**Water Desalination Plant:**
**Is It for Arizona, the Western United States, the World - - Or Is It a Mirage Dancing in the Desert?**
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**Overview:**

The State of Arizona is working to have the federal government reopen its 'moth-balled' Water Desalination Plant (WDP) that is located on the west side of the City of Yuma, Arizona. The Water Desalination Plant (WDP) cost $280 million[1], it was completed in 1992, it operated for only 9-months, operated only at one-third capacity before being moth-balled for technological deficiencies and flooding, and it remains the largest reverse-osmosis desalting plant in the world,

The WDP is a Bureau of Reclamation facility, is called the Yuma Water Quality Improvement Center, and is one of five such specialized research stations in the United States. The WDP was built to take high salinity water (i.e., 2,700 to 3,000[2] to 6,000[3] part per million)(ppm) that is generated by the irrigation runoff waters from the Welton-Mohawk Irrigation District farming practices within Yuma County, Arizona. In comparison, the Colorado River water just below Parker Dam is about 750[4] ppm and at Morales Dam, the last dam before water goes into Mexico, is about 1,000 ppm.

The soils in the Welton-Mohawk Irrigation District are very sandy with water usage of 9 to 12[5] acre-feet (af) used on the various citrus crops compared to the Phoenix Active Management Area usage of from 3.26 af to 3.99 af for citrus crops[6].

The cost to reopen the WDP is about $30 million with an annual operating cost ranging

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[1] Shaun McKinnon, *"Dry State Will Fight to Restart Desalter*", Arizona Republic Newspaper, November 7, 2003, p. A-1 & A-6.

[2] Ibid.

[3] Frank Welsh, How to Create a Water Crisis, Johnson Publishing Company, Boulder, Colorado, 1985, p.135.

[4] Ibid, pp 215-216.

[5] Ibid, p 135.

[6] Arizona Department of Water Resources, Third Management Plan for Phoenix Active Management Area 2000-2010, Phoenix, Arizona, December 1999, Appendix 4, p 4-22.

from $24 million to $30 million per year[7]. It is hoped that the WDP will produce about 25 billion gallons of 300 ppm desalted water[8], which is roughly 76,700 acre-feet per year. One acre-foot of water equals 325,851 gallons, or equals one foot of water covering one acre. Only using the estimated annual operating costs, the desalted water will **cost from $311.00 to $392.00 per acre foot** compared to less than $10 per acre-foot paid by farmers for existing water from the Colorado River.

The 25 billion gallons, or 76,700 af, is about **0.6 percent of the Colorado River's total annual flow**[9]. Again for comparison purposes, it is estimated 286,000 af of effluent was produced within the Phoenix Active Management Area in 1995 with most coming from the City of Phoenix 91st Avenue Wastewater Treatment Plant. Of this effluent amount, at least 67,000 af/yr are being used by irrigation districts for their crops. By year 2025, the effluent amount is estimated to increase to 502,000 af, or an increase of 216,000 af from 1995.[10] Lastly, wastewater or effluent presently has about 900 ppm of salts, and major damage to crops does not occur until about 1,000 ppm[11]. Again existing irrigation districts within the Phoenix AMA are already using 67,000 af/yr of effluent for the crops. Possibly the funds for the Yuma WDP should be reallocated to using effluent for appropriate purposes.

**Water Cheaper Than Dirt:**

In the western United States, and Arizona specifically, water is not just "cheaper that dirt", **water is 100 times cheaper than dirt**(See Chart 1)[12]. The Central Arizona

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[7] Shaun McKinnon, *"Dry State Will Fight to Restart Desalter*", Arizona Republic Newspaper, November 7, 2003, p. A-1 & A-6.

[8] Ibid.

[9] Ibid.

[10] Arizona Department of Water Resources, Third Management Plan for Phoenix Active Management Area 2000-2010, Phoenix, Arizona, December 1999, Appendix 4, p 11-11.

[11] Frank Welsh, How to Create a Water Crisis, Johnson Publishing Company, Boulder, Colorado, 1985, p.136-137.

[12] Salt River Project, *"SRP Board Sets 2004 Allocation and Fees"*, News for SRP Agricultural & Other Urban Shareholders, Winter 2003, p. 1. [NOTE: The SRP water assessment of $21.00 per acre provides 2 acre-feet (af) of water per acre, or $10.50/af of water in drought Year 2004. However, in typical non-drought years, there are 3 af of water per acre delivered, which means the cost per af is $7.00 per acre-foot of water.]

