding the land with hail and rain. During extremely hot days,

the heat radiating off the land evaporated rain showers before they ever touched earth, and coupled with dry winds, little moisture remained in the soil...In winter, within the span of a few days there could be chilling cold and freezing blizzards, or crystal clear skies and frigid temperatures, or even mild, sunny days" (Sherow 1990: 8-9).

The first ditch off the Arkansas River was built at Milk Fort, Colorado in 1839 and serviced fields at Old Bent's Fort. Just upriver J. Wiley Potter dug a small ditch off the river to water his family's fields. This ditch was expanded in the 1890s, but eventually flooded and was never reconstructed. Other early ditches dug in the 1860s included the Bray Ditch North of Fowler, Stubb's Ranch Ditch northeast of Fowler and Spring Bottom on the northwest side of the river near Manzanola. "The framers of the Colorado Constitution recognized the importance of ditches to bring water to the land and provided for private access for right-of-way across public and private lands for the construction of ditches" (Vranesh 1999: 277).

Even though every ditch company in the Arkansas Valley was different due to the geographic variations present on their system, as well the crops their farmers were growing, they were similar in organizational structure. "The governing structure of mutual stockholding companies was their only similarity. The owners of a company's water stocks directed its policies. Each stockholder had a voice in company affairs in proportion to his/her ownership of the company's stock issue" (Sherow 1990: 8).

Figure 6: Ditch Diagram of the Reservoirs and Canals of the Lower Arkansas River Basin



Source: Colorado Department of Natural Resources Colorado Office of the State Engineer

The town of Rocky Ford was named after the rocky river crossing discovered by Kit Carson. The original inhabitants of Rocky Ford had an agricultural town in mind from the start. The town plans included a post office, a store and enough agricultural land to support a local economy. Some of the earliest rights on the Arkansas River below Pueblo, Colorado ranged between the years of 1861 and 1890. The first registered ditch on the Arkansas River was the Rocky Ford Ditch, started in 1874. This ditch was dug by William Mathews, James Lowe, J. Dowden, John Swift, Asa Russel and George Swink. The Rocky Ford Ditch Company was an outgrowth of the vision of George Swink. "As a matter of expediency, not ideological design, Swink promoted cooperation. Lacking capital to underwrite a large privately owned project, he found it easier to organize his neighbors in a collective effort" (Sherow 1990: 13). The Rocky Ford Ditch was originally made up of 800 shares equaling .08 shares per acre. The Rocky Ford Ditch stretched approximately 20 miles and served 10,000 acres of farmland. Farming under the Rocky Ford prospered until 1978 when the American Crystal Sugar Company closed. "The Rocky Ford Ditch diverted 46,000 to 48,000 acre feet of water annually from the Arkansas River and irrigated around

7,000 acres of land. The American Crystal Sugar Company held some 4,000 acres of land under the ditch" (Milenski 1990: 146-147). Resource Investment Group, based in Denver, bought the rights to the American Crystal Sugar Company's shares in the Rocky Ford Ditch Company giving them 51 percent of the shares in the company, which allowed them to change the company bylaws. "RIG then announced that for a 5 percent fee, they would take care of all the legal matters required if other stockholders of the company wanted to join them in the sale of water to Aurora" (Milenski 1990: 147). In the end, 58 percent of the ditch was sold to the City of Aurora, Colorado.

The Bessemer Ditch Company was another company that was established early in the development of the Lower Arkansas River basin. The Bessemer Ditch Company had the most senior rights on the river, but the company did not sit in as favorable a position on the river as did the Rocky Ford Ditch. The Bessemer originally ran through the south part of Pueblo to the Colorado Coal and Iron Company where it finally irrigated the fields of the farmers on the Bessemer. The fact that the Bessemer ran through the City of Pueblo created a constant conflict between the city and the Bessemer Ditch Company. The conflict concerned who should manage the ditch within the city limits of Pueblo. There were other problems related to the ditch's close proximity to the city as well. "The increasing use of automobiles and the paving of streets created runoffs into the canal tainted by petroleum products. Whenever it rained, oil, rubber, and anything else on top of the asphalt and concrete streets near the canal polluted the ditch water" (Sherow 1990: 41). Transit loss was another problem water users on the Bessemer faced, and with this problem they found themselves at the control of the State Engineer. "The State Engineer calculated how much water would be lost from evaporation and absorption before a given volume reached the Bessemer headgate....If the State Engineer estimated too much loss in transit, the Bessemer incurred a loss in water diversions and a correspondingly poor return on their purchases" (Sherow 1990: 43).

The Colorado Canal was first named Bob Creek, but once T.C. Henry, a business man from Denver, came onto the project, things began to grow. "Several canal companies were formed and much surveying was done, with the view of building a ditch, but all schemes failed until Mr. T.C. Henry, of Denver, organized the Colorado Land and Water company, and constructed a fine large canal at a cost of over $400,000" (Hall 1895: 246). "Theodore C. Henry, one of the principal investors in the La Junta and Lamar Canal Company, preached cooperative irrigation as the panacea that would transform an arid valley into a garden. A man of unlimited vision and ambition, he had more to do with the development of irrigated agriculture in Colorado before 1900 than nearly anyone else" (Sherow 1990: 18). Henry began construction of a ditch that eventually became known as the Colorado Canal and irrigated approximately 56,000 acres of farmland in Crowley County.

The Colorado Canal ran 50 miles along the north side of the river and had become a source of water for Aurora, Colorado Springs and Pueblo. The Colorado Canal water was sold to the cities of Colorado Springs and Aurora by the Foxley Land and Development Company, a Nebraska based operation that bought much of the land as well as the water rights from farmers under the Colorado Canal in order to run a cattle operation and feedlot. "Once they held the majority shares in the ditch, they changed the bylaws allowing them to sell the water to Colorado Springs for $1,300.00 per share...This sale not only involved a great deal of direct flow native water with an 1890 decree, it also involved the two reservoirs under the Colorado Canal—Lake Henry and Lake Meredith" (Milenski 1990: 146). One problem farmers faced on the Colorado Canal was an increased water table, which left standing water in their fields resulting in high deposits of alkali, thus limiting the productivity of the irrigated acreage.

The Rocky Ford-Highline Canal was created by the Rocky Ford Canal, Reservoir, Loan and Trust Company founded in 1889 by B.U. Dye, G.W. Swink, A.C. Comer, J.A. Reinhart, W.A. Colt, W.C. Burke, H.L. Lubers, G.M. Hall and R.G. Scott. This company also purchased 90 second feet of transmountain water in 1950 and 38 second feet with a 1970 decree. The Rocky Ford-Highline Canal Company was made up of 2,250 shares equaling 10.28 shares per acre, and irrigating approximately 24,000 acres of farmland. Around the same time that RIG was brokering the sale of water on the Rocky Ford Ditch, a deal was being set up to sell Rocky Ford-Highline water held in the Busk-Ivanhoe reservoir to the City of Aurora. "The Busk-Ivanhoe water was originally transmountain water that the High Line had purchased in the 1940s so it did not originally belong to the native flow of the Arkansas River. The water was sold mainly to get farmers out of debt so they could keep on farming with their remaining water, and because they were offered $3,500.00 per acre foot by the city of Aurora" (Milenski 1990: 145).

The Holbrook Canal, also referred to as the Laguna Canal Company, was another canal drawing water from the Arkansas River. The Holbrook, also referred to as Lake Canal, was created by H.R. Holbrook to service a colony he brought out from Arapaho County. Holbrook bought land from the State of Colorado just outside of Rocky Ford. This land was part of a failed Native American agricultural project that ended in the 1860s. Construction for the Holbrook Canal started in 1890 and finished in 1892. The Holbrook ran along the north side of the river just east of Manzanola and irrigated about 14,924 acres of farmland. It was made up of 16,000 shares equaling 0.93 shares per acre. The Holbrook Canal also had two off-stream reservoirs for storage: Dye Lake just north of Rocky Ford and Holbrook Reservoir just northwest of La Junta (Milenski 1990).

"Originally the Catlin Canal was started by the Catlin Land and Canal Company" (Milenski 1990: 33). After the first part of the ditch was constructed in 1885, the board members from the Catlin Land and Canal Company went out to sell shares of canal stock in the newly formed mutual ditch company for $1.25 per acre. "One had to buy water for a minimum of forty acres and this amounted to $50.00. People could work out this assessment on the water by moving dirt in the ditch at ten cents a yard" (Milenski 1990: 34). "The Catlin Canal was another canal on the Arkansas River with a senior priority and a significant diversion right. The Catlin's headgate and dam was located on the south side of the river and extended about 40 miles through Manzanola and connected to Timpas Creek south of Rocky Ford. The Catlin Canal Company was a mutual irrigation company and was divided into 18,600 shares equaling 0.9 shares per acre."

The Fort Lyon Canal Company was a mutual stockholding company created by the farmers who diverted flows from the La Junta and Lamar canals (Sherow 1990). "From 1898 to 1903 the Fort Lyon farmers fought two Colorado Supreme Court cases before they finally won cooperative control of the canal system and confirmed their contract with the Great Plains Water Storage Company" (Sherow 1990: 20). The Fort Lyon Canal was the largest Canal on the Arkansas River and, for that matter, the largest canal in Colorado. The Fort Lyon stretched over 113 miles from La Junta to Lamar running along the north side of the river. The Fort Lyon Canal originated as a small ditch on the Arapaho and Cheyenne

Indian Reservation, but it failed the tribes and was abandoned. The U.S. Army also used this ditch in the mid 1870s. In 1883, J.C. Abbot, J.F. Minnis and P.O Gainor started the Arkansas River Land, Town and Canal Company, which was the precursor to the Fort Lyon Canal Company. The Fort Lyon delivered water to approximately 94,000 acres of farmland in Las Animas and Otero counties.

"The Amity ditch was a direct flow canal flowing from the Arkansas River and was supplemented by a system of plains reservoirs located a short distance north of the river and filled from the Arkansas River through the Fort Lyon Canal" (District 67 Federal Land Bank Wichita 1978: 137),

Table 4: List of Major Ditch Decrees for the Lower Arkansas River Basin above John Martin

Canal Name	Decreed Volume (Cubic Feet per Second)	Priority Date
Amity Ditch	283.5 cfs 500 cfs	2/21/1887 4/01/1893
Bessemer Ditch	44 cfs 27 cfs 320 cfs	9/18/1873 3/31/1882 5/10/1887
Catlin Canal	248 cfs	12/03/1884
Catlin Canal	97 cfs	11/14/1887
Colorado Canal	756 cfs	6/09/1890
Fort Lyon Canal	165 cfs 597 cfs 171 cfs	4/15/1884 3/01/1887 8/31/1893
Highline Canal	56 cfs 30 cfs 2 cfs 378 cfs 2.5 cfs	12/31/1861 6/01/1885 3/11/1886 1/06/1890 10/14/1890
Holbrook Canal	155 cfs 455 cfs	9/25/1889 8/30/1893
Rockford Ditch	112 cfs 97 cfs	5/15/1874 5/06/1890

Source: (Milenski 1990)

Dam and Reservoir Building (1890-1990)

Growth along the front-range of the Rocky Mountains came with the discovery of gold in the Colorado territory. The discovery of gold in the Colorado territory was followed by a rush of people to the region hoping to find their fortunes panning for gold in the rivers of the Rockies. In 1874, the territorial governor of Colorado requested help from the federal government for developing reservoirs for mining and irrigation.

> "The mining interest was dependent on local agriculture. You cannot work your mines profitably on imported bread. The thousands who now, and will thereafter delve in these mountains and lift their glittering treasures to the sunlight must draw their sustenance from the fertile valleys that lie enveloped in their arms and stretched away from their feet. And until this condition of things was compassed, your mines will never be economically or successfully worked. Until the plain shall send to the mountain its oft of bread, the mountain will withhold from the nation its gift of gold" (Hockenmeyer 1983).

Shortly after Colorado was admitted to the union, the newly appointed Governor John Routt asked the Colorado Legislature to begin to construct reservoirs for mining, irrigation and manufacturing (Hockenmeyer 1983).

On the Arkansas River, there were two on-channel reservoirs: Pueblo Reservoir and John Martin Reservoir. All the other reservoirs drawing off the flows of the Arkansas River are off-channel reservoirs, and they were limited by their overall intake capacity. "The off-channel intake capacities were limited by their headgate diversion ability in flood time; and these can be further limited by debris and ice in the river. On-channel storage facilities were not hindered by either of these problems. Also off-channel storage was limited to the capacity of the canal which carries water to the storage facility" (Milenski 1990: 154).

Off-Channel Reservoir Building – Local Efforts – 1890s to 1910s

In the early days of agriculture in the Arkansas River basin, it was common for the river to completely dry up once the snow melted in the mountain snow fields; therefore, water users in the plains were forced to build storage facilities off the main stem of the river to store unappropriated water whenever it was available. "The reason for the development of the storage reservoirs was the over-appropriation of the Arkansas River by 1890. The off-channel storage reservoirs were developed primarily from 1890-1910" (Milenski 1990: 156). "The people in the valley had three basic choices in resolving their predicament. They could agree to limit their water use to the free flowing water of the valley, they could cooperate to apply more elaborate technology to trap more water to supply rising demand, or they could fight one another for every drop of water through expensive litigation" (Sherow 1990: 120). Water users in the valley chose option two and created off-channel reservoirs. Once a canal company finished constructing their reservoir, they filed for a storage right and were issued a priority in the system. "Storage occurred primarily when there were sustained large flows of water in the river due to reoccurring floods. Storage was also helped by the use and reuse of water from the canal systems which act to keep the water circulating. Early priority return flows helped create flows for junior appropriators" (Milenski 1990: 154).

"Reservoirs were an important factor in the water supply of the Arkansas River basin, and were used to supplement direct flow rights" (District 17 Federal Land Bank Wichita 1978: 16). There are seven primary off-channel reservoirs in the Lower Arkansas River basin: Lake Henry, Lake Meredith, Dye Reservoir, Holbrook Reservoir, Great Plains Reservoir, Horse Creek Reservoir and Adobe Creek Reservoir. Lake Henry and Lake Meredith were originally developed as part of the Colorado Canal system for off-channel storage of flows from the Arkansas River. "Lake Henry, which was over by Sugar City had the earliest priority below the Pueblo Reservoir" (Milenski 1990: 7). Dye Reservoir, located north of Rocky Ford, and Holbrook Reservoir, located near Cheraw, and were developed as part of the Holbrook Canal system. The Fort Lyon Canal Company built off-channel storage facilities at this time as well. Adobe Creek Reservoir and Horse Creek Reservoir were part of the Fort Lyon storage system. "From 1901-1927, guided by engineering studies, the Fort Lyon Canal Company constructed a new concrete diversion dam, rebuilt many of the overflows in concrete, bought and enlarged Horse and Adobe Creek reservoirs, and oversaw the construction of a feeder ditch to convey floodwaters from the Arkansas River to storage sites" (Sherow 1990: 35). The Great Plains Reservoir was located below John Martin Reservoir and was owned and operated by the Amity Canal Company. "The Great Plains system of reservoirs was comprised of four reservoirs (the Neopa, the Neo Grande, the Neo Sho and the Queens) with a decreed capacity of 265,552 acre-feet, an actual capacity of 150,000 acre-feet, and available storage capacity of 110,000 acre-feet. This chain of natural lakes was converted to reservoirs by placing small dams across two of the lakes" (District 67 Federal Land Bank Wichita 1978: 147). The Amity

Mutual Irrigation Company ran water through the Fort Lyon canal and its Kicking Bird extension to fill this series of reservoirs.

Table 5: Off-Channel Storage in the Lower Arkansas River Basin

Reservoir	Maximum Decreed Storage (acre-feet)	Priority Date
Adobe Creek Reservoir	87,000 af *61,575 af in 1906* *25,425 af in 1908*	01/12/1906 12/29/1908
Lake Meredith	26,028 af	03/09/1898
Horse Creek Reservoir	28,000 af *26,887 af in1906* *1,113 af in 1908*	01/25/1906 12/29/1908
Lake Henry	9,914 af *6,353 af in 1891* *3,561 af in 1910*	12/31/1891 09/10/1910
Holbrook Reservoir	4,566 af *4,247 af in 1892* *319 af in 1909*	03/02/1892 09/15/1909
Dye Reservoir	7,986 af *4,500 af in1903* *3,486 af in 1909*	10/10/1903 09/03/1909
Great Plains Reservoir	265,552 af	08/01/1896

Source: (Milenski 1990)

On-Channel Reservoir Building – Federal Efforts (1938 to 1990)

The economic potential of the western part of the United States was unrealized until the early 20th century when the Bureau of Reclamation entered the picture. The Bureau of Reclamation was the administrative bureau formed out of the Reclamation Act of 1902. "In the late 1890s, many who favored federal reclamation simply wanted the federal government to build dams and canals, leaving the states to dole out the water. At that time, most westerners conceived of federal reclamation as a program to aid established farmers and to stimulate private enterprise" (Pisani 2002: 277). Congress, on the other hand, did not support the idea of using federal dollars to support the economic development of such small numbers of land developers. These developers then switched their tactics and made a pitch for the development of small family farms built on the ideals of rural America, and they expanded their program to include virgin public land. This was a significant step for the federal government, and taking it meant that they would not only be responsible for building reservoirs, but they would also be responsible for constructing new canal systems.

> "Congress refused to give the Reclamation Service authority to screen potential settlers, and many of those settlers were poor. Not surprisingly the first wave demanded that the government construct the lateral canals that led to their land, as well as the main canals. And eventually, they demanded that the Reclamation Service build drainage ditches to prevent the buildup of alkali, and that it maintain and operate the hydraulic systems" (Pisani 2002: 278).

There was also a considerable amount of debate over whether the federal government should control the water in the west, or whether that responsibility should be handled by the states. According to Pisani, one of Colorado's primary champion's for state sovereignty over the waters of the west was Colorado water attorney Delph E. Carpenter. Carpenter's argument was based on two premises: 1) the federal government relinquished control over western water once statehood was granted, and 2) the administration of water can only be done at the state level. Carpenter's first point, and quite possibly the argument that served as the foundation of the court ruling, was found in the State of Colorado's constitution drafted in 1876 in Article 16, Chapter 5 where the state clearly proclaimed its sovereignty over its waters. "The water of every natural stream not heretofore appropriated within the State of Colorado, was hereby declared to be the property of the public, and the same was dedicated to the use of the people of the state subject to appropriation as hereinafter provided" (Pisani 2002: 37). If there was any doubt on how this debate was going to pan out, it became very clear with the U.S. Supreme Court decision on Kansas v. Colorado. "Kansas v. Colorado denied that the federal government had any right to control interstate streams" (Pisani 2002: 41). This ruling officially smashed any hope that the Reclamation Service would control the entire river basins they were developing, therefore, guaranteeing that reclamation projects would be relatively small in nature.

Without the ability to control the entire river basin under development, the Bureau of Reclamation was forced to work with private entities, but the bureau was not in favor of private enterprises gaining access to bureau construction permits because it would encourage land speculation and line the pockets of a small few. "In 1905, the secretary of the interior noted: It was obviously not the intent of the reclamation act to irrigate at public expense large private holdings and increase the wealth of a small few unless the public received an equivalent gain" (Pisani 2002: 57). The Reclamation Service made it the responsibility of the private entity needing bureau assistance to make the case for public benefit.

With this need came the creation of the water users association. The first water users association was the Salt River Water Association formed in 1903. "Membership was a function of stock ownership. The association sold shares for fifteen dollars a piece, but no member could acquire more than one share per acre or more than 160 in all. Each share entitled the bearer to one vote in the association and one measure of water created by the federal governments promised storage project" (Pisani 2002: 62). Even with the commitment of this new water users association, it was not until the landowners offered

200,000 acres of land as collateral that the secretary of the interior approved the Salt River Project.

By 1910, the Salt River Project, and the water users association that governed it, served as a template for almost every federal project except for the Minidoka, Shoshone and Truckee-Carson projects. "Reclamation welcomed such institutions in the hope that they would guarantee the repayment of construction charges" (Pisani 2002: 62). Unfortunately for the federal government, these organizations did not guarantee payment, "Nor did they promote home rule or democracy, curb speculation, or force the sale of excess lands" (Pisani 2002: 62). In the end, "The largest landowners—many of whom did not reside on their land—dictated the policies followed by the associations, and often they evaded promises made to the Department of the Interior" (Pisani 2002: 62). Eventually, the Bureau of Reclamation recognized the inherent weaknesses of water users associations and with future projects, they used irrigation districts and conservancy districts to guarantee repayment. The importance of this fact cannot be understated. Because of the 1902 Reclamation Act, it is no longer possible for the federal government to construct a federally funded project without a local sponsor who had the intention and capacity to take the project over when it was completed, as well as pay for it over the duration of the facilities operation.

Table 6: Major Storage Points in the Lower Arkansas River Basin

Reservoir	Maximum Decreed Storage (acre-feet)	Priority Date
John Martin Reservoir	603,465	12/14/1948
Pueblo Reservoir	357,678	08/03/1959, 02/10/1959, 07/29/1957

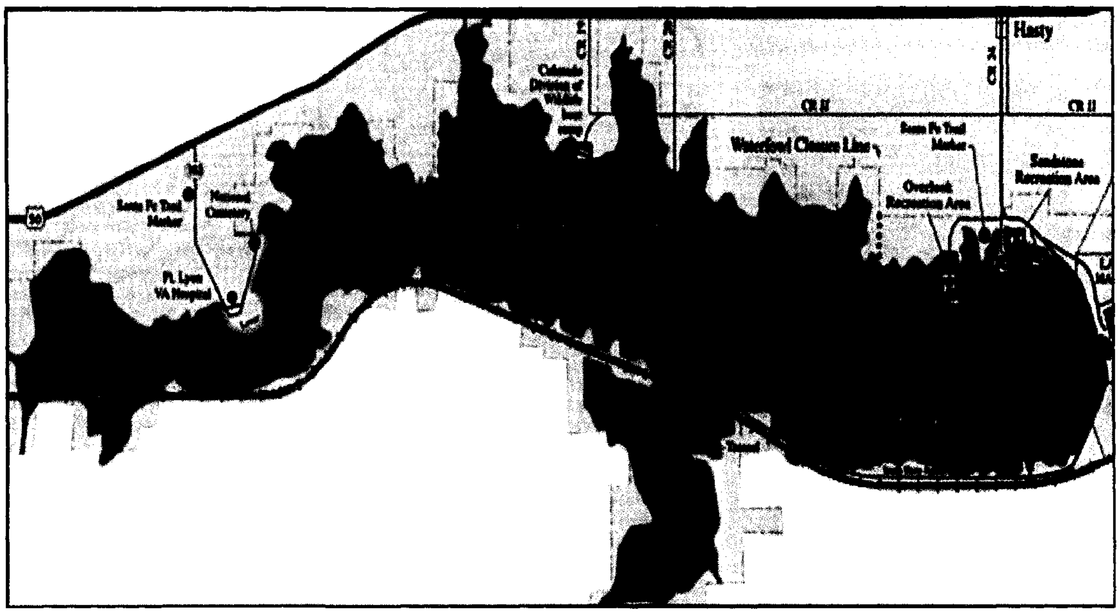
Sources: (Colorado Division of Water Resources Office of Dam Safety Database; Colorado Water Conservation Board 2006)

On-Channel Reservoir Building – Federal Efforts – John Martin Reservoir (1939 to 1948)

In the Arkansas River, basin there have been various attempts to alleviate the unpredictable river flows in an effort to make farming, mining and other water uses more economically viable. "The flood of 1921 wreaked havoc all along the river. An intense downpour in the Upper Arkansas Valley and along the Fountain Creek watershed unleashed a voluminous runoff" (Sherow 1990: 33). These floods were especially problematic for canal companies with physical structures off the main stem of the river. As a result of the flood of 1921, irrigators on the Rocky Ford system suffered severe damage to their diversion dam, and the Bessemer Ditch Company lost four major flumes, suffered two canal breaks, and took damage to the spillway close to the diversion dam (Sherow 1990). All of these damages were costly to irrigators in the lower Arkansas River basin, and because of this, they lobbied their local representatives in the U.S. Congress for help. "In 1942 another spring flood caused serious damage to the Bessemer canal. A mud and rock slide nearly wrecked the upper end of the ditch. Moreover, the slide almost altered the river's course 1.25 miles above the company's headgate. Had this occurred, the company's diversion dam would have been left high and dry" (Sherow 1990: 34). As a result of damages suffered by canal companies from the reoccurrence of flash floods in the Arkansas Basin, and coupled with the fact the State of Kansas filed its first of many law suits against the State of Colorado, the federal government created John Martin Reservoir, originally referred to as the Caddoa Reservoir Project, just east of Lamar. At the time John Martin was constructed (1939 to 1948), it was the largest reservoir in Colorado. Located in Bent County, John Martin Dam is 2.6 miles in length and rises 118 feet above the streambed creating a reservoir with the holding capacity of 618,000 acre feet of water.[5]

> "Work on the John Martin dam actually started before the compact agreement was reached. Earth work and cement were in place before W.W.II, but because of the shortage of steel, flood gates weren't put in until after the war. The capacity of the John Martin is 600,000 acre feet. It is the largest reservoir in the Sate of Colorado, providing you could ever get it full. There are 400,000 acre feet in the conservation pool and 200,000 acre feet for flood control" (Milenski 1990: 154).

Figure 7: Map of John Martin Reservoir



John Martin Reservoir was an essential part of a comprehensive flood control and water management plan for the Arkansas River basin. "In 1952, John Martin Dam stored no water at all. Then, and until May 18, 1955, it had very little water. On May 18, 2955, flood waters washed out a number of the diversions above John Martin and the reservoir

[5] This information was taken from http://sangres.com/features/johnmartin.htm.

was able to accumulate 244,315 acre feet of water in May of that year" (Milenski 1990: 154). John Martin Reservoir was administered by a six member compact commission, three members were from Colorado and three members were from Kansas. "One of the commissioners had to be from above District 67 in Colorado, one from District 67 below the John Martin, and one from the Colorado Water Conservation Board. The ones from Kansas included their State Engineer, a representative from the Finney and Kern County Association, and a water user of the Arkansas River in Kansas" (Milenski 1990: 45). The John Martin Reservoir does not have a river decree, but with the exception of water available through the Winter Water Storage Program and special orders from the Army Corps of Engineers, neither Pueblo Reservoir nor Trinidad Reservoir could store native water until the John Martin Reservoir was filled (Milenski 1990). The compact agreement that created John Martin Reservoir was not intended to impede future development in the Arkansas River basin for Colorado or Kansas, but one of the stipulations for operating John Martin Reservoir states that no one can do anything to materially affect the water in the reservoir. "This is one of the thorns that sticks in the backs of the people upstream from John Martin. Since the dam was only about 60 miles from the state line, everyone upstream had to tighten their belts in bad years so the dam would not be materially affected" (Milenski 1990: 44).

On-Channel Reservoir Building – Federal Efforts – Pueblo Reservoir and the Frying Pan/Arkansas River Project (1962 to 1990)

Finally, Pueblo Reservoir was the last major reservoir constructed by the Bureau of Reclamation in the lower Arkansas River basin. Pueblo Reservoir, which finally went on line in 1980, was designed to regulate storm flows on the Arkansas River and as a storage vessel once John Martin Reservoir was filled. 51 percent of the water in the Pueblo Reservoir was earmarked for municipals along the front-range and 49 percent was earmarked for agriculture (Keck 1999: 235-245).

The first thoughts of transmountain water diversions from the western slope of the Rocky Mountains to the eastern slope of the Rocky Mountains were directed at stimulating and sustaining economic growth in a booming post World War II economy. The community leaders in the lower Arkansas River basin recognized the economic potential of the Arkansas Valley, but those same leaders realized that without water this economic potential would fail to be realized. This inspired the leaders in the lower Arkansas River basin to push for the capture and transfer of west slope water to the irrigated fields and growing communities on the east slope. The original plan was for to divert water from the Gunnison River, as well as many of the tributaries of the Colorado River. However, as time, passed the original plans were limited to the first phase of the project, which diverted water from the Fryingpan River near Aspen, Colorado. The diversion of water from the Fryingpan River resulted in the project being referred to as the Fryingpan/Arkansas River Project. This name took on even more significance when the people in the Arkansas Valley started selling golden frying pans in order to send representatives from the Arkansas Valley to lobby the U.S. Congress in support of building the project.

> "The sale of golden frying pans in the valley were brisk. Burros were used to carry the frying pans to towns up and down the Arkansas Valley. During Water Week in January of 1955 groups were able to buy small frying pans for $5 and large ones for $100 or more. More than $30,000 was raised by the end of the week. The money was used to send backers of the project to Washington D.C."[6]

[6] The information was taken from the website of the Southeastern Colorado Water Conservancy District http://www.secwcd.org/History%20and%20Description.htm.

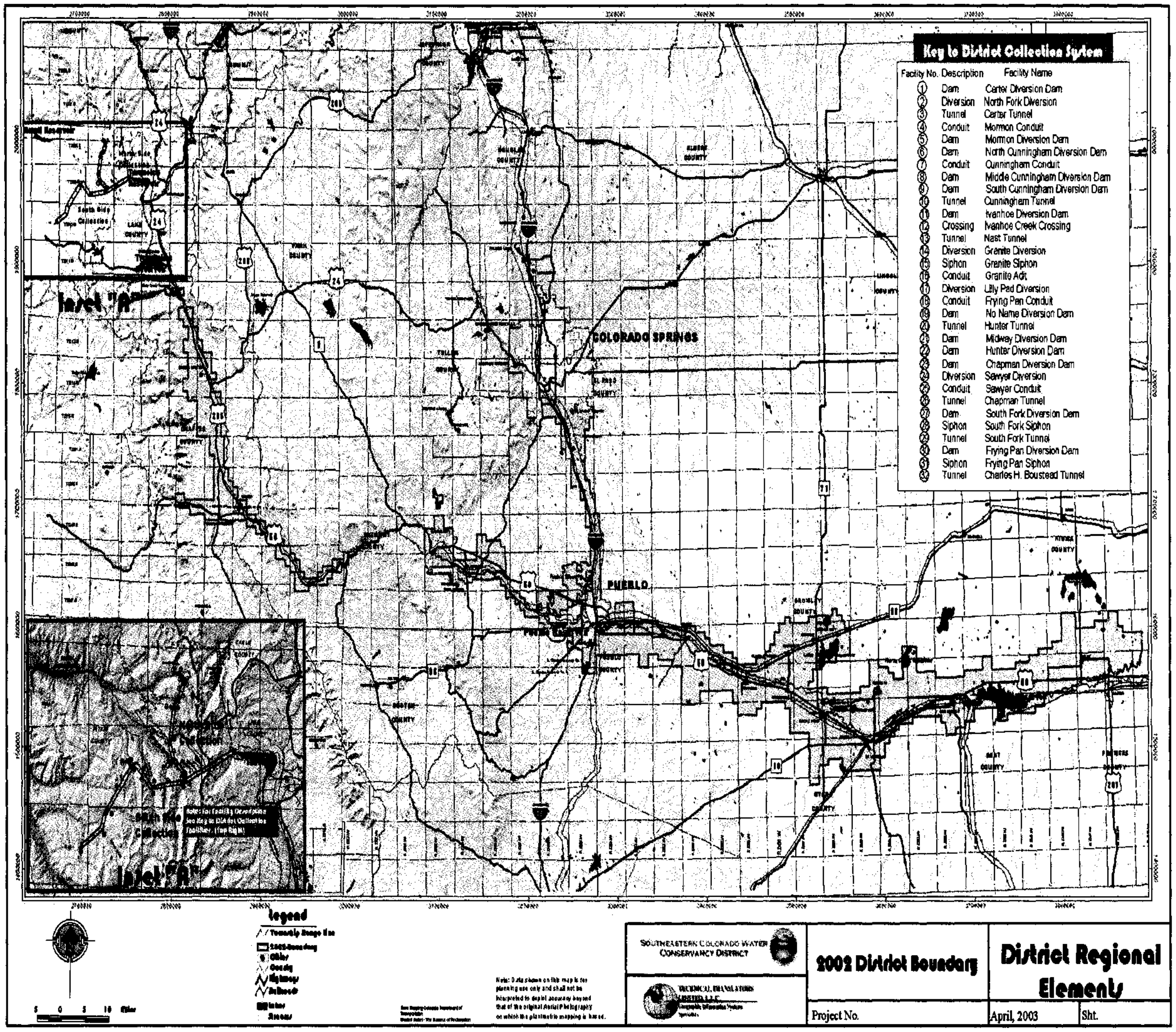
The Fryingpan/Arkansas River Project was finally authorized by the U.S. Congress and signed into law (Public Law 87-590) by President Kennedy on August 16, 1962, and on January 21, 1965 the Southeastern Water Conservancy District entered into a repayment contract with the U.S. government for the repaying the construction costs of the project. The first phase of construction started in 1964 with the creation of Reudi Reservoir and continued without interruption until September 29, 1990 when the fish hatchery was dedicated at Pueblo Reservoir.

The project consists of two distinct areas, one on the west slope located in the Hunter Creek and the Fryingpan River basins and one on the east slope in the Arkansas River basin.

> "The operation of the Fryingpan-Arkansas Project begins at Ruedi Reservoir, located 15 miles east of Basalt, Colorado west of the Continental Divide. Ruedi Reservoir provided a "compensation" for the diversion of water from the Colorado River basin to the Arkansas River basin. The diversion began with the North and South Side Collection Systems, which collected the high mountain runoff and conveyed water into the portal of the Charles H. Boustead Tunnel. A total of 16 diversion structures, containing eight tunnels, on the west slope were used to divert water into the Project collection system. The Boustead Tunnel transferred water from the North and South Side Collection Systems under the Continental Divide into Turquoise Lake near Leadville, Colorado. Project water then reached Mt. Elbert Forebay, where water was used to generate power. The water reaches Twin Lakes and was released to Lake Creek and the Arkansas River. It was at this stage where the delivery of Project water began for water users upstream from Pueblo Reservoir. The water then reaches its terminal storage facility for the Project at Pueblo Reservoir. Project water was released to the Arkansas River for irrigation and municipal use within the nine-county service area of the District; Bent, Chaffee, Crowley, El Paso, Fremont, Kiowa, Otero, Prowers and Pueblo Counties"(SECWCD 2004)[7].

[7] This information came from the Southeastern Colorado Water Conservancy District's website: http://www.secwcd.org/History%20and%20Description.htm)

Figure 8: Map of the Fryingpan/Arkansas Project



Source: (SECWCD 2006)

The primary management objectives of the Fryingpan-Arkansas Project were as follows:

1. Maximize the storage of Project water from both the west slope and east slope.
2. Fill Turquoise and Twin Lakes each year during the summer.
3. Keep Turquoise and Twin Lakes full during the summer and early fall to provide recreational opportunities (this objective has been added since the Project was originally authorized by federal legislation).

4. Minimize the loss of Project water to evaporation.
5. Maximize electric power generation at the Mt. Elbert Power Plant.
6. Fulfill contractual obligations for providing storage space and conveyance facilities.
7. Deliver water at the time and place of needs to customers of the Southeastern Colorado Water Conservancy District (Management, Reclamation et al. 2000: 18).

The Southeastern Colorado Water Conservancy District

The creation of the Southeastern Colorado Water Conservancy District was the end result of a collective vision to make the Arkansas River basin less vulnerable to drought and to transport enough water from the western slope to provide for growing cities and irrigated agriculture on the eastern slope. The dustbowl days of the 1930s taught farmers the harsh realities of irrigating in a desert, and during those times of severe drought, community leaders created a plan to attain transmountain water to create a plentiful supply of water for development in the Arkansas River basin. These community leaders pooled their resources and lobbied the U.S. Congress to authorize the Fryingpan-Arkansas Project.

The Southeastern Colorado Water Conservancy District was originally created by the District Court of Pueblo, Colorado on April 29, 1958 for the purpose of developing and administering the Fryingpan/Arkansas Project. The creation of the Southeastern Colorado Water Conservancy District was a necessary first step for the development of a federal reclamation project. Due to the stipulations of the Reclamation Act of 1902, in order for the federal government to begin construction on a project, they need a local sponsor; therefore, without a local sponsor to take over and maintain the project once construction is finished, the federal government cannot begin construction of a project. The district was the legally responsible entity in charge of paying for the project, as well as "making supplemental water from the Fryingpan-Arkansas Project available for use by approximately 280,600 acres of irrigated land under various private and mutual ditch companies, and for use by the many municipal and domestic water suppliers who directly serve the District's approximately 600,000 constituents" (www.secwcd.org/history.htm). The district was governed by fifteen directors representing nine counties; all elected by the state's district court system and served four year terms.

> "The board of directors distributed and accepted applications from municipal and agricultural water users each spring. This began the process of allocating the available water from the Fryingpan-Arkansas Project. By May 1 of each year, the Bureau of Reclamations estimated the amount of water available for allocation based on estimates of spring runoff available for diversion in the project collection system. This estimate of allocable Fry-Ark diversions was the basis for the allocation, which was finalized by the board at their May meeting...The district's allocation principles allow for domestic use of project water to take priority over irrigation usage. Fifty-one percent of the available water was reserved for that purpose, and forty-nine percent was reserved for irrigation purposes" (SECWCD 2001: 13).

The Southeastern Colorado Water Conservancy District assumed responsibility for payment of the Fryingpan-Arkansas Project in 1982 with the beginning balance of $132.2 million to be repaid to the federal government. Of that $132.2 million, $57.8 million was to be paid by municipal and industrial water users and $74.3 million was to be paid by irrigation water users. Over the period of 1982 to 2002 the Southeastern Colorado Water Conservancy District paid back $30.9 million; and of that $30.9 million; $26.5 million was paid by municipal and industrial water users and $4,407,922 was paid by irrigation water users. This left the Southeastern Colorado Water Conservancy District with a balance of

$101,302,502 owed to the federal government before the district assumed full ownership and control over the Fryingpan-Arkansas Project (SECWCD 2002).

The Winter Water Storage Program

The Southeastern Colorado Water Conservancy District took on other responsibilities in the Arkansas River basin as well. One project that the Southeastern Colorado Water Conservancy District has been administering since its inception is the Winter Water Storage Program. When the Fryingpan/Arkansas Project was initially conceived both the Bureau of Reclamation and the irrigators and ditch company representatives recognized the need for added storage for use during the irrigation season. In order for the Winter Water Storage Program to be possible, it was necessary to gain unanimous support from all irrigators who owned water rights decrees. In the end, eleven ditch companies participated in the Winter Water Storage Program: the Bessemer, the High Line, the Oxford, the Catlin, the Consolidated, the Riverside, West Pueblo, the Colorado, the Holbrook, the Fort Lyon, and the Amity (SECWCD 2002). The Winter Water Storage Program was governed by one representative from each participating ditch company along with one alternate. A unanimous agreement was reached in 1975 when Pueblo Reservoir went on line creating the Voluntary Winter Storage Program, and except for 1977, unanimous agreement has been reached every year since. The agreement was not reached in 1977 because one ditch company failed to agree on the start date, but even in 1977, it was recognized throughout the irrigation community that the ability to store a percentage of their legally decreed water rights was a beneficial option for farmers in the Arkansas

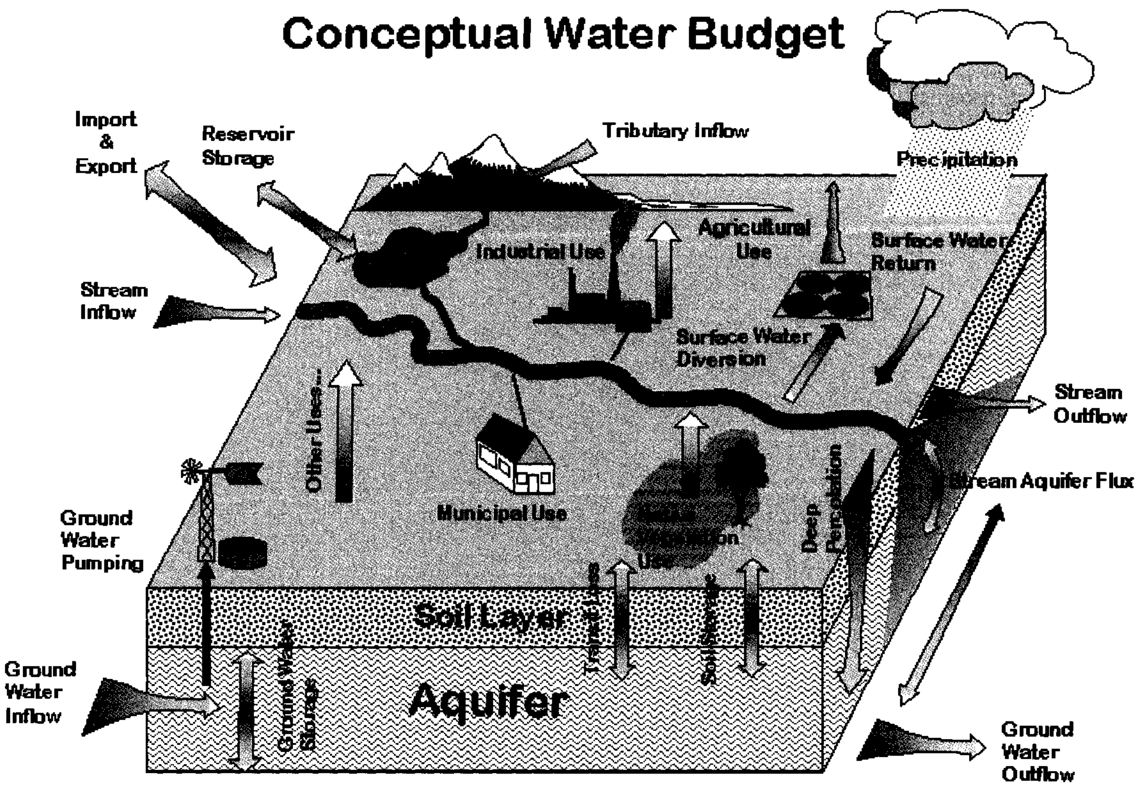
Valley. "During extremely dry years it was found that the stored water made the difference between starting a crop, and not having that opportunity. In other years, farmers were able to retain winter stored water until the fall months to help complete valuable crops" (http://www.secwcd.org/WinterWtr.htm). After years of voluntary involvement in the Winter Water Storage Program, a decree was filed on December 26, 1984 and that decree was finalized on November 10, 1990.

Surface and Groundwater Administration in the Arkansas River Basin

Surface water and groundwater were originally seen as separate sources of water in the State of Colorado, even though the State of Kansas was raising issues concerning groundwater pumping and the depletion of state line flows as early as 1950. The State of Colorado finally recognized the connection between surface water and groundwater in the 1960s with the passage of two bills: the Groundwater Management Act of 1965 and the Water Rights Determination and Administration Act of 1969. These two acts recognized for the first time in Colorado the fact that groundwater and surface water were connected, and that groundwater pumping inevitably depleted river flows, which injured senior appropriators on the river, as well as the State of Kansas. In 1985, the State of Kansas filed suit against the State of Colorado claiming that well pumping in the lower Arkansas River basin was depleting the river's flows to such an extent that the State of Kansas was not receiving its allotted 40 percent of the water stored in the John Martin Reservoir in accordance with the Arkansas River Compact of 1949.

When thinking about the hydrology of the Arkansas River basin, it should not be thought of as a direct pipeline delivering water from the headwaters in the mountains to its confluence, but as a tilted sponge comprised of river water moving between the surface water in the river channel and underground aquifers in groundwater basins as the water flows down the gradient towards its ultimate delivery to the Mississippi River.

Figure 9: Illustration of the Hydrologic Cycle in the State of Colorado



Source: (Colorado Division of Water Resources, Colorado Office of the State Engineer 2007): http://waterknowledge.colostate.edu/hydr_img.htm

Surface Water

Surface water rights were governed by Colorado's prior appropriation system. "Under this doctrine, rights to water were granted upon the appropriation of a certain quantity of water for a beneficial use. The date of appropriation determined the priority of the water right, with the earliest appropriation establishing the senior, or superior, right" (CWCB 2006: 28). Two other important stipulations for utilizing an existing water right were: "first, a water right does not include the right to waste the resource. Second, the right to use water must be sufficiently flexible to accommodate changes of use and the free transferability of water rights in order to allow the maximum use of water" (CWCB 2006: 28). When it comes to surface water rights, there were two different types: direct flow water rights and storage water rights. The user of a direct flow water right has the ability to divert the water for immediate use. In contrast, the user of a storage water rights can store the water for use at a later time.

"The perennial streams comprising the headwaters of the Arkansas River were supplied by the snowpack of the mountains surrounding the area of Leadville, Colorado" (Abbott 1985; CWCB 2006: 17). There were numerous flow measurement gauges along the Arkansas River, but four of these gauges give an accurate read of the river's flows from its headwaters to the state line: Arkansas River at Cañon City, Fountain Creek at Pueblo, the Arkansas River at Las Animas, and the Arkansas River at Lamar.

