

**Administrative, Institutional and
Structural Characteristics of
an Active Water Market**

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ADMINISTRATIVE, INSTITUTIONAL, AND STRUCTURAL CHARACTERISTICS OF A FUNCTIONING WATER MARKET¹

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ABSTRACT: Voluntary water transfers through markets have been advocated by many diverse groups as a means to reallocate scarce water supplies in the semi-arid western U.S. Although transfers of water rights have occurred almost since the creation of prior appropriation laws over a century ago, functioning water markets have been very slow to develop and are few in number. The structure, composition, administration and transactions of one of the most well established water markets, shares in the Bureau of Reclamation, Colorado-Big Thompson project, are examined to better understand the institutional and transfer conditions that sustain an active water market. Results from a detailed study of C-BT project records reveal that between 1970 and 1993 there were 2,698 transactions through which over one-third of the project water changed ownership or type of use. Further analysis shows that the transactions involved many individual sellers and categories of buyers with different uses, including agricultural buyers. The transfer activity and efficiency of the C-BT market has lead some to suggest that it be used as a model for other markets. However, because this market has fewer institutional restrictions, a well developed infrastructure and unique market conditions, it will be difficult to transfer this model to other areas without accompanying modifications in water right administration and institutions.

(**KEY TERMS:** water transfers; water markets; water rights; institutions; reallocation; administration.)

INTRODUCTION

Economists, water resource managers, lawyers, environmental groups and politicians have advocated the use of voluntary water markets as a means to reallocate scarce water supplies in the semi-arid western U.S. (Anderson and Turner, 1993; Howe, 1986; Driver, 1986; Yardas, 1993; Meyers and Posner, 1972). The demand for water continues to increase with the growth in population, industry, recreation, environmental and other uses. At the same time, the normal flows of many western rivers are already fully allocated and new water supplies are increasingly difficult,

if not impossible, to develop further. This is seen as evidence that the western United States' water economy is moving from the expansionary phase to the mature phase (Randall, 1981). In other words, "we are moving from an era premised on the continual development of new supplies to a reallocation era premised on the better use of existing supplies" (National Research Council, 1992). One consequence of these conditions is that there is increasing attention on transferring water rights from one use or location to another. My purpose here is to examine one of the more established water right markets in an effort to learn about the institutional, administrative and transaction characteristics of a functioning water market.

MARKET TRANSFERS ADVOCATED

Interest in transferring water through markets has grown quickly. Numerous individuals and groups have advocated and discussed water market issues in publications, papers and conferences, often with the recommendation that market transfers should play a significant role in meeting current and future water needs. For example, in a study for the Western Governors' Association, the Water Efficiency Task Force reported that "Voluntary transfers are the linchpin of a strategy to enhance water use efficiency in the West" (Driver, 1986). Following a series of workshops in 1991 and 1992, the Western Governors' Association and Western States Water Council endorsed a set of principles and recommendations for managing western water. Their report includes recommendations to manage water on a watershed or problemsheds basis

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and the preference for using market-like rather than command and control approaches (Western Governors' Association, 1993). Two reports were issued by the Freshwater Foundation concerning water transfers. The first in 1985 was entitled *Water Management in Transition*, followed in 1986 by *Water Values and Markets: Emerging Management Tools* including an article titled "Water Marketing: An Idea Whose Time Has Come" (Anderson, 1986).

Conferences devoted solely to water markets have been held in Denver, Colorado, Sacramento, California and Lincoln, Nebraska. The title of a 1986 Denver Conference, "Water Marketing: Opportunities and Challenges of a New Era," is an early reflection of the optimism for water markets and a recognition that problems exist in implementation.

Many books and papers have been written on the virtues and vices associated with water transfers and markets (National Research Council, 1992; Howe *et al.*, 1986; Checchio, 1988; Gottlieb and Wiley, 1987; Weatherford and Shupe, 1986; Young, 1986; Wahl, 1989). Other publications have sought to provide market information, at a price, for those interested in ongoing transactions. The *Water Strategist* (Stratecon, Inc., 1990) is a newsletter that reports on water right transactions where information on transfers has been made available by private or public sources. The *Water Exchange Information Service*, another subscription service created to advertise and sell water rights, was established in Denver in the fall of 1986, then discontinued about a year later. There are brokers who specialize in water right transactions (e.g. Harrison Resources, Inc., Fort Collins, Colorado) and investment companies have been formed which make speculative investments in water rights. For example, Western Water Rights, Inc. amassed \$35 million to develop a portfolio of water rights along the Colorado Front Range (*Water Market Update*, 1987) and another investment company is now being developed.

Even the popular media have taken notice of water marketing (*Time*, 1991; *National Geographic*, 1993; *Sunset*, 1987; *The Washington Times*, 1987; *The Denver Post*, 1987; NOVA, 1987). Another example of the widespread interest in water markets is that seemingly divergent groups such as the U.S. Department of Interior (Wahl and Osterhoudt, 1986), Western Governors' Association (Park City, 1993; Driver, 1986), The Nature Conservancy (Chisholm, 1994) and Sierra Club (Udall, 1987) are advocating water marketing as an efficient method to allocate water and reduce economic and environmental costs. From the Governors' Association point of view, water marketing translates into lower public costs for additional water supplies. From the Sierra Club's point of view, water marketing can mean more efficient allocation, potentially fewer dams and less environmental impact.

