# WATER USE EFFICIENCY IMPROVEMENTS: A SOLUTION TO COLORADO'S URBAN WATER SUPPLY PROBLEMS

**LAND AND WATER FUND OF THE ROCKIES** [1]

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**Summary:**

Colorado faces a serious drought and potential long-term water shortages. The drought affects everyone from farmers to city dwellers to the river ecosystems upon which we all rely. In theory, there are two basic solutions to our water problems: (1) stretch existing supplies by water conservation and other "non-structural" water use efficiency measures and (2) develop additional "structural" supplies through more dams and additional trans-mountain diversions.

This paper summarizes why the state of Colorado and its urban water providers should focus on the efficiency solution. Best-management conservation practices and creative, "non-structural" supply-side options will maximize the use of existing water supplies and should be pursued much more aggressively before launching what could be a fruitless, expensive and environmentally damaging program to develop more structural supplies.

**The Problem:**

We have read and heard about it for weeks. Fast-growing localities are facing emergency measures in this time of drought. Cities across the state have increased the price their residents pay for water, greatly restricted outdoor water use, and hired special officers to enforce these restrictions. Examples can be found all across the state.

The City of Lafayette recently enacted an emergency drought ordinance placing a moratorium on new taps, restricting outdoor irrigation to one day each week, doubling water rates for the low-use block, and tripling rates for the high-use block.[2] The towns of Parachute and Silt, in western Colorado, were some of the first cities in the State to impose restrictions on lawn watering. Violators in these towns face fines up to $1,000 and misdemeanor charges that could earn water wasters up to a year in jail.[3] The City of Boulder has adopted mandatory water restrictions and hired six new security officers

[1] Through its Smart Water Project, the Land and Water Fund is assessing urban water use efficiency in Interior western states. This paper is based on this ongoing assessment. The paper was authored by Bruce Driver, Executive Director, Land and Water Fund, and is based on writing and research by Bart Miller, Land and Water Fund Water Program Director, and Eli Feldman, Smart Water Project researcher.
[2] City of Lafayette Ordinance number 12 Series 2002, Amendment to Chapter 120 Article III.
[3] Denver Post (May 17, 2002)

whose sole purpose is to enforce watering restrictions.[4] After encouraging discretionary water conservation, Denver's water department imposed mandatory water restrictions.

How did we get here? Two causes are obvious: several dry years in a row and robust population growth, especially along Colorado's Front Range. Another cause is not so obvious: inefficient water use.

We waste water. We pour it on bluegrass and other foliage that cannot live here naturally because of aridity.[5] We use more water than is needed for a wide range of indoor uses, from toilets to dishwashers to showers. We lose a lot of water in municipal water supply systems. We fail to re-use water when we can, after it has been used once. We fail to take maximum advantage of opportunities to use surface and groundwater conjunctively, storing surplus surface supplies in wet years in aquifers for retrieval in dry years. Our water providers do not always coordinate their water supply programs with each other, resulting in duplication of facilities and plans.[6] And, discouraged by our state's outdated "use it or lose it" dogma, our cities don't work enough with farmers and ranchers to increase irrigation water use efficiency, where a portion of water salvaged could flow to the cities. In short, we still act as if water were not the valuable resource that it is in this arid place we call home.

Water usage figures, stated in gross gallons per capita per day (GPCD), while not a perfect measure of an area's conservation water use efficiency, suggest that along the Front Range we can do much more to stretch our water resources. For example, water use in the Denver metro area is well over 200 gallons per capita per day.[7] Residents in Tucson, Arizona, use roughly 160 GPCD.[8] San Antonio, Texas, used 143 GPCD in the year 2001 and is shooting for 140 GPCD in 2008 and 132 GPCD in 2015.[9] Santa Fe, New Mexico, and El Paso, Texas, are also under 160 GPCD and shooting for lower targets.[10] Experiences from these other western cities reveal that we can live and prosper in the Southwest using less water than we do now.

**Moving Forward:**

Water conservation is a key to enhancing our water use efficiency. At the core of water conservation are rate structures that communicate the full cost of incremental supplies of water, thereby encouraging water users to use less water in light of the cost of the water supplies saved. Inclining block or inverted rate structures are a good way of encouraging cost-based conservation of water.

