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## WESTERN WATER MARKETS AND PRICE DIVERSITY

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I want to follow up very briefly on Bonnie Colby's talk. It is wonderful to see dry year options making progress. A number of economists, including myself, worked on these many years ago. In the late 1980s, I worked with the City of Fort Collins, some electric utilities, and The Nature Conservancy. They were all interested in pursuing dry year options with farmers so that water could remain in agriculture and then be transferred during drought years for payment. They all opted at that time to just go ahead and buy up water rights and lease them back to the farmers because it

was so much cheaper for them to actually purchase the water rights than to enter into dry year options. I am glad that option terms are working out much more favorably.

I'd like to start by acknowledging my co-author, Tom Brown who is with the Rocky Mountain Research Station. Tom has worked with data on water markets that are very recent. I am very pleased we were able to report on market prices and trends.

In preparing slides for this talk, I ran across an old photo that I had that goes back about twenty-five years.

You'll notice in Figure 1 a farmer that had been told by the Bureau of Reclamation that the Bureau was going to turn off the head gates. He took issue with this. I thought it fit well with the conference theme, "Guns, Lawyers, and Money." You will notice the shotgun on the hood of the truck. He invited the Bureau to come on out and try to turn off the gate. I have two young kids. "Guns, Lawyers, and Money" seems to fit water markets pretty well, but the title also reminded me of something like "Rock, Paper, and Scissors." How do we determine who wins the situation?



Figure 1.

As most of you know, water rights transfers are not new. They really started occurring with prior appropriation early on. There are a number of conditions that are necessary for transfers spanning from hydrologic, economic, and legal conditions to the transaction process, which is very important. Phil King mentioned that EBID is working on some of the transaction processes along with the State of New Mexico. There are also a variety of institutions and methods used for water transfers, and these work to varying degrees but take much different time periods. We have administrative techniques that are often used by state engineers or simply irrigation district exchanges. Judicial or water court exchanges are used in states such as Colorado. And then informal exchanges occur from farmer to farmer. Those really make a difference on the prices, the transaction costs, and the length of time that it takes to accomplish those exchanges.

Water markets have been talked about, and many have said, "Yes, let's have a water market. That will make things efficient." Well, what is a market? Just very generally, it is an unspecified number of voluntary trades that for water has common physical and legal characteristics. That is pretty tough, because water is differentiated in terms of priority, where it is, how you

can move it, and what types of uses it is for. Markets have a great deal of diversity. As we will see, diversity varies from market to market. Some of them are quite thin, and some of them are very active.

What do you need for a market? Clearly, we must have defined property rights. Several of the speakers earlier brought this up: Frank Ward, John Shoemaker, and Phil King. You need to know what you have and where to sell it. Otherwise it is like a pig in a poke. You have to know where it is and when you can move it. It has to be mobile, legally and physically, and in an efficiently administered system. In addition, one speaker said that price does not really matter. Well, it does when you look at the expected value. What do you expect to get out of what you are purchasing? That has to exceed both the price and the other costs involved.

Water markets are in addition facilitated by information. Several of our speakers, especially John Shoemaker brought this up. Do we have adequate information for markets? Do you know the quantities, prices, and trading opportunities? Certainly for an efficient market, the presence of many buyers and sellers is necessary. Do we have that? Are there limited transaction costs? Bonnie Colby brought up the importance of third-party issues and the lack of return flow issues. You also actually have to have water in order for a water market to exist. Figure 2 depicts the mighty Rio Grande looking south toward El Paso.



Figure 2. You need to actually have water.

There are two main kinds of water trades. I am just hitting some of the very basics here. Water rights—the perpetual ownership of water. Water leases—the temporary purchase of water. Some of the questions that I am going to try and address here are where are the markets? How widespread are they? How many market transactions are occurring? We keep saying, "water markets." They are all over the place, right? How much? What types of transactions? How many of these are leases and which are sales of water rights?

Who is selling and buying? What are the prices and price trends?

Water market information is critical for markets to operate. There is really limited information available. Most is from voluntary reports, because these are often private transactions. A small number of studies have been done on select markets. That includes studies by Bonnie Colby, Chuck Howe, Larry MacDonnell, Richard Howitt, Chris Goemans, and David Yoskowitz, and I've done some studies. These studies have been on very select water markets. Some of them are fairly dated. The broadest, most readily available information is through a company called Stratecon, which publishes a newsletter with reports of water sales that they have been able to obtain.