TRANSFERS ARE NOT NEW

Water right transfers are not new. Individual water transfers have been occurring in many areas since the time water rights were established by prior appropriation laws one hundred years ago. The incentive for water transfers or reallocation is based on the perception that economic gains may be captured by transferring water from lower-valued to higher valued uses (Saliba and Bush, 1987). As demand increases and the cost to obtain additional water rises beyond lower value current uses, economic pressure is applied to reallocate water to higher value uses. Typically, the market mechanism reallocates resources, in this case water rights, from lower-valued to higher-valued uses.

Agriculture was one of the earliest users of water in the West and, in accordance with the prior appropriation doctrine of first in time – first in right, farmers hold a large share and some of the most senior or reliable water rights. Despite the rapid urbanization of the West, most of the water is still being used by the agricultural sector. Howe *et al.* (1990) state that, according to the U.S. Geological Survey data, "80 percent of all water diversions and nearly 90 percent of all water consumption in the western United States occur in irrigated agriculture." However, the value of water used in agriculture is often lower than the value of water in other uses (Young and Gray, 1972; Gibbons, 1986). Therefore, it should not be surprising that irrigated agriculture is the source of water for many water right transfers.

More than just a few individual water right transfers are necessary to constitute a market. The term water market generally refers to a group of independent voluntary decisions (transactions) by consumers and producers taking place continuously over a period of time (Katz and Rosen, 1994). A transaction concerns transferring the right to use water, either on a short term or long-term basis, and does not necessarily involve changing the purpose or place of use (MacDonnell, 1990). If the number of transactions are few and there is a wide variation in water right price, the market, if any, is considered thin or not well established (Saliba and Bush, 1987).

MacDonnell (1990) collected information on water right transfer applications (permanent and temporary transfers) filed in six southwestern states during the period from 1975 through 1984. During this period, the annual average number of transfer applications was highest in Utah (385), New Mexico (113), and Colorado (86), and lowest in Wyoming (4), Arizona (3) and California (3). However, the quantity of water sought to be transferred was inverse to the number of applications filed in each state. The median quantity

of water sought to be transferred per application was lowest in Utah (6.3 acre-feet) and New Mexico (9.6 acre-feet) and highest in Wyoming (878 acre-feet) and California (5,000 acre-feet). There have been relatively few permanent water transfers in other states. In a recent survey on the "Impacts of Water Transfers on Agriculture in the Great Plains States", less than 7,000 acre-feet of water, excluding Colorado, was reported to have been transferred from agriculture to other uses over the last five years (Michelsen, 1994; unpublished report, Water Committee, Great Plains Agricultural Council).

Markets for the temporary transfer of water rights have also developed to address short-term or immediate drought needs. Examples include water banking in California and seasonal rental markets, usually for agricultural use, in other areas. The focus of this paper is on markets for permanent, rather than temporary, transfers of water rights.

FEW ACTIVE MARKETS EXIST

Although individual transfers are occurring in many areas, markets consisting of regular transactions, rather than sporadic individual transfers, have been slow to develop and are few in number. Examples of areas with some form of established or recognizable water market include: the Arva Valley near Tucson, Arizona; western Nevada's Truckee and Carson Rivers near Reno, Nevada; and the Front Range of the Colorado Rockies from Pueblo to Fort Collins, Colorado. During the 1970s and mid-1980s, the City of Tucson, Arizona, purchased and retired irrigated farmland in the Arva Valley to obtain rights to the ground water for urban use. Because ground water rights are appurtenant (tied) to the land in Arizona, it is necessary to purchase land to acquire the associated water rights and then apply for a transfer of the historical amount of water consumptively used to another location or use. This market has experienced stop and go activity and is essentially dependent on a single buyer, the City of Tucson. In Nevada, agricultural surface water rights are being purchased and transferred in the Truckee-Carson river basin to meet urban growth and industrial demands (upper basin) and to support wetlands (lower basin). Uncertainty about legal, administrative and transfer issues are contributing to the variability and thin market for these rights.

Some of the most active markets are along the Colorado Front Range where water rights continue to be purchased from individual farmers and irrigation companies for transfer to municipal and industrial

uses. Much of the activity along the Front Range occurs within two water management districts, the Northern Colorado Water Conservancy District (NCWCD) and the Southeastern Colorado Water Conservancy District (SCWCD). The NCWCD includes the South Platte river basin in northeastern Colorado and the cities of Boulder, Fort Collins and Greeley. The SCWCD includes the Arkansas river basin in southeastern Colorado and the cities of Colorado Springs and Pueblo. Both districts import additional water from the Colorado River basin through trans-mountain diversions.

The number and size of water market transactions in each of the areas discussed above varies significantly, but transactions are often limited to one or just a few specific types of water rights that are well defined and relatively easily transferable to other locations and uses. Contributing to the slow development and variability in markets and transactions are the lack of well defined or quantified rights (amount of water, time and priority), institutional restrictions and high transaction costs (Young, 1986). In addition, where transactions have occurred, there has been wide variation in the prices for water rights (Colby, 1993; Person and Michelsen, 1994). These conditions indicate that even where transfers are occurring, most of the so called markets for water rights are thin, or very weakly established if they exist at all.

LESSONS FROM AN ESTABLISHED WATER MARKET

My purpose here is to examine one of the more established water right markets in an effort to learn about the institutional, hydrologic, administrative, and supply and demand characteristics of a functioning water market. The water right transfer market that has developed for Colorado-Big Thompson (C-BT) Project water in northeastern Colorado is one of the most active and well established water markets in the western U.S. C-BT Project water has been actively traded between agriculture, municipal and industrial uses since the early 1960s. In several ways the C-BT market symbolizes a best case example of existing water markets, because it lacks many of the restrictions or difficulties faced in other markets. C-BT water rights (actually allotments, representing a share in the delivery of the project water supply) are reliable, well defined, have relatively few restrictions on use and transfer, and can usually be transferred at low cost. In fact, some consider the C-BT market to be a model for the development of other water markets (*Water Strategist*, 1990). Because the C-BT market

has managed to become so well established and successful, I have chosen to focus on the institutional characteristics and composition of this market.