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[4] Daily Camera (June 6, 2002)
[5] Some communities proudly display their healthy bluegrass lawns, while others are actually required by covenant to plant and maintain bluegrass turf in front and back yards.
[6] See Hydrosphere et. al., Metropolitan Water Supply Investigation (MWSI), 1999.
[7] Maddeus et. al. "Qualitative Review of Water Conservation Program (May 2001 at 2-6.
[8] Craig O'Hare, "City of Santa Fe Per Capita Water Demands: Comparison with Other Cities," August 27, 2001.
[9] http://www.saws.org
[10] http://www.epwu.org

A number of Front Range water providers use inverted rate structures. However, none may serve its purpose as well as that of Irvine Ranch in California. The Irvine Ranch Water District (IRWD) sets a base allocation for each property based on historic use, landscape area, number of residents, evapo-transpiration (ET) rates, crop coefficients and irrigation efficiency. For customers who exceed their base allocation by 50%, rates are doubled; by 50-100%, rates are quadrupled; by more than 100% rates are eight times higher.[11] There are rewards as well as penalties. If a customer manages to use less than 40% of the base allocation, a 25% discount is awarded. The IRWD has found their rate structure to be "very defensible" and a means to nurture positive working relationships with their customers.[12] Perhaps most importantly, this rate structure reduced residential water use by 19% during its first two years![13]

**Outdoor uses:**

Outdoor water use accounts for about 54% of total residential water use in the Denver area, most of which goes toward turf irrigation.[14] Conserving water outdoors requires that we plant smart and water smart.

Xeriscaping offers a much lower water-using alternative to bluegrass lawns. Xeriscape incorporates seven principles to promote quality landscapes, water conservation, and environmental protection: (1) planning and design; (2) soil analysis; (3) appropriate plant selection; (4) practical turf areas; (5) efficient irrigation; (6) use of mulches (to retain soil moisture); and (7) appropriate maintenance. Skeptics may worry that xeriscapes are just dull and dry, but well-designed xeriscapes are lush and beautiful, incorporating the native textures and colors of Colorado's grasses, evergreens, ground covers and flowers.

Some local water utilities, like the City of Boulder and City of Aurora, offer incentives for residents who replace turf with Xeriscape. However, we could go much further. Regional leaders, like El Paso, Texas, offer $1.00 per square foot of grass replaced with water-efficient landscapes. El Paso's program led to replacing almost 1 million square feet of grass and saved over 20 gallons per square foot removed each watering season.[15]

Most of us, even when we avoid bluegrass, apply far more water than grass and plants actually need. And most of us use sprinklers, sometimes in the middle of the day, losing a substantial quantity of the water applied to evaporation. We can do better.

A promising technique is drip irrigation, which usefully applies 30%-50% less water than sprinkler irrigation and still meets the requirements of most plants. The City of Boulder offers modest financial encourage to residential water users through a rebate on the cost of these systems. Many providers offer no such help.

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[11] Arlene Wong, "promoting Conservation with Irvine ranch Water District's Ascending Block Rate Structure," in Sustainable Use of Water: California Success Stories (Pacific Institute,1999) at 27-35.
[12] Id. at 31.
[13] Id. at 34.
[14] Denver Water Conservation Master Plan, 1997 at 4.
[15] Anai Padilla, El Paso Water Conservation Program (April 22, 2002) at 8.

Plant water needs are sensitive to the weather. Rain sensors and soil moisture detectors are good, localized means of determining watering needs. However, a large, inter-connected information system can reap substantial benefits. The most well-known system is the California Irrigation Management System (CIMIS), which uses information generated at about 100 computerized weather stations throughout the state to help industrial, commercial and residential property owners determine when to irrigate. Irrigators relying on CIMIS have found an average of 13% savings in applied water. Several golf courses and municipal park managers report savings of 10-25% and school districts have reported 44% reductions in savings.[16]

City ordinances can set the tone for outdoor water conservation. Below are sample ordinance provisions being employed or considered by cities across the southwest:

1. Fugitive water prohibited (no watering of sidewalks, driveways, and streets);
2. Cool season turf grass limited to 50% of landscaped area;
3. Six inches of new soil (or organic matter) required prior to all turf installation;
4. Spray irrigation prohibited on slopes, narrow strips and within 8 feet of a street curb;
5. Spray irrigation prohibited between 9 a.m. and 6 p.m.
6. Prohibition of covenants mandating bluegrass or preventing Xeriscape;
7. Non-ULF (ultra low flow) toilets and showerheads to be upgraded when property is sold;
8. Large Properties (over ½ acre) must have an irrigation audit;
9. Very large properties (over 3 acres) must irrigate with reclaimed wastewater or make plans to transition to reclaimed wastewater within five years;
10. Identified leaks must be fixed within five working days;
11. Penalties for violations start at $100 and move up quickly, including misdemeanor charges and jail as potential penalties for repeat offenders.