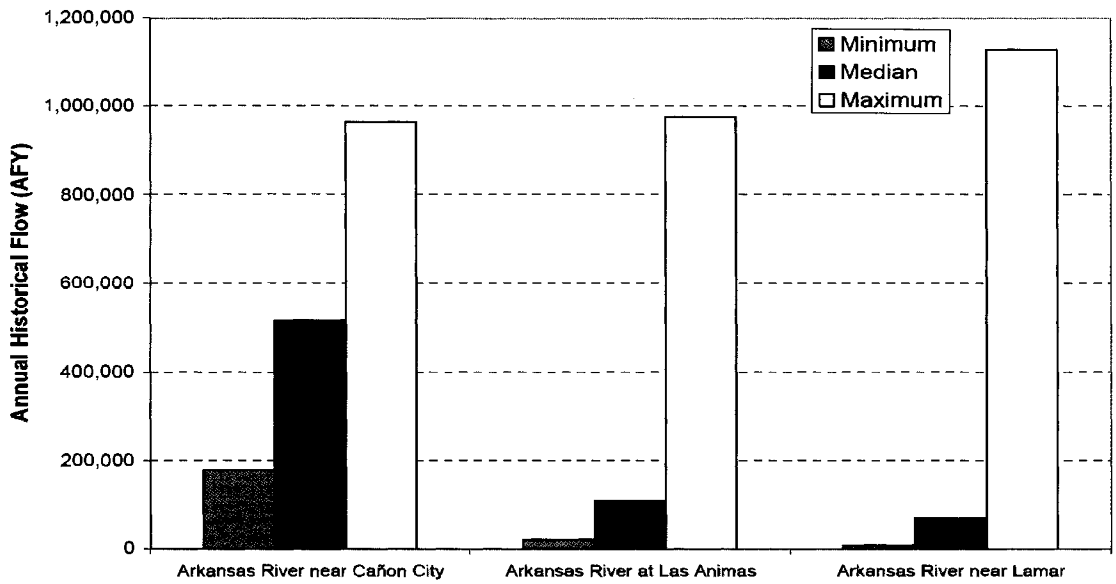
Table 7: Summary of Selected USGS Gages for the Arkansas River Basin

Site Name	Mean Annual Streamflow (afy)	Mean Annual Streamflow (cfs)	Period of Record (years)	Drainage (sq. miles)
Arkansas at Cañon City	534,289	738	1890-2002	3,117
Fountain Creek at Pueblo	73,304	101	1922-2002	926
Arkansas at Las Animas	157,836	218	1937-2002	3,306
Arkansas at Lamar	135,856	188	1913-2002	18,830

Source: (Colorado Department of Natural Resources Water and Supply Needs of the Arkansas Basin 2006)

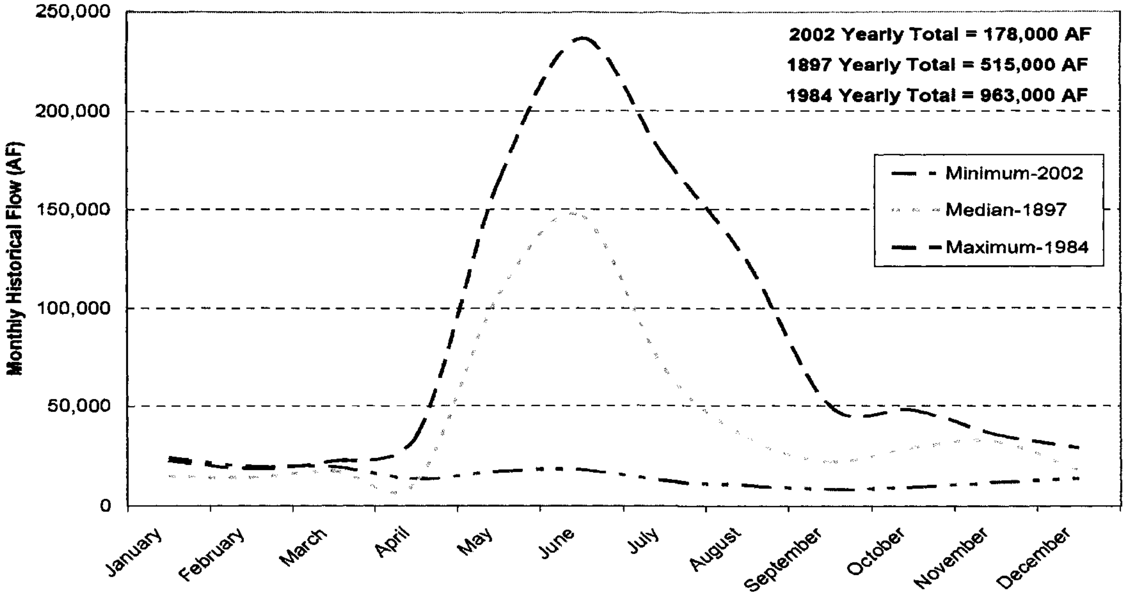
In Figure 10, we see the minimum, median and maximum flows for all of the gauges except for Fountain Creek at Pueblo, and they illustrate the impacts of river diversions and groundwater infiltration as the river flows toward Kansas. In the Arkansas River basin, water flows out of a small drainage area and produces a moderate amount of water at the Cañon City gauge, but then dropped to a small fraction of the water available at Cañon City when measured at Fountain Creek at Pueblo. However, the amount of water available in the river increased at the Las Animas gauge, and it decreased a little at the final gauge in Las Animas due to return flows coming back to the river. The next three figures, unpack the data from the previous table illustrating the minimum, median and maximum flows for the individual gauges measured over a twelve month period. These figures show the extreme variability in the rivers flow. We see that there was extreme variability in the river's flows from its headwaters to the Cañon City gauge with spikes in the river's flow during the months of April, May, June and July. This variability was also represented in the minimum, median and maximum flows at Cañon City. This variability was not as extreme when measured at Las Animas or Lamar. In the lower two gauges, very little variability in the river's flow occurs, in fact, there was very little variability exhibited in the diagrams between the median and minimum flows on the lower reaches of the river. Maximum flows found during times of flood definitely increased the river's flow, but times of flood were seldom the case in the Arkansas Valley, unlike times of median and minimum flows.

Figure 10: Minimum, Median and Maximum Annual Historic Flows in the Arkansas River Basin



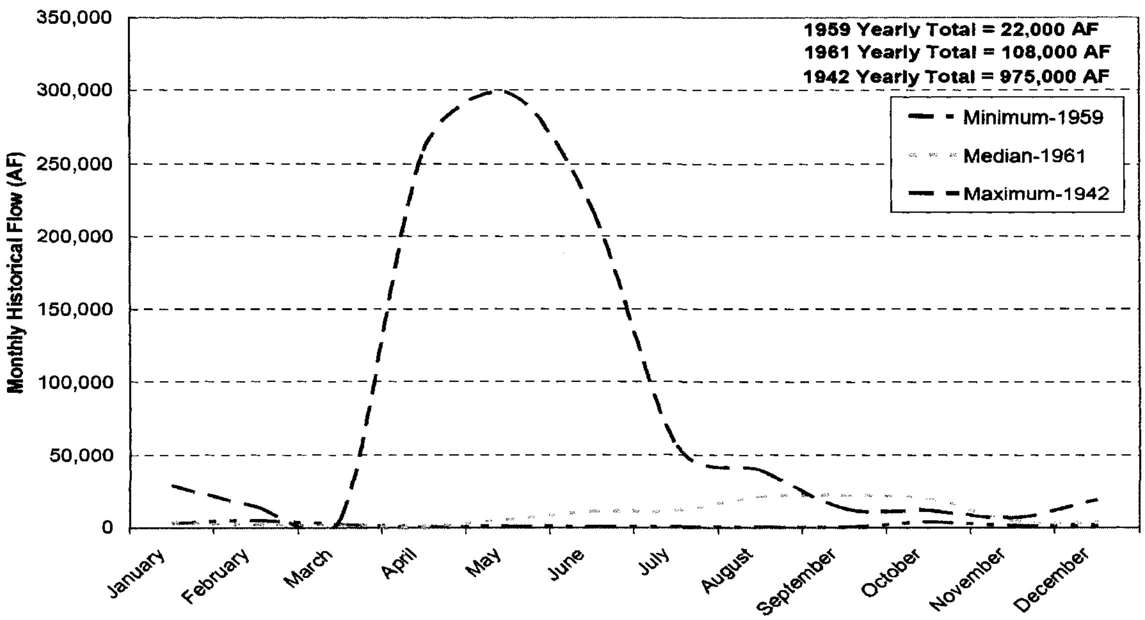
Source: (Colorado Department of Natural Resources Water and Supply Needs of the Arkansas Basin 2006)

Figure 11: Arkansas River Gage at Cañon City



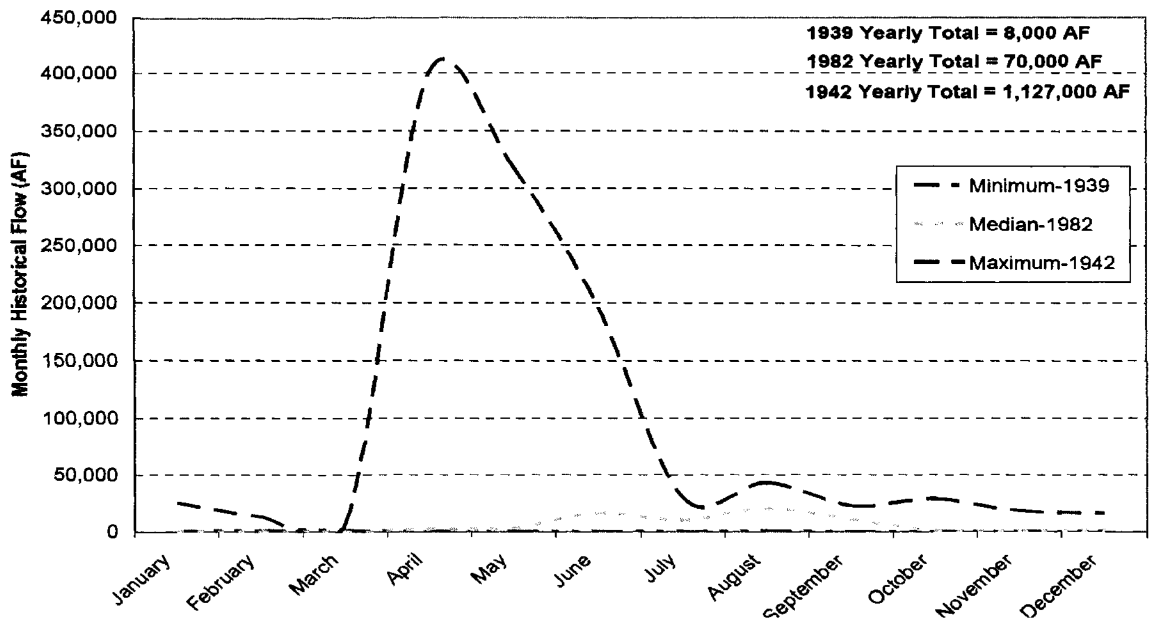
Source: (Colorado Department of Natural Resources Water and Supply Needs of the Arkansas Basin 2006)

Figure 12: Arkansas River Gage at Las Animas



Source: (Colorado Department of Natural Resources Water and Supply Needs of the Arkansas Basin 2006)

Figure 13: Arkansas River Gage at Lamar



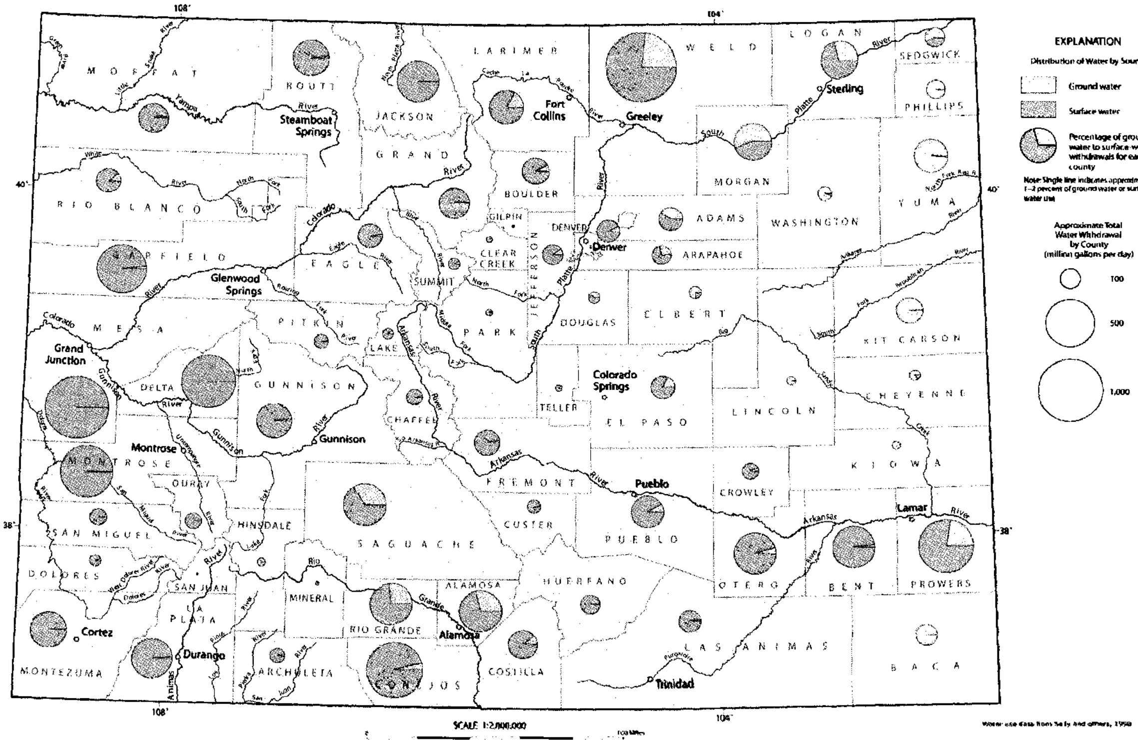
Source: (Colorado Department of Natural Resources Water and Supply Needs of the Arkansas Basin 2006)

With low river flows most of the year, it was rare when native Arkansas River flows satisfied a junior right. "Native Arkansas River flows were available for a junior water right in only 3 of 30 years evaluated. This interpretation was confirmed during the Arkansas Basin Roundtable Technical Meetings where there was consensus that there are no reliable available water supplies for development" (SECWCD 2000; CWCB 2006: 64).

Groundwater

"One of the problems ignored by most of the compacts was the relationship between ground water and free flowing water in the rivers streams" (Milenski 1990: 16). Tributary groundwater was geologically and hydrologically connected with surface flows, but this fact had not always been recognized. There have been many problems associated with deep well pumping, but the most pressing issue was the interconnectedness of groundwater flows with surface water flows. "When you remove water from a deep aquifer, it means that water which would normally be going across one level horizontally will percolate down to that lower level. This meant that shallower wells will dry up and stream flows will be reduced" (Milenski 1990: 25).

Figure 14: Distribution of Colorado Ground Water versus Surface Water Withdrawals by County in 1995



Source: (Groundwater Atlas of Colorado 2003)

Groundwater pumping gradually lowered the water table creating what was known as a cone of depression. As groundwater continued to deplete the water table, the cone of depression expanded eventually reaching the surface stream and depleting its flows. Two methods have been used to calculate return flows to the river: Glover's analytical solution and the Stream Depletion Factor (SDF). "SDF has been the more commonly used method, which was based on Glover's solution but uses a numerical groundwater model to compensate for varying aquifer properties and boundary conditions found in the field" (Warner and Altenhofen 1994: iv). The Arkansas River is a gaining river, which means that the river never completely goes dry because irrigation diversions provide return flows that recharged the aquifer below the Pueblo Reservoir. Much like the South Platte River basin, the water users in the Arkansas River basin implemented plans for augmentation in order to keep wells pumping out of priority. "With augmentation by recharge, water was diverted during times of high flow for recharge to the groundwater...The concept was to time the recharge so that it would return and augment the river when needed during the critical period of the irrigation season. This returned recharge water was therefore available in the river by the senior surface water holder to meet his irrigation need." (Warner and Altenhofen 1994: 4). Without these plans of augmentation, wells would be curtailed under Colorado law.

> "The basic concept was that groundwater pumping by wells from the alluvial aquifer of the Arkansas River caused a net depletion of streamflow in the river and resulted in injury to senior water rights...Groundwater had an important role in the agricultural development of the river basin and to completely shut down all wells to prevent injury to senior surface water rights would have drastic economic consequences" (Warner and Altenhofen 1994: 4).

Once the Colorado Office of the State Engineer approves the augmentation plan, the office monitors and credits the well users association for the water they have recharged to the river in order to supplement their out-of-priority well depletions.

Groundwater augmentation sites must deliver recharge water to different sites depending on the available water supply in the river during spring runoff. Recharge sites with low SDF usually deliver water back to the river two to three months after recharge. Recharge plans with large SDF values were constantly recharging the aquifer with small amounts of water establishing long-term water bank accounts storing flows for future use.

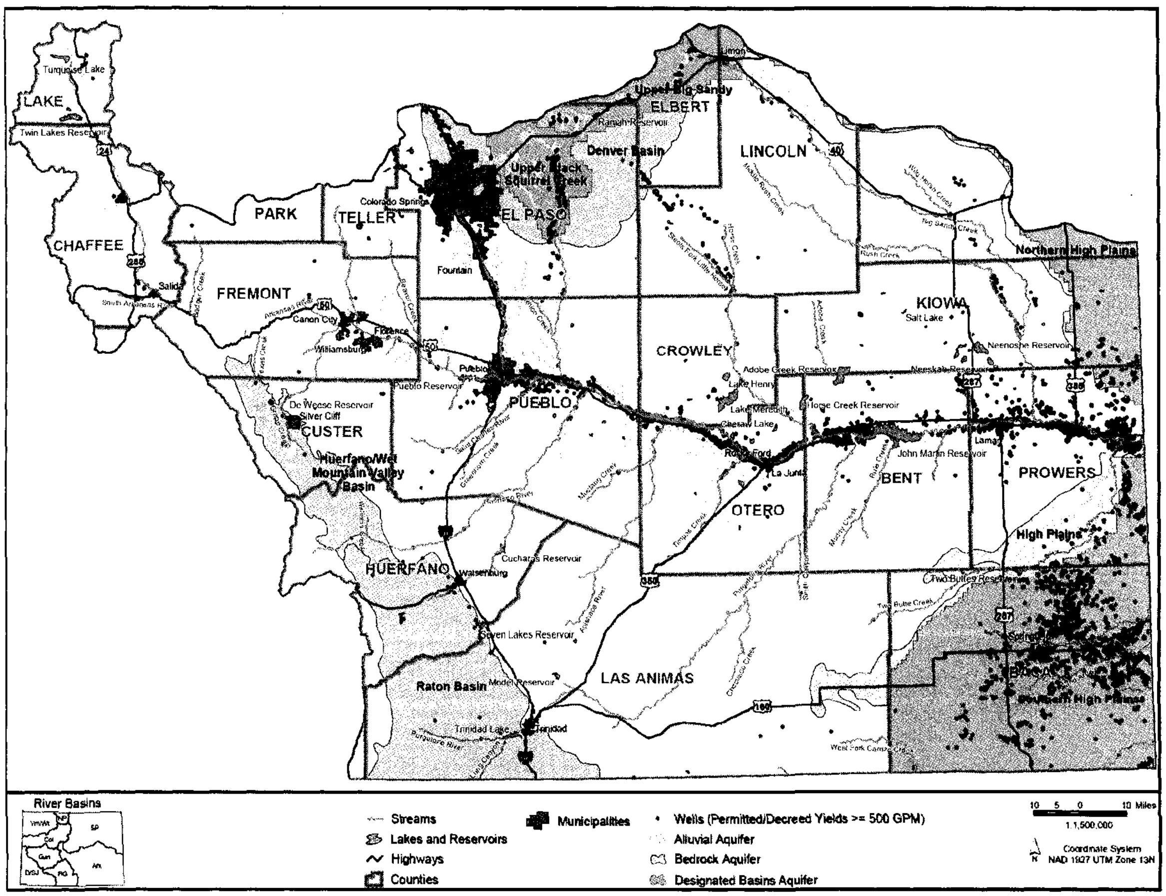
> "If there was a limited supply for diversion to recharge sites during the spring runoff moths of April, May, and June, then it was best to put the supply in recharge sites close to the river with low SDF values so that river accretions were available in that same year. Diversions for recharge from a plentiful spring runoff on winter time river flows should be spread among sites with medium to large SDF values. By such groundwater reservoir banking wells can continue pumping in future years of drought even though the surface water supplies of those drought years will limit the amount of recharging that can be accomplished in those years" (Warner, and Altenhofen 1994: 56).

Groundwater pumps were now seen as alternative points of diversion requiring a decreed junior water right that must be authorized by the Colorado Office of the State Engineer. In an over-appropriated river basin like the Arkansas River, these surface depletions can prevent senior rights holders from appropriating their decreed water right, which eventually results in court cases curtailing junior well appropriators, forcing them to shut off the pumps until they establish plans to recharge the rivers flows and protect senior rights holders from being materially injured. The social solution came in the form of well augmentation plans that used revenues from shares sold in a groundwater users association to buy replacement water used to return the pumped water to the river to insure that senior water rights holders have available water supplies when needed.

The first set of wells using centrifugal pumps was dug in the 1930s to address the drought conditions of the Dust Bowl era of agriculture. Well pumping really came on strong shortly after World War II with the introduction of affordable electricity and the development of the high-capacity turbine pumps. According to Milenski, "It seemed that every ten years after 1934, it was dry; 1944 was dry, 1954 was dry, and 1964 was dry.

These were all big years for the increased use of ground water pumps...Most of the people drilled wells for supplemental water; they also had water rights in existing canal companies" (Milenski 1990: 25). These new wells drew water from the shallow alluvial deposits and the deep wells from the Dakota and Cheyenne sandstone aquifers (Keck 1999). "The Dakota-Cheyenne aquifer lies under the majority of the Arkansas Basin. The stratigraphy ranged from well-sorted sandstone to fine-grained shales. The aquifer provided water for irrigation and domestic water supply in the basin. Due to the diversity of the aquifer stratigraphy, well yields can range from around 5 gpm to over 1,000 gpm" (CWCB 2006: 18).

Figure 15: GIS Map of the Lower Arkansas Valley Groundwater



Source: (Colorado Department of Natural Resources 2006: 25)

The State of Colorado has designated four different types of groundwater: tributary, non-tributary, designated basin and the Denver Basin.

1. Tributary groundwater is water that is hydrologically connected to the stream.
2. Non-tributary water is located outside a designated basin, and withdrawal will not deplete the river within a 100-year period.
3. Designated basins are not adjacent to a continuously flowing stream or required to fulfill decreed surface water rights, but are located within the boundaries of a designated basin as defined by the legislature.
4. Denver Basin is groundwater that is located within the boundaries of the Denver Basin as defined by the legislature in 1985 (CWCB 2006: 56).

"The Arkansas River basin drained a 28,273 square mile area in the southeastern quarter of Colorado. The basin defined Water Division 2 with the divisional office in Pueblo. As of early 2001, there were over 5,450 alluvial wells of record in the Arkansas River basin" (Topper 2003: 5.2). "Figure 16 shows the outline of the aquifers broken down into three groups: alluvial, bedrock (Raton Basin and Dakota-Cheyenne), and Designated Basin (High Plains). Also shown in the Figure 15 was the location of the wells in the Arkansas Basin with a permitted or decreed yield of 500 gallons per minute (gpm) or higher" (CWCB 2006: 18). The unconfined alluvial aquifer in the Arkansas River basin was recharged through surface water flows from the Arkansas River and its tributaries, as well as leaky ditches and canals that distribute those flows around the basin ultimately applying that water to fields in the valley. The depth of the water table in the lower Arkansas River basin ranges from 5 to 30 feet, but it seems as if the water table has been rising since the 1970s. This trend is most likely attributed to return flows from irrigated agriculture, but it must also be noted that irrigated agriculture is the major draw off the groundwater. "The Division of Water Resources well permit database contained over

3,400 wells that have been completed in the Lower Arkansas River basin alluvium. Over 90 percent of these wells were completed at depths less than 120 feet below ground surface with a mean depth of only 58 feet" (Topper 2003: 5.2).

The High Plains aquifer is located in the northeastern and southeastern parts of the basin. The High Plains aquifer had been labeled a "Designated Basin" by the State of Colorado. "A Designated groundwater basin was not adjacent to a continuously flowing natural stream or a stream that fulfilled a surface water right" (CWCB 2006: 18). Since establishing well pumping in the Arkansas Basin, the High Plains aquifer had been a major source of water for the southeast part of the state. "Because of this, groundwater withdrawals have exceeded recharge since the early 1960s" (CWCB 2006: 18).

The number of wells in the area increased dramatically due to the lack of surface water during times of drought. According to Keck, the Federal Housing Authority funded the development of forty small companies in Otero County to install artesian wells using electric pumps. This push for new pump technology made the wind driven pumps a memory of the past. Well pumping became a regulated water use in 1957 when a permitting process was instituted in Colorado. After 1957, a water user was required to attain a permit to drill a water well.

> "In agriculture, the problem with ground water pumping has been that canal companies did not use the water to augment their systems. Instead it has been the individual farmer who put in wells to supplement his supply. The water after all, was under his land. Had the ditch companies put wells in, they could have developed a system like the Salt River Valley in Arizona. There the wells and the surface water are part of the same system." (Milenski 1990: 26)

In 1965, the State of Colorado went a step further with the Colorado Ground Water Management Act, which created management districts empowered to regulate the spacing of wells and setting limits on well pumping in their respective districts as well as regulating tributary wells to protect senior water rights.

> "In response to the Supreme Court's findings regarding tributary wells and surface water, the Water Rights Determination and Administration Act of 1969 was passed. Besides changing the name of the State Engineer's office to the Division of Water Resources, the act required that surface and ground water rights be administered together. Ground water rights were required to be adjudicated in order to protect their priority. Plans for Augmentation were also allowed to mitigate material injury to senior vested water rights" (Colorado Office of the State Engineer 2006: http://water.state.co.us/org/history.asp).

In 1985, the State of Kansas filed a lawsuit accusing the State of Colorado of violating the compact that Kansas and Colorado had agreed upon with the 1949 settlement. Kansas stated the violation occurred because of the operation of Trinidad Reservoir, the Winter Water Storage Plan, and because well pumping depleted the river's overall flow at the state line. The special water master dismissed the first two charges, but found the State of Colorado guilty of taking more of the rivers flows than they were allotted due to groundwater pumping in the Lower Arkansas River basin. With this ruling, came a new set of rules for well pumping in the Arkansas Valley. According to Dave Robbins[8], "It was ruled that in order to pump it, a well user had to have a source of water that he could replace back to the river system. That was why well associations in the lower valley are working furiously to "find" water today through trades, purchases and exchanges: to put back in the system for water pumped out last year" (Rich 2003). Groundwater users

[8] Dave Robbins is an attorney at law specializing in water law in Colorado. Robbins served as lead council for the state of Colorado in the Kansas v. Colorado lawsuit.

associations have also been forced to change in response to the new rules. "Since the well rules of 1996, the three major well associations in the basin — Colorado Water Protective and Development Association, Lower Arkansas Water Management Association, and Arkansas Groundwater Users Association —as well as the smaller groups like the Fort Lyon Well Users Association, have had to play by a new set of rules" (Rich 2003).

Groundwater augmentation in the Arkansas Valley had been long resisted, but now there was no longer a choice. In many respects, the reason the Arkansas Valley found itself in so much trouble was because it had no clear system for groundwater augmentation, and since the well users in the valley were drawing off the same river basin as the surface water users, they ultimately depleted the overall river flow into Kansas giving Kansas the leverage it needed to win its lawsuit with Colorado in 1995. The first action taken by the Colorado State Engineer to bring Colorado back into compliance with the compact was to shut down wells, and grant well permits only to those who could repay the river.

State Compact – Kansas vs. Colorado

Compacts allocate consumptive uses of water among states (Vranesh 1987). "A compact is both state and federal law. It is meant to govern interstate water allocation and replace the original jurisdiction of the U.S. Supreme Court, except with regard to enforcement of the compact" (Hobbs 2006: 18). Every river flowing out of the State of Colorado was governed by the establishment of a compact between two or more states claiming a legal right to the rivers flow. "Ratification of a compact may be seen as the exercise by Congress of its power to consent to interstate commerce limitations inherent in fulfillment of the compact's purpose (see also Simpson v. Highland Irrigation Co. 1996) … A state may create and vest water rights as property, but only with regard to its allocated share of the interstate waters (see also Hinderlinder v. La Plata River and Cherry Creek Ditch Co. 1938)" (Hobbs 2006: 18).

Interstate compacts in the western part of the United States were founded on the idea of equitable apportionment (Vranesh 1987). "In Nebraska v. Wyoming the Court held that the emphasis in equitable apportionment cases was the equity of the particular case and that the result would end on a variety of factors. Development factors were one concern…Future economic development would also be a concern because early economic development in one area should not preclude economic development in another area" (Vranesh 1987: 1670). Interstate compacts were also based on policy propositions that provided for the maximum beneficial use of the resource, as well as the curtailment of wasteful uses. "Physical conditions must be taken into account, and this is particularly true where tributary groundwater withdrawals may affect stream flow and vice versa" (Vranesh 1987: 1671).

In the State of Colorado, there are a number of agencies responsible for the administration and enforcement of interstate compacts. "The State Engineer, who is vested with the authority to administer water rights, is statutorily directed to administer water right in accordance with interstate compacts. Out-of-state commitments are treated as the senior priority on the stream, and in-state uses may be curtailed in order to satisfy those commitments" (Vranesh 1987: 1681). In addition to the Colorado State Engineer's Office, the Colorado Groundwater Commission was vested with the responsibility of developing rules governing the aquifer depletions. "In exercising this authority, the groundwater commission may limit depletions of interstate aquifers in order to avoid "a race to the bottom" between Colorado and those neighboring states" (Vranesh 1987: 1681).

In the Arkansas River basin, the Arkansas River Compact of 1948 allocated the consumptive use part of the Arkansas River's flows between Colorado and Kansas. This dispute dates back to the early 1900s when two ditch companies in Kansas sued the ditch companies in Colorado for over-appropriating the flows of the Arkansas River and keeping the State of Kansas from gaining access to their fair share of the river. At the turn of the 20th century, Coloradoans and Kansans who were developing the land did so with their sights set on realizing the economic potential of their land, but in order for them to do this they needed to also draw more water from the Arkansas River.

> "By 1900 Coloradoans, through the prior appropriations system, had put to use nearly all of the surface water in the Arkansas River Valley. Nearly 100 ditch systems irrigated more than 7,000 farms on more than 300,000 acres. Pueblo and Colorado Springs built elaborate public water works serving approximately 50,000 people...Through prior appropriations, most Coloradoans believed they had secured progress with the proliferation of cities, industries, and farms" (Sherow 1990: 104-105).

Sherow makes the point that development led to the over-appropriation of the river's flow, which in turn forced the irrigators in Kansas to file a lawsuit based on the premise of prior appropriations.

> "Kansas and Colorado argued diametrically opposing theories. Kansas alleged that its riparian water law should require Colorado to by-pass water supplies of the Arkansas River to Kansas because the Kansas Territory, created in 1854, had run to the Continental Divide origins of that river prior to the formation of the Colorado Territory in 1861. Colorado contended that its state constitutional doctrine of prior appropriation had been accepted by the United States Congress when Colorado was admitted to the Union in 1876; thus, all water arising in Colorado was subject to use therein." (Hobbs 2006: 18)

The new state boundaries between Kansas and Colorado did not seem to make much economic sense when considering the geography of the Arkansas Valley, especially if one lived in Kansas. "The contrived demarcation that separated Kansas and Colorado easily yielded several camps contending for control of the Arkansas River. The boundary plagued both states by neatly but irrationally dividing the river basin. All of the upper tributaries remained within the confines of Colorado" (Sherow 1990: 105-106). The lack of control over the headwaters of the Arkansas River created economic stress for irrigators in southwestern Kansas, and eventually they informed the U.S. Senate committee on the irrigation and reclamation of arid lands that Colorado was taking an unfair amount of the flows of the Arkansas River. This dispute was considered serious business in the U.S. Senate, and in response to this problem, they decided that individual states could not be responsible for dividing interstate river flows equitably. "The 'National Government' must, therefore, become the arbitrator between (Kansas and Colorado), and it should immediately intervene to divide the waters in some wise and just manner" (Sherow 1990: 106). In the end the U.S. Supreme Court ruled in favor of the State of Colorado. The court decided that there was not enough economic damage in southwestern Kansas due to the development of irrigation in Colorado. Even though this decision favored the irrigators in the State of Colorado at the time of the lawsuit, it ultimately left the State of Colorado vulnerable to future lawsuits. "Justice David Brewer balanced his award to Colorado by holding that in the event of increasing economic damage, there will come a time when Kansas may justly say that there was no longer an equitable division of benefits, and may rightfully call for relief against Colorado water users" (Sherow 1990: 116).

When the lawsuit was finally settled, the judge presiding over the case instructed the two states to iron out a fair deal, or he would instruct the water master in the case to construct a plan. "The 1980 Operating Plan for John Martin Reservoir, created compact administrators, allocated 40 percent of the stored water to Kansas and divided the remaining 60 percent among nine canal companies located in Colorado Water District 67, located downstream of John Martin" (ARWNA, 2006: 3-49). The 1980 plan also allowed Las Animas Consolidated, Fort Lyon and the Amity Canal Companies to store water in the John Martin Reservoir. This compact established water storage accounts in the John Martin Reservoir to provide water for Kansas and Colorado water users, but if this storage facility was depleted, then the burden of replacement falls on the State of Colorado.

> "The compact was supposed to assure everyone of a fair share of water. However, one of the stipulations was that water above the John Martin Dam (a dam built near Hasty, Colorado to store water for use by the Kansas and Colorado ditches) could be developed as long as it didn't materially affect the water in the John Martin Dam or the Colorado-Kansas compact. When you put a dam in 50 or 60 miles above the Kansas border and then say you can't materially affect it—this really puts the monkey on the backs of the people up above" (Milenski 1990: 15).

With the passage of the Water Rights Determination and Administration Act of 1969, the State of Colorado legally recognized the connection between surface water and groundwater ultimately setting up a test of the previous ruling in Kansas v. Colorado, where the special water master found there to be an insignificant amount of damage to downstream users in Kansas from irrigation in the Arkansas Valley to award any damages. In 1985, the State of Kansas filed a new lawsuit against the State of Colorado making the case that groundwater pumping was depleting the river's flows before reaching the state line, therefore, cheating the State of Kansas out of its 40 percent of the stored water in the

John Martin Reservoir. The liability phase of this lawsuit started on September 17, 1990 with a ruling from the special water master on economic damages in the summer of 2000 (Simpson 2002). Unlike the first ruling in Kansas v. Colorado, the State of Colorado was found guilty and Kansas was awarded a cash settlement of $28.9 million, and all the wells in the Arkansas Valley were brought into the priority system immediately. Even though the State of Kansas won this lawsuit, they were not awarded the full amount they were seeking. The State of Kansas was seeking $52.8 million for damages incurred from well pumping in the Arkansas Valley, but the court ruled that back payments would start in 1985 when the new lawsuit was originally filed, not 1969 when the State of Colorado passed the Water Rights Determination and Administration Act (Frazier 2002).

Water Administration in the Arkansas Valley

Up to this point, the different water organizations in the Arkansas River basin have been discussed, but in order to understand how these organizations operated in the valley, a discussion on how they functioned within a nexus of state water authorities is prudent. It is now time to address the linkage between local organizations and state water authorities.

The Colorado Office of the State Engineer

"The administration of the state's water is no simple task. The cooperative efforts of many agencies were required in order that the system functions as envisioned by the drafters of the Colorado Constitution" (Vranesh 1987: 453). The Colorado Office of the State Engineer was created on March 8, 1881 by the Colorado General Assembly with the responsibility of delivering and measuring the water flow in the state's streams and canals. According to the 1969 Water Rights Determination and Administration Act, "The State Engineer, acting through the division engineers, is responsible for the administration and distribution of the waters of the state on the basis of priorities established by adjudicated decrees, the Colorado Constitution, statutory and case law, and written orders of the State Engineer. Subject to the authority of the Water Quality Control Commission, the State Engineer has exclusive jurisdiction over the administration of water of the state" (Vranesh 1999: 169). The State Engineer is appointed by the governor of Colorado and must be a registered engineer in the State of Colorado with a background and experience in the administration of Colorado water. It is the job of the State Engineer to determine whether water in the state has been administered according to Colorado water law. The State Engineer achieves this goal by appointing division engineers to administer the authority of the State Engineer in each water division in the state. "The State Engineer has authority over and is responsible for the actions of the division engineers, and he provides them with the staff and other resources to carry out their duties" (Vranesh 1999: 170).

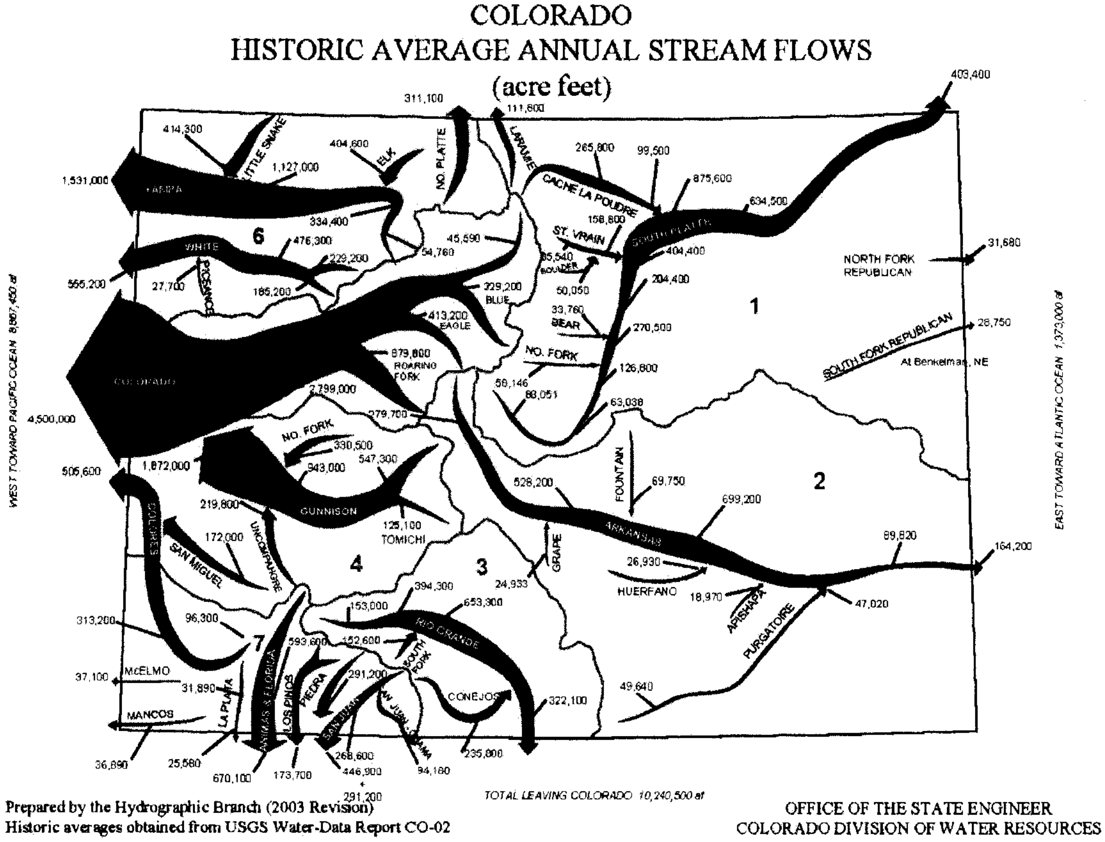
The State Engineer presides over the Division of Water Resources, which is a branch of the Department of Natural Resources. The division of water resources administers water in the State of Colorado through three sections: a water operation section, an engineering section and a hearing section. "The water operations section, divided into surface water operations and groundwater operations branch is charged with the actual administration and distribution of the state's water...The engineering section consists of the branches of engineering records, dams and reservoirs, hydrographic, and investigations...The hearing section was the source of legal services to the State Engineer in water matters" (Vranesh 1999: 171).

Division 2 Engineer

"In 1903, the Colorado legislature abolished the office of the superintendent of irrigation and in its place established the office of the division engineer...The division engineer exercised general supervisory power over the division of water commissioners and had the authority to issue regulations to insure fair distribution of water within the division" (Vranesh 1987: 480). As a result of the passage of the 1969 Water Rights Act, the State of Colorado increased the number of water divisions to seven with the 1903 legislature, which abolished the position of the superintendent of irrigation, to seven water divisions, each with a division engineer and a river commissioner, as well as an administrative office of the division engineer. There are seven recognized water divisions in the State of Colorado. The offices are maintained in the following locations:

1. Division 1: South Platte Basin located in Greeley
2. Division 2: Arkansas River basin located in Pueblo
3. Division 3: Rio Grande River Basin located in Alamosa
4. Division 4: Gunnison River Basin located in Montrose
5. Division 5: Colorado Main Stem located in Glenwood Springs
6. Division 6: Yampa and Green River Basin located in Steamboat Springs
7. Division 7: San Juan River Basin located in Durango

Figure 16: Colorado Historic Average Annual Stream Flows



Each division has a division engineer, a water commissioner and a water court. "Since the water of every natural stream was the property of the public, and since from the very first it was recognized that there would not be enough water at the time of need to fulfill every requirement, a system of administering the water had to be implemented" (Vranesh 1987: 453).

> "While the administration of water was the responsibility of the State Engineer, the actual distribution of water was carried out through the offices of the division engineers. The division engineers are governed in water distribution by priorities for water rights and conditional rights as established by adjudicated decrees…The division engineers' authority to distribute water was limited to decreed rights; a court cannot direct the engineers to distribute water for which there was no adjudicated right" (Vranesh 1987: 484).

The Division 2 Engineer administers the Arkansas River Compact Administration and is responsible for administering priority and well augmentation rights during the irrigation season, water releases and exchanges during the winter months and ensuring that Colorado is complying with the agreements reached between Kansas and Colorado under the Arkansas River Compact. Presently the position of Division 2 Engineer is held by Steve Witte.

Division 2 Water Court

Unlike Wyoming, Colorado has a court run and adjudicated system. Elwood Mead, serving as the Wyoming State Engineer, created a water administration system now referred to as the Wyoming System of Water-right Enforcement. Lagrange was involved in the development of both the Union Colony Canal as well as the Fort Collins Canal, and he saw the problems associated with the over-appropriation of the Cache la Poudre River as a result of the settlement between the two communities. The Wyoming system elected to use an administrative board to determine property rights relative to water because the problems associated over-appropriation with the water courts in Colorado. In Wyoming, "The engineers liked the system because it provided determination by men versed in hydrology, men who were familiar with miner's inches and cubic feet per second. The members of the legal profession, on the other hand, opposed it because they regarded the board's determination as an exercise of judicial powers, in violation of the separation of powers principle of the American constitution" (Dunbar 1992: 112).

In Colorado, there is one court per division. Water courts are also a result of the passage of the 1969 Water Rights Act. "Each water court consisted of a water judge who was appointed by the supreme court from the various district court judges in the division, a water referee who was appointed by the water judge, and a water clerk who was appointed from the clerks of the district in which the judge normally sits"(Vranesh 1987: 384-385). With the passage of the 1969 Water Rights Act, the duties of the water commissioner changed, instead of running the irrigation districts originally established by the State of Colorado, they now serve as an assistant to the division engineers. "The duty of the water commissioner was primarily to divide the waters of the district among the users according to their priorities. Other duties included supervising and directing the placing of headgates and wastegates and keeping the streams clear of unnecessary dams or other obstructions" (Vranesh 1987: 472).

Water Organizations at Work in the Arkansas Valley

There were many water organizations managing water in the Arkansas Valley. The primary organizational forms governing these organizations were mutual ditch companies, conservancy districts, ground water users associations and cities and towns. These organizations managed their water portfolios in compliance with the Division 2 Engineer located in Pueblo, Colorado who administered water rights in accordance with Colorado water law and any existing interstate compacts that bounded the State of Colorado.

Mutual Ditch Companies

The mutual ditch company was an extension of the joint ditch company found throughout the west in the late 19th century and early 20th century (Vranesh 1999). "Farmers soon realized that it was inefficient and in some cases impossible for every settler to have his own ditch, so they worked together to construct large ditches that would carry water to several farms. Initially this cooperation took the form of common or joint ditches" (Vranesh 1999: 277). "The joint ditch company was usually comprised of a relatively small number of participants and it was not likely to be governed by extensive rules, regulations, or agreements" (Vranesh 1999: 278). New forms of organization were necessary as water delivery systems became more capital intensive and complex. The two earliest forms that developed in the State of Colorado were carrier ditch companies and mutual ditch companies. "Carrier ditch was the common designation for a ditch for hire, while a ditch intended for use by its owner was generally referred to as a mutual ditch" (Vranesh 1999: 277). Ultimately, carrier ditch companies could not deal with the high costs of delivering water to farms that were located long distances from the river, and they folded and were replaced by mutual ditch companies.