Information about water right transfers is often difficult to find, in part due to the nature of private market transactions, and because many details of these transactions are not publicly recorded or compiled in a central location. The information reported in this paper on the C-BT market has been compiled from a large number of sources including (unless otherwise indicated): Monthly Minutes of NCWCD Board Meetings (1970-1994), NCWCD records and personal communication (Conley, Werner and Miller, NCWCD, various times), published and unpublished research (Person and Michelsen, 1994; Michelsen and Young, 1992; MacDonnell, 1990; Gardner and Miller, 1983), newsletters (e.g. *Water Strategist* and *Water Market Update*, 1986-1994), and books (Tyler, 1992; Saliba and Bush, 1987; National Research Council, 1992). Specific sources are described in more detail in Person and Michelsen (1994).

C-BT PROJECT BACKGROUND

The Colorado-Big Thompson (C-BT) project was constructed by the U.S. Bureau of Reclamation to provide supplemental water supplies for agricultural, municipal and industrial uses in northeastern Colorado. Started in 1938 under a repayment contract between the United States and the Northern Colorado Water Conservancy District, the project became fully operational in 1957. The purpose of the C-BT project was – and still is – to provide supplemental water from the Upper Colorado River basin to offset the fluctuations in natural supply in the South Platte River basin. Water is diverted from the Colorado River into the Adams Tunnel which transfers water from the west slope of the Rocky Mountains under the continental divide in Rocky Mountain National Park to the Big Thompson River on the east slope where there is an extensive system for storage and delivery along the Colorado Front Range.

The area served by the NCWCD extends from Broomfield (adjacent to, but excluding Denver) to north of Fort Collins, and then east along the South Platte River to Greeley and eventually Julesburg at the Nebraska border. The District includes the cities of Boulder, Broomfield, Estes Park, Fort Collins, Fort Morgan, Greeley, Longmont, Loveland, and Sterling. The cities in the region have grown rapidly. Although the project is authorized to provide water to the Nebraska border, most of the entitlements are held in Boulder, Larimer, and Weld counties. The population in these three counties increased from 213,000 in

1961 to over 572,000 in 1992. Agriculture continues to be an important, but diminishing, part of the economy of the region. The value of crops grown within the NCWCD boundaries was \$298.0 million in 1992, down from \$355.6 million (1992\$) in 1961.

The U.S. Bureau of Reclamation actually holds the water rights granted to the Federal Government by the state of Colorado to supply the C-BT project. The NCWCD is then granted, by contract, the perpetual right to use all water made available by the construction and operation of the C-BT project, provided it abides by the terms and conditions of the repayment contract (*Water Strategist*, 1990). Some water transfer issues faced by managers of other Bureau of Reclamation projects are non-issues here, in part because the project was authorized to be multipurpose and is operated by the NCWCD. The NCWCD is governed by a twelve member appointed board with the authority to allocate, reallocate (transfer) and set assessment rates on water allotment contracts. The district is also authorized to assess a mill levy on all land within the district boundaries irrespective of the direct delivery of water (MacDonnell, 1990). Permanent ownership and transfer of water allotments can only be approved for beneficial uses within the project area boundaries.

C-BT PROJECT ALLOTMENTS

C-BT project water right allotments are defined in terms of a 1/310,000 share or "acre-foot unit," with each unit representing an equal claim on available project supplies. Every year, the NCWCD Board of Directors determines an "April Quota" which sets the maximum amount of water to be available from project supplies for the current year. A quota of 100 percent means that 310,000 acre-feet of water can be used by the shareholders during that season, in which case one C-BT unit confers a right to one acre-foot of project water. A 60 percent quota would yield 0.60 acre-foot per C-BT unit. The annual quota is set according to hydrologic conditions (snowpack, runoff forecast, soil moisture, reservoir storage) and anticipated water demand. However, the April quota may be increased at any time by the board when required by the hydrologic conditions of the year. In eleven years since 1957, a second additional quota from 10 to 30 percent has been declared. In accordance with the primary purpose of the project, the board attempts to import and store west slope water on the east slope during wet years (set a lower quota) to make more project water available for delivery to the east slope during dry years.

Figure 1 illustrates the history of annual quotas and deliveries from 1957 through 1993 (Person and

Michelsen, 1994). The long-run yield of C-BT units has averaged 0.73 acre-foot per unit. Annual deliveries have averaged 65 percent of the 310,000 maximum acre-feet over the same period. Yield corresponds to the quota, or the annual quantity of water declared available for use, whereas deliveries represent the quantity of water actually used. It is interesting to note that water users take relatively less of their allotment during low-quota years than they do during high-quota years. Annual deliveries average 81 percent of the quota when the latter is less than 75 percent (typically wet years), and 90 percent when the quota is 75 percent or above (dry years), (*Water Strategist*, 1990). That is, more imported CB-T water is demanded when native or base supplies are low in the South Platte river basin.