**Indoor Uses:**

While outdoor use is more discretionary than indoor use and comprises the bulk of potential conservation savings, indoor uses may also be conserved. In the residential sector the biggest bang for the buck comes from converting to efficient toilets and washing machines. Plumbing fixtures are also appropriate conservation targets.

Most toilets more than ten years old use 5 gallons of water per flush. Since 1994, federal law has required that new toilets sold be ultra-low-flow (maximum 1.6 gallons per flush). There are an estimated one million "older" toilets in the Denver metro area. Early

[16] Peter Glieck, "Reducing Water Use in Residential, Industrial and Municipal Landscapes" in Sustainable Use of Water at 49.

retirement of these toilets, facilitated by rebate programs administered by water providers, would save millions of gallons per day as have successful programs in Tampa, Florida, Austin, Texas, New York City and Los Angeles.

The typical residential washing machine uses 50 gallons per load. Models exist that use between 16-27 gallons per load.[17] These machines cost more than conventional washers, but they save their users water and electricity. Rebates by water providers have been useful in encouraging customers to purchase these more efficient machines.

Plumbing fixtures can save water, too. In Seattle, Washington, over 330,000 low flow showerheads were distributed to residential customers door-to-door, saving close to 6 million gallons of water per day.[18]

Rebates by water providers to customers to buy down the incremental cost of new appliances are the most time-tested and successful way of achieving the savings available in indoor uses. Low-flow showerheads are so inexpensive, they usually are simply given away, the savings to the water provider covering the costs in little time.

Many of the conservation measures discussed above are relatively inexpensive compared with the construction of new large dams, especially those that depend on the importation of water from the West Slope.

**Other water-use efficiency measures:**

Water conservation is but one way of making existing supplies go further. Several other techniques exist. One of them is reducing the amount of unaccounted-for water (UAW), a/k/a fixing supply system leaks. Denver Water is a regional leader, reducing UAW to 6% in 2001, yet many of our water providers lag behind this benchmark.

Another such technique is re-use of water. Only about 50% of the water diverted and delivered for municipal uses is actually consumed in its initial application. The remainder returns to the stream in the form of wastewater, return flows from irrigation of lawns, parks and golf courses, and subsurface losses from the treated water distribution system. Some of this water can be reused. For example, "effluent management" utilizes municipal return flows to increase municipal water supplies. There are two ways to accomplish this goal: return flows can be treated and reused for potable and non-potable purposes; and/or return flows can be reused under substitution or exchange arrangements.

Conjunctive use of surface and groundwater, another technique, has the greatest potential in areas where some component of supply is from underground aquifers, as is the case in the south Denver metro area. Conjunctive use of surface and groundwater means that in wet years, cities rely on surface water and use "surplus" water to recharge aquifers, and in dry years, cities rely more heavily on groundwater. Overall, the goal is to stabilize ground water tables and have emergency supplies available in case of prolonged drought.

[17] Amy Vickers, "Conservation Handbook" at 145.
[18] "Regional Water Conservation Accomplishments 1990-1998," Seattle Public Utilities and Purveyor Partners.

Cooperative use of existing water supplies Excess water currently exists in some parts of the Front Range water delivery system. This water can, through cooperative arrangements, sales, leases, and other mechanisms (and with some system delivery additions) be directed to "drier" cities. With greater collaboration and cooperation among Front Range municipalities (and farmers) the entire region, and therefore the State, could find much more stability and efficiency.

Dry year-leasing can be a win-win solution for both farmers and cities. It allows farmers to lease water on a temporary basis to cities to help cities get through a dry year. Often, in drought years, farmer's stand to earn better profits from leasing their water than they would by raising crops.

Irrigation water salvage Urban water providers might be able to help farmers and ranchers implement irrigation water conservation measures, such as ditch-lining, laser-leveling and other water-saving techniques, generating water for municipalities while enabling irrigators to continue in business using less water. However, Colorado's "use it or lose it" doctrine discourages these innovations because it declares that water salvaged in this manner is not available to the irrigator or to the provider helping to conserve. Thus, no one presently has the incentive to conserve irrigation water use.

There is promise that these supply-side efficiency measures can develop water at a fraction of the cost of new, large conventional supply facilities.