> "A mutual ditch company was a cooperative formed by a group of irrigators to provide water for their fields. Like other agricultural cooperatives they were private associations organized to provide services for members. Each member was a stockholder, and each share of stock represented a share of the water supply, expressed in fractions, quantity, or irrigated acreage" (Dunbar 1992: 28).

Mutual ditch companies have existed in the Arkansas Valley since the late 1800s. "With or without incorporating, individuals may unite to form a company for construction and management of irrigation ditches. Shares of stock usually represent water rights associated with the enterprise. Nonprofit incorporated organizations created in this manner were known as mutual ditch companies" (Vranesh 1999: 282; Dunbar 1992 & Maas and Anderson 1978). Articles for incorporation of a mutual ditch company were very similar to those for creating a private corporation with one important exception, its distribution of assets. "The assets of a mutual ditch company were primarily limited to water rights and ditch systems; its purpose was the distribution of water, not profits, to its shareholders. This aspect of mutual ditch companies sets it apart from other types of corporations, and accordingly, Colorado has adopted a special article in its statutes dealing exclusively with ditch and reservoir companies to augment its general corporation laws" (Vranesh 1999: 283-284). As a result of the Ditch and Reservoir Company article found in the Colorado corporation law and the Nonprofit Corporation Act, mutual ditch companies were empowered to assess stockholders for maintenance of ditches and reservoirs on their system.

"This power to make assessments distinguished ditch and reservoir companies from other corporations which must use earnings, loans, or sales of stock or corporate property to raise money" (Vranesh 1999: 284). The power to make assessments also made the maintenance of the mutual ditch a part of the payment structure; therefore, stock certificates purchased from the mutual ditch company varied from year to year, depending on the amount of water available that year and the transportation loss from the main diversion to the individual farmers headgate, otherwise known as the shrink and the ditch maintenance cost. Mutual ditch companies distribute their water to their members by issuing stock certificates that entitled the shareholder to a pro rata right of ownership to the water owned by a particular mutual ditch company. "Stock was most commonly apportioned among shareholders on the basis of the number of acres of land to be irrigated. One share of stock represents a constant number of acres and gives its holder a proportion of the water available in the ditch equal to the proportion of land represented by one share" (Vranesh 1999: 285).

Water Conservancy Districts

Water conservancy districts, authorized by the passage of the 1937 Water Conservancy Act, represent another organizational form that developed out of the necessity to develop Colorado's water resources (Tyler 1992). "The state was rapidly risking loss of priorities on rivers originating within its borders to other western states that were constructing projects on the waters as they flowed out of Colorado" (Vranesh 1999: 306). Water conservancy districts were the State of Colorado's attempt to conserve the state's water resources for the benefit of industry, municipalities, irrigation and the general public. Conservancy districts serve three primary purposes:

1. To facilitate the application of unappropriated water originating in the State of Colorado to beneficial use.
2. To make the best use of the State of Colorado's water for domestic and irrigation purposes, within the legal parameters of interstate compacts.
3. To facilitate cooperative agreements with the United States government under the federal reclamation laws for the construction, financing, operation, and maintenance of water projects in the State of Colorado (Vranesh 1999: 306).

Conservancy districts are formed through a formal petitioning process that required a requisite number of signatures from landowners within the proposed water conservancy district, which in turn must be filed with the district court in the county where the proposed district will be located. These signatures help establish the need and support for the new conservancy district. Once the new water conservancy district is created, it is then governed by a board of directors. "A board of directors, appointed by the court, administers the conservancy district. The board cannot exceed fifteen members and must consist of residents of the district" (Vranesh 1999: 308). Water conservancy districts are usually created to build large water works projects; therefore, one of the most important powers that a water conservancy board had was the power to levy an ad valorem tax on those within the district. Unlike mutual ditch companies that raised their operating budget through assessments and the sale of stock certificates, water conservancy districts used four different classes of taxes and assessments to fund their intended projects. "These four classes included Class A which empowered the district to levy and collect on all property, and Classes B, C, and D which were special assessment taxes for property allotted water within municipalities, public corporations, and individuals, respectively" (Vranesh 1999: 308).

A water conservancy district has many other powers outside of the main mission of financing water projects. One of the most important aspects of a conservancy district is its ability to enter into contracts with the federal government for the construction and operation of water projects along with perpetual use rights of the water held in these facilities. "It can also own and hold necessary property, construct projects, maintain works across any public street or vacant land, allot water to all land susceptible of irrigation from district sources, and acquire water and water rights trough appropriation or acquisition of stock from ditch companies" (Vranesh 1999: 309).

Groundwater Users Associations

Groundwater users associations have been present in the Arkansas Valley since the early 1970s.

> "In November 1972, the State Engineer proposed rules and regulations governing use of ground water in the Arkansas River basin. These rules became effective on February 19, 1973 ("1973 Rules"). They provided for curtailment of well pumping for not more than four days per week when necessary to prevent material injury to senior surface rights and allowed well users to avoid curtailment altogether if they had written plans to replace depletions approved by the State Engineer or used the wells as alternate points of diversion for surface rights. The 1973 Rules were not protested and were implemented" (Harrison, Sperling and Sims, 2005: 15).

Groundwater users associations were created to provide replacements to the river for depletions from groundwater pumping by members with shares in the groundwater users associations. These new associations came online in response to the changes in the State of Colorado's administration of groundwater and surface water. The 1973 rule of three days on and four days off was the law of the land. Most groundwater organizations did little in the way of promulgating rules for pumping groundwater in the early 1970s, but in 1985, the State of Kansas filed a lawsuit against the State of Colorado for over depleting the river's flows at the state line and thus preventing the State of Kansas from receiving their rightful 40 percent of the stored water held in the John Martin Reservoir. "In December 1985, the State of Kansas commenced suit against the State of Colorado in the United States Supreme Court alleging violations of the 1949 Arkansas River Compact by Colorado, including depletions of usable state line flows by post-compact wells in Colorado"

(Harrison, Sperling and Sims, 2005: 15). Due to this lawsuit, the Colorado State Engineer immediately promulgated rules that placed stringent measurement requirements on groundwater pumping in the Arkansas River basin. In 1995, Governor Ray Romer established the Arkansas Valley Commission in an effort to establish rules to govern groundwater pumping in the valley. These new rules were established after water users in the valley were able to give their input into the problems associated with groundwater pumping, and in the end it was decided that the new rules must take care of the problem of state line depletions in order to make the State of Kansas whole in reference to the Arkansas River Compact. It was also decided that groundwater users needed to make sure that senior surface water appropriators were protected from river depletions due to groundwater pumping.

In the lower Arkansas River basin there are three groundwater users associations that run augmentation plans in order to replace river depletions due to groundwater pumping from their members. "These include Arkansas Groundwater Users Association which had approximately 400 member wells (AGUA), Colorado Water Protection and Development Association which had approximately 800 member wells (CWPDA) and Lower Arkansas Water Management Association which had 650 member wells (LAWMA)" (Harrison, Sperling and Sims, 2005: 17). AGUA and CWPDA primarily service well users above the John Martin Dam by leasing water from the City of Colorado Springs, Pueblo Water Works and the Southeastern Colorado Water Conservancy District, whereas the primary service area for LAWMA was below the John Martin Reservoir and they augmented their river depletions through the purchase of senior agricultural water rights financed through low interest loans acquired from the Colorado Water Conservation Board.

All of these groundwater users associations are organized along the lines of the traditional mutual ditch companies that have been active in the valley for more than 100 years. As with other organizations using the mutual ditch company form, groundwater users associations are not-for-profit entities that are comprised of members who bought shares in the organization and then received the benefit of water deliveries to replenish the rivers flows due to their groundwater depletions which were taken out of priority.

Municipalities

"Colorado municipalities had traditionally obtained water by four basic methods: appropriations, purchase, condemnation, and leasing" (Vranesh 1999: 317). Municipals had been accessing appropriative rights to water in accordance with the priority system in the State of Colorado since their inception. Even though the courts had recognized municipal use as a beneficial use, they did not give municipals any special standing within the priority system. "Although the Colorado Constitution established a preference for municipal water use, the Colorado Supreme Court had not allowed cities and towns to obtain appropriative rights outside of the priority system...the court held that a municipal corporation had no different status from that of an individual or any other party to the proceeding" (Vranesh 1999: 317). In an effort to help municipals deal with the special water problems created by rapid population growth, the courts came out with a ruling as early as 1939 called the Great and Growing Cities Doctrine, where the courts encouraged and gave deference to growing cities working on long-term water plans that would account for future growth.

With the scarce availability of unappropriated water in Colorado, the municipals had to search for alternative solutions, and one of the most utilized alternatives was the outright purchase of a water right from a willing seller. "The supreme court first considered and approved the right of a municipality to buy a farmer's senior water right and to transfer it to a municipal use in *Strickler v. City of Colorado Springs*[9]." The court spelled out their intent of the previous law in *Farmers Highline Canal & Reservoir Company v. City of Golden*[10]:

> "There was absolutely no question that a decreed water right was valuable property; that it may be used, its use changed, its point of diversion relocated; and that a municipal corporation was not precluded from purchasing water rights previously used for agricultural purposes and thereafter devoting them to municipal uses, provided that no adverse affect be suffered by other users from the same stream, particularly those holding junior priorities" (Vranesh 1999: 319).

Municipalities also have the ability to condemn water rights, but due to the expensive nature of this process and the unpopular social response before and after the fact, they rarely make use of this power. Colorado cities also lease surplus water supplies among themselves as well as leasing water to and from mutual ditch companies, conservancy districts and irrigation districts. "In 1931 the legislature enacted a statute recognizing the right of any municipality with a population over 200,000 to lease its surplus water without fear that its vested rights would be impaired by downstream

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[9] 16 Colo. 61, 26 P. 313 (1891).

[10] *Id.* At 579, 272 P.2d at 631. *See also City of Thornton v. Bijou Irr. Co.*, 926 P.2d 2 (Colo. 1996); *City of Westminster v. Church*, 167 Colo. 1, 445 P.2d 52 (1968); *Green v. Chaffee Ditch Co.*, 150 Colo. 91, 371 P.2d 775 (1962).

appropriators claiming a right to the return flow from such leased water."[11] As a result of this legislature, the leasing of water acquired for future growth has served as a primary strategy for redistributing water among eastern slope cities. One last strategy being used by municipals is that of water exchanges between irrigators and municipals. "The idea behind these exchanges was to create a mutually beneficial arrangement whereby a city received first use of a farmer's water and then released treated, nutrient-rich effluent to the farmer's ditch...By this process, the city obtained a reliable water supply and advanced purification of its wastewater through land treatment; the farmer retained his water rights and enjoyed improved agricultural production from the wastewater" (Vranesh 1999: 321).

Municipalities like Colorado Springs and Pueblo have been at work in the Arkansas Valley since their arrival on the scene in the early 1900s. Recently, out-of-basin cities like Aurora and Thornton have come down to the Arkansas Valley looking for water to buy or lease from farmers. Of all these cities, Aurora has been the most successful at buying irrigation water that had traditionally served agriculture in the Arkansas River basin and transferring the consumptive use of that water out of the basin for metropolitan use in the South Platte River basin. The case of Aurora was a special case, and it is worth spending a little time looking at its details.

The City of Aurora rests east of Denver covering 144 square miles of land in Adams, Arapahoe and Douglas counties and is located in the South Platte River basin. Aurora is ranked as the third largest city in Colorado with 290,000 residents. From the early 1900s to the late 1980s, Aurora received the majority of their water from Denver, but as the two towns continued to compete for growth throughout the 20th century, Aurora began to diversify its water portfolio. Now Aurora possesses water rights in the South

[11] C.R.S. § 31-35-201 (1998).

Platte River basin where it is geographically located, the Colorado River basin and the Arkansas River basin. Aurora draws roughly 47 percent of its water from the South Platte River basin, 24 percent from the Colorado River basin and 23 percent from the Arkansas River basin (Rich 2003). In the South Platte River basin, Aurora draws an average of 35,000 acre-feet of water from Antero, Spinney Mountain and Eleven Mile Reservoirs. This water is then delivered to Strontia Springs Reservoir where it is piped to Aurora.

Aurora obtains approximately 24 percent of its water from the Colorado River basin (Rich 2003). Aurora had worked closely with both Colorado Springs and Pueblo to finance water projects that delivered water from the western slope of the Rocky Mountains to the cities and agricultural water users on the eastern slope of the Rocky Mountains.

> "The water came from three systems on the western slope and the Homestake Reservoir in the amount of 12,000 to 13,000 acre-feet per year. Together, Pueblo and Aurora own the Busk-Ivanhoe system, which brought 2,500 acre-feet to the city, and about 5 percent of the Twin Lakes system, which provided another 2,700 acre-feet of water each year. All of this water eventually flowed through the Twin Lakes system, which the lower Arkansas Valley uses for its Fryingpan-Arkansas Project water. Water from Twin Lakes was then taken out at the Otero Pump Station, which was owned by Aurora and Colorado Springs" (Rich 2003).

Aurora also gets approximately 23 percent of its water from the Arkansas River basin (Rich 2003 & Porter 2002). This water primarily comes from three different water transfers where in the first two cases the city of Aurora purchased water rights on the Colorado Canal and the Rocky Ford Ditch. "Water owned from these two to date averages 17,000 acre-feet annually, and Aurora already owns 32 percent of the Colorado Canal and 58 percent of the Rocky Ford Ditch. The city of Aurora will claim an additional 36 percent of the Rocky Ford Ditch when the city's most recent purchase of water rights on the Rocky

Ford Ditch goes through" (Rich 2003.) Aurora can gain access to this water by changing the original point of diversion through adjudication from the water court, which allows Aurora to take out the water upstream. In the third case, the City of Aurora leased water from the City of Pueblo. This water lease between the two cities accounts for approximately 6 percent of Aurora's water supply.

The City of Aurora was always on the lookout for new water resources to fulfill its growth needs, and their approach created problems for water users in the Arkansas River basin. In 2003, Doug Kemper, Aurora's water resources manager, stated that the city looks 30 years ahead in regards to its water resource portfolio. Aurora was generally interested in cultivating new water projects that yielded at least 10,000 acre-feet of water per decade. "Every day it gets a little tougher and a little more expensive. Back in the 1960s and 1970s, water cost $1,000 to $1,250 an acre-foot. Now, it's $3,000 to $3,500 an acre-foot" (Porter 2002). Approximately 75 percent of Aurora's water was originally owned by agricultural water users, and those rights have been transferred to municipal uses. Aurora is still pursuing these types of transfers for the future. Kemper goes on to say that Aurora's water supplies from the Arkansas River basin and the Colorado River basin were limited by the delivery capacity of the Otero Pumping Station, which pumped Aurora's water back upstream; therefore, if the City of Aurora was able to find another way to move the water out of the Arkansas River basin, then they would.

Tools for Addressing Water Needs in the Arkansas Basin

There are a certain number of tools available to water administrators in the Arkansas Basin to address water shortages within the legal framework of the doctrine of prior appropriation. They include: water storage rights, conditional water rights, change of water rights, leases of water, augmentation plans, instream flows, new appropriations, groundwater rights, reuse and conservation activities. Water storage rights, along with the reservoir space to store them in, are one of the more important options for providing water to the Arkansas Basin during times of drought. As with direct flow rights, storage rights were assigned a priority and must not injure junior water rights.

Conditional water rights are used to make an initial claim by proving the water users intent to divert a water right and put it to a beneficial use without actually completing the process. "A conditional water right allowed an appropriator to secure a place in the priority line before any water was actually applied to a beneficial use" (CWCB 2006: 30). A change of water use is also used to address water needs in the Arkansas Basin. A change of water rights only deals with the historical consumptive use not the actual amount diverted thereby protecting the historical return flows making them available to other appropriators in the Arkansas Basin. "A change of water rights included a change in the type, place, or time of use, a change in the point of diversion, and changes in the manner or place of storage. A change in the water right would not be allowed unless it was approved by the water court" (CWCB 2006: 30).

Water leases are another option available in the basin. During the 2003 legislative session, the Colorado Congress authorized the State Engineer to create water banks in each division in an effort to simplify the process for temporary water transfers by removing the need for water court approval for short-term leases and transfers. "The statute provides that the rules shall allow for the lease, exchange, or loan of stored water within a water division, including a transfer to the CWCB for instream flow purposes, without the need to submit to any adjudication proceedings" (CWCB 2006: 31). Another potential lease agreement was interruptible supply agreements between agricultural and municipal/industrial users. "Interruptible supply agreements would potentially allow flexibility between agricultural and municipal/industrial users to rotate or fallow crops in certain years, thereby freeing up water supplies for municipal/industrial uses during such years" (CWCB 2006: 31).

Augmentation plans are another useful tool. "An augmentation plan allowed a water user to divert water out-of-priority from its decreed point of diversion, so long as replacement water was provided to the stream from another source, to make up for any deficit to other water users" (CWCB 2006: 31). Augmentation plans are also subject to the "no injury rule," and much like a change in water rights, augmentation plans must also be approved by the water court. "In times of scarcity, an augmentation plan allowed a water user to continue diverting even under a relatively junior priority, so long as it can provide replacement water to satisfy the needs of downstream seniors" (CWCB 2006: 31). Augmentation plans will become more important in the Arkansas Valley as junior appropriators, especially well pumpers, continue to draw off the river's flows. The water court now requires adjudicated augmentation plans before junior appropriators can divert water out of priority.

Instream flows also serve as an important tool for moving water around the Arkansas Basin. "Under the 1969 Water Administration Act, the CWCB was authorized to appropriate water for minimum stream flows or for natural surface water levels or volumes for natural lakes to preserve the natural environment to a reasonable degree" (CWCB 2006: 32). By allowing the CWCB to acquire water rights for instream flow purposes, the State of Colorado gave each division the ability to protect wildlife and the environment, especially during times of drought. "By acquiring a water right with an enforceable priority, the state can place environmental concerns on equal footing with agricultural, commercial, municipal, and other uses of water" (CWCB 2006: 32). Instream flows were used not only for wildlife and environmental concerns, but also to stimulate or protect recreational economies in the upper and lower Arkansas River basin. In the State of Colorado, recreation is considered a beneficial use, and with the rising popularity of kayaking, many cities, Pueblo included, have attempted to acquire instream flow rights solely for the purpose of creating a kayak course. New appropriations are also another option, but not a realistic one in most basins. Most basins in the State of Colorado, and especially the Arkansas Basin, have been over-appropriated since the early 1900s.

Groundwater is another source of flexibility in the administration of Colorado's waters. As pointed out in the section on groundwater and well pumping, the State of Colorado recognized four types of groundwater: tributary groundwater, non-tributary groundwater, not non-tributary groundwater and designated groundwater. A different sets of rules governs each of these groundwater classifications. "Thus, while tributary water was subject to the prior appropriations system, non-tributary groundwater and not non-tributary groundwater was allocated according to landownership, and designated groundwater was subject to a modified prior appropriation system within each designated basin" (CWCB 2006: 34). Groundwater banking can be a useful tool for water marketing and moving water around the landscape in the lower Arkansas River basin. By converting agricultural water to augmentation water, groundwater users associations can sell and buy water within their organization without the problems associated with a change of use or a change of point of diversion. Groundwater users associations with an augmentation water decree have the potential for managing water markets in the lower Arkansas River basin.

Reuse was becoming a popular option for those water users with foreign water rights. Foreign water rights are for water that is brought in to the basin from other river basins and is not part of the native flows of the particular basin using the flows. "Foreign water includes non-tributary groundwater introduced into a surface stream as well as water imported from an unconnected stream system (transmountain water). Importers of foreign water enjoy rights of reuse that native water appropriators do not have" (CWCB 2006: 33). Agricultural water rights that were changed to municipal water rights could also be consumed to extinction because the applicant requesting the change of use "may take credit for, and reuse, the historical consumptive use associated with the prior decreed use" (CWCB 2006: 34).

Conservation activities are also used by both agricultural and municipal water users to make more efficient use of the limited water supply available. Demand reduction through water restrictions has been used by municipalities during times of drought, even though they use this right only if they have too. Agriculture also has a part to play in conservation efforts in the Arkansas River basin. New technologies have been instituted in the Arkansas River basin to increase the efficiency of water use. Delivering water to crops using drip tape is one strategy that is successful for farmers in the Arkansas.

In order to understand the problems associated with water management in the lower Arkansas River basin, an assessment of the problems relative to these tools is required. These tools are important because organizations like the Lower Arkansas Valley Water Conservancy District, the Southeastern Colorado Water Conservancy District, the Lower Arkansas Valley Water Management Association and the Colorado Water Protection and Development Association use these tools to address the collective water management problems in the valley.

Salinity in the Arkansas Valley

Soil salinity has been the downfall of agricultural civilizations since humans stopped migrating and started planting. For example, the South Asian societies residing in the Indus Valley over the period of 3000 to 1500 B.C., a region that now covers Pakistan and India, declined due to agricultural failure which was the result of high levels of salinity in their agricultural soil. "Salinity is defined as the soluble mineral salts present in water or soil" (Garcia, Elhaddad et al. 2001: 9). Salinity is another problem in the Lower Arkansas River basin. The rising river channel and surrounding water table is laying concentrated salt deposits on fields making them unusable. Salinity is now a problem prevalent in the State of Colorado, especially in the Arkansas Valley. "The Arkansas River was one of the most saline rivers of its size in the United States. Salinity levels increased from 300 mg/L near Pueblo to over 4,000 mg/L at the Colorado/Kansas border" (Garcia, Elhaddad et al. 2001: 9). This increase in the levels of soil salinity is causing the decreased yields of farmers' fields throughout the valley. "It was estimated that over 200,000 acres in the

Arkansas Valley were being irrigated with water that contains greater than 1,400 mg/L salinity concentrations" (Garcia, Elhaddad et al. 2001: 9). Salinity continues to be a growing problem in the Arkansas Valley which does not seem to be going away anytime soon.

Applying Common Property Resource and Collective Goods Theory to the Arkansas River Basin

Schlager reminds us that in Colorado, "local water providers and water users exercise substantial authority in developing, monitoring, and enforcing water rights, with very little central direction from state governments" (Schlager 2001: 134). Schlager (2001) goes on to illustrate that unlike other western states, Colorado water law is primarily governed by local water users through water courts. Therefore, the development of a pilot water bank program run by the State of Colorado that circumvents the function of the water court is a new and different type of institutional mechanism in the State of Colorado, in general, and the Lower Arkansas River basin, in particular.

The lower Arkansas River basin possesses characteristics of all three property regimes. In the present system, the private property regime exists below the individual farmer's head gate. Once the farmer diverts the water out of the ditch onto his fields, he has excluded other users from the availability of that resource, at least for the time being, because the consumptive use of water used on a farmer's fields was only a fraction of the water used, and the rest returned to the river directly or was deposited into the ditch of another water user organization to be used again. James Sherow (1990) attributes the development of the Rocky Ford Ditch Company, including the Rocky Ford Ditch, to the entrepreneurial interests of George Swink. Swink's vision for the Arkansas Valley was certainly determined by his underlying belief in market cultural values. These market values allowed for the development of the land in the Arkansas Valley for farming by harnessing the Arkansas River and diverting a portion of its flow to irrigate crops. One of the pitfalls of the private property regime is the possibility of a water user, having access to more resources than others, buying up the rights to the water in order to transfer its use to another point of diversion.

> "Ditches in the Arkansas Valley have been plagued by a number of buy outs in the last two decades. These buy outs not only have the potential of changing the flows of the river, they have the potential of ruining whole communities whose existence was dependent on the agriculture under the ditches" (Milenski 1990: 145),

These ditch company buy outs continue to plague water users in the Arkansas Valley. The recent attempted buy out on the Fort Lyon Canal, which promised to deliver upwards to 75,000 acre foot of water from the Arkansas River basin to a Front Range community with deep pockets, was just one example.

The Arkansas Valley water users have irrigation ditches that represent common property resources. This level in the system is characterized by the not-for-profit mutual ditch company, where ditch companies cooperatively owned by irrigators like the Bessemer Ditch Company, the Rocky Ford Ditch Company, and the Fort Lyon Canal Company diverted water through canal network systems, to shareholders who own stock in the ditch company diverting the water.

Finally, the Arkansas Valley irrigation system has characteristics of public goods property regimes as well. The Lower Arkansas Valley Water Conservancy District was created for keeping the flows of the Arkansas River in the basin. The goal of this organization was to protect the rivers flows for the benefit of everyone in the. At this level in the system, organizations approach water management from the public goods perspective. When ascending this nested system, the divisibility of the resource decreases and there are no excludability and no rivalness; therefore, the final tier of the collective good resource was represented by an agreement between Kansas and Colorado, known as the Arkansas River Compact. This Compact governs the entire river basin, and a collective good is discovered when the entire river basin is examined, especially when discussing the creation of the Lower Arkansas Valley Water Conservancy District, and the protections and benefits accrued from the creation of the this new organization.

The Threat of Water Transfers in the Arkansas River Basin

The trend of water transfers out of the valley has continued to concern irrigators relying on the Arkansas River flows. "One of the most serious potential threats to the river comes from ditch buy outs and the subsequent transfer of water to another point on the river" (Milenski 1990: 145). Even though all water transfers out of the valley are problematic, transfers of native flows of the Arkansas River cause greater harm than do transfers of transmountain water. Milenski (1990: 145-146) makes this argument by emphasizing the difference between the Rocky Ford-Highline Canal Company's sale of the Busk-Ivanhoe water to the city of Aurora, which was transmountain water, but "more crucial to the Arkansas River and to the surrounding communities has been the sale of a great deal of native water from the Colorado Canal and the Rocky Ford Ditch." The reason that the sale of the Rocky Ford Ditch is more detrimental than the sale of the Busk-Ivanhoe water was because the loss of Rocky Ford water was a loss of the native flow of the river, but this was not the case with the Rocky Ford-Highline Busk-Ivanhoe transmountain water.

Table 8: Water Sales from the Arkansas Valley to Front Range Municipalities

Canal	County	Amount of water sold	Date	Purchasing City
Las Animas Canal	Bent	10,000 af	1971	Pueblo West
Highline Canal	Otero	2,500 af	1971	Pueblo
Booth-Orchard	Crowley /Otero	9,000 af	1972	Pueblo
Holson Ditch	Crowley	,488 af	1972	Pueblo
Las Animas Consolidated	Bent	10,186 af	1984	Public Service Co.
Colorado Canal	Crowley /Pueblo	43,180 af	1985	Colorado Springs
Twin Lakes	Lake	57,000 af	1985	Pueblo/Colorado Springs
High Line Canal	Otero	2,250 af	1986	Aurora
Foxley Cattle Co.	Crowley	17,500 af	1986	Colorado Springs
Rocky Ford Ditch	Otero	8,200 af	1986	Aurora
Keesee Ditch	Bent	3,500 af	1991	
Rocky Ford Ditch	Otero	5,000 af	2000	Aurora

Changing trends in the priority system have created concerns for water users in the Arkansas Valley. Soil salinity, a product of old existing soil conditions, new ditch practices and water management, was raising the water table and creating a salinity problem in the valley. Projected urban growth, environmental preservation, and recreational use have also begun to draw on the river's flow in ways that have no precedent in the development of the Colorado Doctrine. In 2006, Kansas won a lawsuit where the U.S. Supreme Court found the State of Colorado guilty of not meeting the prior Compacts agreement to provide 40 percent of the water stored in the John Martin Reservoir to

Kansas. This lawsuit was founded on the changing water uses in the Arkansas Valley. The impacts of groundwater pumping on the direct flows of the river put the State of Colorado in violation of the Kansas/Colorado compact, and now the State of Colorado must pay. Not only is the State of Colorado going to have to make reparations to Kansas, it is also going to have to adapt to the changing institutional environment for the administration of water in the State of Colorado.

The crisis is building in the Arkansas River basin. Over pumping groundwater, increasing levels of soil salinity, agriculture to urban water rights transfers and the latest ruling in the Colorado vs. Kansas lawsuit created a situation in the Arkansas Valley that requires new innovations in the institutional framework to solve the problems in the valley. The proposed solution for these problems is the creation of water markets in the Arkansas Valley. These water markets will allow irrigators, who have excess water to lease, exchange or outright transfer their water rights to those who are water short. The neoclassical economic problem with a water market in the Arkansas Valley is that the transaction costs have always been too high. Legal procedures and engineering costs are far too expensive for present market mechanisms to pay off for prospective investors. Therefore, one way of establishing a water market in an area that lacks a formal mechanism to regulate and manage that market is to create a water bank. According to Larry Mac Donnell, "A water bank was an institutionalized process specifically designed to facilitate the transfer of developed water to new uses" (MacDonnell 1994: 2-23). Water banks are a popular solution to the changing water use patterns in the west. Idaho and California have led the way in the use of water banks, and now it seems that Colorado was following suit.

Water Banking in the Arkansas River basin

In the past 30 years, the population on the Front Range of the Rocky Mountains has developed into a string of metropolitan cities, which represents over 90 percent of the State Colorado's population. This demographic shift towards metropolitan areas is creating an urban bias in the state that is changing the focus of the Colorado State Legislature away from agriculture towards urban interest favoring industry, recreation and environmental needs. This process is being fueled by individual farmers in the Arkansas Valley who sell their water rights for retirement to urban interests, and thus destabilizing rural communities that relied on that water to fuel its local economy. There have been a variety of programs directed at buffering the effects of these social and economic changes. This research will focus on three: the Arkansas River Pilot Water Bank Program, the Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Water Management Association.

With House Bill 01-1354: *Arkansas River Water Bank Pilot Program*, the State of Colorado passed legislation mandating the creation of a water bank in the Arkansas Valley as an alternative to water transfers that have been wreaking havoc on the water system in the valley. This legislative mandate brought water banking back into the mix of water management tools available in the Arkansas Valley, but it was not the first time that water banking was considered. "A 1991 proposal to purchase a majority of shares in the Fort Lyon Canal Company for permanent transfer of the associated water to urban users in the Front Range of Colorado prompted the State of Colorado to sponsor a study of alternatives" (MacDonnell and Howe 1994: 2-23). The Fort Lyon Plan, which was a result of this study, recommended the creation of a water bank by emulating the organizational structure of the mutual ditch company. The 1991 proposed water bank in the Arkansas Valley would be operated by a not-for-profit organization with a full-time manager and a board of directors. Unlike the other water banks in the west, like the Idaho Water Supply Bank, the Arkansas River Water Bank Pilot Program will only allow stored water to be traded in the market. According to Hal Simpson, the Colorado State Engineer, "We're trying to create a mechanism for farmers to lease stored water through a water bank, rather than have to sell the water off the land permanently" (Flanagan 2002).

In 2001, the State of Colorado passed HB-1354 authorizing the creation of a water bank in the Arkansas Valley. It was conceived as a pilot program with a well-thought out administrative procedure protecting third party injury and utilizing state-of-the art computer access. However, very shortly after the passage of the bill, communities in the lower Arkansas Valley proceeded with a totally separate initiative. This involved the creation of the Lower Arkansas Valley Water Conservancy District (LAVWCD) in 2002. The lower basin was represented by that reach of the Arkansas River extending from Pueblo, Colorado to the Colorado-Kansas state line.

Although not a water bank, the new conservancy district was a defensive response to the proposed purchase by a Louisiana-based investment firm of 40 percent of the water rights in the Fort Lyon Canal, the largest canal company in Colorado. Therefore, it was largely an emergency initiative designed primarily to keep decreed water from migrating out of the lower valley through purchases and exchanges. It developed a successful but limited land conservation easement program and later began purchasing water outright from local landowners. The conservancy district generally expressed no interest in allowing water transfers out of the lower basin. Meanwhile, the state's pilot water bank has been terminated for lack of utilization.

The Arkansas River Water Bank Pilot Program and the Lower Arkansas Valley Water Conservancy District were new attempts at water marketing in the Arkansas Valley, but upon further inspection, another water bank in the Arkansas Valley, run by the Lower Arkansas Water Management Association (LAWMA), was located. Unlike the two previously mentioned attempts at water banking, LAWMA is a functional water bank that was created in 1972 with the passage of the 1969 Water Administration Act. "The purpose of LAWMA evolved somewhat by the rulings of the Special Master and U.S. Supreme Court in Kansas v. Colorado to also include the development of a program to replace well depletions both to Colorado surface water rights and to usable flow at the Colorado-Kansas state line in compliance with Colorado law and the Arkansas River Compact" (Williamsen 2006: 1). In 1998, LAWMA filed for non-profit status with the State of Colorado and issued stock to its members. LAWMA developed a water portfolio by purchasing direct flow rights from a number of ditches in the lower Arkansas Valley worth a value of $8.75 million dollars. In conjunction with these water rights purchases, LAWMA was required to dry-up 8,283 acres of irrigated land in order to make that purchased water available to well pumpers owning shares in LAWMA.

Now that the programs for this research are identified, the original research question can be revisited:

What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good?

The next chapter contains an analysis of three different organizational forms that have been introduced into the institutional environment in the Lower Arkansas River basin to address water scarcity and water management problems. These three organizational forms are represented by: the Arkansas River Water Bank Pilot Program in the Lower Arkansas River basin, which was a legislative solution to severe drought conditions in the State of Colorado; the Lower Arkansas Valley Water Conservancy District, which was created to deal with a pending water buyout on the Fort Lyon; and the Lower Arkansas Water Management Association, which was created to dell with well depletions in order to protect Kansas state line flows in accordance with the Arkansas River Compact as well as protecting senior water rights holders in the State of Colorado. All of these organizations had a similar mission, which was to give farmers flexibility with their water rights by allowing them to engage in short-term water leasing agreements without having to sell their water rights outright, thereby keeping the ownership of the water right in the control of the farmer while simultaneously allowing municipalities, farmers and other water users that are water-short to access water in times of drought. The previous text summarizes the water programs histories to this point in time. An explanation follows of the differences and similarities between these organizational forms by bringing a keen theoretical eye to the research that has been gathered throughout the data collection process.

Chapter 5

FINDINGS

Research Question

What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good? Employing conceptual models of organizational form, this research effort is directed at systematically comparing and contrasting the uses and limits of three organizations:

1. The Arkansas River Bank Pilot Program implemented by the State of Colorado,
2. The Lower Arkansas Valley Water Conservancy District,
3. The Lower Arkansas Valley Water Management Association.

The discussion now turns to a comparison of observed attributes of common property resource and collective goods in these organizations with those advanced by the ideal type conceptual models.

Ideal Types and Methods

The method is to compare three water banking organizations--the Arkansas River Water Banking Program, the Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Water Management Association—to the integrated conceptual model.

Ideal types, as discussed in chapter 2, will be applied in a hypothesis generating framework. The ideal types were constructed as models against which to observe and critique the three organizations. The critique includes design features and modes of operation of the three organizations. The critique provides important insights regarding the varying success of these organizations in achieving their stated objectives for local communities and water users.

FINDINGS

Common Property and Collective Goods Provided by the Arkansas River Water Bank Pilot Program

Out-of-basin transfers and water sales have been a growing concern throughout the State of Colorado, but they have been especially problematic in the Arkansas River basin (Rich 2001). Late in 2000 the Governor's Commission on Saving Open Spaces, Farms and Ranches offered suggestions for helping water users in the Arkansas Valley deal with the changing water market conditions by offering them a variety of different water marketing options. These options included pilot water markets and banks, as well as conservation easement programs designed to give farmers the ability to short-term lease their water rights without permanently transferring those rights.

> "Through this type of effort, the Commission believes that farmers and ranchers will have the ability to lease their water rights on a short-term basis to other users while still maintaining their water rights for future use within the original basin. This could allow for better maintenance of county tax bases and enhance the continuation of farming and ranching as viable industries in areas where farming is on the decline" (Streamlines 2001: 1).

HB-1354 was developed in 2001 as a legislative effort to follow through on the recommendations. HB-1354 was sponsored by Colorado State Representative Diane Hoppe from Sterling, Colorado and Colorado State Senator, Lou Entz from Hooper, Colorado. HB-1354 authorized the Colorado State Engineer to promulgate rules for the pilot water bank and to ensure that the new water bank was in compliance with existing Colorado water law[12]. The Southeastern Colorado Water Conservancy District was selected to administer the daily operations of the water bank, as well as design the water banking website that would create a web-based portal for water banking in the Arkansas Valley. According to the state engineer, "The operator of the bank, pursuant to the rules, could act as a broker, in a sense that the bank would list the amount of water being offered for lease or exchange" (McAvoy 2002). The intent of the new water banking legislation was to protect the water supply in the Arkansas Valley by facilitating short-term water leases from individuals who had a surplus of water to water users with a temporary water shortage. The primary participants in the water bank on the supply side of the equation were to be individuals possessing water shares within a ditch company participating in the valley's Winter Water Storage Program[13]. The primary participants on the demand side were to be municipalities and industrial and commercial interests within or out of the basin. This plan gave in-basin transfers preference. However, if there were no acceptable bids

[12] "The purpose of these rules was to implement a pilot water bank that simplifies and facilitates water leasing, loans and exchanges, including interruptible supply agreements of stored water within the Arkansas River basin; and to reduce the costs associated with such transactions. Further, it is also the purpose of these rules to increase the availability of water-related information and assist farmers and ranchers by developing a mechanism to realize the value of their water right assets without forcing the permanent transfer of those water rights from the land" (Rules Governing the Arkansas River Water Bank Pilot Program).

[13] The Winter Water Storage Program was originally conceptualized in the early 1930s in cooperation with the irrigation companies in the Lower Arkansas River basin and the Bureau of Reclamation when they determined there was a need for storage space for the purpose of capturing decreed water rights during non-irrigation months. Before this program went online in 1978, all thirteen mutual ditch companies in the lower Arkansas River basin had to agree on the creation of the program as well as the rules governing its administration. For more information on the Winter Water Storage program, go to Southeastern Colorado Water Conservancy District's website: www.secwcd.com/WinterWtr.htm.

posted from in-basin water users within ten days of the original posting, the water was to be made available to out-of-basin water users as well.

The Arkansas River Water Banking Pilot Program was designed to serve the lower Arkansas River basin water users and the cities along the Colorado Front Range. Legislation for the Arkansas River Pilot water bank was passed in 2001, and the pilot water bank officially opened for banking on January 22, 2003. Three valley water users had successfully deposited their water in the water bank by March of 2003. One participant deposited 89 acre-feet of water for an asking price $800 per acre-foot. Another deposited 30 acre-feet of water for $800 per acre-foot. The last participant deposited 4.25 acre-feet of water for $1,200 per-acre foot in the bank. All of the water users owned shares on the Colorado Canal, and their water was stored in Lake Meredith or Twin Lakes.

Bidders were also registered by March of that year. On the demand side were the City of Las Animas, another individual, and a corporate farm operation. According to the Southeastern Colorado Water Conservancy District, "We're already getting a lot of attention from people wanting to buy water…I think that demand in turn might influence more people to want to sell" (Wood 2002). However, the water bank never completed a water bank transaction.

The water bank was designed to facilitate one-year leases or interruptible supply agreements between farmers with a surplus of water to individual water users, most likely cities and other industrial and commercial uses, with a water shortfall. One of the most controversial aspects of the water bank from its inception was the inclusion of out-of-basin transfers. According to the Upper Arkansas River Water Conservancy District manager, "The basis of our opposition (to the water bank) is that there's inadequate public notice of water leases and there is no judicial review." The district manager went on to say, "Earlier this year, participants in the winter water storage program at Pueblo Reservoir said they don't want to be involved in water banking...Representatives of the Amity and Fort Lyon canal companies and the District 67 irrigating canals association also expressed opposition at hearings on the water bank rules last week" (Wood 2002). These comments represented a concern on the part of existing local organizations, particularly mutual irrigation companies and special districts already managing water in the valley.

Public hearings were held in 2001 and 2002 to comment on the development of the rules of the new pilot water bank. There were four objectors. These included the South Eastern Colorado Water Conservancy District, the Fort Lyon Canal Company, District 67 representing the Amity Mutual Irrigation Company and the Upper Arkansas Water Conservancy District. Three primary objections raised were:

1. Objectors feared the new legislation would not protect due process of law under the Doctrine of Prior Appropriation. The concern related to the potential injury to senior water users who are presently protected from injury under the Doctrine of Prior Appropriation.
2. The second objection was related to the time it takes to complete a water transaction in the pilot water bank compared to the time it takes to complete a water court petition. There was reason to worry that the proposed 45-day process was not long enough to protect senior water rights, and they were concerned that the process placed the burden of proof of injury on water users not involved in the water transactions, unlike the current system.
3. The final objection was related to the rules creating the posting process. It was decided that the posting of water transactions would be done electronically through a website administered by the South Eastern Water Conservancy District. This process was different from the standard operating procedures that call for the public posting of water sales and leases in the local and regional news media; which some argued disadvantaged those water users who are accustomed to the old way of doing things[14].

[14] These issues were raised at the Public Water Bank hearings in Pueblo, Colorado May 7-8, 2002. An interesting point should be made here. When the State Engineer's office issued the new rules, the State Engineer's office did not meet any of the demands made by the dissenters.

Rules of Operation

The rules governing the water bank were finally promulgated by the State Engineer's office in the early part of 2002. This rule making process resulted in the creation of thirteen rules designed to govern the operation of the new water bank (Colorado Office of the State Engineer 2001).

Rule 1: Established the official title of the new water bank, the Arkansas River Water Bank Pilot Program.

Rule 2: Mapped out the scope and purpose of the water bank. In accordance with rule two, only stored water could be traded in the water bank. This rule also set up a sunset provision of June 30, 2007 for the current set of rules promulgated by the State Engineer's office.

Rule 3: Established definitions for important concepts governing the water bank.

Rule 3A1: "Bankable water" was defined under this rule as legally stored water as opposed to direct flow water. Under these rules direct flow water could not be banked in the new water bank.

Rule 3A2: "Article II water" is defined as water stored within individual Water District 67 ditch accounts pursuant to Section II of the Resolution Concerning an Operating Plan for

John Martin Reservoir adopted by the Arkansas River Compact Administration on April 24, 1980 (as amended) and accounted as "winter stored water" under "Agreement B" dated November 1984.

Rule 3A3: Defined "beneficial consumptive use" as the actual water consumed when applying the water right to its legally defined use.

Rule 3A4: Defined "the deposit account" as the actual amount of water a water user places in the water bank.

Rule 3A5: Defined "interruptible supply" as the temporary cessation of the historic use of stored water, and the temporary use of such water at another location, and/or for a different use and/or at a different time. Such temporary cessation/use may be during a full or partial season of historic use.

Rule 3A6: Defined "legally stored water" as stored pursuant to a water court decree, statutory provision or authorization under the Arkansas River Compact Administration.

Rule 3A7: Defined an "option agreement" as an agreement by which a buyer pays a seller for the option to use a specified amount of stored water and pays for the right, but is not obligated to purchase a defined amount of banked water at a specified price within a fixed time period. The buyer of the option may be required to pay a defined premium to the seller for this right. An option agreement may authorize the water bank operator to release deposited water for the seller's use at times when the water was available for use and the buyer was not exercising the option, or allow the seller to use the stored water until the option was exercised.

Rule 3A8: Defined "return flows" as the amount of water that was not consumed during use and returns to the river for other uses.

Rule 3A9: Defined "transit loss" as the amount of water defined by the State Engineer that was lost during the delivery of that water from point A to point B due to local stream conditions.

Rule 3A10: Defined "the water bank" as the Arkansas River Water Bank Pilot Program as established by the Colorado General Assembly to accept and distribute legally stored water for short-term lease, exchange or option.

Rule 3A11: Defined "water banking" as temporarily placing legally stored water into an account within the Water Bank whereby that water was then leased, loaned, optioned or exchanged to another user.

Rule 3A12: Defined the "water bank operator" as the State Engineer, a delegated public entity or a delegated public-private partnership who administered the water bank and was entitled to charge a transaction fee for deposits, withdrawals, or both, sufficient to cover the bank's administrative costs.

Rule 3A13: Defined "winter water" to mean water stored using the Winter Water Storage Program as described in Case No. 84CW179, Water Division 2.

Rule 4: Established the limitations on where water leased in the water bank could be used and on what type of water could be used in the bank. It also established the bank to be operated on a yearly basis, which allowed the State Engineer to adapt the operation of the new bank based on available storage space and local environmental conditions.

Rule 5: Established the application process necessary for depositing water in the water bank. This rule was there to ensure that the depositor had been given the appropriate permission from the reservoir operator to move the water being deposited in the water bank. This set of rules also established historic use patterns as well as historic consumptive use numbers needed when moving water from one use to another or one point of diversion to another. This set of rules ensured that once the water was deposited in the bank it could be marketed to an acceptable buyer. This rule kept water users from depositing water in the bank and then taking it out and selling or leasing it outside of the water bank.

Rule 6: Set the parameters on who could list water in the bank as well as who could place bids on the water that had been listed in the water bank. This set of rules established a balance between in-basin and out-of-basin water needs, as well as determined the legal eligibility of those listing and bidding water in the water bank.