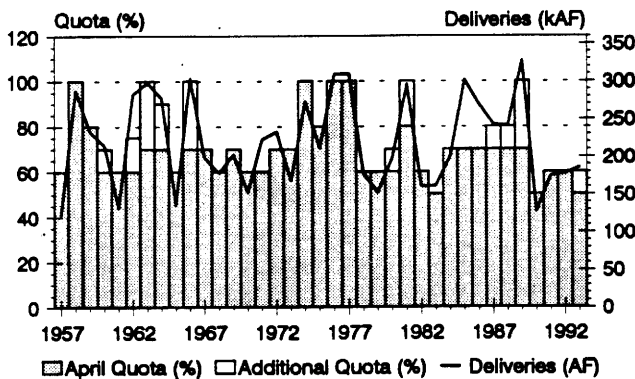


Figure 1. CBT Quota and Annual Deliveries.

The water supply available from the C-BT project can be expected to be reliable. An allotment quota of 70 percent or greater was declared in 22 out of 37 years of operation (60 percent of the time). In only two years was a quota of less than 60 percent declared (five percent of the time); and a quota of 90 percent or greater has been declared in 9 years, about 25 percent of the time.

Water deliveries also consist of two other types of project water, carry-over water and non-charge water. A carry-over policy was introduced in 1986. Prior to this time, an allottee's unused water would be stored to increase the project water available in subsequent years for all contract allottees. With the carry-over policy, water unused by an allottee in a particular water year can be carried over for use from April 1 to July 15 of the following year, increasing flexibility in the way project water can be used.

During high runoff years, when C-BT storage is fully utilized, non-charge (unappropriated surplus)

water may be released into the district's service area. Allocation of non-charge water is managed by river commissioners, and does not necessarily correspond to the contract allotments. Non-charge plus carry-over water deliveries are significant and, although only provided in twelve years, they have averaged 27,499 acre-feet per year or 12.2 percent of annual project deliveries for the period from 1962 through 1993.

C-BT WATER OWNERSHIP AND USE

The majority of C-BT units have traditionally been owned by the agricultural sector. However, C-BT unit ownership patterns have changed significantly during the past three decades (Figure 2). In 1962, agriculture held 82 percent of the total number of C-BT units. Since then, municipalities and industries have been bidding water away from use in irrigation to cover their immediate and future demands. In thirty years, municipal holdings more than doubled, from 18 percent of the total to over 40 percent. It should be noted that industrial holdings were originally combined with the municipal holdings, which explains the apparent absence of C-BT ownership in the industrial sector in 1962 (most of the industrial acquisition has occurred since 1962). During the same time, the relative quantity of C-BT units owned by the agricultural sector shrank from more than 80 percent to about 55 percent.

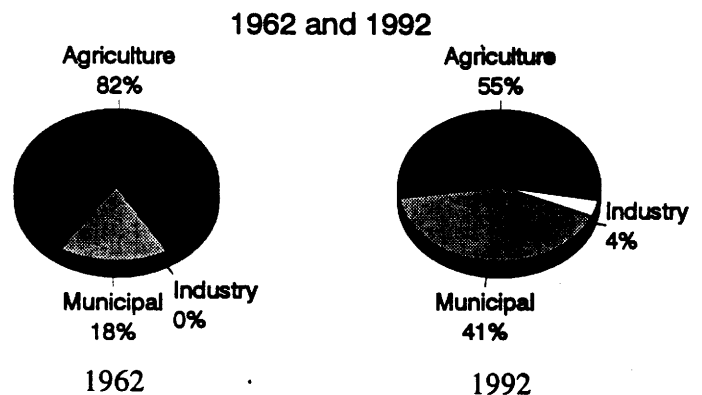


Figure 2. Ownership Evolution of CBT Shares.

Reflecting of the shift in ownership, irrigated acreage within the NCWCD has been shrinking over the past 30 years. From 720,000 irrigated acres in 1960, the total had fallen to 622,272 acres in 1993 (NCWCD). The main crops produced are corn (grain

and silage), alfalfa, other cereals, pinto beans and sugar beets. Vegetable crops account for a small, but valuable, amount of irrigated acreage (4.2 percent).

It is instructive to glance at the current distribution of C-BT share ownership of the biggest allottees (Table 1). It appears clearly from this table that ownership of C-BT units is rather concentrated: half of total units are held by 10 organizations. The concentration in C-BT unit ownership is increasing over time: as will be shown in more detail below, the typical supplier is an individual or a farm, and the typical purchaser is a municipality, water district, irrigation company or industry.

TABLE 1. Ten Largest CBT Unit Shareholders.

Shareholder Organization	CBT Units (Total 310,000)	Percent of Total
North Poudre Irrigation Company	40,000	12.9
City of Boulder	21,015	6.8
City of Greeley	18,985	6.1
City of Fort Collins	18,699	6.0
City of Loveland	10,355	3.3
Platte Valley Irrigation District	10,320	3.3
City of Longmont	10,148	3.3
Public Service Company	9,997	3.2
Little Thompson Water District	6,594	2.1
Riverside Irrigation District	6,000	1.9
Total*	152,113	49.1

Source: Northern Colorado Water Conservancy District.

*Percent total differs from individual sum of percentages due to rounding.

Figure 3 illustrates historical annual C-BT share ownership and water deliveries in agricultural and non-agricultural sectors as a percent of the project total. From the graph, it can readily be seen that agriculture uses more water than it owns, suggesting that municipalities, after purchasing allotments for future and drought use, rent their unneeded water to irrigators, reducing the immediate impact of transfers on agricultural production.