The first part I am going to cover is based on the sales reported by Stratecon. This is evidence of fourteen years of water sales, and Tom Brown compiled the most recent set of these. Again, these are voluntarily reported, so they are not a complete census of trade. They are not all of the transactions that have occurred, and they are not a random sampling. However, they do provide an indication of the market activity, composition, locations, prices, and trends. I am also going to cover some other studies that were done recently.

Looking at fourteen years of data, there were 2,453 plus transactions reported in total (Table 1). Of those, a number were culled out for several reasons. The Colorado Big Thompson (CBT) water rights market is probably the most active water market, not only in the West, but in the world. They would really dominate any of the results. Therefore CBT transactions or trades were combined. If you had ten trades in a month for farmer sales to municipalities, they were combined as one trade. That really reduced the number and disproportionate weight. You can see that CBT transfers accounted for about a quarter to a third of the total trades. A lot of trades also include more than just water. Maybe water and land and other rights were sold, so those were culled out. Some of these were just exchanges and did not represent a water sale or price. Some included treated water effluent. Sometimes no water quantity was listed. They sold some water, but you do not know how much. In other cases, they were not market trades. They were donations. Again, no prices were associated with that or other information. This resulted in just fewer than 1,400 transactions included over the period.

Table 1.

Number of Transactions from Stratecon Inc. 1990-2003	
• Total Transactions	2453
• Trades removed from consideration:	
– by combining CBT trades	722
– more than just water included	81
– exchanges, not sales	31
– not raw water (treated water or effluent)	81
– no water quantity listed	19
– not market trades (e.g., donations)	138
• Number of qualifying trades	1381

What was the distribution of the market? Three states accounted for about two-thirds of all of the trades: Colorado, California, and Texas (Table 2). In the case of Texas, most of those were leases and not water rights sales. When you add in Arizona, you are up to almost three-quarters. Notice four states covered about seventy-three to seventy-five percent of all the trades. They are very concentrated.

Table 2.

Activity is Concentrated in a Few States		
Number of Trades by State		
	N	Cum prop
Colorado	427	0.31
California	290	0.52
Texas	207	0.67
Arizona	90	0.73
Nevada	69	0.78
Idaho	66	0.83
New Mexico	60	0.88
Oregon	44	0.91
Utah	43	0.94
Wyoming	36	0.96
Washington	25	0.98
Kansas	16	0.99
Montana	5	1.00
Oklahoma	3	1.00
	1381	

Where were they occurring? The numbers on the chart in Figure 3 are hydrologic units. The dark areas represent greater than seventy-five trades or cases. Colorado, parts of California, and the lower valley of Texas are all dark areas. Then you start looking around the rest of the western United States, it gets pretty thin. There are very few transactions in many of these areas.

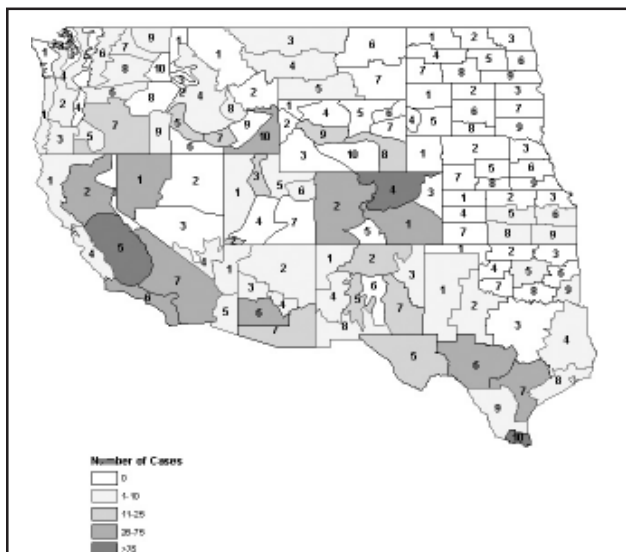


Figure 3. Water Market Activity: Number of water market trades by climatic division occurring over the past 14 years

How consistent are these markets, and where are they going? Let's look at the trends in the number of trades and leases versus rights (Fig. 4). The number of rights traded bounce around a little bit, but stay at an even keel in terms of the number of trades over the 14 years. The number of leases, though, is increasing over that period of time. These are short term. It is easy to go out and get a short-term lease.