Rule 7: Dealt with the transactional processes that were required for establishing an agreement between the willing sellers who were listing water in the bank as well as the buyers who were bidding on the water in the bank. This rule set also mapped out how the administrators of the water bank proceeded once the water transaction had been agreed upon.

Rule 8: Dealt with the quantification procedures for water to be released from the water bank. This set of rules was designed to create an efficient, economical and timely method for moving water through the water bank without the expense of a costly historical consumptive use study that was necessary for a temporary change of use. The water bank used the Hydrologic Institutional (HI) Model. This model, created by Boyle Engineering for the State of Colorado, was determined to be a satisfactory method for state line depletions of the flows of the Arkansas River over the timeframe from 1986 to 1994 in the case of Kansas v. Colorado. The HI Model established transit losses and consumptive uses, as well ensured that other water users with the same type of water were not injured when the amount of water being banked was transferred. This was done by ensuring that transit loss and canal/lateral loss reflected the historical consumptive use patterns with a portion of that water not being used to return to the stream over a determined period of time. This determined period of time was established by using the Ground Water Accounting Model used by the Division 2 Engineer.

Rule 9: Established the procedures for delivering water from storage facilities as well as establishing a credit and debit accounting system to be used by reservoirs storing water in the water bank.

Rule 10: Established a process for ensuring that the general public had access to summaries of the transactions being run through the water bank.

Rule 11: Established the date of termination of the pilot water bank to be July 1, 2007 as well as authorized the Colorado General Assembly to extend the timeline of the water bank after taking in to consideration the report given by the State Engineer on the progress of the Arkansas River Water Bank Pilot Program.

Rule 12: Stated that if any rule is determined to be illegal, all other rules are still legally binding.

Rule 13: Established the official dates of operation for the pilot water bank to be July 1, 2002 through June 30, 2007.

Water Bank Procedures

Water users interested in depositing their surplus water in the water bank for trade had to first fill out the proper forms for application to the water bank. It was then the role of the Division 2 Engineer's office to review the application to ensure that the consumptive use of the water being placed in the bank was actually available for trade. Once the water availability was verified, it was the job of the Southeastern Colorado Water Conservancy District's staff to post bids on the water bank's website. This was where the bidding started. In-basin water users were given a ten-day preference, but on the 11th day, if there were no qualifying bids from in-basin users, then the bank was open to out-of-basin water users as well as in-basin water users.

Upon acceptance of a bid, a lease was prepared and posted under contract for a thirty day public review and feedback period. Once the thirty day review process expired, the onus of responsibility shifted back to the Division 2 Engineer, who then reviewed the comments and criticisms collected during the public review process in order to establish the final terms and conditions for the water lease or interruptible supply agreement. After the final agreement was established and the individual parties agreed on the terms, the paperwork was signed and the transaction fee was paid to the water bank administrator. Finally, the Southeastern Colorado Water Conservancy District's staff was to notify the Division 2 Engineer, who supervised releases from the reservoir operator where the water was located, and the people on the notification list that the water trade was completed. The lessee was to notify the water banks staff twenty-four hours prior to the delivery of the leased water.[15] "Any costs in moving the water, or exchanging it upstream, as well as any transportation losses were to be born by the buyer" (Baird 2002). Stored surface water was the only bankable water available for trade in the bank. "Bankable water meant any legally stored water that meets the necessary criteria established by the rules. Direct flow water rights were not included in this definition" (Colorado State Engineers Office 2001).

Effectiveness of the Arkansas River Water Bank Pilot Program

In November of 2005, the Colorado State Engineer, presented a report to the Colorado General Assembly on the effectiveness of the Arkansas River Water Bank Pilot Program (Simpson 2005). It was determined that the pilot water bank had garnered little interest and made a limited impact in the Arkansas River basin. Only two water users deposited water in the bank, none of which resulted in a completed water lease. The report listed a number of constraints to the development of a working water bank in the Arkansas River Basin. The first set of constraints was statutory, regulatory or contractual constraints.

One constraint to the water bank was the limitation on the type of water that could be placed in the pilot water bank. By limiting the water bank to stored water, those owning direct flow rights were eliminated from participating in the water market. The fact that most water users in the lower basin did not own storage rights made the absence of direct flow rights even more problematic.

Another constraint on the pilot water bank was that it did not allow for out-of-basin transfers. Originally out-of-basin transfers were part of the water banking legislation, but in 2003, the Colorado General Assembly removed out-of-basin transfers, and by doing so,

[15] For more a more thorough understanding of this process refer to the Southeastern Colorado Water Conservancy District Water Bank Website: http://www.coloradowaterbank.org/.

removed some of the most interested potential users, particularly those metropolitan areas in the South Platte River basin located along the Front Range of the Rocky Mountains. By removing these players from the leasing pool, the general assembly deflated the market before it could ever take flight.

Another legislative action that constrained the success of the pilot water bank was the passage of HB-02 1414, which amended the Water Rights and Determination Act to allow for substitute water supply plans based on approval by the State Engineer.

> "This act allows temporary approval of changes of water rights, augmentation plans and exchanges of water for periods of up to five years, while providing notice to water users and greater flexibility than the pilot water bank project can allow under existing legislation. Further, there are no restrictions to using only stored water in the streamlined temporary approval, and wells can be augmented" (Simpson 2005: 5).

This legislation also made temporary out-of-basin transfers part of the water marketing mix. In essence, the changes to the Water Rights and Determination Act created more flexibility in water management than did the pilot water bank. According to one water user in the Arkansas River basin, "There is nothing I cannot do with a temporary substitute water supply plan that I can't do with the water bank and, in fact, I can do much more (than with the water bank) and it still solves my problem of getting something accomplished quickly" (Simpson 2005: 5). This new legislation is one of the reasons cited by the Southeastern Colorado Water Conservancy District for pulling out of their commitment to the administration of the Arkansas River Water Bank Pilot Program.

Another constraint on the water bank was the involvement of a federal facility Pueblo Reservoir, where the winter water supply was stored. By locating the water bank in Pueblo Reservoir, the new water bank was subject to review specified by the National

Environmental Policy Act. Also, by allowing the water bank to operate in Pueblo Reservoir, the Southeastern Colorado Water Conservancy District was placing the entire Frying Pan/Arkansas River Project, the federal project, into question.

Another constraint on the success of the water bank was its failure to incorporate rules to prevent early withdrawal of one's water from the water bank.

> "It became apparent during the operation of the bank that some water users were using the advertising potential of the bank's Internet presence to draw interest in their water right. Once a potential buyer was found, the depositor would withdraw their water from the water bank and enter into a separate deal with the party in interest, thereby avoiding the payment of any administrative fees for using the bank" (Simpson 2005: 6).

The fact that water was being advertised in the bank, but then being sold outside of the bank, made it essential for the rules promulgated for the development and administration of the program to sanction those water users if they pulled their water out early.

The second set of constraints reported on by the State Engineer was institutional in nature. One of those constraints was that the water banking legislation made the State Engineer the regulator of the bank, as well as the promoter and operator of the water bank. This put the State Engineer in a compromising position, and upon reflection, was probably not a good idea. Another institutional constraint was that many of the mutual irrigation companies in the Arkansas River basin passed by-laws preventing the leasing of shares outside their system. Irrigation companies like the Rocky Ford Highline Ditch Company and the Catlin Canal Company required their respective board of director's approval in order for individual share holders to lease water outside of their system, whereas the Fort Lyon Canal Company did not have bylaws specifically limiting individual share holders from leasing their water outside of the system. This left the Fort Lyon Canal Company exposed to a potential buyout by interests outside of the basin. A final institutional constraint discussed in the State Engineer's report alluded to potential problems with the Arkansas River Compact (see Chapter 4). These problems never materialized with the operation of the Arkansas River Water Bank Pilot Program, but the fear of violating the compact ever present.

The third set of constraints in the State Engineer's report was social and economic in nature. One of those constraints was referred to as the conservative nature of the farmer in the Arkansas River basin. Valley water users, according to the Colorado State Engineer, had a legitimate reason to fear new water marketing legislation and its impact on the local economy. This concern made it even less likely for farmers to participate in a water bank run through a widely available internet portal. The State Engineer also made reference to the need for a more comprehensive advertising campaign teaching water users about the potential benefits of the water bank as well soliciting their involvement. The final economic constraint considered in the State Engineer's report was the lack of price controls on the water listed in the water bank. There was no mechanism that required the person who deposited the water to lower the price if the market did not clear it. In the end, it allowed water users to place water in the bank at seemingly unreasonable prices making it less likely for water users in the Arkansas River basin to look to the water bank for short-term water leases. In this respect, the water bank had the resemblance of operating like an auction.

Another problem with the Arkansas River Water Bank Pilot Program was its appeal to individual water users owning shares in mutual irrigation companies depositing their surplus water in the water bank for trade instead of approaching the mutual irrigation companies[16]. This approach seemed to undercut the power of the mutual irrigation companies by encouraging share holders to remove their water from the mutual irrigation company in favor of depositing it in the Arkansas River Water Bank Pilot Program[17].

> "It was recognized that, unlike many other prior appropriation states, where the board of directors of such enterprises may have an important trustee role in approving or denying water transfers, Colorado treats canal company stock as real property. Unless stated in the bylaws of the enterprise, the selling of water stock out of the ditch was legal in Colorado and generally does not require board approval, although only the historical consumptive use of the water on the landowner's land was allowed to be transferred" (Wilkins-Wells and Lepper 2006: 5).

The rules promulgated for the water bank also underestimated the collective power of valley mutual irrigation companies and their ability to discourage individuals from participating in the water bank. Individual landowners owning water shares in a local mutual irrigation company were imbedded in a bounded social network where their reputation was of great importance. An individual landowner could damage their reputation in the mutual irrigation company and the greater agricultural community by participating in the water bank. In the end, individual economic interest was confronted with deeply historical collective economic interest in a valley already tense over permanent

[16] The Fort Lyon Canal Company, represented by Jim Leferdink, expressed its concerns over individual stock holders from canal companies depositing their water in the water bank and what impacts that would have on the management of canal companies in the Arkansas Valley (Public Meeting on Promulgation of the rules for the Arkansas River Pilot Water Bank in Pueblo, Colorado 5/7/02). Another point of contention from the Fort Lyon Canal Company was whether the new water bank would challenge the canal company's ability to veto individual transfers of water from their canal company. Steve Witte, Division 2 Engineer, was unsure of how this issue would be handled in the new water bank. Leferdink continued to press Witte on this issue of the individual versus the canal company by asking how the State Engineer's Office would assess an individual's deposit of water in the water bank by asking whether the State Engineer's Office would do a farm specific or a ditch-wide analysis of the water deposit. Once again, Witte was unsure of how this analysis would be conducted.

[17] The Amity Ditch Company and District 67 were also concerned about mutual irrigation company sovereignty. Both of these mutual irrigation companies stated that, in the past, it has been the mutual irrigation companies right and responsibility to move water around the landscape, but now the State wants to move in on what has traditionally been the mutual irrigation companies responsibility (Public Meeting on Promulgation of the rules for the Arkansas River Pilot Water Bank in Pueblo, Colorado 5/7/02).

water transfers of water out of the lower basin. One of the consistent themes throughout all the interviews conducted for this research was that mutual irrigation companies in the lower Arkansas River Basin did not support the development of the Arkansas River Water Bank Pilot Program, at least in its present form[18].

Mutual irrigation companies were not given a voice in the development of the mission of the water bank, nor were they asked to give their input in regards to the rules and procedures either[19]. By alienating the mutual irrigation companies from the planning process, the State appeared to have created a sense of mistrust between the mutual irrigation companies and the representatives of the Arkansas River Water Bank Pilot Program. This mistrust was reinforced by the fact that the Arkansas River Water Bank Program was relying on stored water located in the Winter Water Storage Program, which was owned by the same mutual irrigation companies. "The lack of trust adversely conditioned the entire program, culminating in a relatively insignificant amount of people depositing water in the bank with no actual trades being conducted over the five year trial timeframe" (Wilkins-Wells and Lepper 2006: 21).

Another common criticism of the water bank was related to the value of the irrigation water, and how a short-term leasing program might ultimately devalue the valley's water[20]. Many of the interviews indicated that most farmers in the valley did not

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[18] Even the Division 2 Engineer stated that Arkansas Valley Ditch Association does not support the water bank because they thought the water bank would devalue their water, and he admittedly said that the support for the water bank in the lower Arkansas River Basin was mixed at best.

[19] According to one mutual irrigation company board member, there was too much input from the end users of the water (municipals) in the water bank and no voice was given to those entities who owned the water (mutual irrigation companies)(Interview May 31, 2002).

[20] According to a representative of the Lower Arkansas Water Management Association, farmers were against the new water bank because they thought agricultural water would be devalued due to the use of short-term water leasing (Interview September 15, 2006). Another informant from the Rocky Ford Highline Canal Company stated that the only entities to benefit from a water bank in the lower basin would be the cities. According to this informant, leasing water without having to purchase it will drastically change the value of water in the prior appropriation system (May 31, 2002).

want short-term leasing agreements like those offered in the pilot water bank. The fear was that those short-term agreements would finally demonstrate that irrigation water in the Arkansas River Basin was not as valuable as farmers believed. This would impact the overall value of their capital assets as well as their ability to secure loans from their local banks to cover operation and maintenance costs.

Finally many informants interviewed commented that the costs associated with fallowing a farmer's field were significant. This was especially true in the lower Arkansas River basin where the rules governing the Arkansas River Compact placed demands and limitations on how and where that water could be used. The generalized state of anxiety among water users and administrators in the Arkansas River basin about the water bank's potential conflict with the Arkansas River Compact was real. Everyone in the basin was concerned about the success of the Arkansas River Water Bank Pilot Program since the possibility that diminished return flows at the Colorado-Kansas state line could put the State of Colorado in violation of the compact and give Kansas another reason to file suit against Colorado. The possibility of another lawsuit coming from the State of Kansas put the lower Arkansas River basin in a state of paralysis when it came to instituting innovations in the way water was run in the basin. The new water bank appeared to create more questions than it solved.

Common Property and Collective Goods Provided by the Lower Arkansas Valley Water Conservancy District

While the pilot water bank was being initiated by the state, efforts were being made to organize another entity to address pressing water resource issues in the basin. On

November 7, 2002, the five counties comprising the lower Arkansas River basin (Bent, Crowley, Prowers, Pueblo and Otero) voted in a public referendum to create the Lower Arkansas Valley Water Conservancy District. "The new district levied a 1.5 mill property tax—costing less than $15 a year for the owners of a $100,000 house and organizers of the new district hope to leverage the tax revenue into $50 million or $60 million in grants and bonds to purchase water rights and conservation easements" (Wood 2002). The new conservancy district's mission was to provide an alternative market for irrigation ditch shares and other water rights in order to prevent the sale of water outside of the Arkansas River basin. The new district would have an operating budget of approximately 1.6 million dollars to begin purchasing water rights from willing sellers in the lower Arkansas River basin.

The development of the new conservancy district might have seemed unexpected to some people outside of the Arkansas Valley, but to those living in the valley, the arrival of the new conservancy district could not have come at a better time. In 2001, a group of investors from Nevada incorporated under the name of High Plains A&M started buying water shares in the Fort Lyon Canal Company. The Fort Lyon Canal Company is the largest canal company in the State of Colorado. By September of 2002, High Plains A&M had purchased nearly 20 percent of the company shares and had contracts on 5 to 6 percent more. According to Steve Wertz, president of the Fort Lyon Canal Company,

> "The speculators arrived at the perfect time finding farmers who had been hammered by drought and heat all through the spring and summer. In fact, the mighty canal had been dry since mid-July, and its water usage from winter storage and direct flow this season totaled only 85,000 acre-feet. The lowest on record for the canal company, lower than the drought in the 1950s and lower than the drought in the 1930s which diverted a total of 102,000 acre-feet" (Wood 2002).

To make matters worse, High Plains A&M did not have a specific end user in mind for the water. "They told us they had visited with several people along the Front Range, but they did not have a final customer" (Wood 2002).

The people of the lower Arkansas River basin decided to fight back in response to arrival of High Plains A&M. In December of 2001, representatives from five counties in the lower Arkansas River basin formed the Arkansas Valley Water Preservation Group.

The first step taken by the group was to conduct a "first look" feasibility study on the development of a new water conservancy district in the Arkansas Valley[21]. The findings raised three primary questions for the preservation group to consider in creating the new conservancy district: First, how much money could be raised to support the new conservancy district? Second, did the group want to pass a bond to support the conservancy district? And third, should a sunset clause be written into the legislation?

One finding from the feasibility study was that 68 percent of the assessed property value, or $964 million, was found in one county (Pueblo), with $545 million of that located in the City of Pueblo. Pueblo County accounted for 79 percent of the registered voters in the five counties, as well as 76 percent of the voters in the past four elections (Trust for Public Land Feasibility Study 2002). Therefore, Pueblo County was the one county where support for the new district had to come from if the initiative had any chance of passing. The Pueblo Chieftain heralded the importance of the new conservancy district to the

[21] "The Trust for Public Land conserves land for people to improve the quality of life in their communities and protect their natural and historic resources. To help public agencies and community groups conserve land, the Trust for Public Land assists communities in identifying and securing public financing for conservation and recreation land acquisition" (The Trust for Public Land: Arkansas Valley Water Conservancy District Feasibility Study. Report given by Richard Skorman 07/31/02. p. 2).

residents of Pueblo as well as the rest of the residents of the lower Arkansas River basin. The editor of the Pueblo Chieftain wrote numerous editorials in support of the new conservancy district for the lower Arkansas River basin.

> "BEWARE. The leeches are coming for the Arkansas Valley's water, and if they are successful, they will dry up the lower Arkansas River and the economies that it supports...A group of speculators – leeches – is buying farms on the largest irrigation ditch on the Arkansas River, the Fort Lyon Canal. In Colorado, water runs uphill to money, and in Colorado the big money is along the Front Range" (Pueblo Chieftain Editorial 2002).

On November 7, 2002, the general public in the five counties went to the polls and voted to create a new conservancy district by a 3 to 2 margin. The mission of the new conservancy district was to protect the water resources in Division 2 for use in the lower basin. "The district, and the associated mill levy authorization, won solid majorities in Crowley, Otero, Bent and Prowers counties. Pueblo residents approved a Ballot Question 4A by a margin of 28,712 in favor and 17,393 against. The majority of voters here realized how vital it was in the valley and to have robust economies, to keep water in the valley which in turn supports Pueblo." (Hoag, Hoag Jr. & Rawlings 2002).

With the passage of the new conservancy district, things began to take form. The first task was to certify the vote by December 13, 2002 in order for the district to begin collecting tax revenue starting in 2003. The district was required to establish a mailing address and a place of operation. A temporary space at Otero Junior College was given to as a base of operation. Eventually, the office was moved to Rocky Ford, Colorado.

The next order of business was to appoint a board of directors for the new district. "The selection of the district's board was much the same as the Southeastern Colorado

Water Conservancy District. Board members were appointed by the chief district judge in Pueblo, who chose from among the people who applied for the post" (Amos 2002). All members appointed to the board had to be landowners in the district, and they also had to be knowledgeable in water use in the west. On Monday, December 15, 2002, Pueblo District 2 Judge Maes appointed seven members to the board. The initial board appointments were for one year. After that, new board members would be nominated to staggered terms of one, two and four years. The new board was chaired by Leroy Mauch, representing Prowers County.

Immediately following the passage of the referendum to create the district, High Plains A&M sued the district along with the five counties involved in its creation challenging the constitutionality of the district. "High Plains A&M attorney Robert Bruce of Denver filed the suit, arguing that the ballot question which created the district was unconstitutional because it contained more than one subject" (Amos 2002). "According to the lawsuit, High Plains A&M sought to win an immediate injunction preventing the five counties from collecting the tax and also sought to have the ballot measure declared null and void" (Cochran 2002). In essence, High Plains A&M challenged the creation of the new conservancy district based on five criteria:

1. The election violated Colorado law because the wording did not fit constitutional requirements.
2. High Plains A&M would be negatively impacted by the creation of the new conservancy district.
3. The tax proposed to finance the Lower Arkansas Valley Water Conservancy District was unlawful.
4. The combination of two issues on the same ballot, the creation of the new conservancy district as well as the creation of the new tax, was unconstitutional.
5. Finally, the text and title of the question on the ballot was confusing (Rich 2002).

In the end, High Plains A&M lost the lawsuit. Judge Maes ruled that the creation of the Lower Arkansas Valley Water Conservancy District was constitutional, and it was allowed to continue to develop.

Once the district was legally formed, the next steps were to find a district manager and to draft a preliminary budget. Richard Hallock of Pueblo volunteered to fill in as the district manager until a person was found to fill the position permanently. Hallock, a retired Army veteran, was accepted by the new board to get things started. The board of the conservancy district adopted a $1.7 million dollar budget for the 2003 fiscal year. The new budget allocated $200,428 for administrative costs, $130,000 for legal, accounting and other public relations costs, $14,400 in capital costs, $25,000 in county collection fees and $44,000 for reserves. This left a budget of approximately $1.2 million to be used for water rights acquisition. Again, the primary mission of the new conservancy district was the acquisition of water rights and conservation easements in an effort to keep water from leaving the lower Arkansas River basin.

Conservation Easements

The idea that conservation easements could be used as a lucrative alternative to selling farmers water rights to water users outside of the basin was first discussed by the Otero County Water Works Committee. This committee was created in 2000 by the Otero county commissioners and was composed of concerned water users from Otero, Bent and Prowers counties to explore alternatives to the outright selling their water rights. This resulted in the formation of the Otero County Land Trust, a precursor to the creation of the Arkansas Valley Land Preservation Trust. The Otero County Water Works Committee found it important to establish a new organization immediately due to the state requirement that an organization intending to collect conservation easements to be in existence for two years before initiating such activities.

The Lower Arkansas Valley Water Conservancy District made conservation easements a centerpiece of its water protection strategy. Such a land trust represented a legal entity established to receive a conservation easement. Land trusts can be private, non-profit organizations or government organizations like the Lower Arkansas Valley Water Conservancy District. The new conservancy district currently provides information to landowners on conservation techniques and tax deductions, as well as being a group that receives the conservation easement and enforces the stipulations on land use in compliance with the restrictions of use imposed by the conservation easement. Landowners enter into conservation easements in order to preserve that land in its present natural state with limited or no new development to the land. Each easement is written to address the unique needs of the individual and his land, while following the strict guidelines of the program.

There are a series of steps to entering into a conservation easement. The first step was for the landowner to contact the conservancy district to discuss the costs and benefits of putting a conservation easement on their land. Next, the landowner needed to consult with an appraiser, a banker, an accountant, a lawyer and a surveyor. The accountant was necessary for discussing the tax ramifications of placing a conservation easement on the land. The lawyer was there to discuss the legal ramifications of conservation easements, while the appraiser was there to determine the agricultural value of the land as well as the developmental value of the land. The banker took care of any issues related to a mortgage on the property, while the surveyor was there to subdivide the land if the landowner stipulated it in the easement.

Once a landowner agreed, a lawyer then drafted the conservation easement by following a template available on the conservancy district website and submitted it to the district for approval. It was then the responsibility of the district staff, attorney and board of directors to ensure that the easement was acceptable. If for some reason the district did not accept the easement, the board would usually try to renegotiate the easement in order to meet district requirements[22]. Within the first year of operation, the district accepted 19 conservation easements from water users in the lower Arkansas River basin.

Lower Arkansas Water Management Program: Land Fallowing/Water Leasing Program

The Lower Arkansas Valley Water Conservancy District's second primary objective was water acquisition. One program they were investigating was the Lower Arkansas Water Management Program. This new program was designed to service the area stretching from Pueblo Reservoir to John Martin Reservoir and was expected to begin operation in 2007 or 2008. The overall goal of this water acquisition program was to provide water users in the lower Arkansas River basin with alternative water management strategies other than the permanent separation of agricultural water rights originally stipulated for irrigation from the main-stem of the Arkansas River. The land fallowing/water leasing program would utilize short and long-term leasing options with the

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[22] For more information on the conservation easement program administered by the Lower Arkansas Valley Water Conservancy District, please visit their website at http://www.lavwcd.org/conservation/steps.htm.

Lower Arkansas Water Management Program actively pursuing water users for participation in a more localized supply and demand market.

One important element for creating the Lower Arkansas Water Management Program was the concept of the "Super-Ditch." A super-ditch in the lower Arkansas River basin would combine the water resources of seven mutual irrigation companies in the lower basin (Bessemer, High Line, Oxford, Otero, Holbrook, Catlin and Fort Lyon) in an effort to protect the water resources of individual mutual irrigation companies, as well as create a pool of water large enough to support a water market during dry years, average years and wet years. According to a study conducted by HDR Engineering and Honey Creek Resources, the new water management program was advised to incorporate a three-tiered system of leasing to maximize revenues for shareholders in the super-ditch[23]. "A three-tiered system of leasing could maximize revenues for super-ditch shareholders. Suggested annual rates, which could be adjusted for inflation: dry year: \$450-\$700; average year: \$400-\$600 and wet year: \$50-\$250" (Woodka 2007). HDR and Honey Creek went on to project available water supplies based on the assumption that 40 percent of the irrigators holding shares in the seven mutual irrigation companies would participate and fallow 25 percent of their land: dry year yield, 8,628 acre-feet; average year yield, 17,618 acre-feet; wet year, 27,949 acre-feet. KDR and Honey Creek also recommended the need for storage of approximately 25,000 acre-feet strategically placed along the river to balance the availability of water during wet years with the need for water during dry years.

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[23] According to the Lower Arkansas Valley Water Conservancy District's June 2007 board meeting minutes, the feasibility study for the Lower Arkansas Water Management Program was conducted by Jerry Kenney of HDR Engineering. HDR Engineering determined that eight of the sixteen mutual irrigation companies in the lower Arkansas River basin will be of no use to the program, but the other eight can provide an ample amount of water for leases that can serve as a pool for water marketing in lower basin from Pueblo Reservoir to John Martin Reservoir. These eight mutual irrigation companies are the Bessemer Ditch Company, the Rocky Ford Highline Canal, the Oxford Farmers Ditch, the Otero Canal, the Catlin Canal, the Holbrook Canal, the Fort Lyon Storage Canal, and the Fort Lyon Canal.

Pricing in this market would be determined by the leasing entity, the Lower Arkansas Valley Water Conservancy District, and the willing buyers. The type of water pursued for the new market would be both storage and surface water rights held by the mutual irrigation companies belonging to the super-ditch, therefore, making it absolutely necessary for an inventory of all the available water resources in the lower Arkansas River basin before the conservancy district could move forward. The water management program would use a variety of water marketing strategies to give water users in the lower Arkansas River basin alternatives to permanent water transfers. These strategies included rotating land fallowing, water leasing, interruptible supply contracts, water banking and purchase and lease-back arrangements[24].

Common Property and Collective Goods Provided by the Lower Arkansas Water Management Association

LAWMA is an organization designed to provide a common property resource, as well as a collective good. When an organization is designed to protect a common property resource, the natural resource is usually characterized by moderate levels of rivalness of consumption and moderate levels of excludability. This is the case with LAWMA. LAWMA is structured like most common property resource organizations in the State of Colorado. In 1998, LAWMA restructured its organization along the lines of a mutual irrigation company; an organization that has been present in the basin since the late 1800s. The mutual irrigation company model was a familiar organizational structure that had been tried and tested by water users in the lower Arkansas River basin. Unlike the Arkansas

[24] The information used to describe this evolving program was provided in November of 2005 by an informant from the Lower Arkansas Valley Water Conservancy District.

River Water Bank Pilot Program and the Lower Arkansas Valley Water Conservancy District, both of which operated at the basin wide level and focused on protecting a public good, LAWMA is focused primarily on providing a common property resource to individual shareholders within the organization and in a limited geographic service area. However, it will be shown that LAWMA also possessed characteristics of a collective goods organization. LAWMA's overall goal is to develop a water portfolio in the lower Arkansas River basin for further use and development. Without this water, the lower Arkansas River basin would dry up and die. Therefore, LAWMA's efforts to keep the water in the lower basin clearly represented characteristics of a collective goods organization, but one could possibly say this of the other two organizations as well.

The Lower Arkansas Water Management Association was established in 1972 and has been an active groundwater users association for 34 years. "LAWMA's primary service area was the Arkansas River main stem below John Martin Reservoir in Bent and Prowers Counties, but it had members above John Martin Reservoir near La Junta and Las Animas and in the tributary areas of Big Sandy Creek and Two Butte Creek" (Williamsen 2006: 1). LAWMA had been a working organization since 1972, but it was not until 1985 that its primary goal came into focus. This was when the State of Kansas filed suit against the Colorado for over depleting the flows of the main stem of the Arkansas River with post-compact wells drawing off the river's tributary groundwater, that the organization actually started operating a groundwater recharge program. "In 1998, LAWMA re-organized as a non-profit corporation and was now operated in the manner similar to a typical Colorado mutual ditch company. Replacement water was delivered to the Arkansas

River to make up or replace the depletions to the stream flow caused by pumping the wells" (Williamsen 2006: 2).

In order to keep LAWMA's members in good standing with the State of Colorado and in compliance with the Arkansas River Compact, it decided to purchase senior surface water rights, which were measured through river gauges near the original points of diversion. These rights were then turned back to the river to gain groundwater recharge credits from the state for irrigation wells in the lower basin. "LAWMA has purchased direct flow and surface water rights at a cost of $8.75 million and fallowed 8,283 acres of irrigated farmland to develop a water rights portfolio so that its members could continue to use their wells" (Williamsen 2006: 7). LAWMA purchased senior surface water rights in the Sisson-Stubbs Canal resulting in 480 dry-up acres, the Manvel Canal with 392 dry-up acres, the Fort Bent Canal with 84 dry-up acres, the XY Ditch with 3,488 dry-up acres, the Highland Ditch with 2,867 dry-up acres and the Kessee ditch with 972 dry-up acres.

In 2002, LAWMA filed for a change in use for its senior surface water rights shifting them from irrigation purposes to groundwater augmentation purposes. By switching the historical use of these senior surface water rights from irrigation to groundwater augmentation, they made the water in their portfolio more flexible. This flexibility allowed irrigation water to move to higher value uses, including, but not confined to, irrigation. A groundwater market for domestic, commercial, municipal, industrial, livestock, fish, wildlife, recreation and power generation, as well as irrigation water, represented a more diverse water market; one that could attract the development of new uses. These new uses could help diversify the local economy reliant on water for growth. "The changed water rights would be used in the Rule 14 Plans and in the plan for augmentation" (Williamsen 2006: 4). In 2005, LAWMA's Rule 14 Plan included 520 wells that were in use prior to 1986[25].

How the Lower Arkansas Water Management Association Works

"In the 1950s and 1960s, high capacity irrigation wells were constructed in the valley aquifer of the Arkansas River to supplement water supplies and to irrigate additional land. The development of irrigation wells went largely unnoticed until the Water Rights Determination Act of 1969 was enacted by the Colorado legislature" (Williamsen 2006: 2). With the passage of the Water Rights Determination Act, well pumpers in Colorado were required to register their wells with the Colorado Office of the State Engineer and were given a water right decree with a priority date, diversion rate and point of diversion. In order to keep pumping their water out-of-priority, well pumpers in the lower basin purchased shares of augmentation water in LAWMA to "pay back the river" for their out-of-priority depletions.

In order to augment these out-of-priority depletions, LAWMA operates a groundwater augmentation program in the lower Arkansas River basin east of John Martin Reservoir. Before LAWMA purchases surface water rights, it does a feasibility study of the water available for purchase for the water leasing pool as well as conducting a feasibility study to determine dry and average year yields from the purchased water rights.

> "LAWMA combined the water yields of the assigned water rights with its yields from direct flow and storage water rights and then distributed the combined replacement supplies as needed to replace the depletions. When

[25] These 520 wells include 479 wells in use for irrigation with 299 of these wells being used to supplement surface water rights in a mutual irrigation company and 177 used as the sole source of irrigation water, 31 wells are for municipal use, and 13 wells have commercial use (Williamsen 2006).

> the pending case was finally adjudicated, LAWMA would annually submit to the Colorado Office of the State Engineer a projection of the depletions for the users covered by the plan for augmentation and a schedule of the replacement deliveries" (Williamsen 2006: 4).

Since 1989, LAWMA has purchased senior surface water rights in six mutual irrigation companies in the lower Arkansas River basin (Sisson-Stubbs, Manvel, Fort Bent, X-Y, Highland and the Keesee). LAWMA is also full owner in three and partial owner in two Article II Accounts in John Martin Reservoir[26]. LAWMA now issues two different types of stock in their non-profit organization: common and preferred. There were 18,394 shares of common stock issued in LAWMA, and they sold for $1,550 per share. In 2005, LAWMA began formulating a process for issuing preferred stock to water users in need of a non-curtailable source of augmentation water[27]. LAWMA has issued 400 shares of preferred stock selling for $3,167 per share.

LAWMA has two types of stock for sale: Common Stock, 18,394 Shares ($1,550/Share) and Preferred Stock, 400 Shares ($3,167/Share).

> "LAWMA has implemented a procedure to issue preferred stock to those members needing a non-curtailable source of augmentation water. Non-curtailable uses include gravel mines, concrete batching facilities, beef and swine feeding operations and other industrial and municipal uses for which stream depletions are fairly constant year to year. In operation of the plan for augmentation each year, LAWMA will assign a predetermined yield to the preferred shares and then adjust the yield available to the common shares" (Williamsen, 2006: 9).

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26 "Under the Arkansas River Compact, water is stored in John Martin Reservoir during the non irrigation season and during times when the inflow exceeds downstream demands. The storage of water distributed into Article II Accounts, 40 percent to Kansas water users and 60 percent among nine Colorado ditches located downstream of John Martin Reservoir" (Williamsen 2006, ARCA 1980)(p. 5).

27 "Non-curtailable water users include gravel mines, concrete batching facilities, beef and swine feeding operation and other industrial and municipal uses for which stream depletions are fairly constant from year to year"(Williamsen 2006)(p. 9).

In order to make the option of preferred stock in LAWMA a reality, the organization had to be creative in its business dealings. LAWMA could not ask its shareholders to cover the cost of purchasing the remainder of the Keesee Ditch because the costs incurred from the sale would be too high, so they brought in two unlikely partners to help finance the deal.

> "LAWMA, CDOW (Colorado Division of Wildlife) and CDP (Colorado Division of Parks) have executed an option to purchase the remaining one-half of the Keesee Ditch water rights. This direct flow right would be used nine out of twelve years by CDOW and CDP to replenish the 15,000 acre-foot permanent pool in John Martin Reservoir. Maintenance of the permanent pool is important for recreation and fish and wildlife uses. LAWMA would then select three dry years out of twelve years to use the water derived from the Keesee Ditch for replacement purposes under Rule 14 Plans and the plan for augmentation. The cost of this water sale is 3.6 million dollars of which LAWMA will pay $1.26 million. LAWMA will finance this cost by selling 400 preferred shares at a price of $3,166 per share to its members" (Williamsen 2006: 8).

LAWMA is organized around the principles of traditional mutual irrigation companies that have been present in the Arkansas Valley for the past century. LAWMA is a not-for-profit organization that issues stock to finance the operation and maintenance of the organization. Members in the organization buy stock and receive the benefits of groundwater recharge credits that allow them to continue to pump their wells out-of-priority. In LAWMA, there are two different types of well water. These include wells with a decreed water right before 1986, which are accounted for with a Rule 14 Plan, and those wells developed after 1986, which are administered under substitute supply plans that are reviewed by the Colorado Office of the State Engineer on a yearly basis. Since 1996, LAWMA has filed its Rule 14 Plan illustrating how much water each individual well pumper is projected to need and how LAWMA plans on augmenting those well depletions in order to protect both senior water rights appropriators in the Arkansas River basin, as well as the State of Kansas.

LAWMA's seven-member board of directors determines how much water will be allocated for each share based on the forecasted yield for LAWMA's surface water rights coupled with the amount of available carryover storage water they have available in the John Martin Reservoir. The water allocation in LAWMA is determined by the amount of replacement water in acre-feet based on well use (supplemental versus sole source), the type of irrigation system used (gravity versus sprinkler) and the number of shares a member had in LAWMA.

The water allocation is then converted to a measurable amount of water per farm unit available for pumping. Each individual member keeps track of their own well usage and submits the flow meter readings to LAWMA on a monthly basis. LAWMA then submits these readings to the Colorado Division 2 Engineer's office that ensures that LAWMA and the State of Colorado are in compliance with the Arkansas River Compact. Along with flow meter readings, power readings are also used to determine how much water was being pumped and how much water must be returned to the river. Unlike flow meter readings, which were submitted to LAWMA, electrical power records are submitted directly to the Colorado Office of the State Engineer and are based on a combination of the power consumption coefficient and the amount of power supplied. LAWMA uses senior water rights from the Highland, Keesee, Manvel, X-Y and Sisson-Stubbs Ditches as replacement flows for out-of-priority well depletions. Flow gauges near the original points of diversion are used to quantify the amount of water LAWMA returns to the river. LAWMA and the Colorado Division 2 Engineer's office then coordinated their efforts on a monthly basis. This involves monitoring to stream depletions from well pumpers owning shares in LAWMA, as well as replacement flows from surface water rights. This ensures that the amount depleted and the amount augmented match.

ANALYSIS

Observed Organizations and Theoretical Models

The waters of the Arkansas River basin may be viewed as a "common pool" resource that possesses low to moderate levels of rivalness of consumption as well as low to moderate levels of excludability. Recall that a pure public good is characterized by low levels of rivalness of consumption and low levels of excludability. All three organizations, the Lower Arkansas Valley Water Conservancy District, the Arkansas River Water Bank Pilot Program and the Lower Arkansas Water Management Association are examples of organizations designed to provide a combination of a common property resource and collective goods. All three organizations are designed to keep the water in the Arkansas River basin for future development of the basin. All three organizations were nominally organized to keep water in the Arkansas River for future development of the basin, and for, the benefit of the people in the Arkansas Valley.

The objective here is to compare each observed organization to the integrated model as advanced in Chapter 2. Both Ostrom and Freeman developed conceptual models for analyzing common pool resources. The integrated model is comprised of variables taken from each of these two theorists. The variables and relationships in the model provide conceptual benchmarks against which each organizational form can be compared.

Table 9: Integrated Design Principles Present in Arkansas River Basin Organizations

Design Principles	Name of Organization		
	Arkansas River Water Bank Pilot Program	Lower Arkansas Valley Water Conservancy District	Lower Arkansas Water Management Association (LAWMA)
Design Principle 1: Clearly Defined Boundaries	No	Yes	Yes
Design Principle 2: Appropriation and Provision Rules/Share System	No	Yes	Yes
Design Principle 3: Collective Choice Arrangements	No	No	Yes
Design Principle 4: Monitoring	No	Unclear	Yes
Design Principle 5: Graduated Sanctions	No	Unclear	Yes
Design Principle 6: Source of Leadership Recruitment (local vs. cosmopolitan)	Cosmopolitan	Cosmopolitan and local	Local
Design Principle 7: Leadership and Staff Responsibility (looking up to central water authority vs. looking down to local water users)	Looked up and looked down	Looked up and looked down	Looked down

Freeman, on the other hand, focused the variables of his model on the source of leadership recruitment, leadership and staff responsibility, share system, member's propensity to support the organization, members control over the resource and sustenance of democratic rights, due process and responsiveness. In this research project, the analyst focused on three of Freeman's variables-source of leadership recruitment, leadership and staff responsibility and the share system to analyze the development and operation of the Arkansas River Pilot Water Bank Program, the Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Water Management Association.

1. *Clearly Defined Boundaries*

> "Without defining the boundaries of a system and closing it to outsiders, local irrigators face the possibility that any benefits they produce by their efforts will be reaped by others who do not contribute" (Ostrom 1992: 69).

Proposition 1: The greater the clarity of defined boundaries, the greater the opportunity for an organization to sustain the common property or collective good.

Arkansas River Water Bank Pilot Program

The Arkansas River Water Bank Pilot Program did not have clearly defined boundaries. It was a new program in the State of Colorado; therefore, it was to be expected that the rules of operation would be initially unfamiliar to water users in the Arkansas River basin, and for that matter, the entire State of Colorado. Thirteen rules governed the operation of the new water bank, and several of these rules had numerous parts. This created ambiguity as to which entities/persons were within the scope of the pilot water bank and which were not.

Water users in the Arkansas River basin were suspicious about the new organization because many of them thought the new water bank was just another way for the metropolitan districts along the Front Range to take their water. It was also unclear whether the new rules would stand up in court if they were challenged on a constitutional level.

One reason water users in the Arkansas River basin were reluctant to deposit their water in the water bank because the new set of rules governing the water bank made it unclear what impacts these new water transactions would have on the agricultural water users and mutual irrigation companies who owned the water. The new water bank solicited individuals to deposit their water in the water bank, but it was the mutual irrigation companies who owned the rights to the water, and it was unclear whether those individual water owners could deposit water in the water bank without the consent of the mutual irrigation company board of directors.

HB-1354 allowed for out-of-basin transfers, and opened up the new water market to Front Range communities to the north. Even though the pilot water bank was designed to serve the water users in the Arkansas River basin, the area served by the Arkansas River Water Bank Pilot Program could theoretically cover the entire Front Range as long as the water users exporting the water leased could deliver the water to their service area. Opening the pilot water bank to out-of-basin transfers brought opposition from agricultural water users in the lower basin, and ultimately led to the banning of out-of-basin transfers in the HB-1318. HB-1318 expanded water banking to all river basins in the State of Colorado, but it also removed out-of-basin transfers from the newly formed water market limiting the water market in the Arkansas River basin from some of its most thirsty water users.

In the first place, HB-1354 allowed for out-of-basin transfers after a ten-day grace period that gave in-basin water users the first opportunity to lease the water available in the water bank. HB-1318, on the other hand, took water banking to all of the river basins in the State of Colorado, but when the legislature did this, they prohibited out-of-basin transfers from taking place as well. These changes in the legislation affected the direction the water bank could take in the Arkansas River basin. By removing out-of-basin transfers from the Arkansas River Water Banking Pilot Program, the Colorado General Assembly removed most of the major metropolitan areas along the Front Range of the Rocky Mountains from participating in the water bank, therefore, limiting the pool of potential water users from gaining access to the water bank.

Not only did this change in rules limit the pool of water users available for leasing water from the water bank, it also raised questions about the legitimacy of the water bank as a newly formed institution. Water users were reluctant to put their water in a water bank to be promoted out-of-basin transfers, and water users were also reluctant to lease water from a water bank whose rules shifted with each legislative session. Rules must be clearly defined before water users can begin to trust the new institution. This was clearly not the case with in-basin and out-of-basin transfers.

Changing legislation also made the physical boundaries of the water bank less clear. With HB-1354, the physical boundaries of the water bank were defined by water users in the Arkansas River basin during the first ten days of posting water, and after the ten-day grace period, the physical boundaries of the water bank expanded to other river basins as long as the water users in those basins could move the water without harming senior appropriators. These shifting physical boundaries were restricted with the passage of the second water banking legislation. When water banking was taken to the entire state it was also restricted to intra-basin transfers, thus limiting the marketing of the water.

The Lower Arkansas Valley Water Conservancy District

In the Lower Arkansas Valley Water Conservancy District, it was unclear what the physical or organizational boundaries would be. Even though the mission of the new conservancy district was to keep the water in the lower Arkansas River basin for future use and development, the district might choose to market that water to out-of-basin users along the Front Range of the Rocky Mountains making the geographic boundaries similar to those of the Arkansas River Water Bank Pilot Program. The Lower Arkansas Water Management Program was designed to pool large amounts of water from mutual irrigation companies in the lower Arkansas River basin for the purpose of leasing that water for short timeframes to water users who need it, including water users outside of the basin. The addition of out-of-basin transfers to the conservancy district's water marketing strategies made it unclear what would be the geographic boundaries for the conservancy. From the search findings, the LAVWCD's mission was to keep the water in the lower Arkansas River basin, which was comprised of Pueblo, Prowers, Bent, Otero and Crowley Counties. Potentially moving water out of the basin, even for a short-term leasing period, would not appear to fit with that mission. This issue might be expected to raise problems for the district as the LAVWCD continues to develop its water marketing plans.

The Lower Arkansas Water Management Association

In LAWMA, the boundaries were clearly defined both organizationally and geographically. The organizational boundaries were clearly defined based on ownership of shares in LAWMA. Anyone who did not own shares in the organization were prevented from participating in LAWMA's water market and prohibited from augmenting well depletions with recharge credits. The primary service area of LAWMA was below John Martin Reservoir. LAWMA also served a few wells above John Martin, but the vast majority of its shareholders were located below John Martin.

In short, LAWMA was organized in the form of the traditional mutual irrigation companies that had been running water in the Arkansas River basin for over a century. LAWMA was an organization that was focused on protecting the integrity of the economies in the lower basin by keeping the water in the valley while creating a mechanism to move that water to higher valued uses. LAWMA had clearly defined boundaries that determined who participated in the organization. LAWMA utilized a share system that linked benefits received to the costs of operating the organization as well as utilizing graduated sanctions for those who broke the rules. This organizational form was familiar to water users in the Arkansas River basin and familiarity lent itself to confidence and security in the local water market.