# CHART #1:
# WATER CHEAPER THAN DIRT FACTOR

| DIRT | SRP[12] $7.00/a-f | SRP[12] $10.50 / a-f | CAP AgSP $28.00/a-f | CAP LTAg $74.00/a-f | CAP M&IE $106/a-f | CAP Tuc GWRD $199/a-f |
|---|---|---|---|---|---|---|
| $3.00/Yd$^3$ | 690 | 461 | 173 | 65 | 46 | 24 |
| $5.00/Yd$^3$ | 1,150 | ***768*** | 288 | 109 | 75 | 40 |

LEGEND:
SRP = Salt River Project
CAP = Central Arizona Project
AgSP = CAP Agricultural Settlement Pool
LTAg = CAP Long Term Agricultural, and Municipal & Industrial Water
M&IE = CAP Municipal & Industrial Excess Water
TucGWRD = CAP Tucson Groundwater Water Replenishment District

Given: 1 Acre-Foot (a-f) = 43,560 Cubic Feet
1 Cubic Yard ($Yd^3$) = 27 Cubic Feet

Given: Dirt at $5.00/$Yd^3$ = 18.51 Cents per $Ft^3$
SRP water at $10.50/a-f = 0.0241 Cents per $Ft^3$

**Therefore:**

**SRP water is 786 times CHEAPER THAN DIRT!!**

Project [CAP] Agricultural Settlement Pool water costs $28.00[13] per af while dirt costs from $3.00 to $5.00 per cubic yard[14]. After going through the math, the CAP Long Term Agricultural (LTAg) and Municipal & Industrial (M&I) Excess water is about $0.000643 per cubic foot compared to dirt cost of $0.1111 to $0.1851 per cubic foot. Most agricultural water in Arizona costs from less than $10.50 per af (Yuma & SRP area) to $28.00 per af (CAP Agricultural Settlement Pool) water. These agricultural water costs are **much less** than the CAP LTAg and M&I (i.e., $74.00 per af) water costs; therefore water gets much, much cheaper than dirt!! **The estimated 'operational' water cost for the Yuma WDP ranges from $311.00 per af to $392.00 per af**. The farmers will not use nor can they afford this desalted water.

**Arizona Water Usage:**

In 2000, Arizonans used about 6.8 million acre-feet (maf) of water with 1.08 million af used for all residential and industrial water use (16%); power plants and mines (4%); other (1%). In 2000, Arizona agriculture used 5.37 million acre-feet or 79%.[15] Historical data shows Arizona water usage was 7.1 maf in 1957 (96% agricultural); 8.2 maf in 1973 (92% agricultural); and 6.3 maf in 1990 (78% agricultural)[16]. Essentially, Arizona is averaging about 7.0 maf of water per year over a fifty year period.

The Yuma area, known as the Lettuce Capital of the United States, has entitlement to 1.2 million acre-feet (maf) of Colorado River water for its 231,000 crop acres[17], which averages 5.19 a-f of water per year.

According to the Arizona Water Commission (predecessor of the Arizona Department of Water Resources), "The amount of groundwater stored under central Arizona is 627,000,000 while the total amount in storage under the entire state is 1.19 billion acre

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[13] Central Arizona Project, *"Delivery Rates For Various Classes of Water Service"*, February 29, 2004, website (http://www.CAP-AZ.com/management).

[14] Catherine Reagor, *"Contractors Pay Plenty to Buy, Sell Construction Earth"*, Arizona Republic Newspaper, May 1, 1999, p E-1 & E-3.

[15] Shaun McKinnon, *"Tribes Gain Water, Voice in State Future"*, Arizona Republic Newspaper, March 24, 2002, pp A-1, A-10 & A-11.

[16] Joel Nilsson (editorial), *"Valley Should Give Water its Due"*, Arizona Republic Newspaper, December 3, 2000, p B14

[17] Don Pope, Manager of the Yuma County Water Users' Association, comments at the *"Water 2025 Conference: Preventing Crises and Conflict in the West"* public meeting by U.S. Department of Interior - Bureau of Reclamation, Phoenix, Arizona, July 8, 2003.

feet. The capacity of the 13 largest reservoirs in the nation is 175 million af, and the more than 1,500 largest man-made reservoirs is less than 400 maf[18]".