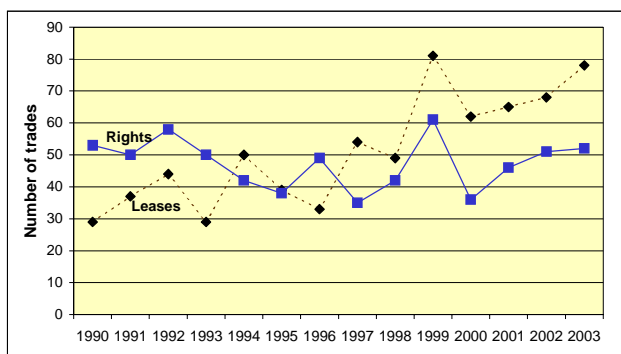


Figure 4. Trend in number of trades

What about the water volume of trades? Leases very much dominate water market transactions (Fig. 5). They are as much as ten, twenty, to one hundred times the number of water rights transactions that are occurring. Water rights transactions remain fairly stable, but are relatively low in number.

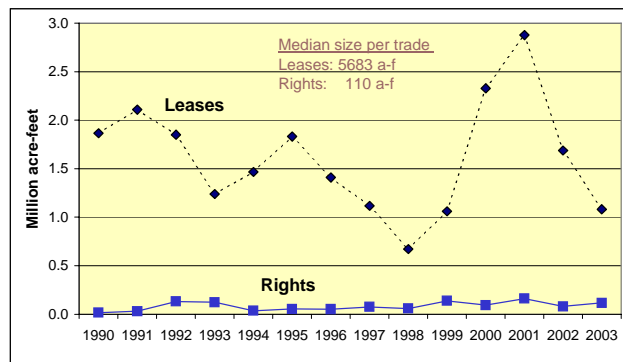


Figure 5. Trend in volume of water sold

To and from where are these transactions occurring? In other words, who is buying and who is selling? Table 3 depicts the information well. It shows where the water starts, and where water is going. Water is moving from farmers to municipalities and urban areas. Along the left side are the sellers. Water is going from farmers to municipal water providers in large part.

Table 3. Number of trades from seller to buyer (both leases and rights, all years)

Seller	Buyer							Total
	Munic.	Farmer	Envir.	District	Public	Other	Severall	
Municipality	26	9	0	7	18	7	4	71
Farmer	175	96	10	60	95	40	55	531
Environmental	1	0	1	0	1	0	0	3
Water district	21	19	1	38	32	8	16	135
Public agency	39	48	1	32	46	18	40	224
Other	60	12	1	26	22	69	4	194
Severall	53	21	0	20	20	21	87	222
<b>Total</b>	<b>375</b>	<b>205</b>	<b>14</b>	<b>183</b>	<b>234</b>	<b>163</b>	<b>206</b>	<b>1380</b>

Water district includes water storage or irrigation district, water association, water company  
 Public agency includes federal or state agency, conservancy district, water bank, ....  
 Other includes power plant, mining, developer, feed lot, country club, home owner, ....

Then we get to the issue of price. There is a little bit of a gamble here, and I will talk about that in a moment. Is water a risky market? Looking at all of the leases and water rights transactions over 14 years, you can see the mean and median on the left (Table 4). When you are looking at the median, there is a difference between leases and rights. Rights are reported on an annualized basis. They are essentially capitalized over the life of a right to make them comparable to leases.

Table 4. Western Water Market Lease and Right Prices 1990-2003 (2003 dollars per acre-foot per year)

	Mean (\$)	Median (\$)	N	Min (\$)#	Max (\$)
Lease	85	47	715	0	2258
Right*	108	72	662	1	630
All	96	56	1377	0	2258

\*annualized using a 3% interest rate.

#cases with a \$0 price were not included. \$0 indicates rounding of a very low price.

Let’s look at the range in prices. For leases, you go to near zero as a minimum to over \$2,200 for one year of water. What is going on? Consider the conditions. In a drought when you need water, you are willing to pay for it for that year. When you are buying a right, you are buying a long-term right to that water. Again, you see a wide range; in this case, you are looking at roughly a one dollar minimum up to an annualized \$630 per year. There is a lot of diversity within these markets. When you talk about water rights markets or water leasing, you really need to be specific about what market you are dealing with.

Let’s look at leases and rights by state (Table 5). I do not expect to be able to go through all of this, but we will highlight a few states in particular. If we look at places like Montana, it was \$6 for a lease and \$9 in Oregon. There were no water rights sales in Montana and very few in any other state. If you look at New Mexico, it cost \$55 for leases and \$76 for rights. Again, these are capitalized. There is a huge variation, and some of these are hard to explain. What is going on with water in Oklahoma? It is being leased for almost \$350 an acre-foot per year. Some of the reasons have to do with the users in the market. In both Oklahoma and Texas, we have some very high leases, even though the median for Texas is \$29 per acre-foot for a lease. Some of the mining companies, including oil and gas, are paying \$500 an acre-foot. They do not need that much water. They know a few sellers, and simply pay for it.