2. *Proportional Equivalence between Benefits and Costs/Appropriation and Provisions/Share Systems*

> "Self-organizing irrigation systems use different rules to mobilize resources for construction or maintenance and to pay water guards. In long-enduring systems, those who receive the highest proportion of the water are required to pay the highest proportion of the costs" (Ostrom 1992: 70).

Proposition 2: The greater the proportional equivalence between the receipt of benefits and provisions of payments to cover organizational costs, the greater the opportunity for and organization to sustain the common property or collective good.

The Arkansas River Water Bank Pilot Program

Neither the Arkansas River Water Bank Pilot Program nor the Lower Arkansas Valley Water Conservancy District crafted rules to guarantee a proportional equivalence between costs and benefits. Without these rules it was impossible to guarantee a proportional equivalence between costs and benefits. With this said, the conservancy district's conservation easement program had well-defined benefits and costs for landowners, but it was still unclear how the conservation easement program, as well as any of the district's other programs would work in the lower basin. In LAWMA, the maintenance of the organization was paid by the price of each share purchased in the organization. The shares varied in price from year to year depending on the costs incurred in the operation of the organization. Therefore, the price of each share was directly tied to the costs incurred for maintenance.

Freeman's distributional share system is a set of theoretical dimensions that could be used to analyze the proportional equivalence between costs and benefits. The distributional share system stands at the heart of Freeman's theoretical model and centers on two variables: 1) was the benefit of water delivery dependent on fulfillment of organizational obligation and 2) could the organization successfully deliver benefits to all members in the service area without respect to head/tail position? This distributional share system was used to determine whether the delivery of water from any given organization was dependent on the individual water user fulfilling their organizational obligation. For Freeman, a distributional share system consists of three dimensions:

1. A proportion of the benefit stream appropriated by members of the organization (Ostrom's appropriation rules).
2. A proportion of the organizational costs provided (Ostrom's provision rules).
3. A proportion of the organizational governance—voting fraction (Ostrom does not address this variable)

For example, organizations deliver a benefit stream that is divided into portions and members of the organization purchase a portion of the benefit stream, along with proportional voting shares within the organization. If a member purchases 10 percent of the benefit stream, then they are delivered 10 percent of the benefit stream, and they also control 10 percent of the voting shares within the organization.

Freeman's distributional share system is useful for analyzing the Arkansas River Water Bank Pilot Program. There was no share system built into the rules governing the new water bank, at least not in the form that either Ostrom or Freeman discussed. The program operated as a third party broker, focusing on connecting willing buyers and willing sellers of water. Even though all parties listing water and leasing water paid a minimal fee to cover the costs associated with moving the water, those fees were not sufficient to pay for the maintenance of the organization, especially if the new water bank was challenged legally. These parties also had no controlling interest in operating the organization.

In the Arkansas River Pilot Water Bank Program, there were no clear rules crafted to ensure a proportional equivalence between costs and benefits. It was unclear what type of rules could be written to ensure equivalence between costs and benefits; especially with a water bank operating on the principles of a brokering agency. The operation of the water bank was designed to be a low-cost endeavor; therefore, a need to provision for equivalence between costs and benefits was not a priority when promulgating the rules governing the water bank. Water rights owners listing their water in the new water bank were not allowed more input in the operation or direction of the water bank by leasing more water through the bank anymore than someone who purchased less water. The flat fee assessed on each transaction, not on the quantity of water leased, could be construed as an attempt to ensure equivalence between costs and benefits, because a user engaging in more than one lease would be charged a fee for each lease. Even though there was no share system in place in the Arkansas River Water Bank Pilot Program to ensure a proportional equivalence between costs and benefits, this did not seem to be a problem for those interviewed. However, this could be because other problems caused the organization to collapse before a lack of a share system became a problem.

The Lower Arkansas Valley Water Conservancy District

Freeman's share system was also helpful for analyzing the Lower Arkansas Valley Water Conservancy District. In the district, maintenance for its operation was provided for with an annual mil levy. This produced a budget of approximately $1.68 million per year. This tax was paid by all property owners in the five counties making up the lower Arkansas River basin. Consequently, some property owners would benefit more than others; although, the valley landowners would benefit as a whole by having water remain in the valley. Those water users who leased water from the conservancy district had access to a subsidized pool of water that was established for the purpose of keeping the water in the lower Arkansas River basin for future development of the region.

With regard to the collective good (valley's defense of water), the Lower Arkansas Valley Water Conservancy District water delivery was not dependent on fulfillment of organizational obligations, and these obligations were different than what is found in traditional mutual irrigation companies. In the collective goods category where the efforts of the Lower Arkansas Valley Water Conservancy District represented non-excludability and non-rivalness, there was no proportional equivalence between benefits and costs. The organizational obligations were directed at preventing water from leaving the Arkansas River basin (a collective good), but those obligations were not directly tied to the delivery of water to users who needed it in the lower Arkansas River basin, nor is it clear whether users outside of the basin would have access to that water for short-term water leases.

In the case of the common property resource dimension, where the LAVWCD's efforts were moderate excludability and moderate rivalness, there was proportional equivalence between benefits and costs. The district absorbed the shrink (transit loss) and this fulfilled a key criterion for preventing head and tail distinctions. Head and tail distinctions were overcome in the conservancy district's plans of operation because all transit losses were factored into the leasing arrangements agreed upon between the conservancy district and the end user, whether that end user was using the water for agricultural, industrial, municipal or other uses.

The Arkansas River Water Bank Pilot Program did not possess a clearly defined distributional share system, but in the Lower Arkansas Valley Water Conservancy District, there was no clearly defined share system present in the collective goods side of the organization. However, the Lower Arkansas Valley Water Conservancy District plans to incorporate some form of a share system into their standard operating procedures for providing a common property resource. Even though share systems were non-existent, this did not seem to be a problem with those interviewed in this research, or at least it had not surfaced as a problem at the time this research was conducted. The Lower Arkansas Valley Water Conservancy District may have to revisit the issue of share systems in the future, especially if they are able to move forward with the super-ditch concept. The Arkansas River Water Bank Pilot Program in its present form is no longer operating, so it will remain unknown whether a share system could have helped the sustainability of that organization.

The Lower Arkansas Water Management Association

In the Lower Arkansas Water Management Association, the rules specifying the amount of water that a user was allocated were related to local conditions and to rules requiring labor, materials and/or money inputs. "In general, the amount of replacement water provided by LAWMA to each shareholder member was directly proportional to the number of shares of common stock or preferred stock owned by the shareholder member which then converted to a volume of pumping by the shareholder's wells" (Williamsen

2006: 8). LAWMA used the mutual irrigation company shareholder model that allotted one vote per share, which gives shareholders representation that was proportional to the amount of shares they have purchased in the organization.

> "The board of directors sets the allocation to shares based on the projected yield of LAWMA's water rights and carryover storage. The allocation was the amount of replacement water in units of acre-feet per share based on the 1) use of the well, supplemental or sole source, 2) irrigation system, gravity or sprinkler and 3) the number of shares. The allocation was converted to an allowable amount of pumping per well or farm unit" (Williamsen 2006: 8).

In LAWMA, a water user could not gain access to LAWMA water unless they purchased shares in the system and their accounts were in good standing with LAWMA's manager.

The issue of head and tail distinctions was removed in LAWMA because water users were not gaining access to their water through the use of earthen ditches, nor were their water deliveries dependent on upstream users diverting too much water at their headgates leaving downstream users with less than their full allotment of water. LAWMA addressed head and tail distinctions by allowing their water users to pump their allotted water directly from the groundwater basin removing the problems associated with transit loss usually found in mutual irrigation companies using the main stem of the Arkansas River, as well as using the canal companies ditches and laterals to distribute water to their shareholders.

Another strategy LAWMA used to provide a proportional equivalence between costs and benefits was the creation of preferred stocks designed to protect water users with a need for a non-curtailable water right (gravel mines, concrete batching facilities and feed lots). Certain water users needed to know beyond a shadow of a doubt that their water right would be accessible when they needed it, and the preferred stock was designed to provide the assurance. Preferred stocks were priced twice as much as common stocks, but unlike common stocks, which were apportioned based on the water available in any given year after all preferred stocks were made whole, preferred stocks were guaranteed and gave the water user their full share of water every year exactly at the time they needed it. Guaranteed water is extremely valuable in the lower Arkansas River basin, and LAWMA created a water portfolio that consistently provides a supply of water for well augmentation and a variety of other uses.

3. *Collective-Choice Arrangements*

> "Most individuals affected by operational rules are included in the group that can modify these rules...Agreeing to follow rules ex ante is an easy commitment to make. Actually following rules ex post, when strong temptations not to do so are present, is the significant accomplishment" (Ostrom 1992: 70).

Proposition 3: The greater the organizational governance control by its members over the resource, the greater the opportunity for an organization to sustain the common property or collective good.

The Arkansas River Water Bank Pilot Program

In reference to collective-choice arrangements, the Arkansas River Water Bank Pilot Program failed to craft rules guaranteeing that the water users participating in the water bank would have an opportunity to comment and change the rules that impact their involvement in the bank. The Arkansas River Water Bank Pilot Program was created by the state legislature with very little input from the water users in the Arkansas River basin. Public involvement in the crafting of the rules governing the new water bank were heard but not heeded, even during the public hearings administered by the Colorado Office of the State Engineer. All objections filed in the public water bank hearings by the Southeastern Colorado Water Conservancy District, the Fort Lyon Canal Company, District 67 representing the Amity Ditch Company and the Upper Arkansas Valley Water Conservancy District were not factored into the final rules governing the water bank. This failure to incorporate the suggestions of the potential players in the water bank was further evidence that collective-choice arrangements were not present. In the Arkansas River Water Bank Pilot Program there was no share system like what is seen in a mutual irrigation company. The only members in the new water bank were those who signed up to list their water for short-term lease and those who signed up to potentially purchase that water once it had been listed. These members exercised no influence over the rules governing the new water bank. Therefore, it was safe to say that the members control over the resource was low.

The Lower Arkansas Valley Water Conservancy District

The Lower Arkansas Valley Water Conservancy District paid heed to collective-choice arrangements, but the new conservancy district's rules were not as far reaching as LAWMA in regards to water user input into the formation of the rules and direction of the organization. However, the conservancy district rules were more expansive than the State's plan allowed for when they formed rules governing the Arkansas River Water Bank Pilot Program. In the Lower Arkansas Valley Water Conservancy District, water users and citizens of the Arkansas Valley alike participated in the formation of the conservancy district from the beginning. The Arkansas Valley Water Preservation Group was an organization formed by representatives of the five counties in the valley, while the Trust for Public Land was also located in the Arkansas Valley. Both organizations were very instrumental in the formation of the district and the rules that operated it.

The Lower Arkansas Valley Water Conservancy was overseen by a board of directors appointed by the chief district judge located in Pueblo, Colorado. Even though the conservancy district did not utilize the same rules that LAWMA used to guarantee equivalence between costs and benefits it did use an organizational form that was based on providing proportional representation from the five counties represented by the new district. Pueblo County was the most populated county in the valley. Therefore, they were given three representatives on the board of directors and the rest of the counties were given one director a piece. Appointed board members were required to be landowners in the lower Arkansas River basin with knowledge about local water use and economic development.

The Lower Arkansas Water Management Association

LAWMA gave all shareholders a voice in the organization, but by weighting representation based on shares held in the system. This allowed recognition of the investment of those who had purchased shares in the organization. "A seven-member elected board of directors controls and manages the business and affairs of LAWMA" (Williamsen 2006: 8). Water users holding shares in LAWMA have an obligation to cast their vote on an annual basis for or against the elected board members and the direction the board is taking the organization. This opportunity to vote takes place at LAWMA's annual meeting where the general manager of LAWMA gives the annual report and administers the election of board. If a majority of the shareholders decide that a change in the rules governing the organization or the management of the organization is no longer satisfactory, they can amend the rules to be more representative of the new majority. Freeman refers to this collective-choice arrangement as the shareholders control over the resource, and in LAWMA, shareholders had a high level of control over the resource.

The new conservancy district was created to protect all water in the lower Arkansas River basin. Therefore, it was designed to protect a public good that belonged to everyone in the Arkansas River basin. This goal was different than LAWMA's; therefore, a different set of rules were necessary for its operation. The Arkansas River Water Bank Pilot Program was also created with a broader mission of keeping water in the Arkansas River basin. Therefore, it is appropriate to think of the pilot water bank as being another alternative institutional solution for protecting a public good. LAWMA on the other hand was an organization designed to provide a common property resource to water users primarily located below John Martin Reservoir.

4. *Monitoring*

> "Monitors, who actively audit physical conditions and irrigator behavior, are accountable to the users and/or are the users themselves...The costs of monitoring are low in long-enduring systems as a result of the rules-in-use" (Ostrom 1992, 21).

Proposition 4: The more monitoring that is conducted by the management and members of the organization who track the distribution of the benefit stream, delivery of member resources to cover organizational costs, and transparently reviews organizational governance; the greater the opportunity for an organization to sustain the common property or collective good.

The Arkansas River Water Bank Pilot Program

Monitoring the activity of the Arkansas River Water Bank Pilot Program was the responsibility of the Southeastern Colorado Water Conservancy District, the Division 2 State Engineer's Office and senior appropriators. Historically, if a water transaction was challenged in water court, it was the responsibility of the willing buyers and willing sellers to prove that the exchange, lease or transfer of water from one user to another did not injure senior and junior water rights holders. Moving water from one use to another or from one point of diversion to another required a filing in water court. The filing had to be accompanied by legal and engineering studies proving the water transaction was not injuring senior appropriators. The new water bank was designed to circumvent the costly and time-consuming process of the water court by speeding up the time it takes to move water from one use to another. "The purpose of these rules was to implement a pilot water bank that simplifies and facilitates water leasing, loans and exchanges, including interruptible supply agreements, of stored water within the Arkansas River basin; and to reduce the costs associated with such transactions" (Rules Governing the Arkansas River Water Bank Pilot Program, 2001: 1). This was one of the primary complaints filed by the Upper Arkansas River Water Conservancy District during the public hearings process. One of the repercussions of the new water bank was that the monitoring of water transfers largely fell to senior water rights appropriators by shifting the onus of responsibility from the willing buyers and sellers to the senior water appropriators, leaving them without the time necessary to prove their case and protect their water right in water court.

The Lower Arkansas Valley Water Conservancy District

It is still unclear who will monitor the water market created by the Lower Arkansas Valley Water Conservancy District. On one level, the new conservancy district will be monitored, much like the Arkansas River Water Bank Pilot Program, by the Colorado Office of the State Engineer. The Colorado Office of the State Engineer will do this by ensuring that the water transactions being run through the conservancy district were in compliance with all Colorado state laws and compacts governing the operation of water in the Arkansas River basin. Unlike the Lower Arkansas Water Management Association, the Lower Arkansas Valley Water Conservancy District does not have any specific rules crafted for monitoring water users participating in the conservancy districts programs. In the future, these rules may be formulated into the operation of specific programs being offered by the conservancy district. However, until these programs are officially established, the form they take will remain unknown. Both the conservation easement program and the water leasing/land fallowing program could benefit from the creation of a monitoring program that includes the water users. Monitoring the land fallowing program could be a difficult task for the existing staff of the Lower Arkansas Valley Water Conservancy District. Without the involvement of the actual water users themselves, the conservancy district will have to hire a staff to carry out this task, and there is no guarantee that their staff will be able to monitor every water user to ensure their compliance with the rules and regulations established for running the program.

The Lower Arkansas Water Management Association

LAWMA's water market exists in one of the most intensely monitored river basins in the world, one under intense regulatory control since 1985 when the State of Kansas filed suit against the State of Colorado. The creation of LAWMA was in direct response to the institutional changes in the administration of surface and groundwater in 1972. Free-riding was less likely in the Arkansas River basin because of the intense monitoring in the basin due to the over-appropriated nature of the flows of the Arkansas River and the stipulations of the Arkansas River Compact.

It is the Colorado Office of the State Engineer and LAWMA's responsibility to monitor LAWMA well users in accordance with their recharge credits.

> "Flow meter readings for those wells so equipped were submitted to LAWMA by the well owners monthly. LAWMA tabulated the readings and then submitted the readings as a group to the Division Engineer, the State Engineer's administrative representative for the Arkansas River basin. Electrical power records were submitted by the power associations directly to the Division Engineer. For those wells relying on a power consumption coefficient (PCC), the pumping was calculated based on the supplied power record and the PCC for the particular well. The Division 2 Engineer determined the consumptive use based on presumptive depletion factors and lagged the depletion to the Arkansas River using response functions and user groupings" (Williamsen 2006: 8).

Monitors, who actively audit biophysical conditions and user behavior, are at least partially accountable to the users or are the users themselves. According to LAWMA's manager, monitoring is ultimately done by the Colorado Office of the State Engineer, but the Division 2 Engineer is usually about two months behind with the monitoring schedule. Even though the Colorado Office of the State Engineer, as well as LAWMA, monitor well usage, it is the individual well users in the valley who have learned to monitor their own wells to ensure they are in compliance as it is in their individual best interest to do so.

5. *Graduated Sanctions*

> "Users who violate rules-in-use are likely to receive graduated sanctions (depending on the seriousness and context of the offense) from other users, from officials accountable to these users, or from both" (Ostrom 1992: 71).

Proposition 5: The more that the organizational sanction is appropriate to a given infraction, the greater the opportunity for an organization to sustain the common property or collective good.

The Arkansas River Water Bank Pilot Program and the Lower Arkansas Valley Water Conservancy District

Neither the Arkansas River Water Bank Pilot Program nor the Lower Arkansas Valley Water Conservancy District drafted rules concerning graduated sanctions for those water users who broke the rules. None of the thirteen rules governing the operation of the new water bank addressed sanctions to be levied against those who did not abide by the rules of operation. It was unclear how water users brokering deals through the water bank could break those rules. It is also unclear how water users could break the rules operating the new conservancy district. Never-the-less, there were no rules drafted to address infractions if they violated the rules. This issue may become more of a pressing problem once the conservancy district begins implementing its land fallowing and leasing program.

It might be in the best interest of the long-term stability of the program to address the issue of graduated sanctions for those who break the rules.

In terms of LAWMA, monitoring was done by their shareholders, their management staff and by the Colorado State Engineer's Office. If the Colorado Office of the State Engineer finds the well user to be over-pumping groundwater, then the wells are tagged. If the well user keeps pumping, they are fined $150 a day plus what it costs to acquire the water needed to replace their well depletions at current market prices. Not only do the violators have to pay the daily fine charged by the Colorado Office of the State Engineer, but they also have to purchase augmentation water to replace the amount of water they over-pump. This can be quite expensive. LAWMA's manager gave an example of a water user over-pumping 600 acre-feet of water. That water user had to replace the water at a time when the only available water was running $80 per share, which ended up costing the water user approximately $48,000. These sanctions encourage individual well pumpers to monitor themselves because they knew they are responsible for paying back the river for any over pumping done.

6. *Staff Recruitment:*

Proposition 6: To the extent that organizational staff members are hired from the local labor market, opportunity increases for an organization to sustain the common property or collective good.

An important variable not addressed in Ostrom's model is whether the organization recruits its management staff locally or from outside its primary service area. Freeman's recruitment variable was helpful in understanding the issues related to local versus cosmopolitan recruitment especially in regards to whom the organization managers answer. A local is seen as someone who lived and died in the primary service area, as well as someone who had been deeply socialized into the local cultural and economic traditions of the valley. By being socially imbedded in the primary service area, managers might be held more accountable to community traditions by other locals in that service area. A cosmopolitan, on the other hand, would be someone who came from outside the primary service area and only remained as long as the job required it. Each organization analyzed in this research project had a different combination of local and cosmopolitan leadership.

The Arkansas River Water Bank Pilot Program

The Arkansas River Water Bank Pilot Program was legally established with the passage of HB-1354 making the new water bank legislatively mandated as well as legally protected, but this was not enough to make the new water bank a successful new institution for moving water around the Arkansas River basin. Part of the problem with the new water bank was that the legislation passed to create the Arkansas River Water Bank Pilot Program, as well as the process that created and established the rules for operating the new water bank, were primarily established by those outside of the basin. The Arkansas River Water Bank Pilot Program did not recruit its leadership from inside the primary service area; it recruited its leadership from the Colorado General Assembly and the Colorado Office of the State Engineer, as well as the locally based Southeastern Colorado Water Conservancy District. Water banking was heralded as a solution to many of the problems facing Colorado.

Institutional change in an already complex social environment was apparently more difficult than the Colorado General Assembly anticipated. Although there was some notable public involvement to determine what the water users in the lower Arkansas River basin needed, the effort largely appeared to have been politically motivated by outside interests. It appears that the public involvement process should have focused more on agricultural landowners owning shares of stock in local mutual irrigation companies, since those individuals and their respective enterprises had the largest standing and economic interest in the idea. In short, it appears that mutual irrigation companies in the lower basin should have been more directly involved in the development of the water bank, but for some reason they were not.

As for the Southeastern Colorado Water Conservancy District, the leadership changed during the years when the pilot water bank was being implemented. Although this leadership clearly had local roots in the valley, it was not local in the sense that such leadership was particularly accountable to local interests and traditions. This leadership was largely accountable first to the state, and then to a substantial degree to the federal government for its role in managing significant portions of the federal project.

The Lower Arkansas Valley Water Conservancy District

The staff recruitment process of Lower Arkansas Valley Water Conservancy District lies somewhere between the two extremes represented by LAWMA and the Arkansas River Water Bank Pilot Program. LAWMA represents an organization controlled and operated by local water users in the lower Arkansas River basin, while the

State of Colorado's program represented a program developed and administered by outside interests. The Lower Arkansas Valley Water Conservancy District's leadership was drawn from local representatives that were knowledgeable on issues related to western water use, especially water use in the Arkansas River basin. In addition to local county representation on the board, the recruitment of a series of managers for the district was largely drawn from the local area. However, in these instances, district management fell largely under the control of individuals who appeared to have minimal agricultural background and little local water issue knowledge and did not appear to be well connected to local communities in the valley.

The Lower Arkansas Water Management Association

LAWMA was locally managed and operated. It recruited a local farmer from the Arkansas Valley to manage its organization. LAWMA's manager hails from the Arkansas Valley and traces his roots to the original settlers in the valley. Even though LAWMA is imbedded in a larger institutional framework that administers water within the State of Colorado, as well as between the States of Colorado and Kansas, the manager does not answer to these entities accept in reference to the organization's compliance with state and federal laws and compacts governing well pumping in the Arkansas River basin. LAWMA's manager is accountable to the shareholders in the organization, and if those shareholders feel that the manager is no longer serving the organizations best interests, they could vote to replace him at the annual shareholders meeting. The fact that LAWMA's manager is accountable to the shareholders in the organization, and those same shareholders are located in the primary service area, it is much more likely that LAWMA's manager is going to focus the organization's efforts on protecting and developing the organization's water portfolio for local uses. LAWMA's manager has a vision for the future of the lower Arkansas River basin articulated by the shareholders, and LAWMA's management of the water in their organization is part of that future. LAWMA's manager envisions a time when the remaining water in the lower Arkansas River basin will be necessary to reinvigorate the local economies that now rely on that water primarily for agricultural uses. That does not necessarily mean that the water will continue to stay in agriculture. LAWMA's manager sees a day when other water users in the lower Arkansas River basin will need LAWMA's water to build new economies of scale for those in the lower basin. For instance, this desire to have a more reliable, non-curtailable water supply for local water users resulted in the creation of the preferred stock option in LAWMA, as well as LAWMA's 2002 water court case to change its water from primarily agricultural use to augmentation. By having all its water listed as augmentation water, LAWMA could move water around its service area with relative ease by allowing its shareholders to pump water when and where they need it. These were decisions voted on by the shareholders of the organization, and the management of the organization reflects the shareholders' interests.

7. *Staff Authority Relationships*

Proposition 7: The more the organizational staff looks down to the members of their organization for accountability, the more the opportunity for an organization to sustain the common property or collective good.

Another important variable used in Freeman's model is related to whom the organizations staff is ultimately accountable. "Responsibility to the main system authority was indicated by dependence of organizational staff upon the main system for renumeration, and affiliation with managers. Responsibility to farmers was typically indicated when farmers hire and dismiss organizational staff without regard to civil service regulations, and when rewards and services were established by farmers" (Freeman 1989: 26).

The Arkansas River Water Bank Pilot Program

The pilot water bank, on the other hand, recruited cosmopolitan leaders to run the new organization. The outlook of these managers was more directed to the state's central water authority when it came to management of the new bank. The rules governing the Arkansas River Water Bank Pilot Program were promulgated by the Colorado Office of the State Engineer in cooperation with the Colorado General Assembly, and it was the Colorado General Assembly that was responsible for reauthorizing or terminating the water bank upon conclusion of the five-year trial period. This institutional arrangement legislatively mandated that the Colorado Office of the State Engineer must report its progress back to the Colorado General Assembly thereby ensuring the new water bank was accountable to the state's central water authority, rather than to local interests in the valley per se.

Not only was the staff of the Southeastern Colorado Water Conservancy District and the Colorado Office of the State Engineer forced to look up to the Colorado General Assembly and the Colorado Office of the State Engineer for its authority, they also looked down to the water users participating in the new water bank. If these water users found that the water bank was not benefiting their needs, then they could refuse to deposit their water for use in the bank. This situation worked the same for those water users needing to lease water through the bank. If their needs were not met, or those water users decided that the costs outweighed the benefits of leasing water in the bank, then they could decide to not participate in the water bank. As discovered in the Arkansas River Water Bank Pilot Program, the pilot water bank would not be functional without the participation of the water users in and out of the basin. This issue became a significant problem for the water bank, especially since many of the potential water users, in particular the mutual irrigation companies in the lower Arkansas River basin, reported that their input was not incorporated into the rules governing the new water bank. In turn, the mutual irrigation companies, which were comprised of the individual water users in lower Arkansas River basin, refused to participate in the water bank. This lack of support by the mutual irrigation companies in the lower Arkansas River basin proved to be detrimental to the operation of the pilot water bank.

The Lower Arkansas Valley Water Conservancy District

The Lower Arkansas Valley Water Conservancy District was the end result of a campaign that was locally sponsored and funded to protect the water resources in the lower basin to ensure the water stayed in the basin for future development of the local economies in the lower basin, especially those economies that had traditionally relied on the waning agricultural sector of the economy for their economic sustenance. The groundswell of local support for the new conservancy district culminated in the passage of a public referendum to create the new conservancy district thereby intimately tying the mission and agenda of the new conservancy district to the needs of the local water users in the lower basin.

Even though the general management of the district did not necessarily come from local community networks, district management is still held accountable by the board of directors who represents all five counties in the lower Arkansas River basin. The general management of the new conservancy district is hired and can be fired by the board of directors; therefore, the general manager is obliged to be responsive to the needs of the board. Not only could the board of directors fire the general manager, it is also intimately involved in the direction taken by the new conservancy. Once board approval is attained, the general manager is then given the green light to proceed with the implementation of that particular program. The board of directors is then be given regular progress reports on the implementation and operation of the programs being offered by the conservancy district, and if these programs are not operating as they were originally intended, the board can recommend changes.

The board of directors of the new conservancy district is also forced to look down to the local water users for their accountability. The board members are locals owning land in the primary service area and are largely held accountable to the local traditions and culture of the lower basin. Considerable social pressure can be exerted by local water users on a board member when they continue to live, work and socially interact in the same area they are empowered to serve. These water users are usually the board members' peers, as well as their friends. These close ties ensure that the board members cast their vote to support the local agendas that benefit the members of the lower basin or be voted off the board. This local accountability ensures that the board looks down to the water users in the lower Arkansas River basin, therefore, ensuring the needs of the water users are met.

The Lower Arkansas Water Management Association

Within local organizations like LAWMA, member shareholders elected a board to govern the operation and direction of the organization. "This body was empowered by joint agreements with the main system and local irrigation community to direct the affairs of the local organization in accordance with the established charter and by-laws, to which the shareholders had publicly and legally pledged themselves" (Freeman 1989: 41). In LAWMA, the board is comprised of representatives from differing interests groups within the local organization, and those representatives are given the responsibility of creating policy as well as hiring and firing the operating staff. The fact that the board of directors hires and fires the organizations operating staff and the fact that the board of directors is elected by member shareholders in the organization ultimately makes the operating staff accountable to the local water users that pays their dues to be part of the organization. This ensures that the manager of LAWMA looks down to the local users and is held accountable to those local users for the decisions made when operating the organization.

Summary of Findings

Overall, the models extracted from common pool resource organizational theory have proved to be good heuristic devices for organizing the research and analysis. The models used in this research proved useful for analyzing all three organizations present in the Arkansas River basin. The analyst had a wide variation when comparing the Arkansas River Water Bank Pilot Program, the Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Water Management Association, which were deemed central to the development and protection of the lower Arkansas River basin. The Arkansas River Pilot Water Bank Program did not posses any of the design principles offered in Ostrom's model. The fact that the pilot water bank failed supports Ostrom's findings on long-enduring common pool resource organizations. According to common pool resource organization theory, long-enduring organizations usually possess some or all of Ostrom's design principles; therefore, the absence of all of these variables supports the prediction of the failure of the pilot water bank. The findings from this research were simply another affirmation of the importance of Ostrom's design principles with respect to the development and operation of long-enduring common pool resource organizations.

In regards to Freeman's independent variables, the pilot water bank did not possess a share system that tied water delivery to the fulfillment of the organization's obligation nor did it address the issue of head and tail distinctions in the organization's service area. According to Freeman's model, the failure to incorporate a clearly established share system into the organizational framework was a clear sign of weakness when it came to the development of a long-enduring collective goods organization. The absence of a share system was an important omission in the organizational design of the pilot water bank. Freeman's model centers on the share system and an organization without one, he has contended, is doomed to fail.

In the Arkansas River Water Bank Pilot Program the source of leadership recruitment came from cosmopolitan leaders. The cosmopolitan leaders involved in the development, implementation and operation of the Arkansas River Water Bank Pilot Program were representatives of the Colorado General Assembly, the Colorado Office of the State Engineer and the Southeastern Colorado Water Conservancy District. This leadership and their staff then looked up to the central water authority in the State of Colorado and down to local water users participating in the newly developed water bank when it came to whom they were responsible and accountable, too. Freeman's model would predict that cosmopolitan leaders looking up to the state's central water authority for definitions of success and failure constitute an unfavorable condition for creating local long-enduring common property resource and collective goods organizations. The failure of the Arkansas River Water Bank Pilot Program characterized by the combination of cosmopolitan leaders looking up to the state's central water authority coupled with the absence of a share system supports the organizational failure that Freeman's model would predict.

By examining the development and operation of the Lower Arkansas Valley Water Conservancy District, the analyst was able to provide support for using models to compare real world organizations to ideal type models. When comparing the new conservancy district to Ostrom's five design principles, there is an unclear picture. Unlike the Arkansas River Water Bank Pilot Program, which failed to provide any of Ostrom's design principles when crafting their new organization, the new conservancy district provides for provisions within the rules governing the new organization to satisfy at least some of Ostrom's design principles, and it is still unclear on whether they will develop rules to meet the other principles. The fact that the new conservancy district scored inconclusive on Ostrom's design principles left a cloud of uncertainty over the fate of the new conservancy district.

When evaluating Freeman's independent variables for this new district, the picture is a little clearer. Much like the Arkansas River Water Bank Pilot Program, the Lower Arkansas Valley Water Conservancy District does not possess a share system for tying the delivery of water to a specific organizational obligation when providing a collective good, but when it came to setting up guidelines for distributing the shrink (a.k.a. head and tail distinctions), the LAVWCD actually incorporated rules to cover transit losses in the leases brokered. These rules may change as the new conservancy district incorporates new programs into its organizational mission, especially its land fallowing and water leasing program, which is the foundation of its super-ditch cluster.

The absence of a clearly defined share system on the collective goods side of the Lower Arkansas Valley Water Conservancy District is problematic. Although the new conservancy district failed to provide for a clearly defined share system to protect a collective good, it did recruit its leadership from both cosmopolitan pools as well as local pools, and those leaders are forced to look up to the state's central water authority and look down to local water users, as well as the citizens in the five county area comprising the lower Arkansas River basin. The combination of cosmopolitan and local leadership looking up to the state's central water authority and looking down to locals working on the creation of an organization designed to protect a collective good for the Arkansas River basin are essential for the sustainability of the new conservancy district.

The Lower Arkansas Water Management Association was fashioned after the mutual irrigation companies operating in the Arkansas River basin for the past century. These mutual irrigation companies are not usually collective goods organizations, but are common property resource organizations. This is the case with the Lower Arkansas Water Management Association. Unlike the two previous organizations, the Lower Arkansas Water Management Association is the only organization, which was examined in the lower Arkansas River basin that is close Ostrom's model. The Lower Arkansas Water Management Association possesses all of the design principles in reference to Ostrom's model. Ostrom's model provided five design principles that are necessary, but not sufficient for the creation of long-enduring common pool resource organizations. Even though the Lower Arkansas Water Management Association has not been operating long enough to be considered a long-enduring water management organization, it has been a sustainable organization much longer than the previous two organizations. As discussed previously, the existence of these design principles does not cause the development of a successful and sustainable organization; they are merely necessary ingredients to a number of long-enduring organizations that have been researched previously. The Lower Arkansas

Water Management Association represents a successful water management strategy for protecting the water resources in the lower Arkansas River basin.

Not only does the Lower Arkansas Water Management Association incorporate the posited desirable attributes of the integrated model, it is the only organization that actually possesses a viable share system. The share system in the Lower Arkansas Water Management Association serves as the foundation of the organization, much like the share system so central to Freeman's model. This is not a coincidence. Freeman's model was developed not only by observed investigation of common pool organizations in south and southeast Asia, but also in part on the mutual irrigation company form that was prevalent throughout the State of Colorado for more than one hundred years, and the Lower Arkansas Water Management Association based its organization on this is same format.

The Lower Arkansas Water Management Association also draws its leadership from a local pool of water users who look down to the shareholders in the organization for their accountability. Both the manager of the Lower Arkansas Water Management Association and the board of directors re selected from the lower Arkansas River basin. The board itself is comprised of shareholders who are elected by their fellow shareholders to serve in the interests of the organization.

One important variable that was not part of the theoretical model constructed for this project was whether the resource itself was owned by the organization in question. Whether the organization owned the water they were using to form a water market was an especially important issue when it came to the overall success of the organization in meeting its mission. The Southeastern Colorado Water Conservancy District, which administered the Arkansas River Water Bank Pilot Program, did not own the water they were factoring into the prospective water market. This proved to be detrimental to the development and administration of that water market. This was a sticking point once the new water bank went online. The fact that the mutual ditch companies in the lower Arkansas River basin were not sufficiently involved in the rule making process made it less likely that those same mutual irrigation companies would deposit their water in the water bank, leaving the water bank with no water to operate a water market. The fact that the Arkansas River Water Bank Pilot Program did not own the water it was factoring into the operation of the pilot water bank left them susceptible to the whims of the mutual irrigation companies that did own the water. This issue turned out to be extremely important to the failure of the water bank, because in the end, the mutual irrigation companies were able to prevent most of their individual water users from depositing water in the bank making the pilot water bank ineffective at moving water around the Arkansas River basin.

The Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Water Management Association decided to take a different approach to this problem by choosing a path that required the outright purchase of water rights in order to facilitate the formation of new water markets in the Arkansas River basin. The Lower Arkansas Valley Water Conservancy District's original mission was to serve as an alternative buyer for agricultural water rights in an effort to prevent the remaining agricultural water rights from moving to the Front Range communities outside of the Arkansas River basin, especially those communities to the north in the South Platte River basin. This mission is supported with the budget of the new conservancy district where approximately 73 percent of its available budget was earmarked for water rights acquisition. It is still unclear how successful the Lower Arkansas Valley Water Conservancy District will be at forming a new water market in the Arkansas River basin, but the fact that the conservancy district is still in operation is an indication that it has been more successful than the Arkansas River Water Bank Pilot Program.

The leadership in the Lower Arkansas Water Management Association also believed that the solution to the creation of a successful groundwater recharge market is outright ownership of the majority of the water rights available in its water rights portfolio. The manager's role of the Lower Arkansas Water Management Association's main strategy for dealing with interruptions in the groundwater market they are operating is to buy water rights outright. Interruptions can stem from changes in the Arkansas River Compact, changes in the state regulations governing groundwater in the Arkansas River basin or climactic shifts resulting in drought conditions diminishing the amount of water available for pumping in the lower Arkansas River basin. The Lower Arkansas Water Management Association believes it is a waste of their limited resources to fight water battles legally if they are required; therefore, they usually sought a wet solution to their problems instead of a legal solution. Owning the water outright is a primary strategy of the Lower Arkansas Water Management Association and is one of the reasons the organization is able to adapt to the changing legislative and institutional environment that governs the Arkansas River basin.

Another independent variable that the analyst did not factor into the model is whether the organization engaged the individual water user to deposit water into the water bank, or whether the organization engaged the mutual irrigation companies when looking for water to start a short-term water leasing program. One of the main concerns about the development and implementation of the Arkansas River Water Bank Pilot Program was that the mutual irrigation companies who owned the water were not sufficiently involved in the rule making process. This fear was amplified when the water bank solicited involvement from individual shareholders in mutual irrigation companies without involving the mutual irrigation companies themselves.

The Lower Arkansas Valley Water Conservancy District, on the other hand, took a different approach with the concept of their water leasing/land fallowing program. The leadership in the new conservancy district realized that it would not create a large enough rental pool by relying on individual water users depositing water in their new program, so in response to this problem they solicited the involvement of certain mutual irrigation companies in the lower Arkansas River basin and began working on a super-ditch concept that would give each participating mutual irrigation company an opportunity to have their shareholders pool a significant amount of water available in the mutual irrigation company for short-term lease. The Lower Arkansas Water Management Association is a different type of organization because it owns the water resources used to create the market that operated within their primary service area, where the two previous organizations were reliant on other individuals or organizations to place their water under the control of another organization for a short period of time.

The examination of this independent variable leads us into a broader discussion of the differences between an approach referred to as the social contract focused on protecting the collective interests of local water users and the social and economic traditions they preserve versus the utilitarian approach emphasized by the economic interests of individual landowners moving water to growing metropolitan cities. The utilitarian approach was based on the assumption that the market was the most efficient way of moving water to its most beneficial use, where efficiency was defined by obtaining the "greatest good for the greatest number." The utilitarian calculus left no room for preserving local traditions by upholding longstanding social contracts. "In this research water banking was viewed as one of many water marketing techniques, but which more often than not, appeared to be designed more to protect and secure local water rights for continued use rather than as a means of earning profit and/or seeking the highest economic value of the resource" (Wilkins-Wells and Lepper, 2006: 27). The three water management organizations observed in this research ranged from one extreme founded on the assumptions of the utilitarian calculus to the other extreme founded on the assumptions of the social contract. Those organizations founded with a mission of preserving longstanding local water management traditions, especially those represented by the mutual irrigation company model, tended to be more successful than those water management traditions offering new approaches.

Theoretical models addressed by Ostrom and Freeman, and integrated in this effort, focus on the intermediate level between the state and the individual entrepreneur. The general guiding thesis has been that the form of common pool organizations operating in the interface between state bureaucracies, individuals and private sector enterprises has much to do with the success or failure of common pool resource management.

As identified in this study, there were a variety of water marketing strategies tried in the Arkansas River basin, but some were more successful than others. The organization that best fit the model was also the organization that was the most successful. The Lower Arkansas Water Management Association had clearly defined boundaries, a well defined share system, collective choice agreements in place, and a monitoring system enforced with graduated sanctions. LAWMA's staff was also hired locally as well as locally accountable to their board or directors and shareholders. That staff was also responsible for providing routine maintenance to the organizations facilities, as well as providing for non-routine construction and rehabilitation when needed.

The Arkansas River Water Bank Pilot Program, on the other hand, did not fit the model at all and failed to complete a single water banking transaction throughout its five years of operation. In the pilot water bank, there were no clearly defined boundaries, no share system in place to guarantee a proportional equivalence between costs and benefits, no collective choice arrangements in place to deal with problems that may arise, it was unclear who would monitor the program and its impacts and there were no graduated sanctions for dealing with the problems when the do come up. Not only did the pilot water bank fail to incorporate Ostrom's variables into the mix, their staff was also comprised of cosmopolitans who were forced to look upward and downward for their accountability which created an environment with little trust or cooperation.

Chapter 6

SUMMARY, IMPLICATIONS AND CONCLUSION

Summary

What sociological attributes characterize the form of an enduring social organization that empowers individually rational, self-interested actors to provide themselves with a common property resource and collective good? This question has organized this research effort.

The research question was examined by comparing the observed attributes of actual organizations to the theoretical ideal types that were identified in the literature review. The implications of this research in light of methods and theory are considered below.

In order to address this research question, the analyst compared three common property resource and collective goods organizations located in the Arkansas River basin to an integrated ideal type model combining the work of David Freeman and Elinor Ostrom. It was the objective of this research to employ empirical observations while giving consideration to existing common property resource theories in an effort to formulate new theories. The three organizations were:

1. The Arkansas River Water Bank Pilot Program
2. The Lower Arkansas Valley Water Conservancy District
3. The Lower Arkansas Water Management Association

Information was gathered and data were collected using systematic in-depth interviewing of key informants and document collection to construct a detailed case study. This effort examined the social and political dynamics by which the water community in the Arkansas River basin assessed the Arkansas River Water Bank Pilot Program and then proceeded to establish an alternative collective goods organization in the form of the Lower Arkansas Valley Water Conservancy District. Not only did this research assess the development of two new water management programs in the Arkansas River Basin, it also assessed the development and operation of the Lower Arkansas Water Management Association, a common property resource organization designed to augment well depletions from water users in the lower Arkansas River basin. This research was designed as a hypothesis generating study not a hypothesis testing study. As such, the primary thrust of the research was the discovery and advancement of hypotheses that could contribute to the theory building process.

Key findings are as follows:

1. The Arkansas River Water Bank Pilot Program failed to have the characteristics that the analyst's integrated ideal type model would suggest were important to the creation of a long-enduring organization. Incidentally, the Arkansas River Water Bank Pilot Program collapsed.

2. The Lower Arkansas Valley Water Conservancy District had some attributes established in our integrated ideal type model and has established itself as partially successful. Further observation is in order.

3. The Lower Arkansas Water Management Association had virtually all the characteristics of the integrated ideal type model, and it was the only organization studied that should be considered a success story, as defined by member support for the organization and the capacity of that organization to re-regulate flows on the Arkansas River.

The Arkansas River Water Bank Pilot Program's failure

The failure of the Arkansas River Water Bank Pilot Program came as a surprise to many, and yet to others it was the expected outcome of an inadequate rules making process.

> "The results of the Colorado initiative were rather unexpected, given a generally robust state tradition of innovative and successful water marketing. This includes a long tradition of mutual irrigation company rental markets, clever trans-mountain diversion projects initiated by many different local groups throughout the state, the recent successes by landowners in the Arkansas Valley to fallow their land and lease their irrigation water to cities, and a long-standing and innovative market-oriented federal water project; the Colorado Big Thompson Project" (Wilkins-Wells and Lepper, 2006: 1).

When viewing the Arkansas River Water Bank Pilot Program through our theoretical framework, we can gain an understanding of why it failed in reference to the variables of our models. First, the pilot water bank did not have clearly defined geographic or organizational boundaries. This lack of clearly defined boundaries made it difficult for water users to trust the new water bank enough to list their water for lease as well as making it difficult for water users to lease that water once it was listed. The fact that out-of-basin transfers were initially on the table, but with the passage of HB-1318 they were taken off the table, made it confusing on who could participate in the new water leasing market.

The pilot water bank also failed to craft rules to ensure a proportional equivalence between costs and benefits. In LAWMA, this proportional equivalence between costs and benefits is covered with their share system, but the pilot program had no rules addressing this issue. The administration of the program was initially paid for by the State of Colorado, and the operation of the bank was to be paid for by a minimal service fee charged for each transaction run through the bank. Collective choice agreements were also absent in the rules operating the pilot water bank. As discussed throughout this research, mutual irrigation companies in the lower Arkansas River basin were left out of the rule making process and this aggravated the irrigation companies' existing distrust of state and federal government programs operating in the lower Arkansas River basin.

Monitoring was to be done by a variety of stakeholders. The Division 2 Engineer and the Southeastern Colorado Water Conservancy District were legally mandated to monitor the progress and impacts of the new water bank, but it was the senior appropriators who were shouldered with the responsibility for monitoring whether their water rights were injured do to a water lease run through the water bank. Monitoring the movement of the water in the bank was made easier buy only allowing stored water available in Pueblo Reservoir to be traded in the pilot water bank. Graduated sanctions for infractions were not factored into the rules governing the new water bank. The pilot water bank also recruited mostly cosmopolitan leaders to run the water bank. Managers from the Southeastern Colorado Water Conservancy District, the Division 2 Engineer's Office and the Colorado General Assembly who were responsible for creating and implementing the new water bank were all cosmopolitans who did not have strong ties to the culture and communities of the lower Arkansas River basin. These same managers were forced to look up to the Colorado General Assembly and down to the water users moving water through the water bank when it came to accountability.

