Hydrology Days 2003, 141-152

Drought and Water Policy: Implications for Colorado

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Abstract. Three processes coincided in the first years of the 21st Century to create a water crisis in parts of the western United States. Rapid population growth, decline in construction of new water projects, and deep drought shocked water officials who thought their supplies were secure for at least a few years, and unexpected and drastic curtailments in water use were required. These experiences have been especially acute in Colorado, where parts of the state are experiencing the worst drought water shortages since settlement. The first part of the paper outlines the causes and nature of the drought water shortages and the second identifies policy needs. It is argued that if water security for regions can be achieved, building new storage should be easier because more public support will be available. In addition to more and "smarter" storage, the state needs more workable water markets. The idea of balance among regions will also help with that goal because regions can agree externally and internally on water transfers, thus facilitating water markets. Colorado has enough water for its future if it acts wisely. However, new institutional mechanisms to promote the interests of the state's regions can work to improve water availability within and among regions and look after environmental values.

1. Introduction

Three processes have coincided to create a water crisis in the West and particularly in Colorado. The severe drought was enough to create a crisis, but in Colorado population has increased rapidly, and little new water storage had been built for decades. The three facets of the crisis are therefore increased demand, diminishing reserve capacity, and low supplies.

Given patterns of growth and water–use, new storage may have made little difference, because the drought has been so severe and unpredictable that water officials would have been unlikely to conserve enough water for the dry years. Moreover, damages to ecological systems and fire damages to watersheds are mostly independent of water storage.

The drought emergency in Colorado should be considered a wakeup call to reexamine policy for both water management and new storage. The paper discusses growth and water storage, and the policy issues faced by Colorado in confronting the reality of drought with more effective water management. It presents an analysis of the issues and lists areas of needed improvement.

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2. Evolution of water management in Colorado

When Lt. Zebulon Pike judged Eastern Colorado to be a desert, he did not foresee that mountain water could be captured to water crops on the plains, but the settlers who came later unleashed a surge of water development that led to today's water–based prosperity in Colorado.

After claiming the readily–available river and well water, the settlers learned that water storage was needed. This led to a wave of dam–building that lasted from about 1890 to 1970, or some 80 years. Along the way, wells were drilled, and eventually Colorado had a complex network of dams, reservoirs, pipelines, canals, pump stations, wells, and treatment plants.

By about 1970, Colorado had some 9 million acre–feet of reservoir storage and today the state's water system serves about 4.5 million residents and some 32 million acres of farmland, if which about 7 million acres is cropland, about half of which is irrigated. About 14 million acre–feet of water are applied annually to about 3.2 million irrigated acres, requiring about 5 million acre–feet of consumptive use of water (Frank and Carlson, 1999).

Since 1970, three forces converged to reveal a fault in Colorado's water–dependent growth and water management institutions: population growth, lack of new reservoir storage, and severe drought.

3. Growth and lack of storage

This graph of Colorado's population shows that since 1970, growth has been exponential, with most occurring in the South Platte Basin (Figure 1).

Figure 2 shows how new storage has lagged behind population growth, especially after 1970. Colorado's water storage grew until about 1970, then remained about constant. During the last twenty years, reservoir capacity was probably lost to aging and sedimentation faster than it was added by new projects, capacity expansion, and rehabilitation.

Storage is not always located near where it is needed to supply new demands. Much of the storage added in the 1960s was for the West Slope's Colorado River Storage Project, and does not help Front Range water supply needs. The West Slope has much greater storage per capita than the East Slope. Figure 3 shows a significant decline in storage per capita, particularly in Division 1. If an earthquake occurred along the Front Range and placed transmountain tunnels out of service, the Front Range's water supply would truly be in an emergency.