Table 5. Water Lease and Right Market Prices by State

	Leases		Rights*	
	Median (\$)	N	Median (\$)	N
Arizona	58	48	40	38
California	68	250	37	44
Colorado	18	58	84	369
Idaho	8	49	3	15
Kansas	50	11	16	5
Montana	6	5	-	0
New Mexico	55	29	76	30
Nevada	83	4	109	65
Oklahoma	347	2	46	1
Oregon	9	34	7	9
Texas	29	159	24	48
Utah	7	11	17	32
Washington	37	21	13	4
Wyoming	40	34	43	2
All	47	715	72	662

\* Annualized using a 3% interest rate.

Figure 6 illustrates the trends of prices. When you look at all users, prices do look like they are trending up slightly. They are going along fairly evenly, but trending up slightly since about the mid-90s.

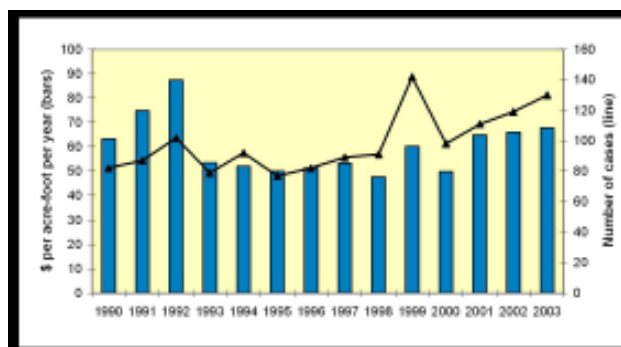


Figure 6. Trend in Price - all water uses

A different story is told when we look at individual uses (Fig. 7). Those individual uses include agriculture, municipalities, industries, recreation, and environment. It is interesting to look at water prices for environmental uses. They are certainly going up and are approaching municipal payments on average.

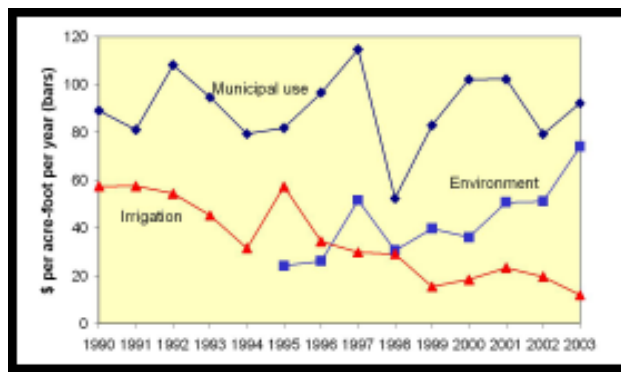


Figure 7. Trend in Price by Purpose of Buyer

Figure 8 is a graph of transfers and prices for a variety of environmental issues. One that is near and dear to most of your hearts is the silvery minnow. Here we look at the trend in the number of cases or the number of trades for environmental purchases and the purchase prices over time. You see a sharp increase. This is very important, because it is the composition of the market that plays a large factor. The composition of who is buying and how much they can afford to pay. Most of the payments for these environmental purposes are paid for by the government. It is the government buying water largely for endangered species. What happens to prices as that happens? They go up dramatically, and they compete much more with agriculture and municipal water demands.

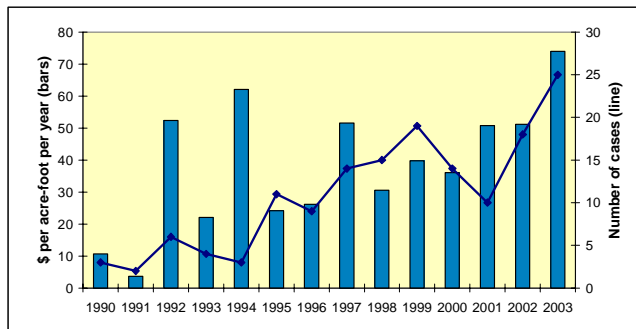


Figure 8. Trend in Price - Environment

Let's take a brief look at the diversity in water markets in terms of leases. Five cases are represented in Figure 9. The green lines at the top and bouncing around are lease prices of San Juan-Chama water. Then you also have Central Arizona Project water prices fluctuating. The Rio Grande water in the lower valley in Texas and the Upper Snake water prices are both pretty low. Look at the difference in prices. We go from just under \$10 an acre-foot to almost \$90 an acre-foot when you look across markets.