Informants uniformly agreed that most farmers did not support the development of a water bank in the lower basin because even though the water bank tried to keep things simple by restricting the water bank transactions to stored water found in the Winter Water

Storage Program, the rules it created proved to be unclear. Lack of clarity, in turn, meant uncertainty. Uncertainty of impact meant—among many—withdrawal of support.

Another problem with the Arkansas River Water Bank Pilot Program was its appeal to individual water users owning shares in mutual irrigation companies to deposit their surplus water in the water bank for trade instead of approaching the mutual irrigation companies as a whole.

The Lower Arkansas Valley Water Conservancy District a Potential Success Story

The Lower Arkansas Valley Water Conservancy District is still a work in progress and it is unclear whether it will be a success or failure. From the theoretical models, it can be determined how the new conservancy district compares to the ideal types. It is unclear whether the conservancy district has established clearly defined boundaries. The new conservancy district established two primary programs for meeting its goals, but it is still vague what will be the geographic boundaries for the conservancy district. The new conservancy district, much like the pilot water bank, may attempt to lease water outside of the basin with short-term leases. This will be a contentious issue for the conservancy district to deal with if it markets its water from the land fallowing program to the Front Range communities to the north. As for the conservancy district's conservation easement program, the conservancy district could only accept conservation easements from within the lower Arkansas River basin. The rules governing the conservation easement program were clearly defined, but the rules governing the land fallowing program were still being negotiated. Much like the pilot water bank, there were no rules guaranteeing a proportional equivalence between costs and benefits either, nor were there rules establishing collective choice arrangements like those found in LAWMA. It is also uncertain whether the new conservancy district would be responsible for monitoring the programs they were offering. Currently, the conservancy district does not have the staff to implement, administer and monitor the programs it is offering and this will be more of a problem once the field fallowing program goes online. Additionally, it is unclear whether the conservancy district would use graduated sanctions for water users violating the rules that govern each program.

As for Freeman's variable of staff recruitment, the conservancy district hired a cosmopolitan manager to run the new district, but they also established a board of directors made up of local landowners with knowledge in western water from each participating county. The combination of cosmopolitan and local leadership could help ease the growing pains of the new conservancy district at the state and local levels. As for Freeman's staff authority variable, both the general manager and the board of directors of the conservancy district are required to look down to the water users in the lower Arkansas River basin when it comes to accountability.

At this time, it is unforeseen to all observers whether the LAVWCD will be a success or a failure. It is clear, however, that the organization possesses some attributes that are associated with successful organizations (clearly defined boundaries and a rough equivalence of benefits and costs), but the organization failed to incorporate other attributes associated with successful organizations. With this said, this organization will offer an opportunity for students interested in common pool resource organizational theory to watch an organization evolve.

The Lower Arkansas Water Management Association's Story of Success

LAWMA was successful for a number of reasons that are consistent with the common pool resource theory. In the first place, LAWMA is a non-profit organization using a common Colorado mutual ditch company format. This organizational form has proven to be stable over the one hundred-year period it has been used in the State of Colorado. This organizational form has been used by mutual irrigation companies for more than a century; therefore, the rules governing the operation of this organizational form are understood as being proportionally equivalent between costs and benefits by water users buying shares in LAWMA. This means that LAWMA has established clearly defined boundaries of who could and could not participate in the water market created with LAWMA's water portfolio.

LAWMA's organization also incorporated collective choice arrangements that allowed shareholders the opportunity to air their grievances without having to formally file charges in the State of Colorado's water court. This familiarity with the collective choice arrangements allows water users in the lower Arkansas River basin to invest their money in LAWMA knowing that they will get exactly for what they paid. If for some reason the shareholders in LAWMA are not happy with the rules governing the operation of LAWMA's groundwater recharge program, they can organize a group of shareholders within the organization that shares their concerns and change the rules to represent their interests. LAWMA also has a clearly defined set of rules governing the appropriation and provision of water within the organization. One share of common stock allows the shareholder access to one acre-foot of water as long as the organization's yearly water yield can meet that demand. If for some reason there is not enough water to meet a one share per acre-foot allotment, then LAWMA's board will refigure the volume of water that each share will yield. Preferred stock, on the other hand, guarantees the shareholder a yield of one acre-foot per share no matter the yearly yield. Preferred shareholders pay twice the price for preferred stock as they would common stock, but they are guaranteed a certain amount of water. Common stock shareholders are also given the opportunity to trade in common stock for preferred stock at a rate of two for one.

LAWMA is also successful because monitoring of water use is done within the organization by shareholders, LAWMA's manager and local well commissioner representing the Division 2 Engineer's Office. LAWMA's manager admits that early on in LAWMA's development he was more involved in the monitoring of the well users within the organization, but as time went on, individual water users became familiar the rules of operation as well as the graduated sanctions they were held accountable by, and in turn they adapted their behavior to make sure they were in compliance with LAWMA's rules of operation. Once individuals within LAWMA make monitoring their water use their responsibility then LAWMA's manager is freed up to monitor LAWMA as an organization. The manager's job is to ensure that LAWMA is in compliance with the laws and interstate compacts that govern water use in the Arkansas River basin. Monitoring is also conducted by the Division 2 Engineer's Office, but the State Engineer's Office is usually about two months behind. LAWMA's manager admitted that his relationship with the local well commissioner, who is responsible for monitoring well use in the lower Arkansas River basin, made it possible for him to address problems with lags that existed between pumping and augmentation, but this may not always be the case, especially if the Division 2 Engineer's Office appoints a new well commissioner for this primary service area. This form of social capital that exists between LAWMA's manager and the local well commissioner serves as a buffer between LAWMA and the Colorado Office of the State Engineer creating a level of graduated sanctions for LAWMA as an organization, as well as establishing an informal process for bringing the organization back into compliance with state laws.

LAWMA hires their staff locally. LAWMA's general manager draws his family's historical lineage back to the original homesteaders settling in the lower Arkansas River basin in the late 1800s. LAWMA's manger works part-time for LAWMA and has a couple of part-time workers hired from the local service area helping with clerical tasks. The board is also local. LAWMA's board is comprised of a mix of water users drawn from the shareholders within the organization thereby ensuring that LAWMA's board of directors is local. LAWMA's board and manager look down to the local water users when it comes to their accountability. These two variables help ensure that the decisions made in regards to the direction the organization moves and the rules the organization operates under continue to support the development of local agendas by ensuring the water stays in the lower Arkansas River basin.

Another reason this water market is successful is because LAWMA owns the water that they are using to augment shareholders well depletions. The Colorado Water Conservation Board finances the bulk of the water purchase with low interest loans to LAWMA that are to be paid back by selling shares within the organization. This gives LAWMA full control over their water portfolio and allows LAWMA the flexibility they need to adapt to the ever changing legal landscape of water in the lower Arkansas River basin. This is an important distinction, especially when thinking of the other proposed water banks. In the Arkansas River Water Bank Pilot Program, the state does not own the water; the mutual ditch companies participating in the winter water program did. And when it came time to deposit water in the bank, the mutual ditch companies decided not to participate. Another reason for LAWMA's success is that, when possible, LAWMA solved its water shortage problems by purchasing water outright from senior ditch companies like the Highland and Keesee ditches below the John Martin Reservoir instead of fighting those battles legally. This also allows LAWMA to redirect those funds that are traditionally used for legal challenges to the purchase more senior water rights.

These organizational attributes enable LAWMA to secure support of the members owning shares in their organization. LAWMA's member support is exhibited as follows:

1. LAWMA members keep purchasing shares in the organization;
2. LAWMA members keep voting their shares in LAWMA's active governance system in support of the direction LAWMA is moving;
3. LAWMA members continue to pay their operation and maintenance expenses by paying assessments.

Member support is also evidenced by the non-existent shareholder default rate in LAWMA. In LAWMA, if a shareholder does not pay their assessments, then they run the risk of losing their shares in the organization, and more importantly, they lose access to the benefit stream provided by LAWMA. According to LAWMA's manager, LAWMA's default rate is zero. This rate might seem unrealistic, but those members owning shares in LAWMA recognize the value of their shares and will go to great lengths to protect those rights. Shareholders have been known to take out bank loans to cover the assessments on their shares, as well as short-term leasing their shares to other members to raise money to cover their assessments.

Of the three organizations, it appears that the Arkansas River Water Bank Pilot Program was the least successful of the organizations and the furthest away from the models. The Lower Arkansas Valley Water Conservancy District was exhibiting success when this research was concluded, but it was still unclear whether the new conservancy district's success would continue. The limited success of the LAVWCD can be understood in regards to our models where they are closer to the models than the Arkansas River Water Bank Pilot Program, but not quite as close as LAWMA. On the other hand, LAWMA was the most successful organization and it turns out that LAWMA was the closest of these organizations to the integrated ideal type conceptual models used for this analysis.

It has been contended that the conceptual models found in the literature did identify variables and relationships that are useful in organizing and comprehending the experiences of the three Arkansas River basin water organizations. It should be noted that the most successful organization, the Lower Arkansas Water Management Association, exhibited all the attributes advanced by the theorists, and the least successful organization, the Arkansas River Water Bank Pilot Program, exhibited none of the attributes advanced by the theorists as being important. The Lower Arkansas Valley Water Conservancy District exhibited a mix of these attributes and was partially successful.

The researcher is not positing that the variables and relationships put forth in the models be viewed as causally creating success or failure in these organizations. The reader must realize that there are two senses of causality at work here:

1. The conceptual models do not specify causality in the sense of one variable caused the effect of another variable;
2. Nor do the conceptual models themselves fully and causally explain the success or failure in the organizations at work in the Arkansas River basin.

It is contended, however, that common pool organizations that fulfill the ideal type conceptual model benchmarks have been found in the literature to be long-enduring in the provisioning of common pool resource management. That pattern of findings has been further bolstered by this investigation of three common pool resource organizations in the Arkansas River basin.

Implications for Theory

Theoretical insights have been advanced through the systematic comparison of observed attributes of organizations to ideal type models developed by Elinor Ostrom and David Freeman. It is contended that the discipline of sociology may be enriched by having carefully applied and evaluated propositions extracted from the literature on common pool resource organizational theory.

Proposed Theoretical Propositions

Theoretical Proposition 1: The more attributes advanced by the theoretical models a local common property resource organization has, the greater the organizational capacity to adapt generalized state policies to site specific conditions.

Sociologists building conceptual models of local organizations must pay detailed attention to linkages between organizations and their members. These organizations in turn must become social and political spaces so civil discourse can be conducted with agents of the state.

In the case of the development of the Arkansas River Water Bank Pilot Program these linkages were overlooked; therefore, in the future, conceptual model builders must examine the properties of these linkages more closely[28].

Theoretical Proposition 2: To the extent that common property resource organizations and collective goods organizations provide the social and political space on behalf of the local community to conduct negotiations between individual entrepreneurs who seek access to a community's water resources, then there will be greater equity in the distribution of those assets amidst the local community as compared to negotiations conducted only between private entrepreneurial actors.

This raises a fundamental question about whether water markets delivering water to metropolitan water districts should operate on contracts with individual water users, individual ditch companies or a consortium of ditches that could be referred to as a super-ditch. The answer to this question was still unknown, but individual water users and mutual irrigation companies were finding it harder to defend their water resources against metropolitan districts with ample economic assets and large legal teams. In general, private rationality in exchange will not incorporate the concerns about negative externalities in

[28] Both Freeman and Ostrom make reference to the need for this distinction. Freeman references this problem through the use of his theoretical model that differentiates between federal and unitary models of governance, whereas, Ostrom makes references to the different levels of analysis by drawing attention to nested enterprises.

local communities. If stable water markets were going to take shape in the State of Colorado in general and the Arkansas River basin in particular, then they must be safeguarded with a collective sense of purpose. This collective sense of purpose can take alternative organizational forms and be expressed at different levels in the water management organizational nexus.

One possible solution to this problem was being explored by the Lower Arkansas Valley Water Conservancy District and is referred to as the super-ditch. The super-ditch was a concept that was focused on getting seven or eight mutual irrigation companies in the lower Arkansas River basin to pool their resources in an effort to lease that water on a long-term basis in conjunction with a land fallowing program. By pooling their resources and offering larger amounts of water, these eight ditch companies could empower their organizations to negotiate long-term water deals with the metropolitans while retaining the water in the mutual irrigation company's portfolio. Two of the more difficult tasks for any organization attempting ditch consolidation will be getting the individual ditch companies to trust each other and to establish a share system that would distribute the organizational costs as well as the benefits.

The remedy to these problems lies in the history and culture of the mutual irrigation company. Trust is easier established than one might think. Shareholders in individual mutual irrigation companies should think back to their grandfathers who trusted their neighbors enough to create cooperative agreements to dig ditches which allowed them to develop farming operations that provided for their families and are still in operation today. These mutual irrigation companies also provide insight into the share system. Mutual irrigation companies have equitably distributed the costs and benefits of running their organizations by selling shares to individual water users to finance it. These shares not only guarantee the shareholder will have a portion of the benefit stream, but also empower the shareholders to elect the board of directors as well as provide for the maintenance of that organization.

There has not been much ditch consolidation in the State of Colorado, but if mutual irrigation companies or conservancy districts are interested in this process and how it could help stabilize their operations, they should look to the Palo Verde Irrigation District and Metropolitan Water District Land Management, Crop Rotation and Water Supply Program in California or the Consolidated Sevier Reservoir and Ditch Company in Delta Utah. The Consolidated Sevier Reservoir and Ditch Company was an attempt to stabilize a number of mutual irrigation companies through consolidation, which lowered operational costs for each mutual irrigation company by sharing those costs across all participating ditch companies, instead of each individual ditch company separately paying for those services. The Palo Verde Irrigation District's Land Management, Crop Rotation and Water Supply Program was created to stabilize their irrigation district in the face of buy-and-dry contracts being negotiated with the Metropolitan Water District and individual water users. Both of these programs can provide valuable insight into the problems water managers are facing in the State of Colorado, as well as providing templates for building new cooperative agreements designed to preserve agriculture throughout the state.

Recent efforts at water banking throughout the western part of the United States have frequently been driven by interests wishing to transfer water out of agriculture, rather than looking at ways to better secure agriculture's future and the sustainability of the communities that the water has traditionally served. This was apparent in the Arkansas

River basin. Effective change in water management will only come from willing partnerships with all the stakeholders, and that includes the mutual irrigation companies that own a significant amount of the water being figured into the newly developing water markets.

One thing is for certain when forming a new water market, everyone must be clear on the rules governing the new institution if it is going to work. Unclear rules can aggravate an already prevalent distrust of state and federal government agencies that exist within the agricultural community in the lower Arkansas River basin. As evident in the water bank, there was widespread fear throughout the agricultural community that the water bank was going to represent another alternative market mechanism to move water from agriculture to municipal uses.

Theoretical Proposition 3: The greater allocation control a water banking organization has over the ownership of the diversion rights and storage rights of the water resource, the greater the adaptability that organization will have to changing common property resource requirements.

Ownership of diversion rights is superior in principle than not owning diversion rights. It is important to remind the reader that nobody actually owns the water because water is owned by the citizens of the State of Colorado. What water users own is the right to divert the public's water under a state registered priority for diversion at a particular time and a particular place for a specific beneficial use. Both Freeman and Ostrom inadvertently made reference to the importance of ownership rights. Freeman did so with his share system, and Ostrom did so with her appropriation and provision rules. Neither Ostrom nor Freeman incorporated resource ownership into their theoretical models as independent or intervening variables, but in this research, resource ownership seemed to play a central role in determining the organization's overall success.

This was certainly the case with the Arkansas River Water Bank Pilot Program. The pilot water bank was set up to administer the lease or sale of water rights between willing buyers and sellers, but it was not given the authority or the budget to actually purchase and hold water rights. The LAWMA experience tells a different story. The LAWMA experience started with ownership of the resource; therefore, all the strategies the organization made came from the fact that LAWMA owned the diversion rights they had in their water portfolio.

One of the things witnessed with the failure of the Arkansas River Water Bank Pilot Program was the importance of ownership of the water rights versus renting or leasing the water available in their water portfolio. There was never enough water deposited in the water bank to run a viable water market that would entice metropolitan water districts to engage in short-term water leases to fill immediate needs without the burdens of the water court. The new pilot water bank found itself at the whims of the mutual irrigation companies who owned the majority of the water to be used in the water bank, and when it came time to deposit their water in the bank for trade, those mutual irrigation companies decided to hold their water.

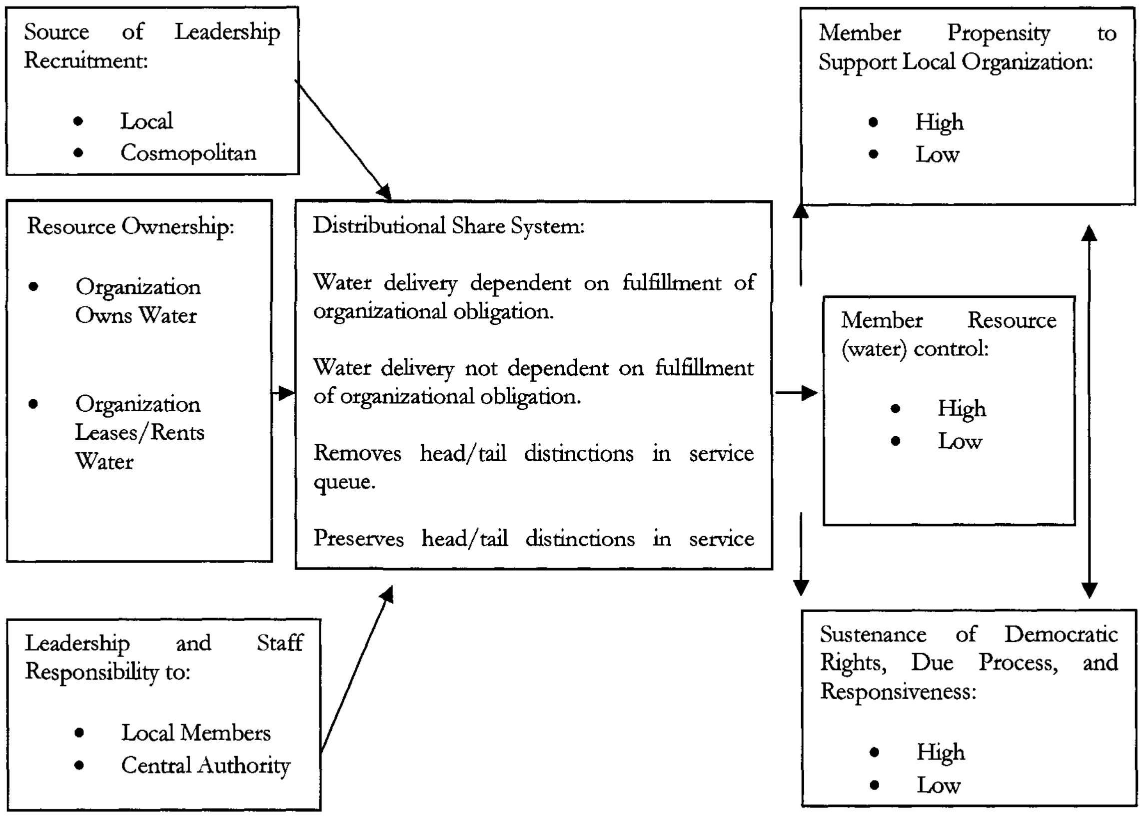
LAWMA on the other hand, made it part of their water management strategy to purchase senior surface water diversion rights in order to augment their out-of-priority well pumping, and by doing so they were able to guarantee the availability of at least a portion of a full share of water to water users owning shares in the organization. As we mentioned in our background and findings, LAWMA offered two types of stock; one was a common stock that was prorated based on the water available in any given irrigation season, and one was a preferred stock that was guaranteed in any given irrigation season. Both of these types of stock were made possible because LAWMA knew exactly how much water they were legally entitled to; therefore, if the river produced their full yield the water users owning shares in the organization knew how much water they would receive every irrigation season. This information allowed water users owning shares in LAWMA to manage their own water portfolios with greater certainty than they could get from the Arkansas River Water Bank Pilot Program.

The Lower Arkansas Valley Water Conservancy District also recognized the importance of owning the rights to the water in their water portfolio, but it was still uncertain how this would impact the success of their organization in meeting its missions of protecting the water resources and economies of the Arkansas River basin by ensuring that the water remained in the basin. The Lower Arkansas Valley Water Conservancy District set aside nearly 75 percent of its budget for water rights acquisition, but at this point the conservancy district had been a limited buyer in the Arkansas River basin. The outright purchase of water rights may or may not be the best use of the conservancy district's budget, but having resources to lease water rights on a medium to long-term basis certainly was the best use. These types of medium and long-term water leases may serve as the foundation of the super-ditch concept that the Lower Arkansas Valley Water Conservancy District is exploring.

Resource ownership is a variable that must be considered if you are creating organizations that run water markets in general and water banks in particular. As mentioned earlier, the current models are not specific about ownership of the benefit stream, but it appears that ownership of the water resource provided management flexibility and water predictability, both of which served to increase water control from the central water authority, to the middle level mutual irrigation companies and finally to the water users themselves.

The adapted version of Freeman's local organization model (Figure 17), resource ownership had been added vertically inline with source of recruitment and leadership and staff responsibility. In the adapted version of Freeman's model, ownership of the resource was a variable that preceded and directly impacted Freeman's share system. Once again, it is important not to impute causality in the use of this model, nor can it be said that an item located further to the left in the model is causal for those to the right. What is contended is that if a common pool organization possesses the assembly of all fulfilled variables in Freeman and/or Ostrom's models plus Lepper's variable of resource ownership, that common pool organization will have a higher probability of long-enduring organizational capacity to manage resources that are moderately rival to non-rival, and moderately excludable to non-excludable.

Figure 17: Freeman's Local Organizational Model with the Addition of Resource Ownership



Theoretical Proposition 4: To the extent that a common pool resource produced by one organization is compatible with the agendas of other common pool resource organizational agendas in the local network, then there will be greater acceptance (i.e., less resistance) to that organization's agenda.

For example, the Arkansas River Water Bank Pilot Program failed, at least in part, because it would permit—even-encourage—local mutual ditch company members to lease their water from a given ditch community without necessarily addressing the potential negative side-effects (externalities) for other water users in the ditch community. Some mutual company boards possess powers of review invested in their by-laws and others do not. To alienate the consumptive use portion of a given farmer's water from the ditch community can have direct negative impacts on others who may be—to varying degrees—dependent on that water remaining in the ditch community.

Theoretical Proposition 5: The greater the interdependence in sharing common pool resources in a network of multiple common pool resource organizations and the greater the uncertainty of any potential negative impact upon other common pool organizations, then the greater the resistance to any shift in historic common pool organizational patterns of resource use.

The uncertainty of the potential negative impacts to senior appropriators in regard to the changed patterns of return flows due to water leases brokered by common pool resource organizations in the Colorado portion of the lower Arkansas River basin was a problem. The threat to senior appropriators was a significant concern when developing these new organizations, but it was the State of Kansas, not senior appropriators that concerned the State of Colorado. The uncertainty created in light of the potential negative impacts of water transfers and leases of any common pool resource organization in the lower Arkansas River basin on the Arkansas River Compact was especially problematic. The State of Colorado and the State of Kansas have just finished with a challenge to the Arkansas River Compact, where the State of Colorado was found in violation of the compact and was ordered to pay the State of Kansas roughly $28 million.

It is important to inform the reader that theoretical propositions 4 and 5 are not about the form of common pool resource organizations per se, they are about interrelationships among common pool organizations. Although they do not contribute to further specification of the integrated model, they are advanced for consideration by other researchers in the domain of common pool resource organizational theory.

Implications for Policy

Institutional change in an already complex social and organizational water environment was apparently more difficult than the Colorado General Assembly and the Colorado Office of the State Engineer and the Southeastern Colorado Water Conservancy District anticipated. Although there was some notable public involvement to determine what the water users in the lower Arkansas River basin needed, the effort largely appeared to have been politically motivated by outside interests. The collaborative process should have brought the mutual irrigation companies into the discussion in a more meaningful way, especially since they owned the water available in the Winter Water Storage Program. It was the opinion of many of the lower Arkansas Valley water users, especially those representing the interests of mutual ditch companies, that their input into the creation of the water bank was largely overlooked. For example, issues such as how the bank should be regulated and who would constitute the key decision makers were not adequately addressed. This in turn created an institutional climate pervaded by a lack of trust between the mutual ditch companies and those responsible for creating the water bank. After all, it was the mutual irrigation companies that managed the water in joint stock companies that was to be traded by shareholders through the bank. This appeared to have been a major disconnect in the design and initiation of the program. This lack of trust adversely conditioned the entire program, culminating in a relatively insignificant amount of people depositing water in the bank, with no actual trades being conducted over the five-year trial timeframe.

The Arkansas River Pilot Water Bank Program was destined to fail in the minds of many agricultural water users in the lower Arkansas River basin. For starters, the water being sold in the water bank was too expensive for agricultural water users in the valley. Only municipals, industry and other commercial users could afford the $800 to $1,200 per acre-foot of water being listed in the new water bank. Not only were farmers unable to afford the water listed in the water bank, but they were also afraid of the water bank, and the Lower Arkansas Valley Water Conservancy District for that matter, devaluing their water for agricultural purposes. The fact that the overall value of the water possessed by water users in the lower Arkansas River basin was not clearly defined was an advantage when those water users went to get loans from bankers for upgrades on their farms, as well as when water users chose to sell their water rights after retirement. Because of these factors, as well as others, the farmers and the mutual irrigation companies those farmers hold shares in withdrew their support.

Proposed Policy Propositions

Policy Proposition 1: To the degree that the state in its formulation and administration of policy, focuses its effort to fully acknowledge the existence of intermediate level organizations that stand between the state bureaucracy and the individual entrepreneurs, the greater the likelihood of effective problem solving discourse in the locality.

There is a tendency for policy makers and administrators to think of communities as consisting of agreements of individual's from a reductionism perspective. The research here has clearly demonstrated that standing between these two stakeholders was a level of local organization that provides a social and political space for:

1. Reconciling state interests in ways that were responsive to local needs;
2. Promoting new policies that were being considered by the state;
3. And social and political space was central to educating the state to local needs as well as educating the locals to the needs of the state.

In the future, there must be a better attempt made to get all the stakeholders impacted by the development of the new water bank to the table during every stage of development and implementation. One of the consistent findings of this research was that mutual irrigation companies that owned the water being factored into the water bank were not given a voice in making the rules that would govern the use of that water. In the future, agents of the state, especially those representing the Colorado Office of the State Engineer and the Colorado General Assembly, must pay attention to the needs of these mutual irrigation companies, and those agents of the state must also begin to think organizationally when promoting its water bank. If the state does this, then the mutual irrigation companies could become the social and political space where a water bank could be promoted, as well as a place where interested parties would go to be educated.

The inter-basin water roundtables taking place in Colorado represent a forum for discussing these types of issues by bringing together a wide spectrum of water stakeholders in order to discuss present and future water management strategies within the basin, while at the same time addressing future water management strategies for the entire state of Colorado. These inter-basin water roundtables could potentially lay the groundwork for equitable changes in the way water is managed in the Colorado by giving all stakeholders a voice at the table for determining how the limited water in the basin, as well as the state, should be appropriated.

Policy Proposition 2: The more that state authorities were to promote the Arkansas River Water Bank Pilot Program to potential users within the framework of existing intermediate level common pool organizations (LAVWCD, LAWMA and mutual irrigation companies), the greater the organizations prospects for:

1. Devising successful program attributes;
2. Securing the acceptance of the organization by local water users.

Another problem was there was little effort given to developing educational or marketing components to the new water bank in order to disseminate information about the new programs impact and availability to the general public. It would behoove the next organization that tries to create a new water market in the Arkansas River basin, or any other river basin in Colorado for that matter, to make a concerted effort at getting the word out about the new program. Even though an internet portal was deemed a necessary facet for the development of the Arkansas River Water Bank Pilot Program, it was not sufficient by itself. One important point that came out of the public hearings leading up to the promulgation of the rules for the pilot water bank was that agricultural water users were uncomfortable with a water market run through an internet portal. The Upper Arkansas River Water Conservancy District voiced its concerns over the internet-based water bank by proposing that the new rules mandated the posting of the water in local newspapers in the Arkansas River basin, as well as posting the water on the pilot water banks website. This way a water user who was not comfortable with the internet could still be kept up to date on supply and demand issues affecting their decisions to deposit water or lease water in the pilot water bank. This condition was not considered when the final rules were promulgated by the Colorado Office of the State Engineer.

Policy Proposition 3: Legal and statutory consistencies between the rules governing the newly established Arkansas River Water Bank Pilot Program and the pre-existing rules governing water management in Colorado would produce a greater acceptance of the water bank by local water users.

In the Arkansas River basin, there were certain conditions precedents that needed to be met if successful water markets were to unfold. These conditions were necessary, but not sufficient for the creation of water markets, and they needed to be met before social organizational characteristics and problems could be addressed. The first condition precedent was that statutory, regulatory and contractual inconsistencies at the state and federal levels had to be addressed. The legal climate governing water management in the

Arkansas River basin constantly changed, and those changes affected the operation of the organizations in that market. A series of legal changes and challenges illustrated some of the problems experienced when trying to form new markets in the Arkansas River basin. The first inconsistency in the legislation governing the water bank addressed whether water could be leased as intra-basin leases or would the new water bank be restricted to inter-basin leases. By changing the original legislation that allowed for intra-basin as well as inter-basin leasing to solely allowing inter-basin leasing, the Colorado General Assembly stifled the ability of the market to grow. Out-of-basin water buyers would have had the ability to pay higher prices for the water than water leasers would get for that water inside the basin, so removing them from the equation seriously limited the newly forming market.

The second legislative inconsistency may have proved more problematic than the first inconsistency. The passage of HB 02-1414 made the water bank less relevant because substitute water supply plans were, by their very nature, more flexible than short-term water leases run through the water bank.

> "This act allows temporary approval of changes of water rights, augmentation plans and exchanges of water for periods of up to five years, while providing notice to water users and greater flexibility than the pilot water bank project can allow under existing legislation. Further, there are no restrictions to using only stored water in the streamlined temporary approval, and wells can be augmented" (Simpson 2005: 5).

Many of the institutional hurdles limiting the water bank did not limit new substitute water supply plans conducted under the authority of HB 02-1414. Not only could substitute water plans use direct flow rights where water banking was limited to stored water, but they could also utilize inter-basin as well as intra-basin leases where the pilot water bank could only use inter-basin leases. It was thought by many water users in the Arkansas River basin that if the pilot water bank could have marketed direct flow water rights through temporary substitute supply plans, then the water bank would have been used a great deal more during the drought years of 2002 and 2003. In the end, one of the primary reasons cited by the Southeastern Colorado Water Conservancy District for terminating their involvement in the Arkansas River Water Bank Pilot Program was that the passage of HB-02 1414 made the pilot water bank irrelevant.

The third statutory inconsistency dealt with the potential for a National Environmental Policy Act review of Pueblo Reservoir and the entire Frying Pan/Arkansas River Project. It was discovered during the formation of the Arkansas River Water Bank Pilot Program that any federal project allowing activities not originally provided for in the legislation was subject to review. This was a legitimate concern for the Southeastern Colorado Water Conservancy District, especially since it was the conservancy districts responsibility to operate and preserve the Frying Pan/Arkansas River Project and Pueblo Reservoir. A National Environmental Policy Act review could have tied the project up for years, and it was unclear how that review would turn out. This problem was initially dealt with through cooperative agreements between the Southeastern Colorado Water Conservancy District and the Bureau of Reclamation, but these agreements still did not protect the conservancy district from future challenges or reviews. Until there was a clear process agreed upon by all the agencies involved in governing the water bank at the state and federal levels for using Pueblo Reservoir as a storage point for a water bank and that process was in compliance with the original and/or amended legislation governing the Frying Pan/Arkansas River Project, then there would continue to be significant impediments to the formation of a water bank in the Arkansas River basin.

Policy Proposition 4: Water banks operating without a sufficient storage facility to hold the water for lease will be less successful than water banks operating with sufficient reservoir or groundwater storage.

A successful water bank in the Arkansas River basin requires a place to store the water that is close enough to the metropolitan areas that need it. Pueblo Reservoir represents an ideal location for surface water storage, especially if that stored water is intended to be used north of the reservoir to supplement metropolitan water shortages inside and outside of the basin. The water becomes less valuable as it moves downstream towards the Kansas state line because those wanting to lease or transfer it have to figure out how to move it back upstream in order for them to access it and transport it to their primary service area. In the past, these water transfers were made possible by water exchanges and pipelines that moved the water back upstream, but both of these options offer limited, if any, potential for new water transfers from the lower Arkansas River basin. The inability to move water upstream through exchanges and pipelines made the ability to store water in Pueblo Reservoir an integral piece of the puzzle for creating a viable water market between the mutual irrigation companies in the lower Arkansas River basin and Front Range metropolitan water districts. Pueblo Reservoir is a prime location for water deliveries to water users in the lower Arkansas River basin east of Pueblo Reservoir. These water transfers and exchanges keep water in the river east of Pueblo Reservoir making it easier to deliver other water downstream for a variety of agricultural and municipal uses as well as protecting the Arkansas River Compact. No matter what shape a new water market in the

Arkansas River basin takes, one thing is for certain, Pueblo Reservoir is a necessary storage facility in the operation of that market.

Another option, and one that has been quite successful in the Arkansas River basin, is the use of groundwater storage systems and pumping in conjunction with senior surface water rights augmenting those groundwater depletions. Groundwater storage can offset the need for surface water storage facilities, as is the case with the Lower Arkansas Water Management Association. LAWMA manages a water portfolio that contains both groundwater and surface water rights that allows the organization to provide greater water control, which in turn gives greater water control to the individual water users owning shares in the organization. LAWMA recently filed for a change in use of their water rights from agricultural use to augmentation use, which in turn will provide LAWMA with more flexibility when it comes to augmenting their shareholders well depletions. When available, groundwater storage can cut down on transit losses due to groundwater absorption and evapotranspiration as well.

Whether it is surface water storage or groundwater storage, a functional water market has the greatest chance at success if it has a facility to store water for future use. One of the problems with the Arkansas River Water Bank Pilot Program was that the Colorado Office of the State Engineer, the Southeastern Colorado Water Conservancy District and the Bureau of Reclamation could not come to a solid agreement on whether Pueblo Reservoir could be used to hold water for use in the pilot water bank. LAWMA on the other hand, was able to use a combination of well depletions augmented by senior surface rights to bypass problems related to available storage. By utilizing groundwater storage, LAWMA was able to increase the organizations overall control over the water in their portfolio thereby allowing the organization to better serve the interests of its shareholders.

Policy Proposition 5: Water bank portfolios vary in regard to the types of water exchange and water transfer tools they have at their disposal. Water banks employing a more diverse array of water marketing tools for water exchange and water transfer will have better prospects for success than those who have fewer water marketing tools at their disposal.

If new water markets are going to be successfully formed in the Arkansas River basin, then the need for more flexibility in those markets is imperative to their formation. Markets do not exist in vacuums, and a new market must be flexible enough to deal with the needs of the areas it was created to serve. This was one of the problems with the Arkansas River Water Bank Pilot Program. The pilot water bank was not flexible enough to deal with the complicated supply and demand issues found in the Arkansas River basin. Buy-and-dry contracts designed to permanently move water from the mutual irrigation companies owning those rights, to the cities desiring those rights, were weakening the long-standing cooperative agreements upon which mutual irrigation companies were founded. Problems related to buy-and-dry contracts were especially problematic for rural communities located in the lower Arkansas River basin.

These buy-and-dry contracts threatened to destabilize mutual irrigation companies. Some individual water users owning shares in mutual irrigation companies were willing to permanently sell their water rights to cities like Aurora or Colorado Springs. Many of these individual water users planned their retirements around a payoff from the sale of their valuable water rights and although that decision may be individually rational and financially defendable, when the decision is viewed from a collective standpoint, it proves to be a disaster for the rural economies and lifestyles dependent on the water being available for future use in their primary service areas. If those individual water users have different alternatives to buy-and-dry contracts, then they may choose to sell or lease their water for other uses in the basin or for temporary or long-term leases outside of the basin instead of permanently selling it to high-growth metropolitan areas.

So what types of alternatives to buy-and-dry contracts do water users have at their disposal that would satisfy interests on both the supply and demand side of the equation? "There were three forms of transfer that appear to meet known needs with existing agricultural loan authorities as well as the existing substitute water supply program authorities and they are long-term rotational crop management contracts, long-term interruptible supply contracts and water banking" (Weiner and Yates 2007). These three alternatives to buy-and-dry water transfers represent options that mutual irrigation companies could use to reintroduce economic stability into their organizations, but there are other options as well. One option is to create a new mission for the mutual irrigation companies using groundwater augmentation plans in conjunction with well pumping to create local water markets with built in flexibility in regards to types of use and points of diversion, as was the case with the Lower Arkansas Water Management Association.

Long-term rotational crop management programs are one alternative to buy-and-dry contracts. These long-term leases allow farmers in the mutual irrigation company to continue farming while fallowing the percentage of their land that would traditionally be irrigated by the water being leased. Mutual irrigation companies could pool the water from interested members on the ditch participating in the land fallowing/leasing program and lease it at a higher value to metropolitan areas or other interested water users while still retaining the ownership of the right.

Long-term interruptible supply contracts are another tool for mutual irrigation companies especially during times of drought. Long-term interruptible supply contracts offered farmers the option of making agreements with cities in order to give up their water during times of drought and take all or a percentage of their fields out of production, while the cities paid a mutually agreed upon amount of money to those farmers for the use of their water.

Water banking is a third option. Water banking has taken many forms throughout the western part of the United States, and each successful water bank has adapted to the local water market conditions, both geographically and organizationally. Mutual irrigation companies can build water banking into their water management portfolio or engage in agreements with an organization designed to administer "spot market" water leases moving water around the landscape quickly and with limited legal, engineering and administrative costs.

All of these alternatives have their costs and benefits, but one common benefit they all offer is for individual farmers to retain ownership of their water rights thus successfully avoiding the need to enter into buy-and-dry contracts that ultimately transfer that water to metropolitan areas along the Front Range.

Groundwater management is another option for mutual irrigation companies to consider when facing the changing landscape of water management in the 21st century. In the lower Arkansas River Basin, there are a variety of groundwater users associations. The

Arkansas Groundwater Users Association (AGUA) has approximately 400 member wells, while the Colorado Water Protection and Development Association (CWPDA) has approximately 800 member wells. Finally, the Lower Arkansas Water Management Association (LAWMA) has 650 member wells. All of these groundwater users associations are organized along the lines of traditional mutual irrigation companies that have been active in the valley for more than 100 years. They are non-profit entities that are comprised of members who bought shares in the organization to finance the enterprise. Shareholders then receive the benefit of water deliveries to make whole the river flows depleted by their out-of-priority wells. These groundwater organizations elect their board of directors from the pool of share holders in the enterprise. Shareholders generally have one vote per share of stock in the company, so those who own more in the company have more influence over who was elected to the board of directors (Wilkins-Wells and Lepper 2006).

For more than 100 years, mutual irrigation companies organized around cooperative agreements between individual water users manifested in the form of common property resource organizations, and these not-for-profit organizations successfully deliver water to shareholders through ditches and canals for direct application of water to fields or storage of that water in a reservoir for future use. These organizations serve as the foundations of rural agricultural economies throughout the irrigated west, but during the last 30 years, rural agricultural economies witnessed the decline of this long-enduring water user organization and those rural economies and lifestyles that depend on them. The decline of the mutual irrigation company is the result of the breakdown of cooperative agreements between individual water users and mutual irrigation companies. The fact is that water markets in the Arkansas River basin were dominated by buy-and-dry water transfers brokered between individual shareholders on a particular ditch and municipalities along the Front Range of the Rocky Mountains weakened the mutual irrigation company's ability to control their water portfolio. These buy-and-dry contracts focused the market on permanent transfers between individuals and cities versus temporary transfers between mutual irrigation companies and the cities. This in turn created an environment characterized by uncontrolled, individual rationality in the form of permanent transfers of their water rights to metropolitan water districts along the Front Range. These transfers were rational and beneficial to the individuals, but their result created a collective disaster for the rural communities relying on that water.

Conclusion

Successful water banking programs in the Arkansas River basin have produced common property resources in the form of LAWMA's augmentation program used to cover out-of-priority well depletions, as well as the LAVWCD's programs for selling or leasing their purchased water back to water users looking for short-term water supplies. These same organizations were providing a collective good in the form of valley defense (i.e., outside water users and the State of Kansas). They employ features of the traditional mutual irrigation company. They are designed to place community control over water markets in the name of valley water security and permanency of access to the water resource. This approach stands in clear contrast to many state and federal water banking initiatives that generally promote conservation and price efficiency directed at economic growth. This utilitarian argument for water management proclaims that the market is the most efficient way of moving water to its most beneficial value. This argument is then used to move water out of agriculture to the cities where the resource can reach a higher economic value.

LAWMA, the successful water bank in the lower Arkansas River basin, is based on the mutual irrigation company organizational format. Any potential or existing organizations interested in creating a water bank designed to move water around a river basin in the State of Colorado should pay heed to the history of mutual irrigation company organizational form, especially if this market is going to take place in traditionally irrigated areas. These organizations draw off the farmer cooperative traditions found in mutual irrigation companies and are seen in a favorable light by the agricultural communities that rely on them. "They were largely non-profit in nature, were governed by locally elected boards, distribute water by shares of stock or by acreage and for which the costs of management was equitably prorated across all beneficiaries. However, they were legally bound to state nonprofit corporation acts, water codes or statutes, or federal contracts" (Wilkins-Wells and Lepper 2006: 29).

The integrated ideal type conceptual model used was helpful for understanding why an organization, fulfilling the posited attributes, would have a greater chance at success than an organization that lacked some or all of these principles. The Lower Arkansas Water Management Association possessed clearly defined boundaries, exhibited a proportional equivalence between benefits and costs, instituted collective choice agreements, used management and members of the organization for monitoring, incorporated graduated sanctions for dealing with rule violations, hired locally and ensured that the organizations management looked down to the shareholders when it came to accountability, and it was also a success. Organizations lacking these principles, like the Arkansas River Water Bank Pilot Program, and those that possessed some, but not all of these principles, like the Lower Arkansas Valley Water Conservancy District, had a harder time achieving success at creating stable and long enduring organizations.

The research on water banking in the Arkansas River basin presented here focused on understanding the social and/or organizational problems facing rural agricultural economies in respect to the development of market centered approaches to water management. New water marketing strategies in the lower Arkansas River basin must protect and secure local water rights for continued use rather than focusing these markets on profit seeking and economic efficiency. These same water markets must ensure that legal and statutory conditions remain consistent over time in order to allow a stable organizational nexus to take shape in accordance with the legal and statutory climate. Once these conditions are met at the state and federal levels of the organizational nexus, then local level organizations can build them into their organizational framework in an effort to create water markets and water banking organizations that are stable and long-enduring.

Social organizations make water markets possible; therefore, organizational problems must be addressed in the design stages of the water market. No matter how common pool water organizations are constructed, they do not simply emerge because there is a need. Many experts look to the lack of economic incentives or physical engineering structures and fail to consider social organizational problems when the newly formed water market proves to be unsuccessful. Ultimately, the availability of stable organizations that can communicate and operate within the local, state and federal nexus are necessary to birth new markets and create a security zone for these markets to form.

Appendices

Appendix 1: Interview Schedule

Arkansas Valley Interviewing Schedule:

Primary objectives:

1. To establish a list of the main players in the water banking conversation.
2. Get a list of the major issues concerning the proposed water bank.
3. Get a list of the major positions on the issues, and who falls in what camp.

How do we talk about water in the Arkansas Valley, or on this particular ditch?
How is your share system divided up?

Set up a notebook system: Vol. I, p. 1, put business cards in the back of the notebook.

Remember that this is deep background research, so I guarantee complete confidentiality. Approach them as if they are the experts, and I am the student.
"I'm told you are just the person who can help me understand water banking in the valley"

1. Get the people to talk about themselves. Before we get into the Arkansas Valley, I would like to know how you got into this position, could you tell me a little about yourself.

    a. Open up broadly, give no hint to my agenda. Could you give me a quick overview of how water is operated in the valley, as you understand it? What are the greatest advantages to the current system, and what are the greatest problems?(notice whether they focus on the problems or advantages first, or whether they are polarized on certain issues).

2. Next, how long have you been hearing about water bank? Who talks about water banking in the valley? Who told you about the proposed water bank? When did you first hear about the proposed water bank? Do you think has the best understanding of what is going on with the proposed water bank?
3. Could you define some problems in the valley that the water bank would solve? If you could design and run the water bank, how would it operate? Are there any problems in the valley that the proposed water bank will not address?
4. In your opinion, how important is the water bank to solving the problems in the valley (High priority, medium priority, low priority)?