Of the 627,000,000 af of groundwater under central Arizona, 154,600,000 af are under Phoenix area. According to the Arizona Department of Water Resources, the "projected (groundwater) overdraft (in the Phoenix Active Management Area[AMA]) will increase from over 360,000 af in 1995 to over 471,000 af by the year 2025[19]". What this means is that the **Phoenix AMA has at least 328 years to learn to live within its natural water supplies**. Pima County, where Tucson is located, has enough groundwater for its overdraft to last from 383 to 800 years[20]. Keep in mind that both these estimates are based on groundwater to a depth 1,200 feet - - - there is more known potable water below these depths with the depths going to 8,000 to 9,600 feet[21] under the Phoenix AMA and central Arizona regions. The implications of this groundwater reserve information is that central, southern and western Arizona has one of the best groundwater reserves in the world. Arizona is not going to dry-up and blow away even when it is hit with an extended drought lasting up to 22 to 26 years, which has occurred twice within the last 1,500 years[22].

**Economics of Water in the Western United States:**

The western United States is famous for its gross misuse of its water resources because water is so cheap, subsidized by the federal government, and not being reallocated to more appropriate use because of the "Law of the River" premise. For example, even today, "Most irrigation water delivery canals in the West are currently

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[18] Frank Welsh, How to Create a Water Crisis, Johnson Publishing Company, Boulder, Colorado, 1985, p.196.

[19] Arizona Department of Water Resources, Third Management Plan for Phoenix Active Management Area 2000-2010, Phoenix, Arizona, December 1999, p 11-18.

[20] Frank Welsh, How to Create a Water Crisis, Johnson Publishing Company, Boulder, Colorado, 1985, p.196.

[21] Arizona Department of Water Resources, Third Management Plan for Phoenix Active Management Area 2000-2010, Phoenix, Arizona, December 1999, p 2-10 thru 2-16.

[22] Laboratory of Tree Ring Research (Dendrochronology), University of Arizona [NOTE: Unable to find specific reference material, but I read an article about these droughts. May want to contact Director Tom Swetnam in Tucson, Arizona, or Bob Logan, Senior Director of Development, College of Science, phone #1-520-621-4015.]

unlined"[23] with lining reducing seepage by up to 50 percent. Some classic studies documenting water follies in the West include *The Politics of Water in Arizona* (1963) by Dean Mann, who was forced to leave Arizona once the book was published; *Water Supplies and Economic Growth in an Arid Environment* (1973) by Maurice M. Kelso, William E. Martin, and Lawrence E. Mack; and *An Economic Analysis of the Central Arizona Project: U.S. Bureau of Reclamation* (1978) by Thomas M. Power, Chairman, Economics Department, University of Montana.

The Law of the River premise (precedent) was established when the West was initially being settled when lives, families and whole communities were being scrapped out of barren, desolate, and parched lands. Whoever used 'surface water' first for beneficial purposes, they established for themselves top priority for surface water use in times of drought over persons that used surface waters after them. The Law of the River might have been appropriate for those pioneer and early development times. However, the Law of the River doctrine has caused wasteful agricultural water usage today, flood irrigated lawns in Phoenix and spits-in-face of the American concept of no taxation without representation!

Two examples of the lack of representation include 400 agricultural businesses (farmers) of California's Imperial Irrigation District holding the rights to more water (2.6 million acre-feet) from the Colorado River than the entire States of Nevada (0.3 maf) plus New Mexico (0.843750 maf) plus Wyoming (1.04 maf). How many people live in these 3 States compared to 400 farmers? Or how many non-farming Californians equal these 400 farmers water usage? This Imperial Irrigation District water allocation (2.6 maf) is almost equal to the State of Arizona's (2.85 maf) of Colorado River water; yet Arizona has a population of about 5.5 million people versus Imperial's 400 farmers. You can not get much further from American principles than this Law of the River! **The Law of the River needs to be eliminated and replaced with a more representative and market allocated (within limits) water usage system**.

The second example is the Salt River Project where Board membership is based on one acre owned - then you have one vote rather than one person - one vote. Therefore one farmer owning 100 acres is equivalent to 500 urban land owners (presuming one home per 1/5th acre). Oh, renters have no vote since they do not own any land! It is tough for any candidate running for office to overcome a 500 to 1 voting advantage, especially if they want to reallocate waters from farm usage to non-farm usage or it they want to increase water rates to allow market to reallocate water usage. Corporate farmers do not like higher water costs since they are the biggest water users.