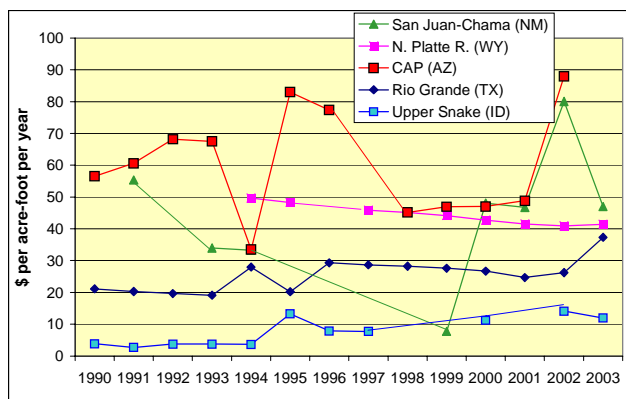


Figure 9. Trend in Water Price - Selected Markets

Back to what is a water market? Again, they are very site specific, and there are only a handful that are very active. This is the case looking at rights, where we see the same thing (Fig. 10). All of these are in Colorado. Again, we are looking at roughly \$50 an acre-foot for the purchase of a right on an annualized basis to well over \$500 an acre-foot. For a number of years, there were zero trades.

How can you go out and say, "I am going to get a good price, because it is a market? It is efficient. It has to be. It's a market." You have to ask and know, is there much activity going on? Is there much competition going on in these markets? No. Many of them are very limited.

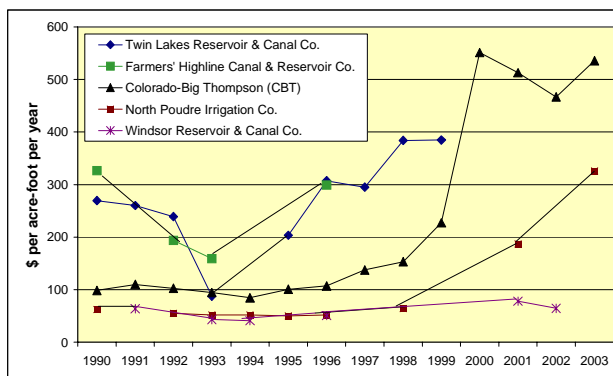


Figure 10. Trends in Water Price - Selected Markets  
Median price of water rights in five Colorado markets, 2003 dollars

I am going to move on to a study that was done very recently by Richard Howitt and Kristiana Hansen, in *Choices* (2005). It was published in 2005, but uses water strategist data also (Table 6). In this study, they actually excluded Colorado Big Thompson sales completely, but they took a look across the states at the volume of water traded by leases and by water rights sales, and then the lease to sale ratio—in other words, how many leases per sale? You have places like Idaho where there were 692 leases and only one sale over this four-year period. In general, leases really dominate. The average was eight to one of leases to sales of water rights. You also can observe the prices of leases versus sales. For New Mexico, lease prices were \$66 per acre-foot, and this is much cheaper than middle Rio Grande water at this point at \$1,200 per acre-foot for the sale of a water right.

Table 7 comes from a study done by Larry MacDonnell, and it covered the period from 1975 to 1984. There were a lot of contributors to this study from each of the states. The reason that I like to show this is that this comes from thirty years ago. What we are looking at here is the number of water transfer applications. This is fairly consistent with the more recent data on transfers, although California was fairly low at that time. Colorado, New Mexico, and Utah were all quite high. The real purpose of this is to look at the administrative process. This is the length of time to approve the transfer of rights. You will see that it goes from just under six months to over eighteen months. That is a lot of time when you are paying lawyers and engineers and others to work on the transfer of your right. The administrative process used really makes a difference.

## Western Water Markets and Price Diversity

Table 6. Results from another study using water strategist data

State	Volume (thousand acre-feet)				Price (\$/acre-foot, in 2004 dollars)	
	Lease	Sale	Total	Lease/sale ratio	Lease	Sale
AZ	1,371	24	1,395	53	73	894
CA	3,127	227	3,354	14	80	1,207
CO	74	242	316	0.3	22	3,451 <sup>a</sup>
ID	692	1	693	692	10	201
KS	4	0.2	4.2	20	51	—
MT	5	—	5	—	5	—
NM	338	10	348	34	66	1,233
NV	—	49	49	—	—	2,572
OK	10	—	10	—	59	—
OR	532	38	570	14	283	1,045
TX	877	322	1,199	3	81	864
UT	6	3	9	2	6	870
WA	68	13	81	5	53	513
WY	105	—	105	—	40	—
<b>Total</b>	7,211	929	8,140	8	86	1,299

<sup>a</sup> CBT sales omitted. If included the average sale price is \$7,801.