Showing deliveries as a percent of total can be misleading because the pattern of deliveries appears quite uniform. However, recall that the C-BT project is intended to provide supplemental water to the east slope, and as such, annual deliveries of C-BT water are highly variable depending on both east and west slope hydrologic conditions. Figure 4 shows the historical annual quantity of C-BT water in acre-feet delivered for agricultural and non-agricultural uses (excluding multipurpose use deliveries). Although initially constructed to provide supplemental water to

the South Platte river basin and despite the large variability in annual deliveries, some municipalities and irrigators now rely on C-BT water as a primary rather than just a supplementary source of supply because of the high reliability of delivery.

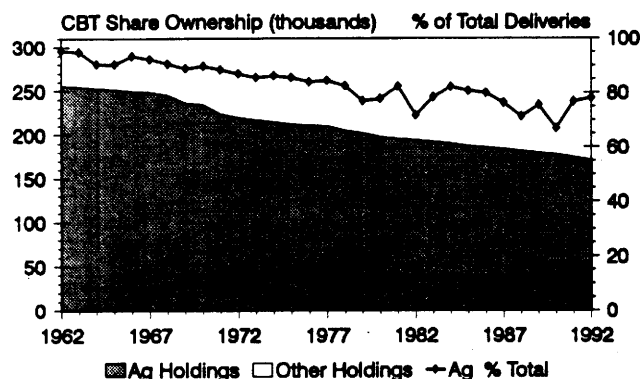


Figure 3. CBT Share Ownership and Percent of Total Deliveries to Agriculture.

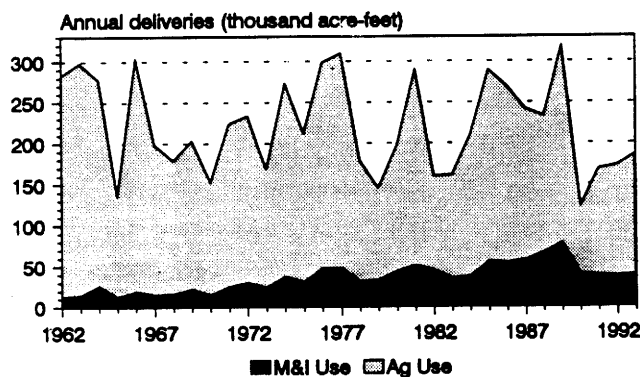


Figure 4. CBT Water Deliveries for Agricultural Use and Municipal and Industrial Use.

TRANSFERS OF C-BT ALLOTMENTS

Rights to C-BT water are easily transferable within the district service area. Not only can allottees seasonally rent and transfer water from one location of use or class of service to another, but they can also sell and purchase permanent allotment contracts. Since C-BT water is imported from another basin, there was no prior reliance of users in the South Platte River basin on the return flows of project water. Therefore, transfers of C-BT water are for the full quantity of the water allotment; that is, in contrast to

transfers of other water rights, a C-BT allotment transfer does not require the determination of the amount of consumptive use or return flow to protect the rights of other water users. However, the allotment is for one use only and return flows from allotments are dedicated back to the stream and cannot be appropriated or sold.

A complex network of reservoirs and ditches makes C-BT water physically easy to transfer almost anywhere within the district service area. One of the few constraints on C-BT transfers is that the water must be put to beneficial use (as a hedge against excessive speculation in water rights). The NCWCD Board of Directors is the authority that approves all applications for allotment transfers.

Individual water users obtain the right to use project water through allotment contracts signed with the District. There are three types of allotment contracts, classified by group and water use: municipal (Class B and Section 131); individuals, public or private corporations, mutual ditch companies and water user associations (Class C and Corporate Form); and allotments to lands for irrigation use (Class D).

Annual fees are collected on each C-BT allotment in order to cover the fixed and operating costs of the project (assessment costs). The assessment amount depends on contract class and whether it is an original allotment (fixed) contract or if the allotment has been transferred (open rate contract). Assessment costs are based on the concept of user ability to pay (agricultural uses less, municipal and industrial uses more) rather than the actual delivery costs to individual users. The assessment cost for irrigation districts with fixed (beginning of project) contracts is \$1.50 per unit. The 1994 schedule of assessment costs for any allotments that have been transferred (open rate) by contract class are as follows: agriculture \$5.95 per C-BT unit; municipal \$13.85 per unit; and industrial \$21.45 per unit.

ADMINISTRATIVE PROCESS

The permanent transfer of C-BT water within the District can be accomplished through administrative procedure and, in contrast with most other water rights in Colorado, does not involve filing an application with the state and the often lengthy adjudication process to ensure there are no adverse impacts to obtain approval. Instead, the administrative procedures to transfer C-BT allotments are straight forward and clearly defined by the District. The first step is to file a joint (seller and buyer) application for transfer with the NCWCD. The application requires

information about seller ownership (title to the property and buyer need (justification) for the water to limit purely speculative purchases. The District charges a flat \$70 transfer fee per application regardless of the number of units transferred.

For example, to transfer a Class D agricultural allotment (where water use is tied to the land) to the same use or another location and use, the seller and buyer must submit a single application to the NCWCD Board of Directors. The signatures of all of the landowners involved in the transaction and a title search to certify property ownership are required to ensure that there is no cloud on the property transfer. When the transfer is to another farmer (Class D contract), a legal description and title search of the land on which the water will be used is required to certify ownership as submitted in the application and that the water allotment will be put to beneficial, rather than excess or speculative, use. A field exam by district staff may also be conducted to determine actual needs for a given parcel of land. When the transfer is to a municipality or industry, the buyer must describe the use and justify the need for the allotment and, when approved, enter into a new type of contract (municipal, industrial or multipurpose) with the NCWCD.