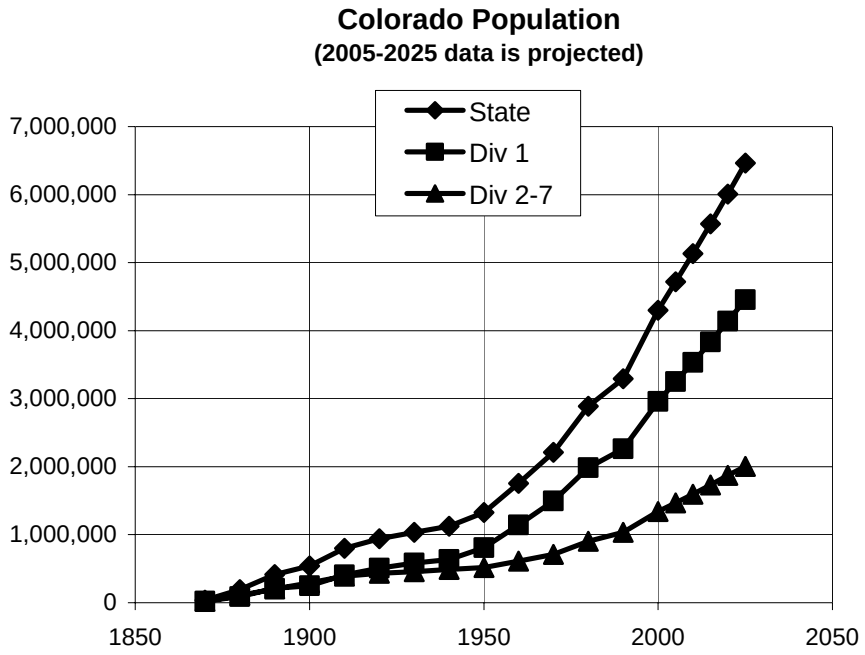

Figure 1. Colorado population

The population–storage dilemma placed Colorado's Front Range water supplies under greater stress than a generation ago. To place an exclamation mark on this reality, the current drought hit is now in its fourth year.

4. Drought in Colorado

With Colorado's variable climate, drought occurs periodically and can have serious consequences, especially when preparation is inadequate. The current drought, now in its fourth year, is historically significant in its severity.

Tree–ring studies and climatic data show that Colorado experiences wet and dry cycles. The great Colorado drought of 1276–1299 apparently drove the Anasazis from their homes in southwestern Colorado. Eight periods of severe and long–lasting drought have occurred since about 1700. The period from 1875 to about 1890 seems to have been very dry. The 1890–94 drought in Eastern Colorado brought disappointment to newly–arrived dryland farmers, as described by author James Michener in *Centennial*. The 1898–1904 drought was the worst on record in Durango. The 1900–1930 period was wetter–than–average. Drought returned from 1930 to 1940, and in 1939, several Front Range gages recorded their driest single year in history. West Slope droughts seem to coincide with those on the East Slope more often than not, but not always. The 1950–1956 drought affected the whole state, and was worse in general along the Front Range than the 1930s drought. The 1974–1978 drought featured the driest winter in history, in 1976–1977 ((McKee, Doesken, Kleist, Shrier, and Stanton, 2000; Woodhouse, 2002).

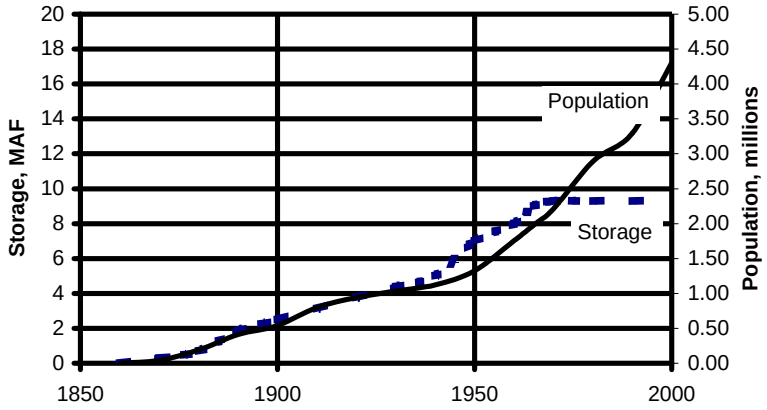

Figure 2. Storage versus population

At the 2002 Drought Conference, State Engineer Hal Simpson (2002) explained that tree–ring studies showed that 2002 was the driest year since 1703 in the South Platte Basin. The drought led to damaging summer fires, loss of wetlands and habitat, and stressful conditions for wildlife. Farmers suffered greatly, and rafting, fishing, and landscape businesses also suffered.