Source: Data from the Water Strategist. The authors acknowledge Adams, Crews and Cummings (Georgia State University) for generously providing us with their database of Water Strategist transactions; and Alex Lombardi for assistance.

<b>SEVER AND TRANSFER APPLICATIONS BY STATE (1975-84)</b>				
<i>State</i>	<i>Number of Applications</i>	<i>Percent Approved</i>	<i>Mean Months to Decision</i>	<i>Percent Protested</i>
Arizona	30	93	8.2	17
California	3	83	N/A	48
Colorado	858	80	19.5	61
New Mexico	1,133	96	5.8	6
Utah	3,853	90	9.4	9
Wyoming	41	75	17.7	32

Lawrence MacDonnell. 1990. The Water Transfer Process as a Management Option for Meeting Changing Water Demands. Vol. 2. Natural Resources Law Center, University of Colorado.

Table 7. An Earlier Report on Market Activity by State, 1975-1984 (MacDonnell et al.)

Table 8 is from a study that was published in a book by Bonnie Colby in 1987. Again, it shows a select number of markets and the prices that existed then. It illustrates how thin these markets really are. If you look at Avra Valley, it has prices starting in the low 400s going up to \$870 in 1984, but many years with no trades or no data. It is similar to many other markets. The one that has the most consistent data is the

Colorado Big Thompson. You can see that starting in 1961 water right shares were at about \$130 in constant dollars up to over \$1,000. Colorado Big Thompson unit prices right now are about \$12,000 per unit. A unit provides about .7 acre-feet on average. That market had been up to \$15,000-\$20,000 per unit. It has had several peaks during its history. What is going on? Is this an unstable market for water?

Table 8. Representative Prices for Sales of Perpetual Water Rights (1986 dollars per acre-foot)

Year	Arizona <sup>a</sup>		Colorado <sup>b</sup>		Nevada <sup>c</sup>	New Mexico <sup>d</sup>			Utah <sup>e</sup>
	Avra Valley	Type II	C-BT	Twin Lakes	Truckee River	Gilla	San Francisco	DMAD	Ground-water
1961			130		150				
1962			150		140				
1963			220		170				
1964			370		150				
1965			440		130				
1966			530		160	1,790			
1967			560		160	ND			
1968			600		150	1,300			
1969			850		140	ND			
1970			920	900	140	ND			
1971	430		860	1,400	130	1,630			
1972	420		860	2,400	120	ND			
1973	NT		930	2,400	120	ND			
1974	NT		1,050	ND	110	1,240		330	
1975	570		1,090	ND	100	ND		ND	
1976	570		1,330	2,300	90	1,150		300	
1977	630		2,540	ND	90	1,420	510	550	
1978	NT		2,590	ND	80	3,210	480	550	
1979	700		3,050	ND	70	2,070	440	ND	
1980	NT		3,600	11,820	ND	3,270	ND	2,440	2,440
1981	NT		2,990	10,950	ND	2,090	1,110	1,200	1,150
1982	NT		1,880	ND	470	1,780	510 <sup>f</sup>	750	680
1983	NT		1,600	ND	1,730	1,460	ND	430	ND
1984	870	560	1,460	ND	1,570	2,520	1,460	430	740
1985	NT	920	1,080	ND	1,450	ND	1,250	350	710
1986	630	1,430	ND	ND	NF	ND	1,210	ND	
1987	NT	1,000	ND	8,180	1,750	1,810	1,110	ND	

NT indicates no transactions occurred in this market during the year indicated.  
 ND indicates no price data was obtainable for transactions occurring during the year indicated.

Source: Bonnie Colby Saliba and David Bush. 1987. Water Markets in Theory and Practice. Table 5.2.



I am going to look briefly at some of the more specific trades of the Colorado Big Thompson. As I mentioned, in most of the other studies, these were excluded. What I am reporting on here is based on almost 2,700 individual transactions, that is every transaction that occurred within the CBT over a 15-year period. The market is in northeast Colorado. These are individual farmers selling water.