To highlight that laws, and precedents can be changed, I will use Arizona as an example

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[23] *"Water 2025 Conference: Preventing Crises and Conflict in the West"* public meeting material quote on "Conservation, Efficiency, and Markets" page by U.S. Department of Interior - Bureau of Reclamation, Phoenix, Arizona, July 8, 2003.

regarding water laws. In 1980, the Arizona Legislature passed the 1980 Arizona Groundwater Law that changed the long held Arizona (western) belief that if you owned the land, you owned the groundwater under it. This 1980 groundwater law was challenged as unconstitutional and a taking of private property (i.e., groundwater) without compensation. The Arizona Supreme Court decided that it was not a takings since "groundwater was a public good" (not private property) owned by the Arizona public - not by individual landowners. The landowner can use the groundwater within constraints if they can afford to pump it, but they do not own the groundwater. The Court likened it to the air since we all can use it as a 'public good', but no person or corporation owns it. The Law of the River should be changed so "surface waters" are a "public good" too - not a private property right.

**Alternative Uses for These Yuma Water Desalination Plant Monies:**

The Yuma WDP will require $30 million to restart plus $24 to $30 million per year to operate. So what can be done with the first $54 million rather than restarting the Yuma WDP?

The three books listed above by Mann, Kelso, and Power provide a variety of ways to reduce water usage while continuing to exist in an arid environment. In addition, a 1983 Congressional Budget Office study titled, *Public Works Infrastructure: Policy Considerations for the 1980's*, April 1983 noted "Water projects are not the most efficient investments to stimulate jobs or counter cyclical economic developments".

Some alternatives include:

1. Require that all irrigation water delivery canals be lined in the West to save 76,700 af per year of seepage, which equals the annual Yuma WDP output.
2. Fund the Bureau of Reclamations Fiscal Year 2004 budget request of $11 million for the Western Water Initiative[24] **and eliminate need (save) $43 million**, which is the first step in laying the foundation for addressing current and future water needs in the West. I would modify the first of six principles to say, "Recognize and respect ... to use water, AND CHANGE OR MODIFY INSTITUTIONAL ARRANGEMENTS WHEN NEEDED TO EFFECT BETTER WATER STEWARDSHIP." [NOTE: This means to address the issue of the Law of the River changes.] In addition, a seventh principle should be added, "CHANGE DEMAND RATHER THAN TRYING TO INCREASE WESTERN WATER SUPPLIES".
3. Buyout and retire 10,800 acres of Welton-Mohawk irrigated farm lands at a maximum of $5,000 per acre. It is likely farm land will be in the $2,500 to $5,000

[24] Ibid, page "Preventing Crises and Conflict in the West".

per acre range[25] The land purchased needs a history of using 7.1 af per year.

4. Invest the monies $54 million in the (Arizona) International Genomics Consortium project - now called the Translational Genomics Research Institute, to find plants that do not use much water to grow.
5. Invest the monies in the agricultural usage of the University of Arizona - Arid Lands Studies "Environmental Greenhouses" that produce tomatoes that use **1.0 percent** of the water that an open field tomato needs. They have a variety of other water thrifty crops that can be used today in Arizona. Currently, these tomatoes called Euro-Fresh, or Nature Sweet can be bought at Safeway and Albertson for about twice the cost of open field tomatoes; yet people are buying them. Agriculture in the West could save immense amounts of water by converting to these types of crops, or by using bits-and-pieces of the Arid Land Studies technologies,
6. Invest monies in developing Optics Valley from Tucson thru Phoenix to Flagstaff to find technologies and process improvements to reduce or eliminate water requirements in agriculture, industry, and residential activities, and finally,
7. Invest monies to reclaim, and reuse wastewater effluent within Phoenix, Tucson, Yuma or sub-division size developments. Studies show that wastewater facility projects produce about 30% more jobs than Bureau of Reclamation Water projects.

I could go on but it is time to close.

**Conclusion:**

The Yuma Water Desalination Plant is a waste of federal, state and local monies. With limited federal funds, the federal government needs to focus on projects that are "cost effective". Cost effective means that you take all the potential projects that have a positive cost/benefit analysis and select the one with the highest cost/benefit analysis first. You do this so you get the biggest bang for the buck. With huge federal deficits projected over the next 10 years, the federal focus should be **"cost effectiveness"** - not cost/benefit selection!

Although I believe in "basic" research for the sake of research, this Yuma WDP is an "applied" research project. Therefore these funds could be spent on more promising alternative research listed above - with far higher water savings potential for the West, the nation, and the world.

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[25] Ron Rayner, former president of Arizona Cotton Growers Association, comments about Imperial Irrigation District farm land values at the *"Water 2025 Conference: Preventing Crises and Conflict in the West"* public meeting by U.S. Department of Interior - Bureau of Reclamation, Phoenix, Arizona, July 8, 2003.