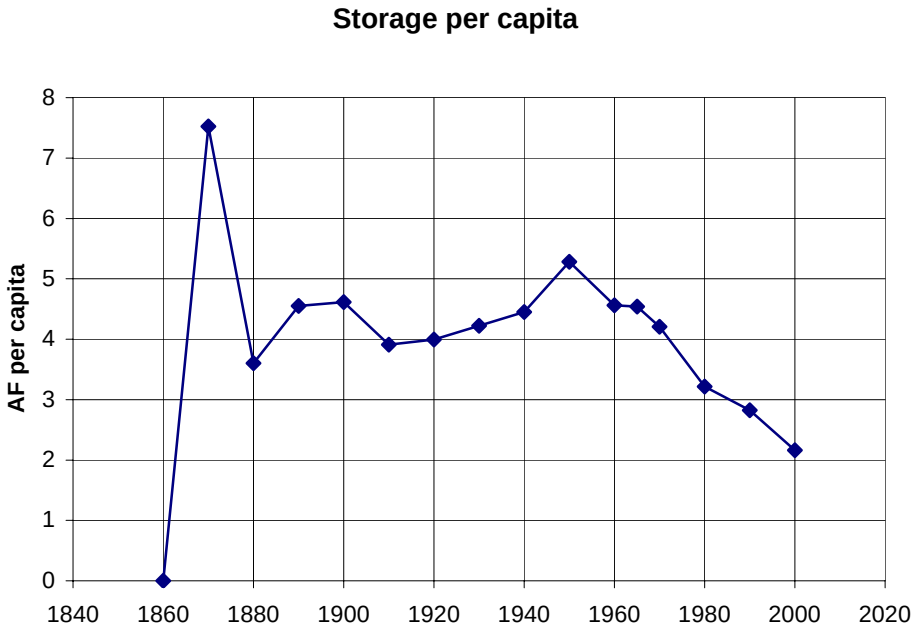

Figure 3. Storage per capita in Colorado

Average annual flow on the South Platte River near Kersey was 325 cfs, compared to the average of 894 cfs. River calls began in early April and flow at the Colorado–Nebraska state line averaged only 25 cfs. Plains reservoirs east of Kersey were empty by the end of August, and October storage was only 5% of capacity. In the Arkansas, streamflow set record lows. On July 17, a 1869 call was made for the first time in history, and the City of Pueblo's 1874 right for was called out. Several communities experienced water supply emergencies. In the San Luis Valley, total flow on the Rio Grande at Del Norte was 7% of average and reservoir storage became empty or nearly empty. The Closed Basin aquifer reached its lowest recorded level.

On the West Slope, the Gunnison River set a low–flow record and for the first time since Blue Mesa Reservoir was built, the Gunnison Tunnel placed a call in April. On the Colorado River, 2002 was the driest year since 1579. Near Dotsero, October flow was 707 cfs, compared to the average of 1,317 cfs. The Yampa River experienced record lows at several gages in 2002. Flow in the Animas River near Durango was 316 cfs, compared to the average of 413 cfs. . Many perennial streams were dry early in the summer. The LaPlata River Compact operated under the "futile" delivery criteria.

5. Does Colorado need more storage, or to use its storage more efficiently?

The option of building more storage has proponents and opponents. Proponents say that it is obvious that more storage is needed, as shown by recent experience with the drought. Opponents say that we need "smart storage, not more storage" (Kassen, 2003).

Both are right. Unless the state has adequate storage capacity, it simply cannot sustain current water management practices. On the other hand, unless it uses its storage wisely, it will run short of water no matter how much storage it has.

In general, everyone will agree with the opponents' calls for using existing water supplies fully and more efficiently, expanding existing capacities incrementally for flexibility, emphasizing efficient use of existing interbasin transfer water to avoid new transfers, and involving citizens to address environmental, economic, and social impacts.