Who are they selling it to? The lime green on Figure 11 are municipalities and water providers. What is interesting in this market though is that individual farmers and irrigation companies are also very active in the market. Why is that? Should they be active in the market? Is that water really worth it to them in terms of agricultural production, alfalfa, corn, and other products? We will get to that very briefly.

Figure 12 indicates what the water prices looked like between 1961 and 1991 for the CBT. These cost about \$100 per acre foot in 1961. I would have liked to have invested back then. Now, look at the spike, but look at what happened later, too. The top axis here is \$6,500. Prices more than doubled in just a few years. Does this look like a stable market? What would be driving this? That is part of what we tried to look at.

What drives water right prices? We looked at transfers, the activity in the market similar to stock markets, but that does not explain the fluctuations. We looked at growth. Figure 13 refers to the area along the Colorado Front Range. Is urban growth driving this? It did not appear to be. It certainly was not when we looked at things like agricultural production, debt of farms, and other issues. Very little can describe the fluctuations.

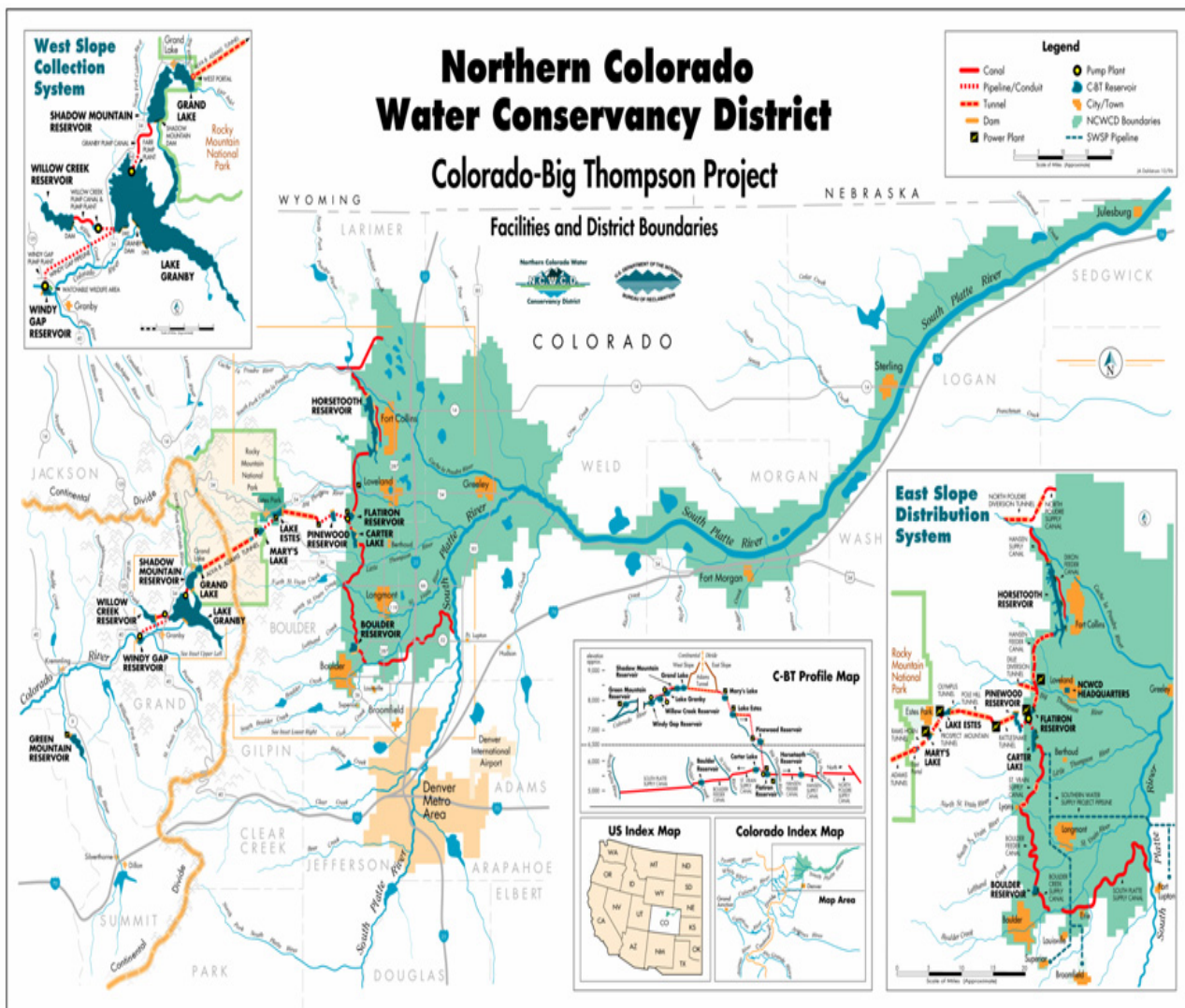


Figure 11.