The NCWCD uses a formula to determine if a municipal water allotment transfer is "justified" in terms of the water supplies already owned by the purchaser and purchaser demand. The formula to test for need is based on demand, calculated from the ten year average of purchaser annual usage times two, plus estimated water needs for projected growth, compared to the amount of water supply available from all sources assuming drought (low) yields. Relatively few applicants have been required to further justify their need for the water transfer, and only a small number of applicants have been denied. The District is in the process of revising the municipal water justification formula to more realistically assess the combined supply available and current and projected water demand.

When the application is complete it is submitted to the Board of Directors for consideration and approval at their monthly meeting. Following Board approval of the transfer another public record check for ownership is conducted. In most cases it takes about two weeks from the Board meeting to obtain final approval of the transfer. No state engineer review or approval is needed for a C-BT water allotment transfer, significantly reducing the time and cost of a transfer compared to the Colorado water right adjudication process which takes an average of 20 months to complete (MacDonnell, 1990). Typically, the whole C-BT transfer process can be accomplished in four to six

weeks. The main transaction costs are limited to the effort in completing and filing the transfer application, the title search (usually a cost of a few to several hundred dollars) and the transfer fee, all-in-all relatively inexpensive.

Seasonal water transfers of C-BT allotments are even less complicated. A seasonal transfer can be accomplished by mailing a postcard that identifies the allotment owner and temporary water user. The price water allotment owners charge for a single seasonal transfer is typically just the NCWCD assessment cost for the allotment. It is common for municipalities and developers to rent their C-BT water back to agriculture on a seasonal basis until needed to meet drought demand or for urban growth.

There are important differences in the transfer of C-BT and other water rights. Transfer of other native (within basin of origin) water rights in Colorado (and most other states) requires that the transfer will have no adverse effect on senior or junior owners of other water rights. One result of this requirement is that only the historical amount of water consumptively used can be transferred. Differences between water right owners and other users about the amount of water that was consumptively used (and thus return flow), the impacts from a change in the location of use, and conversion of seasonal irrigation water use to year-round municipal water use (and associated return flow) significantly increase the time and cost to accomplish other water right transfers.

Another important and unique feature that distinguishes C-BT transfers from almost all other water right transfers that occur under traditional interpretation of prior appropriation law is that conserved (saved) water can be bought and sold. That is, if a farmer improves application efficiency and can produce a crop with less water, the saved portion of that water can be transferred to another use. In most other jurisdictions with prior appropriation water law, conserved water cannot be separately transferred from the original water right to another location or use. These restrictions are largely the result of established beneficial use quantities for an activity (e.g. three acre feet per acre; if less is used then that water was not being put to a beneficial use and no longer meets the requirements of the water right, therefore the right to use the conserved water reverts back to the state) and to maintain (protect) return flows for downstream appropriators. Although restrictions on the transfer of conserved water in other areas do not encourage improvement in water use efficiency, they are considered an important and established element of prior appropriation law. The ability to transfer conserved (or supplemental) water is believed to be a contributing factor in the development and activity of the C-BT market.

MARKET ACTIVITY

Information about the number of transactions (market activity), quantity of water transferred per transaction and types of sellers and buyers is important for understanding the structure and development of a water market. In many other areas this type of information on water right transfers, when it exists, is difficult to obtain or reconstruct through investigation. However, some of this information for the C-BT market can be found or constructed by carefully reviewing the minutes of each of the NCWCD Board of Directors monthly meetings.

All transactions within the NCWCD have to be approved by the Board of Directors. Transfer applications are reviewed every month during Board meetings, and all approvals are recorded in the minutes of these meetings. Although transfer price is undisclosed to the Board, every single transaction is reported, with the names of the applicants, the type of contract (which refers to the type of use), the quantity of water involved and the legal description of the land on which water is to be applied (irrigation only).

The NCWCD monthly minutes from 1970 through 1993 were examined to gather information about each permanent C-BT water allotment transaction during this period. Transaction data were categorized and numerically coded for quantitative analysis by type of seller and buyer, type of contract, and type of water use prior to and after the transfer (further detail can be found in Person and Michelsen, 1994). Transactions involving only a change in location of use for the same entity were excluded. Transfer applicant types were categorized as: (1) individuals, farms, ranches, farm and cattle companies; (2) irrigation companies; (3) municipalities or water districts; (4) industries; (5) developers; (6) banks and insurance companies; (7) investment companies; (8) churches; and (9) other.

Classification of water right user categories is based on the names of applicants and type of contracts (stating use) that were reported in the minutes. In some cases this required substantial interpretation or judgement calls (invaluable assistance was provided by Marilyn Conley, NCWCD). For example, a manufacturing company might hold water under an irrigation contract because it owns farming land, and a corporate contract may be used for irrigation by an irrigation company. Finally, knowing the former and the new use for each contract transferred provided a means to classify the transactions as: (1) Agriculture to Agriculture; (2) Agriculture to Domestic; (3) Agriculture to Industry; (4) Domestic to Agriculture; (5) Domestic to Domestic; (6) Domestic to Industry; (7) Industry to Agriculture; (8) Industry to Domestic; and (9) Industry to Industry.

A potential source of interpretation error involves the applicants' typology. Types 1 (individuals, farms, ranches and cattle companies), 5 (developers) and 7 (investment companies) were difficult to distinguish from each other because the NCWCD contract type is the same and the applicant names may not be explicit. A related limitation is that only the immediate new use of water is reported, and not the long-term purpose of use. A consequence of these limitations is that the transactions involving developers (or speculative purchases) may have been underestimated.