When talking to farmers on a ditch, I should start out with asking how the canal works, where they are located on the ditch, could you draw me a quick diagram of the ditch and your location?

1. I need to understand more about your situation?

2. How does your ditch run (shares, how much water is delivered on the system)?
3. Are you seeing a water squeeze on your ditch?
4. Do you think a water bank could solve the problems on your ditch?

When talking to lawyers,

1. Is your practice primarily in water law?
2. Who are your clients?
3. Could you draw a map of the ditches you represent?
4. How many ditch companies do you represent?
5. Do you report to them or are you on retainer?
6. Are there any problems that your clients experience that can be solved by the proposed water bank?
7. Are there any problems that your clients will experience because of the proposed water bank?
8. Can you recommend anyone else who I might talk to about water banking? Who would be the top three people in your opinion?

Talking to the Water Commissioner,

1. Could you give me a brief description of how the river operates?
2. What are the earliest priorities on the river?
3. What are the biggest problems he faces in running the river?
4. How many problems do you face with running the river?
5. Will the proposed water bank solve any of these problems?
6. Will the proposed water bank create any problems for you in running the river?
7. Can you recommend anyone else who I might talk to about water banking? Who would be the top three people in your opinion?

Talking to the Division Engineer,

1. Could you give me a brief description of how the district operates?
2. What are the biggest problems in operating the South Eastern Water Conservancy District?
3. What is the number one problem you have to deal with in the district?
4. Will the water bank help you with the problems you have in the district? How?
5. Will the proposed water bank create any problems in new problems for operating the district?
6. Can you recommend anyone else who I might talk to about water banking? Who would be the top three people in your opinion?

Appendix 2: Informed Consent Form

COLORADO STATE UNIVERSITY
INFORMED CONSENT FORM

WILLINGNESS TO PARTICIPATE IN WATER BANKING/LOWER ARKANSAS VALLEY WATER CONSERVANCY DISTRICT STUDY

TITLE OF PROJECT:

Banking on a Better Day: Water Banking in the Arkansas Valley

NAME OF PRINCIPAL INVESTIGATORS:

Dr. John Wilkins-Wells, Department of Sociology, Colorado State University.
M.S. Troy Lepper, Department of Sociology, Colorado State University

CONTACT NAME AND PHONE NUMBER FOR INTERVIEW PROBLEMS:

Dr. John Wilkins-Wells
970-491-5635

SPONSOR OF PROJECT:

Colorado State University Agricultural Experiment Station

PURPOSE OF THE STUDY:

The purpose of this research is to use organizational theory to help shed light on water use policy in the Arkansas Valley River basin in Southeastern Colorado. By bringing collective goods and common property resource organizational theory to bear on the administration of water in the Arkansas Valley we can systematically examine and advance our understandings as to why each of these organizations formed, and whether the organizational forms chosen will accomplish the announced objective.

INTERVIEW PROCEDURES:

Interviews are expected to last about one hour, with the possibility of a follow-up interview later in the data collection process. Interviews will be conducted by one of the principal investigators. We would like to take some notes and photos. Notes and photos will not be shared with anyone other than the principal investigators, nor will their contents be divulged in any way that would associate them with your organization.

BENEFITS AND RISKS:

It is important to state upfront that there will be no direct benefit to any particular participant in this study, nor will there be any compensation to any person interviewed. We hope the policy world of water will be enriched by thick and rich description of how an organization was put into place that promises to provide and sustain a collective good in the form of preserving water in the Arkansas Valley. This organizational research also has the potential of reshaping the manner in which water is managed in a strategic Colorado River basin.

CONFIDENTIALITY:

Strict confidentiality will be maintained regarding all information and/or records voluntarily provided by your organization. The researchers are not to publish or otherwise allow data collected and/or analyzed to be associated with your organization or the names of individuals in your organization.

All research records will be kept by the Co-PI on the CSU campus at the Sociology Water Lab under lock and key. All interviews will be kept as a hard copy and an electronic copy in the Sociology Water Lab for 3 years after the completion of the study, and then the interviews will be deleted and destroyed.

LIABILITY:

The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

Questions about subjects' rights may be directed to Celia S. Walker at (970) 491-1563

PARTICIPATION:

Respondents' participation in our research is voluntary. If they decide to participate in the project, they may withdraw their consent and stop participating at any time.

Appendix 3: List of Informants

List of Informants

Bob Appel
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05/21/02

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USDA Farm Specialist/Grower
6/12/03

Dan Henrichs
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Don Higbee
Manager, Lower Arkansas Water Management Association
719.688.5431
9/14/06
10/30/06

Bill Malinski
Valley Land and Water Appraiser
719.384.5141
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Appendix 4: Notes on Methodology

This research is utilizing an action research methodology "which bridges the divide between research and practice. It directly addresses the knotty problem of persistent failure or research in the social sciences to make a difference in terms of bringing about actual improvements in practice." (Somekh 1995, 339) Somekh then maps out five major differences between traditional research and action research:

1. Research being conducted is actually carried out by people that are concerned about the situation that they are researching, and they are also interested in initiating change.
2. The findings from the research are directed back to the area being studied for the purpose of social change.
3. Another difference is that action research is very practical. This methodology recognizes that there are limitations, especially in regards to specific knowledge bases that can be done by practitioners in the field.
4. Action research is also grounded in the cultural values of the area under study, especially when those involved in the research are both participants in the research as well as the researchers conducting the research.
5. Finally, action research is accompanied by a series of ethical dilemmas, therefore a list of ethical guidelines most be instituted at the start of the research process. (Somekh 1995, 342)

Somekh goes on to illustrate that different occupational cultures require different action research strategies. For example, nurse practitioners must meet rigorous research demands to establish credibility in the medical profession (Titchen and Binnie 1993; Meyer 1993); whereas action researchers working with non-governmental organizations domestically and internationally must focus their efforts participatory action and grass roots development in order to give them political clout (Maclure and Bassey 1991).

Appendix 5A: Rules Governing the Arkansas River Water Bank Pilot Program

RULES GOVERNING THE ARKANSAS RIVER WATER BANK PILOT PROGRAM

AUTHORIZATION

These rules are promulgated pursuant to the authority granted the State Engineer in sections 37-80.5-101 et seq., C.R.S. (2001) to implement a pilot water banking program in the Arkansas River Basin.

ORDER OF THE STATE ENGINEER

IT IS ORDERED that the following rules governing the Arkansas River Water Bank Pilot Program are adopted by the State Engineer.

Rule 1. **Title.**

The title of these rules is "The Rules Governing the Arkansas River Water Bank Pilot Program." The short title for these rules is "Water Bank Rules" and they may be referred to herein collectively as the "rules" or individually as a "rule."

Rule 2. **Scope and Purpose.**

A. These rules apply to the establishment and operation of a pilot water bank for owners of stored water in the Arkansas River Basin and its tributaries. These rules are effective through June 30, 2007.

B. The purpose of these rules is to implement a pilot water bank that simplifies and facilitates water leasing, loans and exchanges, including interruptible supply agreements, of stored water within the Arkansas River Basin; and to reduce the costs associated with such transactions. Further, it is also the purpose of these rules to increase the availability of water-related information and assist farmers and ranchers by developing a mechanism to realize the value of their water right assets without forcing the permanent severance of those water rights from the land.

C. These rules shall not permit any expansion of use of stored water deposited into and leased, loaned, optioned or exchanged through the water bank.

D. Nothing in these rules is intended to restrict the ability of the holder of a water right to sell, lease, option or exchange that water right in any other manner that is currently permitted under Colorado law. These rules shall not be implemented in a manner that would cause material injury to the owner of or persons entitled to use water under a vested water right or a decreed conditional water right.

Rule 3. Definitions.

A. As used in these rules:

1. "Bankable water " means any legally stored water that meets the necessary criteria established by these rules. Direct flow water rights are not included in this definition.
2. "Article II water" means water stored within individual Water District 67 ditch accounts pursuant to Section II of the Resolution Concerning an Operating Plan for John Martin Reservoir adopted by the Arkansas River Compact Administration on

April 24, 1980 (as amended) and accounted as "winter stored water" under "Agreement B" dated November 1984.

3. "Beneficial consumptive use" means the amount of water actually consumed in applying the water right to its legal use.
4. "Deposit account" means the amount of stored water a person or entity places in the water bank.
5. "Interruptible supply" means the temporary cessation of the historic use of stored water and the temporary use of such water at another location, and/or for a different use, and/or at a different time. Such temporary cessation/use may be during a full or partial season of historic use.
6. "Legally stored water" means water stored pursuant to a water court decree, statutory provision, or an existing authorization of the Arkansas River Compact Administration.
7. "Option agreement" means an agreement by which a buyer pays a seller for the option to use a specified amount of stored water and pays for the right, but is not obligated, to purchase a defined amount of banked water at a specified price within a fixed time period. The buyer of the option may be required to pay a defined premium to the seller for this right. An option agreement may authorize the water bank operator to release deposited water for the seller's use at times when the water is available for use and the buyer is not exercising the option, or allow the seller to use the stored water until the option is exercised.
8. "Return flow(s)" means the amount of the water that is not consumed and returns to the stream following a legal use of a given amount of water.
9. "Transit loss" means the amount of water deducted by the Division Engineer in the delivery of water from one point to another due to stream and environmental conditions.
10. "Water bank" means the Pilot Arkansas River Water Bank, which is a program authorized by the Colorado General Assembly to receive and safeguard legally stored water for 3 exchange, lease, options or loans and to facilitate such transactions.
11. "Water banking" means temporarily placing legally stored water into an account within the Water Bank whereby that water is then leased, loaned, optioned or exchanged to another user.
12. "Water bank operator" means the State Engineer, a delegated public entity or a delegated public-private partnership who administers the water bank and is entitled to charge a transaction fee for deposits, withdrawals, or both, sufficient to cover the bank's administrative costs. 13. "Winter water" means water stored using the Winter Water Storage Program as described in Case No. 84CW179, Water Division 2.

B. Any term used in these Pilot Water Bank Rules that is defined in sections 37-90-103 or 37-92-103, C.R.S. (2001) shall have the same meaning given therein.

C. The terms "buyer" and "seller" are used generally in these rules and are intended to encompass lessors and lessees and any other type of party entering into a transaction through the water bank.

D. Any term used in these Pilot Water Bank Rules not defined herein that is defined in other Rules and Regulations of the State Engineer shall have the same meaning given therein.

Rule 4. **Limitations on the Pilot Water Bank.**

A. Nothing in these rules shall be construed to authorize any lease, exchange, option, or loan of water below John Martin Reservoir to points of diversion or storage above John Martin Reservoir without the approval of the Arkansas River Compact Administration.

B. No transfer of water from the bank to instream flow uses as provided in section 37-92-102(3), C.R.S. (2001) is allowed except where such transfer, lease, loan, option, exchange or sale is to the Colorado Water Conservation Board.

C. The water bank shall not be used to export water out of state.

D. The water bank shall not operate in a manner so as to increase water diverted from another water division as set forth in section 37-92-201, C.R.S. (2001).

E. "Winter water" stored in Pueblo Reservoir shall only be bankable if deposited before August 1 following the winter storage program period during which such water was stored.

F. Article II "winter stored water" can be used in the water bank. No Article II "summer stored water" can be used in the bank. G. Any deposit of water into the water bank and any leases, loans, options or exchanges through the water bank must comply with all state and/or federal:

1. statutory and regulatory requirements;
2. operating principles; and
3. contractual requirements governing the use of federally authorized projects in the Arkansas River basin to the extent such project facilities are utilized in banking operations. Operations of the water bank shall not in any way harm or compromise the Fryingpan-Arkansas Project purposes as defined in the Fryingpan-Arkansas Project Act.

H. The bank shall operate within the existing requirements of Colorado water law, including the Arkansas River Compact, the Colorado Ground Water Management Act, (see sections 37-90-101, et seq. C.R.S. (2001)), and the Water Rights Determination and Administration Act (see sections 37-92-101, et seq., C.R.S. (2001)). However, upon approval by the State Engineer, adjudication of the temporary use of the water right is not required pursuant to section 37-80.5-104(a)(IV)(B), C.R.S. (2001). I. Ground water shall not be deemed bankable water for the Pilot Water Bank.

J. The Pilot Water Bank shall operate on a year-to-year basis, subject to available storage space and water supply. K. Leases, loans, options or exchanges of water may be for more than one year, subject to appropriate terms and conditions to facilitate annual operation and administration by the State Engineer. No lease, loan, option or exchange can extend beyond date limitations set forth in any enabling legislation for the Water Bank.

Rule 5. **Procedures for Placing Water into the Water Bank.**

A. To apply to deposit water into the water bank, a prospective depositor must pay any application and/or posting fees required by the water bank and must provide the following information to the water bank operator:

1. Written agreement that the owner or operator of any nonfederal reservoirs from which the water will be released for use in the Pilot Water Bank has approved such use of the water and will properly account for the water in the reservoir, and cooperate in regulating its delivery.
2. When the transaction of water in the water bank requires the use of federal facilities other than John Martin Reservoir, the water bank operator or one or both of the parties will be required to have a storage and/or exchange contract with the United States.
3. Proof of ownership, lease or contract that includes the right to use and control the disposition of the water.
4. The amount of legally stored water that will be deposited into the water bank.
5. A description of the point of diversion, place of storage and historic place of use of the water. Sufficient descriptions may include maps, legal descriptions, and/or aerial photographs.
6. If the subject water historically has been used for irrigation, a description of the proposed use of the historically irrigated land, including proposed sources of irrigation water and methods of irrigating the land, if any. Such description must establish that no expansion of water use shall result from the deposit of the subject water into the bank.
7. Unless utilizing the factors provided in Rule 8 herein, an estimate of the available historic consumptive use and return flows, and documentation of how that estimate was derived, prepared by a registered professional engineer with a minimum of five years of experience in the field of water resources engineering.
8. Anticipated terms that may apply to the lease, loan, option or exchange of the water, including, but not limited to: a. Applicable time frames, parameters and/or limitations for and on use of the water. b. The minimum price the depositor will accept for the water. c. The amount of stored water the depositor is willing to lease, loan, option or exchange.
9. Contact information, including name, address, phone number and email address (if available).
10. Any other relevant information requested by the water bank. B. Based upon its review of the above information, the water bank, in consultation with the Division Engineer, shall determine whether the stored water is eligible for deposit in the bank. If the water bank determines that the water is not eligible, it shall notify the prospective depositor to address any impediments to the water's eligibility.

C. Upon determination that a prospective depositor's stored water is eligible for deposit into the water bank, the water bank and the depositor shall negotiate and enter into a deposit agreement. The terms of the deposit agreement shall include, but not be limited to:

1. Authorization of the water bank by the depositor to advertise and market the water placed into the deposit account.
2. The depositor's agreement that the water bank shall have the exclusive right to market, lease, loan, option or exchange the deposited water on behalf of the

depositor for the term of the deposit agreement, and that the depositor shall not independently market, lease, loan, option or exchange the 6 deposited water during the time that the deposit agreement is in effect.

3. A provision that the depositor may remove the deposited water from the water bank for the depositor's own use or for permanent sale by the depositor at any time prior to an actual water bank transaction in which control of all or a portion of the deposited water is transferred pursuant to terms of the deposit agreement.
4. A provision addressing procedures to be followed upon a breach of the deposit agreement by either party.
5. Any other terms deemed necessary by the water bank and the depositor.

Rule 6. **Listing and Bidding Process.**

A. Upon finalization of the deposit agreement, the water bank shall list the availability of the water on the water bank's web site. Listings of availability shall also be available at any State or Division Engineer field office locations.

B. The listing shall include, at a minimum, the amount of water available, the stored location of the water, the source of water, the minimum acceptable price and the historic type of use.

C. In order to promote use within the Arkansas River basin, during the first ten (10) business days of publication, only in-basin use bids for use of the water may be submitted to the seller. The seller must accept the best offer available meeting at least the minimum acceptable price during this ten (10) day period. If this initial listing period expires without the minimum acceptable price being offered, all bids from potential purchasers, including out-of-basin users, may be considered.

D. If the minimum acceptable price is not offered, the seller may withdraw the water from the bank or leave the water in the bank for the bank to market.

E. The water bank operator shall establish a process for registration of qualified bidders who may participate in the bidding process.

F. The water bank operator shall establish and maintain a Water Bank Notification List. Within thirty (30) days after the effective date of these rules and annually thereafter, the water bank operator shall publish in the Division 2 water court resume and in a newspaper or newspapers as necessary to obtain general circulation once in every county affected, an invitation to be included on the Water Bank Notification List. Persons on the List shall receive notice of all proposed water bank transactions as set forth in Rule 7 herein, and may elect to receive such notice by first class mail or by electronic mail. Persons may be required to pay a fee, not to exceed twelve 7 dollars per year, to be placed on the Water Bank Notification List to cover administrative costs.

Rule 7. **Transactional Procedures.**

A. After the water bank operator negotiates a lease or option agreement between the seller and buyer of the deposited water, the water bank operator will provide the State and Division Engineer with a signed agreement describing the transaction, including but not limited to the amount of water, the place of use, and the proposed time of use. (If needed, the bank will provide a standard agreement form). If the proposed lease/option shall require delivery of water into a different distribution system, the seller or buyer shall provide written consent of the owner or operator of the receiving facility or system, including any terms or conditions related to the use of such facility or system. The lease or option agreement also shall include a provision addressing procedures to be followed upon a breach of the agreement by either party.

B. Within two (2) business days of sending the lease or option agreement to the State and Division Engineers, the water bank operator shall provide written notice of the proposed transaction by first class mail or electronic mail to all persons who have subscribed to the Water Bank Notification List, and shall provide proof of such notice to the State and Division Engineers. The notice shall include the names and addresses of the parties to the transaction, a description of the water right involved, and a description of the proposed transaction, including but not limited to the amount of water, the historic place of use, the proposed new place of use, the proposed time of use, and the proposed type of use. The water bank also shall post the notice on its website.

C. The State and Division Engineers shall allow persons or entities thirty (30) days after the date of mailing of the notice in Rule 7.B to file written comments on the transaction. Such comments shall include any claim of injury or any terms and conditions that should be imposed upon the transaction to prevent injury to a party's water rights, and any other information the person or entity wishes the State and Division Engineers to consider in reviewing the proposed transaction.

D. Within five (5) business days after the close of the comment period described in Rule 7.C, the State and Division Engineers, after consideration of the comments received on the transaction, will provide the seller and buyer, and any person or entity who has submitted written comments, with terms and conditions necessary for implementing the agreement. The terms and conditions shall include any necessary and/or desirable limitations upon the time, place or type of use of the water made available through the water 8 bank, or other terms and conditions as deemed necessary to prevent injury to vested water rights, including dry-up provisions where applicable. In making the determinations necessary to developing such terms and conditions, the State and Division Engineers shall not be required to hold or conduct any formal hearings or proceedings, but may hold or conduct a hearing or formal proceeding if the State and Division Engineers find it necessary to address the issues. Any such hearing shall be held pursuant to the Division of Water Resources Procedural Regulations, 2 CCR-402-5.

E. Upon acceptance by the buyer and seller of the State and Division Engineers' terms and conditions, the water bank operator may finalize the agreement between the seller and buyer. Once the agreement is finalized and all parties, including the water bank, have been properly compensated, the water bank will notify the Division Engineer of the completion of the transaction.

F. A seller of deposited water shall comply with all state and local laws and regulations regarding land use and vegetation (i.e. weed control).

G. The water bank shall establish and charge sufficient fees to cover administrative costs incurred during the operation of the bank.

Rule 8. **Quantification Procedures for Water to be Released from the Bank.**

A. Acceptable Factors. Table A of these rules sets forth acceptable values for stored water deposited in the water bank that was historically applied to lands within a ditch service area as "winter water," Article II water, and/or releases of water pursuant to appropriative storage rights from vessels outside of the ditch service area. These factors are applicable to gross quantities of stored water. To claim values differing from those listed below, parties must submit to the State and/or the Division Engineer(s) a historic consumptive use analysis for consideration.

B. The factors for waters stored within the Holbrook Reservoirs

(Holbrook and Dye Reservoirs) pertain to units of banked water resident within those reservoirs. To claim values differing from those listed in Table B, users must submit to the State and Division Engineers a historic consumptive use analysis for consideration.

C. No factors are proposed for use in connection with waters associated with the Colorado Canal Reservoirs (Lake Henry or Lake Meredith), for which quantification procedures have been established by decrees of the Water Court. Banked water derived from any of these Reservoirs shall be quantified in terms of "net loss water" as that term is used in Case Nos. 84CW62-64, Water Division 2.

D. For water other than those systems listed in paragraphs A, B, or C above, a historic consumptive use analysis must be submitted to the State and/or Division Engineer(s) for consideration. The State and/or Division Engineer shall review and apply the following criteria in considering the historic consumptive use analysis: (1) historic diversion/storage records (1970-present) analysis; (2) applicable decrees; (3) crop evapotranspiration and irrigation water requirements; (4) descriptive maps and diagrams; and (5) additional information and/or analysis deemed necessary by the Division Engineer.

E. The State and Division Engineers shall apply the factors/procedures described in paragraphs A, B, C, or D above in approving and developing terms and conditions for proposed leases, loans, options and exchanges of water as set forth in Rule 7 in the following manner:

1. Only that portion of each unit of deposited water determined to be consumable shall be deliverable less any amounts deducted by the Division Engineer for evaporation and transit loss.
2. That portion of each unit of deposited water determined as transit loss that historically would have occurred in the delivery of water to the ditch headgate, shall be released from the reservoir at the time that other waters of the same type (i.e. winter water stored by a particular ditch company, for a particular year) as that deposited in the water bank are released, except as provided for in Rule 8.E.4 and 8.E.5.
3. That portion identifiable as canal and lateral loss is to be dedicated to use of other water users within the ditch service area and shall be released from the reservoir at the time that other waters of the same type as that deposited in the water bank are released, except as provided for in Rule 8.E.4 and 8.E.5.

4. In the event that all of the waters of a given type have been deposited in the water bank, then the timing of release of the transit loss and canal/lateral loss components of the deposited water shall be the same as that determined for the tail-water and deep percolation components in Rule 8.E.5.
5. 5. The remaining tail-water and deep percolation components shall be released to the river by the Division Engineer to maintain historic return flow patterns. These releases shall reflect the return flow response resulting from historic patterns of use and 11 shall be implemented starting at the time of completion of the transaction and continuing for a twelve (12) month period.

Rule 9. **Procedures for Delivering Water from Storage Facilities.**

A. The user of banked water must notify the Division Engineer at least 24 hours prior to a request for delivery of water from the bank. Such notification must include the account number, date, time and location of release. The Division Engineer will administer the delivery of water per the terms and conditions of approval for the account and the agreement being implemented.
B. In cooperation with the State and Division Engineers, the water bank shall develop credit and debit accounting for each reservoir used to store banked water.
C. The State Engineer will determine all transit losses pursuant to sections 37-87-102(4) and 37-83-104, C.R.S. (2001).
D. The State Engineer shall determine all evaporative losses pursuant to section 37-87-102(4), C.R.S. (2001).
E. Exchange operations necessary for the delivery of water made available through the water bank shall be evaluated and approved in accordance with 37-83-104, C.R.S. (2001).

Rule 10. **Reporting Requirements.**

A. The bank, in cooperation with the State and/or Division Engineers, will publish monthly summaries of the bank's transactions on the water bank's and Colorado Division of Water Resource's web sites. Paper copies of such summaries will also be made available to the public at the State Engineer's Office main office in Denver as well as the Water Division 2 Field Office in Pueblo.
B. By November 1, 2005, the State Engineer shall file a report to the legislature and the Governor that discusses the effectiveness of the water banking pilot program. This report will include a discussion of any existing legal, institutional, compact and social or economic constraints on the use of water banking. The report will also include any recommended limitations upon the use of water banks within Colorado.

Rule 11. **Pilot Project Time Limitation.**

A. These rules effectuate the laws set forth in sections 37-80.5-101 et seq., C.R.S. (2001). In accordance with the nature of the pilot project set forth therein, that law and these rules are repealed automatically on July 1, 2007. Any water left in the bank at that time shall immediately revert back to the owner of record.
12
B. If, after reviewing the State Engineer's report on the effectiveness of the Pilot Arkansas River Water Bank, the legislature extends the pilot water banking

program for three (3) years or more, or authorizes a permanent water bank, the State Engineer shall review and revise these Rules to address issues related to the continued operation of the water bank. If the legislature extends the pilot water banking program for less than three (3) years, the State Engineer may review and revise these Rules as necessary to address issues related to the continued operation of the water bank.

Rule 12.

If any part of these rules is found to be invalid by a court of law, the remaining rules shall remain in full force and effect.

Rule 13. **Effective Dates.**

These rules shall take effect on July 1, 2002 and shall remain in effect until amended as provided by law, or until June 30, 2007, whichever date comes first.

IT IS FURTHER ORDERED that any person wishing to protest these rules may do so in the manner provided in sections 24-4-101 et seq., C.R.S. (2001), (the State Administrative Procedure Act); however, any protest of these Rules must be filed with the Water Court for Water Division No. 2 in Pueblo, Colorado.

END

[RRB- Above rules presented to SECWCD on Nov. 21, 2002 by Steve Witte; effective Jan. 1, 2003]

Appendix 5B: Report to the Governor and Legislature on the Arkansas River Water Bank Pilot Program

Report to the Governor and Legislature
on the
Arkansas River Water Bank
Pilot Program

Hal D. Simpson
State Engineer

November 1, 2005

Report to the Governor and Legislature on the Arkansas River Water Bank Pilot Program

Pursuant to Section 37-80.5-106(1), C.R.S., the State Engineer must submit report to legislature and Governor on or before Nov. 1, 2005.

Contextual History

The Arkansas River Water Bank Pilot Program, authorized under Section 37-80.5-106, C.R.S. (2004), received its genesis as a result of Governor Bill Owens Commission on Saving Farms, Ranches and Open Space in 2000. The 16-member commission, appointed in May of 2000, examined Colorado's land preservation efforts and identified means of protecting the state's natural landscapes to deal with the issues of growth, congestion and open space. The commission obtained input from the public across the state on a variety of ideas toward the end of protecting the farming community and open space that is so vital to the lifestyle that the citizens of Colorado enjoy. Increasing population and development have, in some areas, been seen as a threat to this aspect of Colorado's lifestyle and the commission was tasked with developing ideas that would bring a balance between competing pressures.

Within this context, water necessarily plays a vital role. As a result, the commission examined various innovative ways to balance the water needs of farms, ranches and open space with the competing needs of cities and development for the same resource.

In the commission's final report to the Governor, one recommendation was to initiate pilot programs for water trading, banking and easements that provide farmers and ranchers with options to respond to changing market conditions without permanently removing water from the basin. From that recommendation, legislation (HB01-1354) was passed that resulted in the Arkansas River Water Bank Pilot Program. This legislation became effective on June 5, 2001.
The legislation required the State Engineer, in consultation with the Colorado Water Conservation Board, to develop a pilot water banking program in the Arkansas River basin. This basin was chosen as a test basin, in part, due to the hydrologic knowledge obtained

and developed as part of the Kansas v. Colorado litigation. Extensive knowledge of irrigation practices, storage facilities and return flow patterns, including the existence of a ground water model, were seen as useful tools that could allow such a program to develop in a more controlled environment. Other factors favoring the use of the Arkansas River included the interest and support of the Southeastern Colorado Water Conservancy District (the District).

As originally developed, the law allowing for the creation of the pilot water bank permitted the export of banked water outside of the basin of origin. Limitations to such export were part of the law and required the rules and regulations to set forth requirements favoring in-basin use over trans-basin development. Further limitations within the law restricted the type of water placed in the bank to storage water rights only, with no provisions for placing direct flow water rights in the bank.

The State Engineer held several public input meetings throughout the basin in the summer and fall of 2001 and negotiated with the Bureau of Reclamation to allow use of Pueblo Reservoir as one of the main vessels to place water placed in the bank for transfer in the pool. After obtaining this input, draft rules and regulations were developed in December 2001 and public hearings were held resulting in the promulgation of the Arkansas River Pilot Water Banking Rules and Regulations (effective July 1, 2002). These regulations resulted in rules to be followed by both the water bank operator and the State Engineer in the functioning of the bank. The District agreed to operate the bank and start-up funds that were part of the legislation were provided to the District for development of a web site and the infrastructure to begin business transactions.

In May 2005, the District informed the State Engineer that they no longer wished to operate the bank. Limited interest by the water users and recently passed legislation concerning substitute water supply plans were reasons provided for relinquishing their sponsorship of the program. As a result, the Upper Arkansas River Water Conservancy District began negotiations with the State Engineer and amended rules and regulations have been initiated to streamline operations of the bank and meet the needs of the water users and the Upper Arkansas Water Conservancy District in future operations.

Effectiveness of Pilot Water Banking Program

The Water Bank Pilot program incurred limited interest. Only two water users within the basin made water available for lease in the bank during the operations under the District's promotion of the bank. No transactions were consummated resulting in the use of those waters within the bank.

Some positive developments occurred during the water bank's short history. The program allows farmers and water users to examine different means of operations.

During the public input phase of the rulemaking procedures, an open dialogue between water users occurred with different ideas being shared and discussed concerning the marketing and transferring water.

The water bank also created a visually transparent water market by placing the price of water available for lease directly on the Internet. The value of water has historically been negotiated in private, leading to under-value and over-value pricing. Placing prices on the bank's website provides an opportunity to develop a clearer context of real market value. A clearer, more realistic water value is helpful to water users and those involved in water resources planning and development.

Existing statutory, regulatory, or contractual constraints on the successful use of water banking in Colorado

Limitations on the type of water that can be placed in the water bank

The most significant constraint to the pilot program was limiting the type of water allowed in the program to decreed storage rights only. While reservoir storage is easier to administer and lessens concerns over maintaining historic return flow patterns and dry-up provisions, most water users in the basin do not own decreed storage rights. This in turn limited the number of water users in the market place to participate in the program.

Restricting waters placed in the water bank to in-basin use

The legislation originally allowed trans-basin transfers through the water bank. In theory, allowing external basin use of waters placed in the bank would provide an opportunity for cities along the front-range to enter into long-term dry year lease agreements. These arrangements could potentially limit the permanent transfer of water out of a basin by allowing farmers to lease their water rights to cities during times when the city is short on supplies, while continuing to allow irrigation by the farmers in the basin of origin during times of sufficient metropolitan supply.
A lower fee would be paid to the farmer during years of non-use by the city, with a higher value being paid during times of shortage by the city, with the resultant dry-up of the irrigated acreage limited to only those periods.

Allowance for using the bank for trans-basin exchanges was disallowed by amending the banking provisions in 2003. Fear within the Arkansas and other river basins over the trans-basin export of water appear to have driven the removal of the allowance for export. While the fear is understandable, removal of the allowance for export also removes one of the benefits that water banking provides, i.e. keeping water in the basin of origin over the long term.

Even as originally construed with the allowance for exportation of water under the original legislation, the tenure of the pilot project (only five years existed under the program once implemented) did not allow for long-term (ten to twenty year leases) arrangements that are more attractive for municipal planning purposes.
Cities require long-term yields and assurances that the supply will be there when needed, i.e., during a drought. Five-year planning windows are not adequate when developing stable water supplies.

Substitute supply plan legislation

One of the stated reasons the District pulled its sponsorship and operation of the water bank in the Arkansas River basin was due to the passage of House Bill 02-1414, which amended the Water Rights Determination and Administration Act to allow for temporary substitute water supply plans through approval by the State Engineer. See Sections 37-92-308(4) and (5), C.R.S. This act allows temporary approval of changes of water rights, augmentation plans and exchanges of water for periods of up to five years, while providing notice to water users and greater flexibility than the pilot water bank project can allow under existing legislation.

Further, there are no restrictions to using only stored water in the streamlined temporary approval, and wells can be augmented. The time constraint of five years that limits the effectiveness of long-term water supply planning in the pilot water banking program also exists under HB 02-1414. As one water user stated,

"There is nothing I can't do with a temporary substitute water supply plan that I can't do with the water bank and, in fact, I can do much more (than with the water bank) and it still solves my problem of getting something accomplished quickly."

The passage of HB 02-1414, with its allowance for trans-basin export may have reduced the available market and eliminated many potential water transactions in the water bank. It has been suggested if the water bank could have been used to market water made available by a temporary substitute water supply plan of direct flow water rights, it may have increased use of the water bank during the drought years of 2002 and 2003.

Federal NEPA

During the planning and development stages of the water bank, it was discovered that water being stored in a federal facility (Pueblo Reservoir*) is subject to review specified by the National Environmental Policy Act. Any use of a federal reservoir that is outside of the uses originally contemplated during the enabling legislation places the use of the entire facility into question. This problem was solved through a cooperative effort with the Bureau of Reclamation by allowing temporary if and when contracts for the use of the facility.

Dry-up concerns

Many water users expressed concern over the potential for expanding the use of water rights placed in the water bank. In a change of water right proceeding,

Colorado water law often requires dry-up of irrigated acreage to occur when transferring water to different uses or places of use in order to balance historical consumptive use of water with the consumptive use of the new use. The rules and regulations promulgated by the State Engineer addressed these concerns, however, water users continued to express concerns over this issue. A potential resolution to this problem could be amending the legislation with language specifically requiring appropriate dry-up, when necessary, for any water placed in the water bank.

Streamlining calculations of historical consumptive use

Owners of water rights seeking a change in use, including those seeking participation in the water bank, require a historical consumptive use analysis to ensure no expansion of use or potential injury to other existing water rights. Most storage water rights have not been the subject of previous court adjudications quantifying the historical consumptive use. The time and effort required to perform the analysis, though necessary to protect other water rights from potential injury, may have been an impediment to those storage water right owners contemplating participation in the pilot water bank.

While most storage rights have not completed a historical consumptive use analysis, some have. For these water rights, the rules are being amended to allow users who have decrees that set forth the amounts of water transferable to simply provide the decree to the Division Engineer as proof of the amount of historical consumptive use available. This should assist in streamlining quantified water being accepted for placement in the bank.

Early withdrawal penalties

It became apparent during the operation of the bank that some water users were using the advertising potential of the bank's Internet presence to draw interest in their water right. Once a potential buyer was found, the depositor would withdraw their water from the water bank and enter into a separate deal with the party in interest, thereby avoiding the payment of any administrative fees for using the bank. Therefore, appropriate early withdrawal penalties need to be developed and strictly enforced by any water bank operator to provide a disincentive to users who simply want to obtain inexpensive advertising.

Institutional constraints on the successful use of water banking in Colorado

Having the State Engineer act as an operator of the water bank

Under the initial legislation, the water bank could be operated by the State Engineer or delegated to an outside operator. It became evident that placing the regulator in the position of operating and promoting use of the water bank would be problematic due to a perceived conflict of interest by the public. Legislation passed in 2003 addressed this potential problem and only water conservancy or water conservation districts may be operators of the water bank.

Internal water district and ditch company constraints

While the legislation passed allows water conservancy and conservation districts in the operation of a water bank to act outside of their geographic boundaries when administering any water banking program (Section 37-80.5-104.5(1)(d), C.R.S.), apprehension still remains. There is a fear that any operation outside of their boundaries may raise jurisdictional and enforcement issues. Further, many ditch companies have incorporated bylaws or other internal restrictions that prevent leasing of shares outside their system.

Arkansas River Compact

While the problem never materialized, there is concern that operation of the water bank in certain situations within the Arkansas River system could cause problems under the Arkansas River Compact. The Compact generally limits water use to the 1948 level of development unless it can be shown that the new use will not deplete usable state line flows. Any future change of use, plan for augmentation, or approval of a substitute water supply plan must assure historical return flow patterns be maintained to protect the state from a compact violation. With the State and Division Engineers reviewing all potential transfers via the water bank, potential impact to any Compact provision is mitigated.

Social or economic constraints upon the successful use of water banking within Colorado

The farming and ranching community is somewhat conservative by nature and, at times, this can make new ideas difficult to sell. This fear of change is not unwarranted in that the Arkansas River basin, in particular, has seen what many view as raids on their water rights, resulting in impacts to some local economies, environments, and tax bases due to the exportation of water.
This trepidation makes it clear that any operator of a water bank needs to make multiple, ongoing marketing efforts to promote the program and provide information to potential users allaying any existing fears. Placing a web site on the Internet and waiting for customers to come to the bank is not enough to develop solid usage of the bank. Professional marketing of the program by any operator is a key to making the program more successful.

Economically, there is no incentive to use the water bank instead of more traditional marketing strategies of stored water. It appears there is not a large enough price difference between bank and traditional market values to make use of the bank an attractive alternative to obtaining value.

Another constraint inherent in the bank at this time is there is no realistic mechanism to control what a potential user of the bank may ask for their water.
In one instance, a participant set the price so high that it was seen as unreasonable within the water community. In turn, this may have discouraged some users from even looking at the bank because they believed the water would be extremely over-priced. One suggestion to cure this situation would be to allow the user to set an initial price, but if the original asking price does not bring any interest within a time specific, the bank operator can begin to lower the price (within an agreed upon range) to a level the market will bear.

Any recommended limitations upon the use of water banks within Colorado, with specific reference to the time, place, or type of use of waters made available under such recommended limitations and the length of agreements implementing the same

1. Provide incentives for water bank operators to promote the use of the water bank.

2. Modify the Interruptible Water Supply legislation, Section 37-92-309, C.R.S., and the Water Bank legislation to allow water from these agreements to be placed in a water bank.
3. Allow trans-basin exportation of water through interruptible water supply agreements as approved by the water bank operator and the Division Engineer.
4. Allow storage and direct flow water rights to be placed in the water bank after quantifying the historical consumptive use in water court if a change in use is anticipated for the water being placed in the water bank. If fallowing agreements are included in the change in use of a water right, allow the fallowed water rights to be placed in the water bank to facilitate marketing of the water.
5. Place reasonable time constraints on the length of interruptible supply lease agreements created through the water bank, a minimum of ten years is suggested.
6. Develop appropriate penalties through rules and regulations and operator requirements of depositors for early withdrawal of water from the bank if the purpose is to obtain free advertising.
7. Include mandatory dry up provisions, where necessary, as part of any legislation modifying the current water banking statutes.

Appendix 5C: By Laws for the Lower Arkansas Valley Water Conservancy District

[Bylaws adopted in final form]

BY LAWS

OF

LOWER ARKANSAS VALLEY WATER CONSERVANCY DISTRICT

Article I

Offices

1. Organization: The Lower Arkansas Valley Water Conservancy District (LAVWCD) is organized within the Water Conservancy Act (C.R.S. 37-45- 101, etc seq.), and as decreed by the District Court in and for Pueblo County, State of Colorado. In the event of any conflict between these Bylaws and State statutes, State statutes shall govern. Furthermore, these Bylaws shall be deemed automatically amended by any applicable statutory change.

2. Business offices: The principal offices of the District shall be located at Room 109, Humanities Building, Otero Junior College, La Junta Colorado- initially Records of the District shall be kept at the principal office of the District except that the attorneys the District may retain the records at their office.

Article II

Board of Directors

1 . Appointment and Tenure: The business affairs of the district shall be directed by a Board of Directors consisting of seven members. The terms, qualifications and other requirements for the directors and officers shall be set forth in the statutes and in decrees and orders of the District Court in and for Pueblo County, State of Colorado. The Board of Directors shall consist of one member from Bent County, one member from Crowley County, one member from Otero County, one member from Prowers County, and three members from Pueblo County.

2. General Powers: The Board of Directors shall have all of the powers as set forth in the Water Conservancy Act.

3. Regular Meetings: Regular meetings of the Board of Directors shall be held on the days designated by a resolution adopted at the District's first regular meeting of each calendar year or as designated by notice provided consistent with applicable statutes.

4. Special Meetings: Special meetings of the Board of Directors may called by the president or any officer of the District on at least 24 hours notice to each director, either personally, by mail, by electronic mail, by telegram or by telephone. In addition, a special meeting of the Board of Directors shall be called by the president or secretary on the written request of any two directors; such meeting shall be called on at least 24 hours notice to each director, either personally, by mail, by electronic mail, by telegram or by telephone. Public notice of a special meeting shall be provided consistent with applicable statutes. The purpose of a special meeting of the Board of Directors shall be stated in the notice thereof.

5. Place of Meeting. The meetings of the District shall be held at such locations, either within or out of the boundaries of the Conservancy District, as the Board of Directors may determine and as allowed by statute.

6. Quorum : A majority of the directors shall constitute a quorum and a concurrence of a majority of those in attendance, in any matter within their duties, shall be sufficient for its determination, except as otherwise provided for in this article.

7. Vacancies: Vacancies shall be filled as provided by law.

8. Compensation of Directors: Each member of the board shall receive as compensation for his or her service of such sum as shall be ordered by the Court, not in excess of that amount as permitted by law and necessary traveling expenses actually expended while engaged in the performance of his or her duties, or such other compensation as may be permitted by law.

9. Executive Committee: An Executive Committee consisting of six members of the Board including the President (in Office) may be appointed by the Board of Directors annually at the first meeting of the board held after the appointment of directors by the court. It shall have all the powers of the Board in the interim between Board meetings. The actions of the Executive Committee shall be subject to the approval of the whole Board.

Meetings may be held at any time, and at any place within the State of Colorado, upon call by any Committee member. Notice of any meeting shall be given to each member in person, or by telephone, or it may be mailed, electronically mailed or telegraphed to him or her at his or her residence or business address at least 24 hours before the meeting. Public notice shall be provided consistent with applicable Statute. Three members shall constitute a quorum. The secretary shall keep record of the minutes of each Executive Committee meeting in a book kept for that purpose and shall report same to the Board of Directors at its next meeting.

10. Standing Committees: Committees may be formed at any time for any purpose deemed appropriate or necessary by the Board of Directors may be appointed to committees by the President annually or at the first meeting of the Board held after the appointment of directors by the court, or following a resolution to form a committee. The following shall be standing committees of the District:

Agency Liaison Committee
Finance Committee
Legal Committee
Personnel Committee
Water Acquisition Committee

The actions of any committee shall be subject to the approval of the whole Board. Committee meetings may be held at any time, and at any place within the State of Colorado, upon call by any committee member. Notice of any meeting shall be given to each member in person, or by telephone, or it may be mailed, electronically mailed or telegraphed to him or her at his or her residence or business address at least 24 hours before the meeting. Public notice shall be provided consistent with applicable statutes. Two or more members in attendance shall constitute a quorum. Committee meetings shall be public, except that a committee may hold discussion in an executive session consistent with applicable law for the reasons provided therein. The Assistant Secretary shall keep record minutes of each committee meeting in a book kept for that purpose, and shall report same to the Board of Directors at its next meeting.

Article III
Officers

1. General. The Board of Directors shall choose one of their number as chairman of the board and president of the District, one or more Vice Presidents, a Secretary, and a Treasurer, all of whom shall be members of the Board of Directors. All of said Officers shall serve for a term of one year, and until their successors are elected and qualified. Such board shall adopt a seal and shall keep in a well bound book a record of all of its proceedings, minutes of all meetings, certificates, contracts, bonds given by employees, and all District acts which shall be open to inspection of all owners of property in the District, as well as to all other interested parties.

2. Election and Term of Office. The officers of the District shall be elected by the Board of Directors annually at the first meeting of the board held after the appointment of directors by the court. If the election of officers shall not be held at such meeting, such election shall be held as soon thereafter as conveniently may be. The Office of Secretary and Treasurer may be held by one person. The Officers shall have the duties set forth by Statute, and such other duties as the Board of Directors may prescribe.

3. Chairman of the Board and President. The President shall preside at all meetings of the directors, and he or she shall have the authority to execute all contracts, deeds, bills of sale, and other such instruments concerning real or personal property. The President shall see that all orders and resolutions of the Board of Directors are carried into effect and in general shall perform all duties as may from time to time be assigned to him or her by the Board of Directors.

4. Vice-President. The Vice President shall assist the President and shall perform such duties as may be assigned to him or her by the President or by the Board of Directors. In the absence or incapacity of the President, the Vice-President shall have the powers and perform the duties of the President.

5. Treasurer. The Treasurer shall be the principal financial officer of the District and shall have the care and custody of all funds, securities, evidence of indebtedness and other personal property of the District and shall deposit the same in accordance with the instructions of the Board of Directors. The Treasurer shall have the authority to receive and give receipts and a quittances for moneys paid in on account of the District and shall timely pay out of the funds on hand all bills, payrolls and other just debts of the District of whatever nature. He or she shall perform all other duties incident to the office of the Treasurer, and upon request of the board shall make such reports to it as may be required at any time. He or she shall have such other powers and perform such other duties as may be from time to time prescribed by the Board of Directors or the President. The Treasurer shall furnish corporate surety bonds, at the expense of the District, in amount and form fixed and approved by the Court, conditioned upon the faithful performance of his or her duties.

6. The Secretary shall be the custodian of the records of the District and of its corporate seal, and shall assist the board in such particulars as it may direct in the performance of its duties. The Secretary is authorized to attest, under the corporate seal of the District, all certified copies of the official records and files of the District that may be required by this article, or by an person ordering the same paying the reasonable cost of transcription, and any portion of the record so certified and attested shall prima facie import verity.