The problem is, of course, in the details of these water management strategies. These "details" include both the physical aspects and institutional structure of water management in Colorado.

6. Physical aspects of water management in Colorado

Simply stated, the physical aspects of water and land in Colorado place limits on water management. The quantities, timing, and location of supplies place limits on how much water can be delivered to any given place.

Sometimes these limits are physical and sometimes they are economic. Almost any physical boundary can be overcome with some degree of engineering and construction, but it might not be practical to do so. For example, proposals to pump surface water from the Colorado–Utah border or ground water from the San Luis Valley to the Denver region stretch the imagination, as do proposals to tow icebergs to Los Angeles or divert Mississippi River water to West Texas.

Economics define the limits of practicality of physical schemes. However, sociology also enters the picture because there are upper limits to how much organizational complexity the water community can fathom. In that sense, visionary schemes for more cooperation, for example, might founder on the rocks of every day exigencies of work and on sociological practicality. These begin to look like institutional barriers.

7. Institutional structure of Colorado water management

The institutional structure is a complex web of relationships that determines how decisions are made. It begins with the structure of the Colorado water industry, with all of its agencies, firms, and other players. Then, it includes the laws, regulations, and rules that govern behavior, along with the procedures, and customs that guide the participants through the various management processes. It also includes the industry's relationships and relative power positions, along with the business culture that has evolved.

In Colorado, the institutional structure evolved from the dry nature of the land, the needs of the original mining and agricultural settlers, and the early decisions to adopt the appropriation doctrine and the court–based system to manage it.

Structure of the Colorado water industry

The structure of the industry can be viewed as a group of major and minor water users, a judicial system, and a regulatory system. A "water market" operates among the water users, but it involves relatively few participants and is tightly controlled by the regulatory system, which also enforces water right priorities.

While water transfers involve relatively few participants, the number of water rights and owners is large. It is difficult to say how many water rights are in Colorado, but the State Engineer's data base lists some 38,000 "entries" for surface, ground, and storage water rights in the South Platte Basin alone. Each entry is a point of diversion, a storage reservoir, a well, or some other water rights feature. If each of these has an adjudication or other record, it can be considered for management purposes a "water right." Thus Colorado's water managers face much data complexity.

Colorado's court–based water rights system is unique among western appropriation doctrine states because to grant, transfer, or exchange a water right, a decree from a state district water court is required. The other approach, used in most states, involves administrative approval of transfers and exchanges through a government office such as the State Engineer's office.

Proponents of the court–based system say that it is efficient and that most petitions are handled quickly by a referee, who might be an engineer or an attorney. Opponents say that the system invites litigation and increases transaction costs by diverting money from water users to attorneys and engineers.

Laws, regulations, and rules

Colorado's version of the appropriation doctrine originated in the 1876 state constitution and was expanded by many statutes and court decisions over the years. The court decisions and implementing regulations and rules, particularly of the State Engineer's Office, comprise the legal framework in which water is managed.

The state's founders implemented the appropriation doctrine in a much simpler era. They would not have foreseen the tremendous complexity it must deal with today. No session of the legislature goes by without proposing at least a few bills to tune up the system. None of them would ever dare, however, to change the basic system, which is based on property rights in the use of water.

Industry relationships, relative power positions, and culture

Under the appropriation doctrine, water industry participants take on varied levels of power, depending on their relative positions. A few of the most active players are:

water providers (utilities, districts, water departments), business and industry, farm groups, the court system, the Bureau of Reclamation, the State Engineer's Office, the

CWCB, water lawyers, environmental and public interest groups, the Colorado Water Congress, and the Legislature. These are by no means of all of the players, because others that get into the act include the Governor and cabinet, Congress, other federal and state agencies, the press, and the education system.