TRANSFERS AND MARKET COMPOSITION

Over the period from 1970 through 1993 there were 2,698 approved transactions of C-BT water rights (allotments). Through these transactions, 104,895 units of C-BT water were transferred to new owners for another use and/or for use at a different location. Given that the total number of C-BT units is 310,000, as much as one third of C-BT shares (project water) changed hands or type of use from 1970 to 1993. The number of transactions and quantity of water transferred illustrates just how active the market for C-BT water has been over the last two decades. With all of this market activity, who is selling and who is buying these water rights? A closer examination of the market composition is insightful.

As stated previously, agriculture is the single largest consumer of water in the west. Not surprisingly, the primary source of C-BT water that has been transferred since 1970 has been from the agricultural sector. More than 83 percent of the total number of units transferred were sold by individuals, farms, ranches, etc., where the water was being used in agricultural operations. The number of C-BT units transferred by seller water use category from 1970 through 1993 is shown in Figure 5.

A noticeable quantity of water was also sold during two periods, in 1989 and 1990, and to a lesser extent around 1980, by a few municipalities that determined they had excess holdings of water rights. Although the supply of water right units in the C-BT market is concentrated in one user category, there are a large number of individual sellers and the market is not dominated by one or just a few individuals. This is an important factor in the type of market that will develop. A large number of individual sellers (and buyers) aids in the establishment of a competitive market.

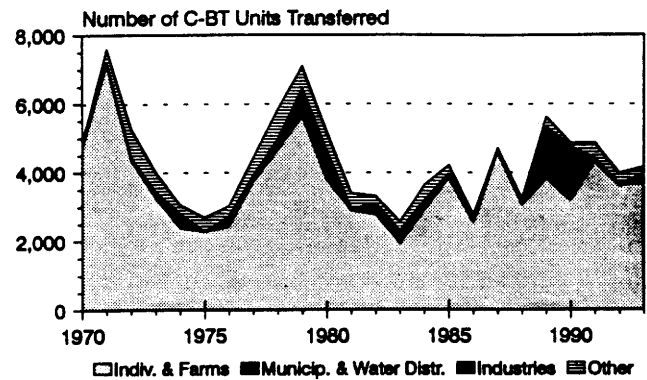


Figure 5. CBT Unit Transfers by Category of Seller

The type of buyers of C-BT units were somewhat more evenly distributed among user categories as shown in Figure 6. C-BT water was purchased by municipalities, farmers, other land owners and industry. Municipalities as a group account for over 52 percent of the total number of units transferred from 1970 through 1993. Somewhat surprisingly, the agricultural sector has been quite constant in its acquisitions, with the category of individuals, farms and ranches accounting for just under 28 percent of the total number of units purchased over this period. Another interesting finding is that purchases of agricultural origin were highest during periods with high prices, suggesting that irrigators not only played the role of suppliers, but also contributed to the demand for water rights. In other words, contrary to the lower values reported for water use in agriculture, higher prices did not stop agricultural purchases. This can be interpreted as support of the hypothesis that speculation plays an important role in the C-BT water transfer market. The industrial sector also purchased significant quantities of water in the 1970's and early 1980's. In particular, the 1971 peak in market activity appears to be due in large part to industrial demand. At this time, the Public Service Company of Colorado and Eastman Kodak were purchasing significant amounts of water.

The distribution of C-BT seller-buyer transactions by user category is summarized in Figure 7. Transactions where water was transferred along with a piece of land are distinguished from other transactions on the graph because in this case water may not have been the main reason for the transaction. The average number of units per transaction varies significantly between seller-buyer categories. In sales between agricultural users the number of units transferred averaged 30.6 per transaction. Agriculture to domestic use transaction quantities were only slightly high-

er with an average of 38 units per transaction. Although only accounting for about five percent of the total number of transactions, agriculture to industry transfers were larger with an average of 90.2 units per transaction.

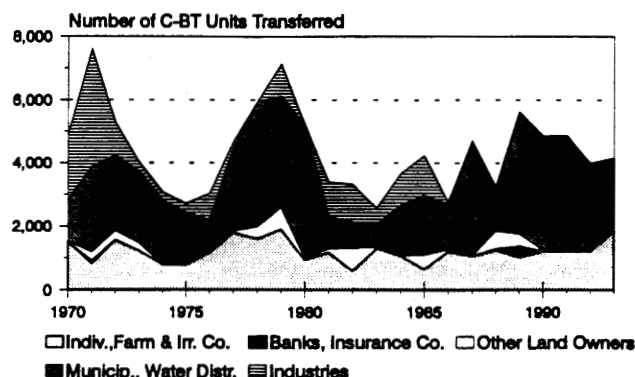


Figure 6. CBT Unit Transfers by Category of Buyer.

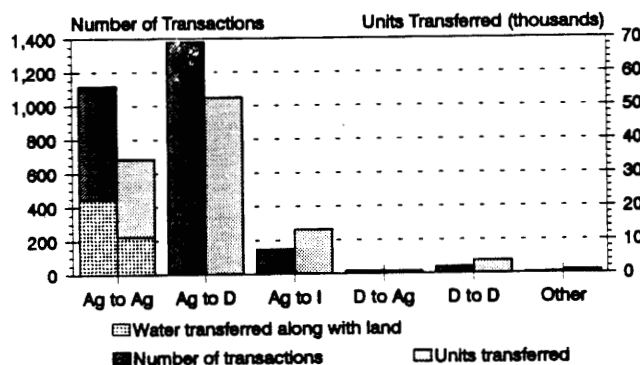


Figure 7. Distribution of Number of Transactions and Units Transferred by Seller and Buyer Category.