7. Assistant Secretary and Assistant Treasurer. There is hereby created the Office of Assistant Secretary and Assistant Treasurer, which offices may be held by the same person who may or may not be a member of the Board of Directors, to exercise all powers and

duties of the Secretary and the Treasurer, in case of the absence or inability of said Officers to perform such duties.

8. Other Officers. The Board of Directors may select such other Officers, employees, and agents with such duties as it may determine from time to time, none of whom need to be members of the Board.

ARTICLE IV

Indemnification of Officers and Directors

Each Director and Officer of the District, whether or not then in office, and their personal representatives shall be indemnified by the District against all reasonable costs and expenses, including attorney's fees, actually and necessarily incurred by them in connection with the defense of any action, suit or proceeding in which they may be involved or to which they may be made a party, by reason of having been such Director or Officer, except in relation to matters in which they shall be finally adjudged in such action, suit or proceeding to be liable for willful misconduct in performance of duty. The District's legal counsel shall serve as counsel to the Director or Officer, unless it appears to such counsel that the interests of the District and the Director or Officer may be adverse or otherwise pose a conflict of interest. In the latter event, the Director or Officer may select separate counsel to be approved in writing by the District. The Director or Officer shall cooperate with the District and its legal counsel in his or her defense.

Such costs and expenses shall also include amounts reasonably paid in settlement for the purpose of settling, or curtailing the costs of litigation, but only if the District's Board is satisfied in its opinion that the person indemnified did not commit willful misconduct. The District shall pay no judgment or settlement claims against a Director or officer where the latter has compromised or settled the claim without the District's written consent. The foregoing right of indemnification shall not be exclusive of other rights to which the person may be entitled as a matter of law or by agreement.

The District affirms that it has not waived any governmental immunity afforded to the Director, its Directors, Officers, employees or agents under any applicable law and the District has relied on and continues to rely on governmental or sovereign immunity to which it and its Directors, Officers, employees and agents are entitled. Each Director, Officer, employee and agent of the District shall be indemnified and protected from any and all liability to the maximum extent allowable under the Colorado Governmental Immunity Act.

Article V

Miscellaneous

1. Waivers of Notice. Whenever notice (other than to the general public) is required by law, or by these Bylaws, a waiver thereof in writing signed by the directors, or other persons entitled to such notice, whether before, or after the time stated therein, or their appearance at such meeting in person, shall be equivalent to such notice.

2. Seal. The corporate seal of the District shall be as follows:

3. Fiscal Year. The fiscal year of the District shall be as established by the Board of Directors and in accordance with law.

4. Amendments. Subject to the quorum requirements heretofore stated, the Board of Directors shall have power to make, amend and/or repeal the Bylaws of the District at any regular meeting of the board or at any special meeting called for that purpose.

Article VI
Severability

If any of the provisions of these Bylaws are declared illegal or unconstitutional by any court, it shall not affect the legality or enforceability of the other provisions which are deemed severable.

Article VII
Waiver

In unique and compelling circumstances and upon a finding that it will not adversely impact the District, the Board may grant variances or waivers from these Bylaws,

These Bylaws were duly adopted by the Board of Directors of the Lower Arkansas Valley Water Conservancy District on this 12th day of February, 2003.

LOWER ARKANSAS VALLEY WATER
CONSERVANCY DISTRICT
By:
President _______[no sig.]______

ATTEST:
Secretary _____[no sig.]________

Appendix 5D: The Arkansas River Compact of 1949

Arkansas River Compact
Kansas-Colorado
1949

K.S.A. 82a-520. Arkansas River compact.

The legislature hereby ratifies the compact, designated as the "Arkansas river compact," between the states of Colorado and Kansas signed in the city of Denver, state of Colorado on the fourteenth day of December, A.D. 1948, by Henry C. Vidal, Gail L. Ireland and Harry B. Mendenhall as commissioners for the state of Colorado, George S. Knapp, Edward F. Arn, William E. Leavitt and Roland H. Tate as commissioners for the state of Kansas, and by Hans Kramer as the representative of the United States of America, which compact is as follows:

ARKANSAS RIVER COMPACT

The State of Colorado and the State of Kansas, parties signatory to this Compact (hereinafter referred to as "Colorado" and "Kansas," respectively, or individually as a "state," or collectively as the "states") having resolved to conclude a compact with respect to the waters of the Arkansas river, and being moved by considerations of interstate comity, having appointed commissioners as follows: Henry C. Vidal, Gail L. Ireland, and Harry B. Mendenhall, for Colorado; and
George S. Knapp, Edward F. Arn, William E. Leavitt, and Roland H. Tate, for Kansas; and the consent of the Congress of the United States to negotiate and enter into an interstate compact not later than January 1, 1950, having been granted by Public Law 34, 79th Congress, 1st Session, and pursuant thereto the President having designated Hans Kramer as the representative of the United States, the said commissioners for Colorado and Kansas, after negotiations participated in by the representative of the United States, have agreed as follows:

Article I

The major purposes of this Compact are to:

A. Settle existing disputes and remove causes of future controversy between the states of Colorado and Kansas, and between citizens of one and citizens of the other state, concerning the waters of the Arkansas River and their control, conservation and utilization for irrigation and other beneficial purposes.

B. Equitably divide and apportion between the states of Colorado and Kansas the waters of the Arkansas River and their utilization as well as the benefits arising from the construction, operation and maintenance by the United States of John Martin Reservoir Project for water conservation purposes.

Article II

The provisions of this Compact are based on (1) the physical and other conditions peculiar to the Arkansas river and its natural drainage basin, and the nature and location of irrigation and other developments and facilities in connection therewith; (2) the opinion of the United States Supreme Court entered December 6, 1943, in the case of Colorado v. Kansas (320 U.S. 383) concerning the relative rights of the respective states in and to the use of waters of the Arkansas river; and (3) the experience derived under various interim executive agreements between the two states apportioning the waters released from the John Martin Reservoir as operated by the Corps of Engineers.

Article III

As used in this Compact:

A. The word "state line" means the geographical boundary line between Colorado and Kansas.

B. The term "waters of the Arkansas river" means the waters originating in the natural drainage basin of the Arkansas River, including its tributaries, upstream from the state line, and excluding waters brought into the Arkansas River basin from other river basins.

C. The term "state-line flow" means the flow of waters of the Arkansas River as determined by gauging stations located at or near the state line. The flow as determined by such stations, whether located in Colorado or Kansas, shall be deemed to be the actual state-line flow.

D. "John Martin Reservoir Project" is the official name of the facility formerly known as Caddoa Reservoir Project, authorized by the Flood Control Act of 1936, as amended, for construction, operation and maintenance by the War Department, Corps of Engineers, later designated as the Corps of Engineers, Department of the Army, and herein referred to as the "Corps of Engineers." "John Martin Reservoir" is the water storage space created by "John Martin Dam."

E. The "flood control storage" is that portion of the total storage space in John Martin Reservoir allocated to flood control purposes.

F. The "conservation pool" is that portion of the total storage space in John Martin Reservoir lying below the flood control storage.

G. The "ditches of Colorado Water District 67" are those ditches and canals which divert water from the Arkansas River or its tributaries downstream from John Martin Dam for irrigation use in
Colorado.

H. The term "river flow" means the sum of the flows of the Arkansas and the Purgatoire into John Martin Reservoir as determined by gauging stations appropriately located above said Reservoir.

I. The term "the Administration" means the Arkansas River Compact Administration established under Article VIII.

Article IV

Both states recognize that:

A. This Compact deals only with the waters of the Arkansas River as defined in Article III.

B. This Compact is not concerned with the rights, if any, of the state of New Mexico or its citizens in and to the use in New Mexico of waters of Trinchera creek or other tributaries of the Purgatoire River, a tributary of the Arkansas River.

C. (1) John Martin Dam will be operated by the Corps of Engineers to store and release the waters of the Arkansas River in and from John Martin Reservoir for its authorized purposes.

(2) The bottom of the flood control storage is presently fixed by the Chief of Engineers, U.S. Army, at elevation 3,851 feet above mean sea level. The flood control storage will be operated for flood control purposes and to those ends will impound or regulate the streamflow volumes that are in excess of the then available storage capacity of the conservation pool. Releases from the flood control storage may be made at times and rates determined by the Corps of Engineers to be necessary or advisable without regard to ditch diversion capacities or requirements in either or both states.

(3) The conservation pool will be operated for the benefit of water users in Colorado and Kansas, both upstream and downstream from John Martin Dam, as provided in this Compact. The maintenance of John Martin Dam and appurtenant works may at times require the Corps of Engineers to release waters then impounded in the conservation pool or to prohibit the storage of water therein until such maintenance work is completed. Flood control operation may also involve temporary utilization of conservation storage.

D. This Compact is not intended to impede or prevent future beneficial development of the Arkansas river basin in Colorado and Kansas by federal or state agencies, by private enterprise, or by combinations thereof, which may involve construction of dams, reservoirs and other works for the purposes of water utilization and control, as well as the improved or prolonged functioning of existing works: *Provided,* That the waters of the Arkansas river, as defined in Article III, shall not be materially depleted in usable quantity or availability for use to the water users in Colorado and Kansas under this Compact by such future developments or construction.

Article V

Colorado and Kansas hereby agree upon the following basis of apportionment of the waters of the Arkansas River:

A. Winter storage in John Martin Reservoir shall commence on November 1st of each year and continue to and include the next succeeding March 31st. During said period all water entering said reservoir up to the limit of the then available conservation capacity shall be stored: *Provided,* That Colorado may demand releases of water equivalent to the river flow, but such releases shall not exceed 100 c.f.s. (cubic feet per second) and water so released shall be used without avoidable waste.

B. Summer storage in John Martin Reservoir shall commence on April 1st of each year and continue to and include the next succeeding October 31st. During said period, except when Colorado water users are operating under decreed priorities as provided in paragraphs F and G of this Article, all water entering said reservoir up to the limit of the then available conservation capacity shall be stored: *Provided,* That Colorado may demand releases of water equivalent to the river flow up to 500 c.f.s., and Kansas may demand releases of water equivalent to that portion of the river flow between 500 c.f.s., and 750 c.f.s., irrespective of releases demanded by Colorado.

C. Releases of water stored pursuant to the provisions of paragraphs A and B of this Article shall be made upon demands by Colorado and Kansas concurrently or separately at any time during the summer storage period. Unless increases to meet extraordinary conditions are authorized by the Administration, separate releases of stored water to Colorado shall not exceed 750 c.f.s., separate releases of stored water to Kansas shall not exceed 500 c.f.s., and concurrent releases of stored water shall not exceed a total of 1,250 c.f.s.: *Provided,* That when water stored in the conservation pool is reduced to a quantity less than 20,000 acre-feet, separate releases of stored water to Colorado shall not exceed 600 c.f.s., separate releases of stored water to Kansas shall not exceed 400 c.f.s., and concurrent releases of stored water shall not exceed 1,000 c.f.s.

D. Releases authorized by paragraphs A, B and C of this Article, except when all Colorado water users are operating under decreed priorities as provided in paragraphs F and G of this Article, shall not impose any call on Colorado water users that divert waters of the Arkansas river upstream from John Martin Dam.

E. (1) Releases of stored water and releases of river flow may be made simultaneously upon the demands of either or both States.

(2) Water released upon concurrent or separate demands shall be applied promptly to beneficial use unless storage thereof downstream is authorized by the Administration.

(3) Releases of river flow and of stored water to Colorado shall be measured by gauging stations located at or near John Martin Dam and the releases to which Kansas is entitled shall be satisfied by an equivalent in state-line flow.

(4) When water is released from John Martin Reservoir appropriate allowances as determined by the Administration shall be made for the intervals of time required for such water to arrive at the points of diversion in Colorado and at the state line.

(5) There shall be no allowance or accumulation of credits or debits for or against either state.

(6) Storage, releases from storage and releases of river flow authorized in this Article shall be accomplished pursuant to procedures prescribed by the Administration under the provisions of Article VIII.

F. In the event the Administration finds that within a period of fourteen (14) days the water in the conservation pool will be or is liable to be exhausted, the Administration shall forthwith notify the State Engineer of Colorado, or his duly authorized representative, that commencing upon a day certain within said fourteen (14) day period, unless a change of conditions justifies cancellation or modification of such notice, Colorado shall administer the decreed rights of water users in Colorado Water District 67 as against each other and as against all rights now or hereafter decreed to water users diverting upstream from John Martin Dam on the basis of relative priorities in the same manner in which their respective priority rights were administered by Colorado before John Martin Reservoir began to operate and as though John Martin Dam had not been constructed. Such priority administration by Colorado shall be continued until the Administration finds that water is again available in the conservation pool for release as provided in this Compact, and timely notice of such finding shall be given by the Administration to the State Engineer of Colorado or his duly authorized representative: *Provided,* That except as controlled by the operation of the preceding provisions of this paragraph and other applicable provisions of this Compact, when there is water in the conservation pool the water users upstream from John Martin Reservoir shall not be affected by the decrees to the ditches in Colorado Water District 67. Except when administration in Colorado is on a priority basis the water diversions in Colorado Water District 67 shall be administered by Colorado in accordance with distribution agreements made from time to time between the water users in such District and filed with the Administration and with the State Engineer of Colorado or, in the absence of such agreement, upon the basis of the respective priority decrees, as against each other, in said District.

G. During periods when Colorado reverts to administration of decreed priorities, Kansas shall not be entitled to any portion of the river flow entering John Martin Reservoir. Waters of the Arkansas River originating in Colorado which may flow across the state line during such periods are hereby apportioned to Kansas.

H. If the usable quantity and availability for use of the waters of the Arkansas river to water users in Colorado Water District 67 and Kansas will be thereby materially depleted or adversely affected, (1) priority rights now decreed to the ditches of Colorado Water District 67 shall not hereafter be transferred to other water districts in Colorado or to points of diversion or places of use upstream from John Martin Dam; and (2) the ditch diversion rights from the Arkansas river in Colorado Water District 67 and of Kansas ditches between the state line and Garden City shall not hereafter be increased beyond the total present rights of said ditches, without the Administration, in either case (1) or (2), making findings of fact that no such depletion or adverse effect will result from such proposed transfer or increase. Notice of legal proceedings for any such proposed transfer or increase shall be given to the Administration in the manner and within the time provided by the laws of Colorado or Kansas in such cases.

Article VI

A. (1) Nothing in this Compact shall be construed as impairing the jurisdiction of Kansas over the waters of the Arkansas river that originate in Kansas and over the waters that flow from Colorado across the state line into Kansas.

(2) Except as otherwise provided, nothing in this Compact shall be construed as supplanting the administration by Colorado of the rights of appropriators of waters of the Arkansas river in said state as decreed to said appropriators by the courts of Colorado, nor as interfering with the distribution among said appropriators by Colorado, nor as curtailing the diversion and use for irrigation and other beneficial purposes in Colorado of the waters of the Arkansas river.

B. Inasmuch as the Frontier Canal diverts waters of the Arkansas river in Colorado west of the state line for irrigation uses in Kansas only, Colorado concedes to Kansas and Kansas hereby assumes exclusive administrative control over the operation of the Frontier Canal and its headworks for such purposes, to the same extent as though said works were located entirely within the state of Kansas. Water carried across the state line in the Frontier Canal or any other similarly situated canal shall be considered to be part of the state line flow.

Article VII

A. Each state shall be subject to the terms of this Compact. Where the name of the state or the term "state" is used in this Compact these shall be construed to include any person or entity of any nature whatsoever using, claiming or in any manner asserting any right to the use of the waters of the Arkansas river under the authority of that state.

B. This Compact establishes no general principle or precedent with respect to any other interstate stream.

C. Wherever any state or federal official or agency is referred to in this Compact such reference shall apply to the comparable official or agency succeeding to their duties and functions.

Article VIII

A. To administer the provisions of this Compact there is hereby created an interstate agency to be known as the Arkansas River Compact Administration herein designated as "the Administration."

B. The Administration shall have power to:

(1) Adopt, amend and revoke bylaws, rules and regulations consistent with the provisions of this Compact;

(2) Prescribe procedures for the administration of this Compact: *Provided,* That where such procedures involve the operation of John Martin Reservoir Project they shall be subject to the approval of the District Engineer in charge of said project;

(3) Perform all functions required to implement this Compact and to do all things necessary, proper or convenient in the performance of its duties.

C. The membership of the Administration shall consist of three representatives from each state who shall be appointed by the respective governors for a term not to exceed four years. One Colorado representative shall be a resident of and water-right owner in Water Districts 14 or 17, one Colorado representative shall be a resident of and water-right owner in Water District 67, and one Colorado representative shall be the Director of the Colorado Water Conservation Board. Two Kansas representatives shall be residents of and water-right owners in the counties of Finney, Kearny or Hamilton, and one Kansas representative shall be the chief state official charged with the administration of water rights in Kansas. The President of the United States is hereby requested to designate a representative of the United States, and if a representative is so designated he shall be an ex officio member and act as chairman of the Administration without vote.

D. The state representatives shall be appointed by the respective governors within thirty days after the effective date of this Compact. The Administration shall meet and organize within sixty days after such effective date. A quorum for any meeting shall consist of four members of the Administration: *Provided,* that at least two members are present from each state. Each state shall have but one vote in the Administration and every decision, authorization or other action shall require unanimous vote. In case of a divided vote on any matter within the purview of the Administration, the Administration may, by subsequent unanimous vote, refer the matter for arbitration to the Representative of the United States or other arbitrator or arbitrators, in which event the decision made by such arbitrator or arbitrators shall be binding upon the Administration.

E. (1) The salaries, if any, and the personal expenses of each member shall be paid by the government which he represents. All other expenses incident to the administration of this Compact which are not paid by the United States shall be borne by the states on the basis of 60 percent by Colorado and 40 percent by Kansas.

(2) In each even numbered year the Administration shall adopt and transmit to the governor of each state its budget covering anticipated expenses for the forthcoming biennium and the amount thereof payable by each state. Each state shall appropriate and pay the amount due by it to the Administration.

(3) The Administration shall keep accurate accounts of all receipts and disbursements and shall include a statement thereof, together with a certificate of audit by a certified public accountant in its annual report. Each state shall have the right to make an examination and audit of the accounts of the Administration at any time.

F. Each state shall provide such available facilities, equipment and other assistance as the Administration may need to carry out its duties. To supplement such available assistance the Administration may employ engineering, legal, clerical and other aid as in its judgment may be necessary for the performance of its functions. Such employees shall be paid by and be responsible to the Administration, and shall not be considered to be employees of either state.

G. (1) The Administration shall cooperate with the chief official of each state charged with the administration of water rights and with federal agencies in the systematic determination and correlation of the facts as to the flow and diversion of the waters of the Arkansas river and as to the operation and siltation of John Martin Reservoir and other related structures. The Administration shall cooperate in the procurement, interchange, compilation and publication of all factual data bearing upon the Administration of this Compact without, in general, duplicating measurements, observations or publications made by state or federal agencies. State officials shall furnish pertinent factual data to the Administration upon its request. The Administration shall, with the collaboration of the appropriate federal and state agencies, determine as may be necessary from time to time, the location of gauging stations required for the proper administration of this Compact and shall designate the official records of such stations for its official use.

(2) The Director, U.S. Geological Survey, the Commissioner of Reclamation and the Chief of Engineers, U.S. Army, are hereby requested to collaborate with the Administration and with appropriate state officials in the systematic determination and correlation of data referred to in paragraph G (1) of this Article and in the execution of other duties of such officials which may be necessary for the proper administration of this Compact.

(3) If deemed necessary for the administration of this Compact, the Administration may require the installation and maintenance, at the expense of water users, of measuring devices of approved type in any ditch or group of ditches diverting water from the Arkansas river in Colorado or Kansas. The chief official of each state charged with the administration of water rights shall supervise the execution of the Administration's requirements for such installations.

H. Violations of any of the provisions of this Compact or other actions prejudicial thereto which come to the attention of the Administration shall be promptly investigated by it. When deemed advisable as the result of such investigation, the Administration may report its findings and recommendations to the state official who is charged with the administration of water rights for appropriate action, it being the intent of this Compact that enforcement of its terms shall be accomplished in general through the state agencies and officials charged with the administration of water rights.

I. Findings of fact made by the Administration shall not be conclusive in any court or before any agency or tribunal but shall constitute prima facie evidence of the facts found.

J. The Administration shall report annually to the Governor of the States and to the President of the United States as to matters within its purview.

Article IX

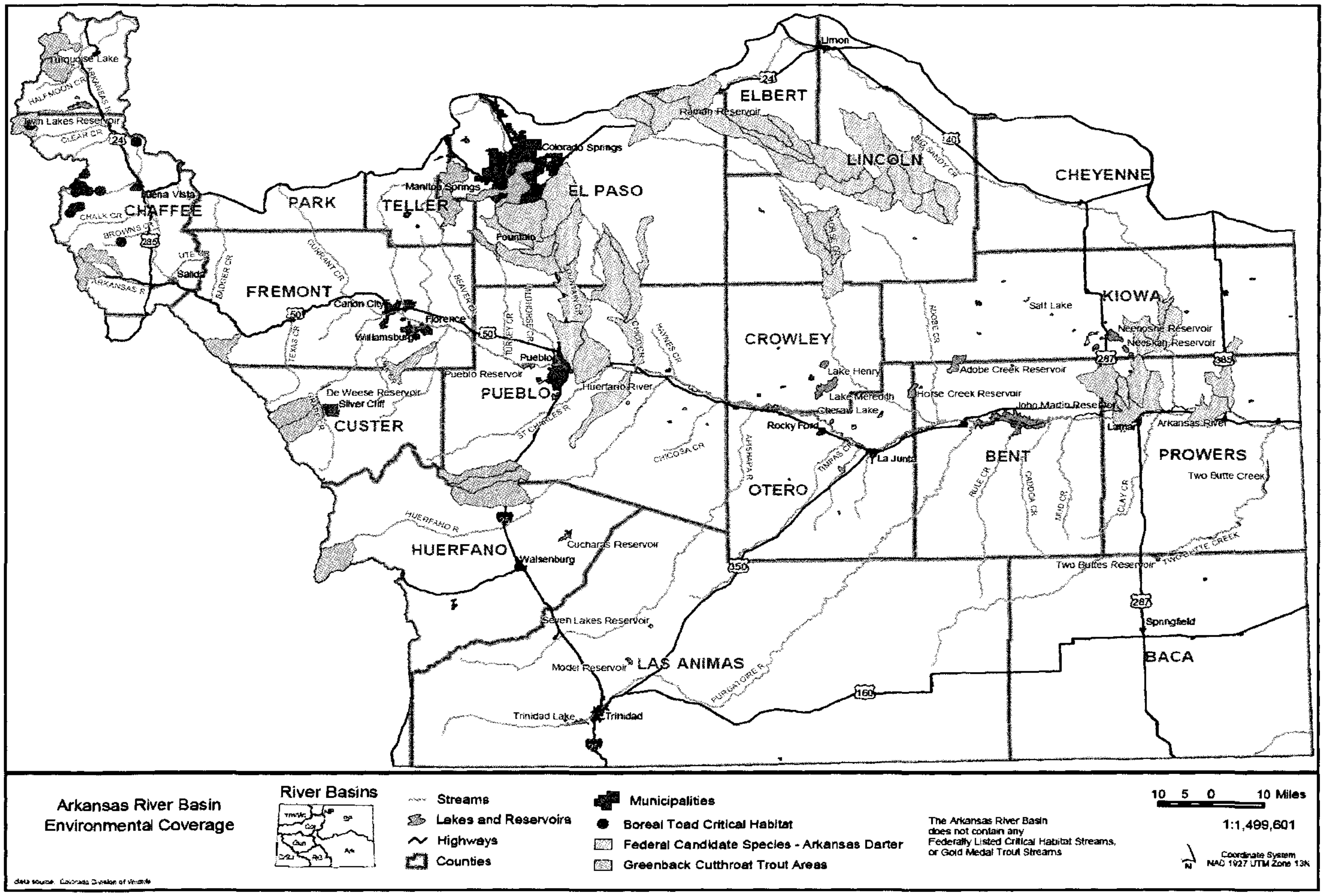
A. This Compact shall become effective when ratified by the Legislature of each State and when consented to by the Congress of the United States by legislation providing substantially, among other things, as follows: Nothing contained in this Act or in the Compact herein consented to shall be construed as impairing or affecting the sovereignty of the United States or any of its rights or jurisdiction in and over the area or waters which are the subject of such Compact: *Provided,* That the Chief of Engineers is hereby authorized to operate the conservation features of the John Martin Reservoir Project in a manner conforming to such Compact with such exceptions as he and the Administration created pursuant to the Compact may jointly approve.

B. This Compact shall remain in effect until modified or terminated by unanimous action of the states and in the event of modification or termination all rights then established or recognized by this Compact shall continue unimpaired. In Witness Whereof, The commissioners have signed this Compact in triplicate original, one of which shall be forwarded to the Secretary of State of the United States of America and one of which shall be forwarded to the governor of each signatory state. Done in the City and County of Denver, in the state of Colorado, on the fourteenth day of December, in the Year of our Lord One Thousand Nine Hundred and Forty-eight.

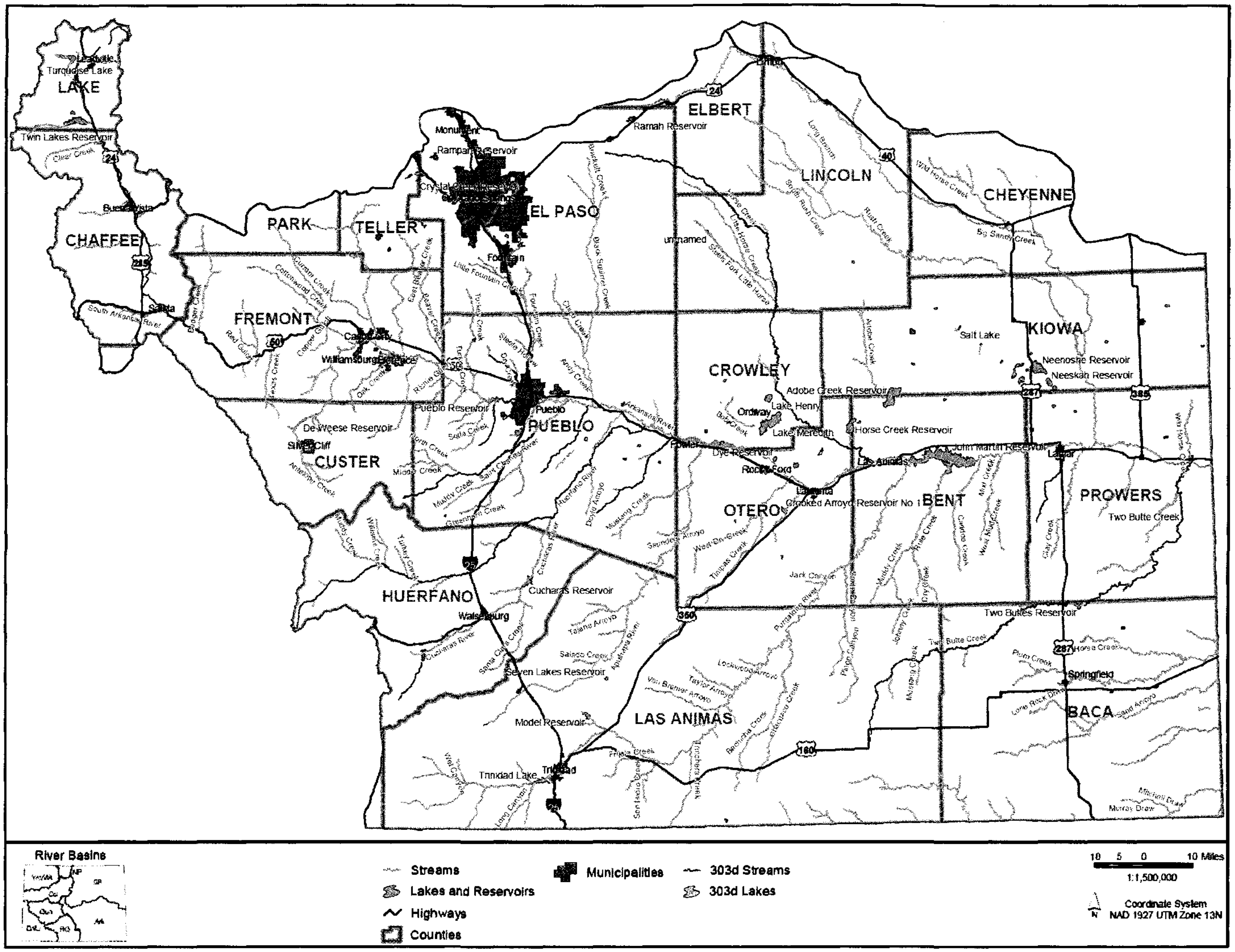
Henry C. Vidal, Gail B. Ireland, Harry B. Mendenhall, Commissioners for Colorado
George S. Knapp, Edward F. Arn, William E. Leavitt, Roland H. Tate, Commissioners for Kansas.
Attest:
Warden L. Noe, Secretary
Approved:
Hans Kramer, Representative of the United States.
History: L. 1949, ch. 509, § 1; June 30.

Appendix 6: GIS Maps of the Arkansas River basin

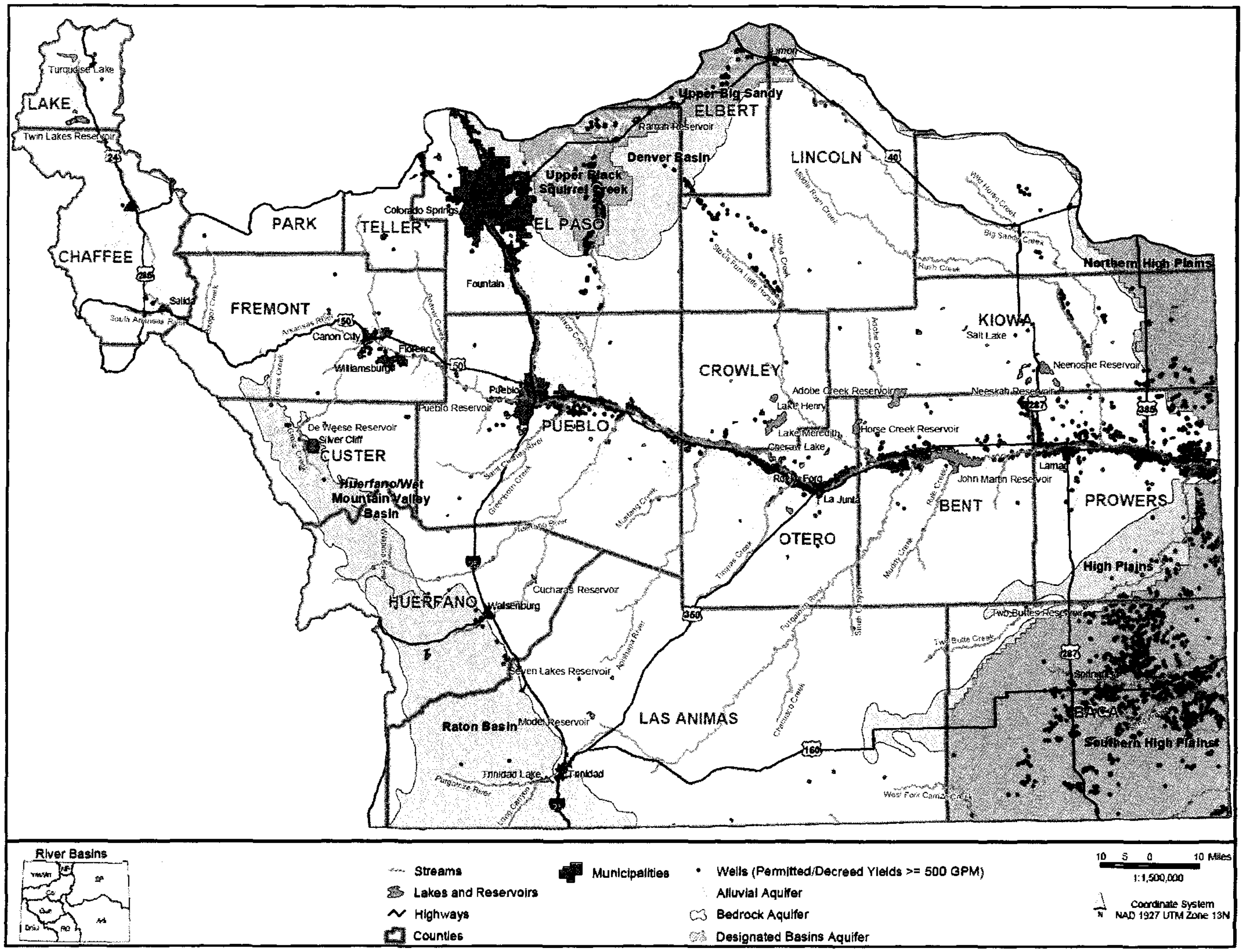
GIS Map of the Environmental Coverage in the Arkansas River Basin



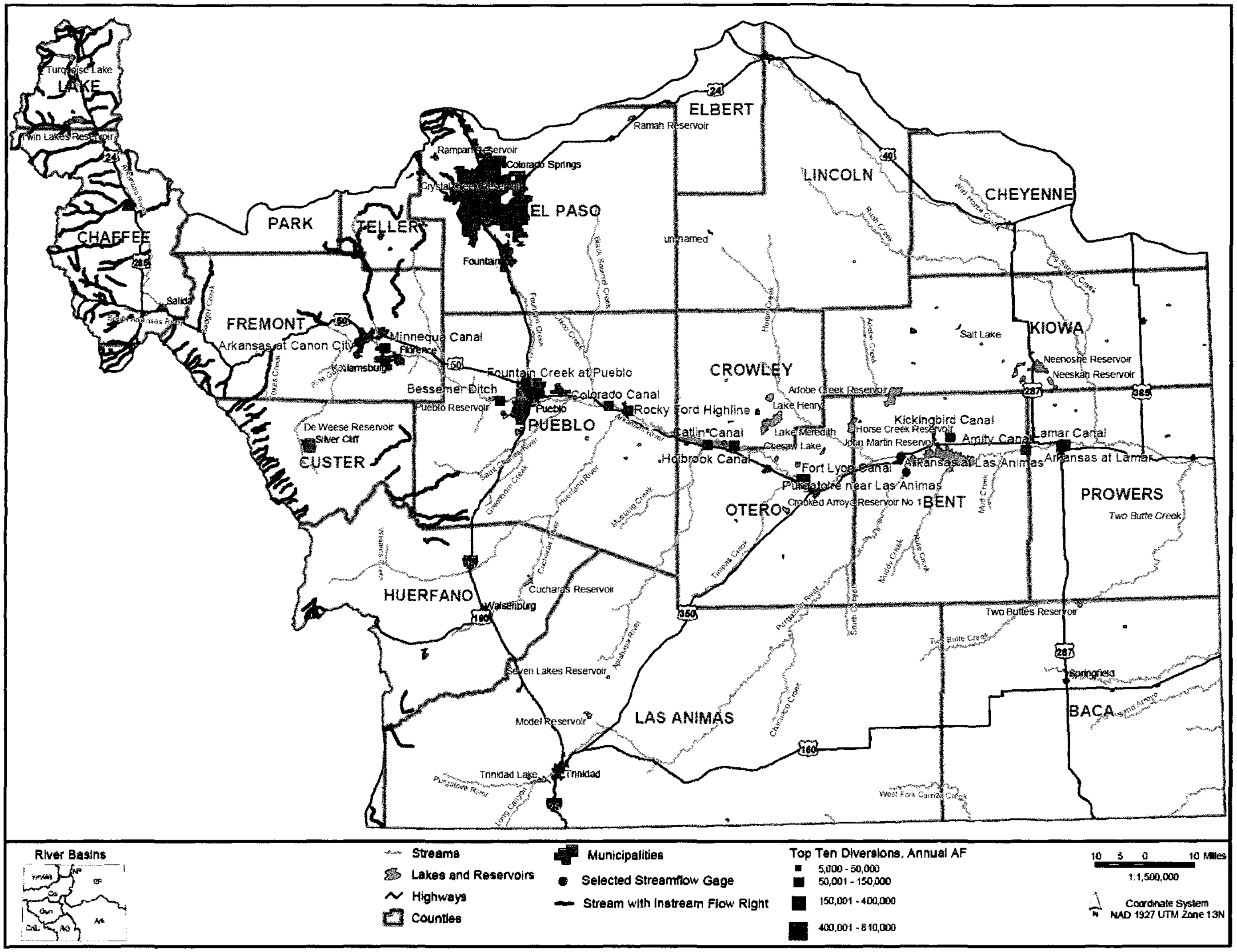
GIS Map of the Streams, Lakes and Reservoirs in the Arkansas River Basin



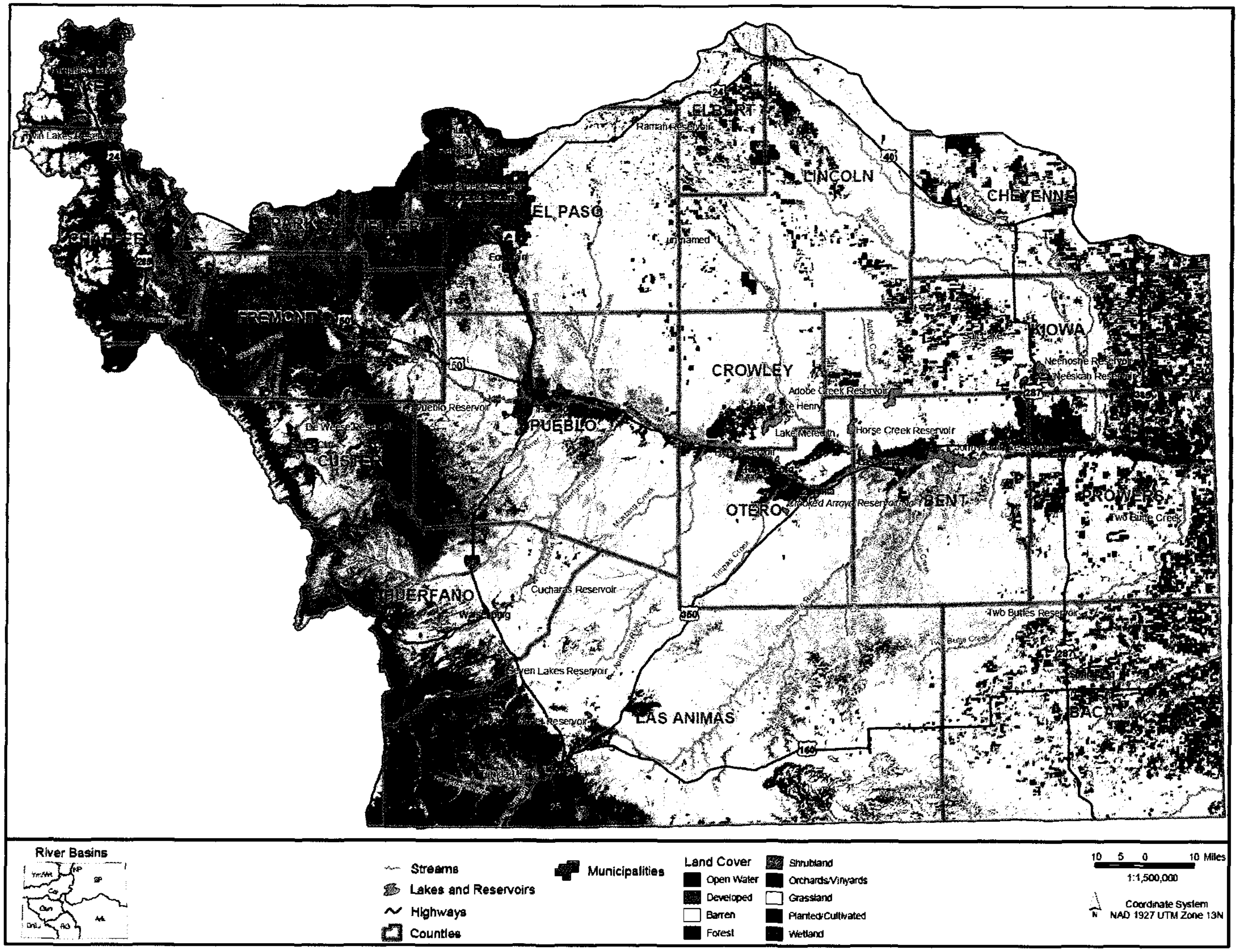
GIS Map of Groundwater Basins in the Arkansas River Basin



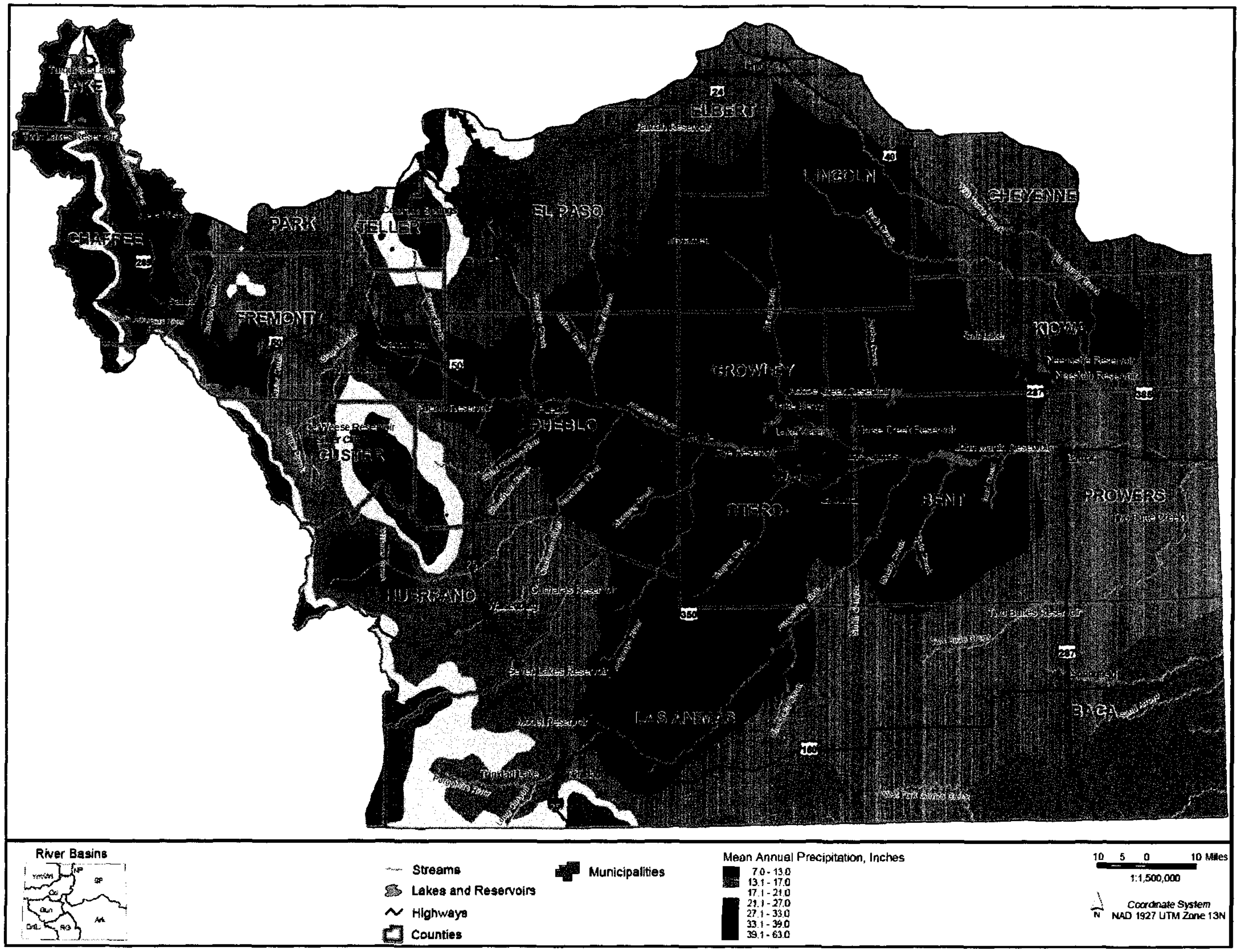
GIS Map of the Top Ten Diversions in the Arkansas River Basin



GIS Map of the Land Cover in the Arkansas River Basin



GIS Map of the Mean Annual Precipitation in the Arkansas River Basin



LAKE
CHAFFEE
PARK
TELLER
EL PASO
ELBERT
LINCOLN
CHEYENNE
FREMONT
KIOWA
CROWLEY
PUEBLO
CUSTER
OTERO
BENT
PROWERS
HUERFANO
LAS ANIMAS
BACA
River Basins
Streams
Lakes and Reservoirs
Highways
Counties
Municipalities
Mean Annual Precipitation, Inches
7.0 - 13.0
13.1 - 17.0
17.1 - 21.0
21.1 - 27.0
27.1 - 33.0
33.1 - 39.0
39.1 - 63.0
10 5 0 10 Miles
1:1,500,000
Coordinate System
NAD 1927 UTM Zone 13N

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