Figure 12. CBT Price & Local Housing Starts

Amazingly, what did prices track best? Talk about speculation. The grey in Figure 13 is silver prices. The red is water right prices. Water rights by their nature, by their laws and institutions are not supposed to be speculative. They have large transaction costs. It is difficult to transfer them. What is happening in this market? One of the things that distinguishes this market is it is very easy to transfer. It is easy to get in and out of this market, which facilitates trades and speculation.



Figure 13. CBT Water Right and Silver Prices

Figure 14 looks at CBT prices compared with oil prices over time. What I like to note about this, and unfortunately economists are not rich, is that CBT prices preceded the peak in oil prices. I wish I had known. I would have invested. Speculation is a very important facet in some water markets. Figure 15 shows CBT water rights price movement and possible causes.

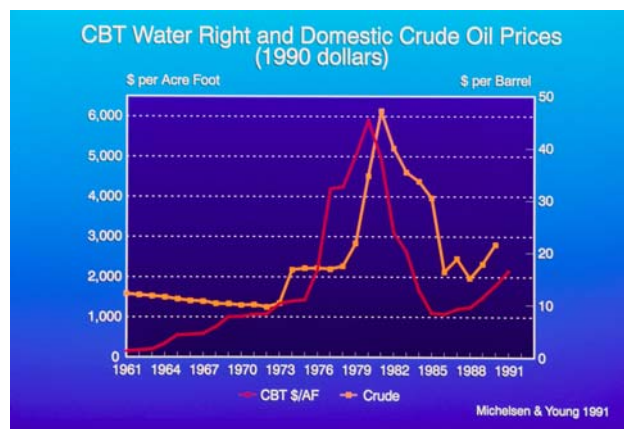


Figure 14. CBT Water Right and Domestic Crude Oil Prices



Figure 15. CBT and North Poudre Irrigation Company Water Right Prices (1961-1991)

In summary, market activity is really concentrated in a few areas. Most of the water is traded on short term leases. Most of the water is traded, big surprise, from farmers or agriculture to urban uses. However, the overall price trend is unclear. With municipalities, it looks fairly stable from the reported data. With environmental prices, they are growing and increasing rapidly. These markets are spatially and location user specific.

One of the important points is the lack of information. We have individual studies, and you have individual brokers that know the market in their specific areas. On the conference program that John Shoemaker is putting on in the spring, if you look at the people speaking, a number are local real estate appraisers. They know that local market. It is very difficult to get a gauge on markets overall.

The hydrology is important. Have you already built the infrastructure for transfers? Down in this area, we have the Rio Grande Project with Elephant Butte and Caballo reservoirs. We have capacity and the institutions. The length of time, the ease, and the cost are major drivers; the supply and demand or scarcity in that area. We do not really have that type of trade in this area right now, although we do have El Paso Water Utilities purchasing water leases for 75 years at \$4,500 per acre for urban acres. That will get them 2.8 acre-feet. On top of that, they pay the tax for the assessment. That is not terribly expensive. In this area, Chuck DuMars talked about prices starting in negotiation at \$6,500 an acre-foot. But before the sale was complete, it was \$8,500 an acre-foot. After Chuck's talk, I spoke with two or three others, and they talked about prices approaching \$10,000 to \$13,000 an acre-foot for Middle Rio Grande rights. Those are pretty steep and are very rapid changes.

In summary:

- 1) market activity is concentrated in a few areas;
- 2) most water is traded in short-term (lease) transactions;
- 3) most common trade is from farmer to city;
- 4) overall price trend is not clear, however, some markets and water uses show clear trends; and
- 5) water markets are spatially and user heterogeneous, that is, they are location and user specific.

Speculation is really driving prices. And there are barriers to market transfers. We have these throughout the western United States, but particularly here in New Mexico and Texas. We are dealing with compacts. We are dealing with how we are going to operate between the two states. Can we transfer? Frank Ward and I and another colleague, Jim Booker, did a recent study looking at if we relax some of the institutional constraints, or barriers, what would be the hydrologic and economic impacts. We estimated that the economic impacts of drought could be reduced by 20-30 percent by allowing some of this water to move through water market transfers.

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