**Metropolitan Water Supply Investigation Report:**

Insight into how the Denver metro area might solve its water supply needs without constructing new trans-mountain facilities is provided by the 1999 report of the Metropolitan Water Supply Investigation ("MWSI"). Initiated by Governor Romer and the Colorado General Assembly in 1993, the MWSI explores cooperative solutions to future needs of the Denver metropolitan area.

The MWSI reports that the future municipal water demand for the entire Denver metropolitan area is expected to reach 911,000 acre-feet annually (AFA) to quench the thirst of 3,269,000 people by 2045. The MWSI concludes that this will leave the Denver metro area short of meeting its needs by between 79,000 and 148,000 AFA, but that this need can made up through re-use, conjunctive use of surface and groundwater, integration of the delivery systems of the region's multiple water providers, innovative arrangements with irrigators and similar supply-side efficiency measures.

The MWSI assumed that water conservation will save 159,000 AFA by 2045, assuming only an extrapolation of conservation programs existing as of 1999. But we know we can do far better than this. If the metro area, spurred on by state water policy, redoubles its efforts on water conservation, the likelihood of needing major new trans-basin facilities is even lower than when assessed by the MWSI.

**Context of Growing Front Range Water Use: Ecology and Equity:**

After a century of agricultural, mining, municipal and other diversions, river systems in Colorado are stretched to the limit. Threatened and endangered species are found on most of our river systems. Increased demand due to population growth is threatening to be the straw that breaks the camel's back, depleting streams and imperiling fish, mammals, birds and invertebrates. Ironically, the health of the state's waterways is a star attraction for millions who have moved here and for the tourists who visit and pump dollars into our economy.

As the state deliberates over water policy options to address the drought and long-term need for water, it is essential that it take into account the impacts of its choices on the ecological health of our rivers and streams. The water conservation and other efficiency improvements that this paper discusses are typically more environmentally sound ways of meeting our urban water needs when compared with conventional structural solutions like new, large dams or new, large diversion facilities.

New large dams, wherever located, typically carry with them a very high cost, controversy, delay, and serious adverse impacts on the environment. The ill-fated proposal for Two Forks Dam, which cost water providers over $40,000,000 to plan and propose before ultimately being vetoed by the U.S. Environmental Protection Agency, is a clear example of the problems facing new dam proposals.

Moreover, in a drought, when existing dams are half-full, there is not much more water to store without wreaking serious damage on the environment. In our view, it is hard at this point to justify use of taxpayer revenues, directly or through extension of bonding authority, on these facilities when there is so much potential to meet our needs with less impact and cost through water use efficiency measures.

Some Front Range planners are looking to additional imports of water from the West Slope to solve our water problems on the Front Range, perhaps financed by the general taxpayer. However, Front Range residents need to know that water arising on the West Slope is already applied to a wide array of beneficial uses. Today's drought makes it hard for the West Slope to meet existing human and environmental needs not to mention those that may develop in the future.

In our view there is something wrong with our system of water allocation if it permits growing, wasteful use of water on the Front Range to claim even more water from western slope watersheds. It is only fair for those of us living on the Front Range to increase the efficiency with which we use existing water supplies before we use the general Colorado taxpayer to finance taking even more water from the state's Western Slope.

**Conclusions:**

We draw the following conclusions on the basis of the information in this paper:

1. There is a wide range of best-management, water-conservation practices that Front Range water providers can use to maximize use of existing water supplies. Some metro area providers are implementing some of these conservation practices already, but we could be doing much more.

2. There is also a wide range of supply-side water efficiency practices, such as better system integration, conjunctive use of surface and groundwater supplies and other measures that can stretch existing supplies even further.

3. These efficiency measures usually are superior environmentally to new dams or large-scale diversion facilities, especially those that would serve to import more water from the West Slope. Efficiency measures also have cost advantages and can be carried-out more quickly than new "structural" alternatives.

4. Colorado water policy should focus on demand- and supply-side water use efficiency as a solution to the current drought and long-term water shortages before it launches a major program to use taxpayers' money directly or our collective borrowing power on new dams and facilities, especially to import water from the West Slope.

5. How the state can encourage greater water use efficiency is a matter that deserves measured and thorough consideration by all the stakeholders involved, certainly Front Range urban water providers, West Slope interests, the Colorado Water Conservation Board, environmental organizations and many others. This consideration can take place with the prospect that a plan for such encouragement could be developed for, and reviewed in, the next, regular legislative session.