Property rights in the court–based system

The most significant issue with Colorado's appropriation doctrine is the property rights that have been conferred on water right owners. If you consider that some 15 million acre–feet of water are diverted in an average

year, and if you value these at a round number of $1000 per acre–foot, you arrive at a value of $15 billion for these water rights. If the value was $10,000 per acre–foot, the total value would be $150 billion. The correct value might be in between these extremes. To put this in perspective, $15 billion would buy some 75,000 homes worth $200,000 each, enough to house a city of around 225,000. The sum of $150 billion would buy 750,000 homes, enough to house half the population of the state. Clearly, the value of water rights is a big issue and if water right owners worry that they will lose their rights, they will sue.

To shed light on how water rights work as property rights, it is helpful to compare them to land property rights. For each category of right, you have title to real property of different classes and the titles can be insured. Property might be rented, leased, or sold. A market analysis will show comparable values among different property classes. Buyers purchase titles from sellers, and the titles are recorded. The property transaction might involve agents, attorneys, surveyor/engineers, inspectors, and conditions of the transaction, as well as covenants on the property.

In the case of water rights, property transactions can be more complex due to the interdependence among properties requiring analysis of possible injury from each transaction and for the court to approve every transaction. Even after this approval, some property owners may sue, claiming injury. The renewable resource attribute of water complicates the picture too, as drought and/or wet years change the water yields from average years. Also, unpredictable water quality and environmental constraints may alter yields and values. Management issues are shared in water as well, and there is need for expensive control structures and systems to maintain access to property. Water right owners may need to cooperate with others in management ventures as well.

The positive attribute of the system is that transferring permanent rights of large amounts of water properly goes through careful scrutiny and helps to give security of title to water.

There are a number of criticisms about transferability of water rights. Temporary exchanges and transfers, the "market for water," should not be so difficult. It doesn't seem efficient to go to court and have delays to settle each issue on water management. This allegation of inefficiency is disputed by some, who say that most transactions go through referees quickly. Others say that too much money goes to lawyers and the court system and the incentive system rewards lawyers and engineers for drawing out water right transfer cases. The appropriation doctrine is also criticized by environmentalists because of its apparent lack of attention to the public trust doctrine.

8. Policy areas

So, as Colorado seeks to use its water more effectively, it confronts the realities of water management—growth, lack of new storage, drought, and a complex institutional environment. These are reflected in this situation:

- Water is short and must be rationed among users.
- Transaction costs are high and the water market doesn't work well
- Conflicts between economic and environmental uses of water are only worked out with inefficient government intervention
- The state has a small amount of water storage compared to its needs and it is hard to build new storage
- Water supplies are highly variable, especially in drought years

Many conceptual ideas about improving water management have been suggested. They include conservation and salvage, new storage projects, agriculture–to–city leases and transfers, interbasin transfers, management of existing facilities, new management methods and technologies, cooperative approaches, and changes in water law.

Some have suggested a "Colorado Water Plan," which seems to make sense in the light of drought and water shortage. However, water war veterans are skeptical of such top–down government planning schemes. Water planning in Colorado is not a neat, comprehensive road map, but it is a loosely–coordinated set of actions among power centers like cities, water districts, and interest groups. Competition between these power centers will not end with a comprehensive water policy or planning process. More subtle measures are needed to coordinate the work of power centers on matters of state interest.

Two over–arching areas of state interest deserve special attention. The first is balance and opportunity among regions, a policy that appears in the "principles" advocated by 58 counties in 2002. Competition between regions and subregions for water inhibits cooperation and coordination among power centers and fear of losing water in regions is a major cause of water wars. The second matter of state interest is environmental sustainability, where there is also broad agreement on the policy, but lack of agreement on the details.

Balance and opportunity among regions

To achieve balance and opportunity and reduce tension, the state's regions should be guaranteed water supplies for their future development. Doing this was an implicit goal of what Getches (2002) called a "comprehensive water planning process, basin by basin, with full public participation."

Some would resist this idea because it sounds like basin–of–origin protection, a controversial policy idea that hasn't passed in Colorado.

However, balancing water opportunity does not rule out interbasin transfers; it would make sure they were negotiated with all regional interests in mind. That might sound naive, but the fact is, all water transfers are negotiated today. By creating regional institutions to handle them on behalf of the regions, the public interest could be served better.