- Notes: Ag to Ag— Seller/buyer transfer from agricultural use to agricultural use.
 Ag to D — Seller/buyer transfer from agricultural use to domestic/municipal use.
 Ag to I — Seller/buyer transfer from agricultural use to industrial use.
 D to Ag — Seller/buyer transfer from domestic use to agricultural use.
 D to D — Seller/buyer transfer from domestic use to agricultural use.
 Other — Any other combination of type of use transfer.

Although transfers of water from agriculture to other sectors are more noticeable and more widely discussed, a significant portion of traded irrigation water is put back to the same use. Again, only the

immediate new use of water is reported for each transaction, and not the long-term purpose of use which sometimes reflects the real motivation for the investment. For example, a developer planning a future housing project may purchase water (and perhaps land) for this particular project, but will lease the water back for irrigation use until needed (also meeting the requirements for beneficial use). It is not until the water is transferred to a municipality that the true motivation of the first transaction appears in this data set. Nonetheless, this limitation should not be over-emphasized. Given the high level of market activity in the NCWCD, even farmers have been buying C-BT shares and selling them a few years later, buying again and so on. In several ways, this is a well-functioning market which gives rise to a certain level of opportunistic behavior among market participants. Therefore, the most accurate picture available is the one which considers the immediate changes of use for water.

To summarize, the C-BT market is characterized by many different sellers and purchasers of water rights, with no single individual or entity dominating the market. The large number of individual sellers and purchasers helps to make the C-BT market competitive and distinguishes it from some of the other, less developed, markets where one or just a few sellers or buyers dominate in most of the transactions.

SUMMARY AND CONCLUSIONS

Voluntary water markets have been advocated by many diverse groups as a means to reallocate scarce water supplies in the semi-arid western U.S. Although individual transfers of permanent water rights have occurred almost since the creation of prior appropriation laws over a century ago, water markets have been very slow to develop and are few in number. The market for Colorado-Big Thompson water rights is recognized as one of the most well established and successful water right markets in terms of transaction activity, infrastructure, and the number and variety of participants.

Development of any market requires well defined property rights to establish clear ownership and, in the case of water, supply reliability or assurance that the water purchased will actually be delivered. C-BT water rights consist of equal shares or allotments of the project's annual available supply. The perpetual rights represented by these allotments are clearly defined and widely understood by users. Each allotment is homogeneous in terms of allocation priority and quantity of water delivered. In other words, purchasers know what they are buying - there is no "pig

in a poke" as may be the case with other less well defined water rights. A review of historical deliveries shows that the supply of C-BT water has been reliable. The infrastructure and distribution systems in the region are already well developed and provide the means to physically move water within the district service area. Because of this, water that is purchased for use at another location can usually be transferred with little or no additional cost in conveyance systems.

The administrative process for transferring C-BT water is simple and straight-forward. The typical amount of time to process and approve a transfer application is four to six weeks. In contrast, the transfer process takes an average of 20 months for other Colorado water rights. The shorter time and lower cost to process C-BT water right transfers can largely be attributed to the administrative versus adjudication process, and to institutional conditions that significantly simplify the requirements compared to most other water right transfers. Because C-BT water is "new" water imported from another basin, the full quantity of the allotment is transferred. This obviates the need to determine the historical amount of consumptive use – the portion of other traditional water rights that can be transferred. This means that a transfer does not involve an evaluation of the impact to others from changes in consumptive use or return flows. This is a major departure from transfers of other water rights where the protection of water rights that are dependent on return flows is provided by most prior appropriation laws and institutions and is often a central issue and transaction cost of a transfer.

Between 1970 and 1993, there were 2,698 transactions resulting in the transfer of over one third of the total project's water right allotments to new owners for another use and/or for use at a different location. The market is composed of a large number of individual sellers and buyers and is not dominated by any one individual or organization. Agricultural users have been the source of most of the allotments transferred, which is consistent with economic theory on the incentive for water transfers. The value of water in agriculture is typically lower than municipal or industrial water use values, and therefore, we would expect water to move from the lower to higher valued uses. Purchasers of C-BT allotments include municipalities, industries, other land owners (e.g. developers) and, somewhat surprisingly, agricultural users. Although discouraged by the NCWCD, agricultural purchasers may be participating in the market as speculative investors with the water continuing to be used in agriculture until the water and/or land is needed for urban development. Some C-BT water has

been purchased by utilities and industry to meet projected demand but, until that demand develops the water is rented back for agricultural use. Because of these interim uses, the final or new use of transfers are not immediately or fully reflected in the deliveries of C-BT water.

In conclusion, successful development of the C-BT market can be attributed in large part to the establishment of clearly defined water rights, the high reliability of supply, its use as a supplemental "new" supply for the region, a well developed distribution system, the large number and diversity of market participants, and especially to institutional rules and administrative procedures that minimize transfer restrictions and transaction costs. Although some have suggested that the C-BT market be used as an example in developing other markets, as shown in this paper, the conditions are unique and are unlikely to be duplicated in other situations without significant modifications in prior appropriation water institutions and administration. Owners and buyers of other water rights often face institutional restrictions that can significantly increase transaction costs or discourage participation in water right transfers. Differences include the limitation with most other rights that only the consumptively used portion of the water right can be transferred to protect downstream water users from injury, purchaser uncertainty about the quantity of water that will actually be transferred and delivered, and beneficial/expanded use requirements that discourage market/use efficiency by prohibiting transfers of surplus or conserved water to other uses.

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