Opposition to this policy might come from water developers or even from farmers, who would oppose negotiation about water because they will think that it might affect the value of their water rights. Some environmental groups might also think that "guaranteeing water" to regions would unleash unbridled growth on the Front Range. These fears should be recognized and dealt with through plans and negotiation, not by covert actions and court battles.

How could an institutional mechanism provide for negotiations among regions? After all, regions are not sovereign governments, like states. It could not negotiate agreements to bind parties in a region, but it could work with power centers, including federal and state government agencies, to arrange projects and programs that would work in the state's interests. Its specific roles need to be studied.

The principle of compensatory storage or water insurance might be expanded to provide senior water right owners security that water changes would not injure them. Rather than hypothetical case–by–case water court decisions, perhaps computer–based mathematical models could show in real time what is actually happening in basins, and indicate water entitlements and compensatory schemes. Who would operate such a system would have to be determined.

To implement this approach, a regional group would prepare water supply plans and meet with neighbor regions on shared interests and agreements. All would come together in an annual meeting to evaluate water policy and results. The regional groups would look after the interests of their regions, and not be parochial. To achieve that perspective, they could be appointed by an authority with areawide interests or even be elected. They might have funding authority, depending on whether they could acquire water rights and enter into projects. They would report annually on the state of the water supplies in their regions, and a central office would report on the state's water.

Given the record of years of mistrust and false starts, designing and implementing this institutional arrangement would be slow and painful. It will not be achieved quickly or simply and it would not happen by the action of one legislative committee or even by starting a few river basin committees or commissions. However, what it needs to do is to provide mechanisms within each region or river basin to negotiate their internal interests in water and their exchanges with other regions, and to provide backup technical support to study issues and make plans.

Lest this sound too vague, I offer two examples. One deals with Northern Colorado and the Denver Region, and the other deals with East Slope–West Slope water transfers.

In the first case, we see a rapidly–developing I-25 corridor that will need future water supplies. All kinds of coordination will be needed to supply raw and treated water to large and small water purveyors. Must this occur from the competitive actions of many players, or can the region cooperate to coordinate raw and treated water services for the economic and environmental advancement of all? After all, the area is integrated economically and environmentally, and it makes no sense not to integrate water with economic and environmental decision making. The coordination mechanism could be an organization of water providers who work together to study and manage aspects of water in the corridor. While models such as Israel's National Water Carrier might be studied, Colorado's system would have to recognize private ownership of water rights, not government control.

East Slope and West Slope interdependence involves different issues. To the West Slope, water transfer to the East Slope is a critical issue. While the East Slope fuels part of the West Slope's economy, some power centers oppose more water transfers and, in fact, would like to diminish existing ones. East Slope and West Slope cooperation in water management is a strategic issue because most of Colorado's unused water entitlements are in the Colorado River. Recent discussion of a "Big Straw" project focuses on this water, and any attempt at large scale transfers like this will attract attention and opposition from many powerful groups. Why not negotiate East Slope and West Slope interests together? Could, for example, the East Slope provide attractive compensatory enhancements for the West Slope in exchange for more access to water, and could this be done without harm to environmental values? Perhaps the negotiation could proceed between regional groups representing the Denver region and the West Slope.

The difference between this approach and past efforts such as the Water Resources Planning Act or studies by the CWCB is that it would recognize and work with the power centers and their incentive structures, not be a blunt instrument.

Once balance among regions is achieved, building new storage should be easier because more public support will be available. After all, the main obstacle to new storage has been political opposition.

In addition to more and "smarter" storage, the state needs more workable water markets. The idea of balance among regions will also help with that goal because regions can agree externally and internally on water transfers, thus facilitating water markets.

Colorado has enough water for its future if it acts wisely. However, new thinking about how to approach matters of state interest is needed.

Institutional mechanisms to promote the interests of the state's regions can work to improve water availability within and among regions and look after environmental values. Many decisions are needed, and the path would be long and difficult. A new approach might change the power structure of Colorado water, but more "planning" will not be enough without cooperation and coordination among the major players.

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