A Cross Texas Water Grid: Key Challenges & Costs

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24 April 2025

1968 Was a Year For Thinking Big About Water

"***Next to the air we breathe, water is our most precious resource***."--President Lyndon B. Johnson, 30 September 1968 Remarks Upon Signing the Colorado River Basin Project Act.

LBJ was talking about the Central Arizona Project, a 336 mile canal system to bring 1.6 million acre-feet/year of Colorado River water into the Phoenix metro area and central Arizona. The project ultimately required 12 years from commencement of construction to delivery of first water to customers.

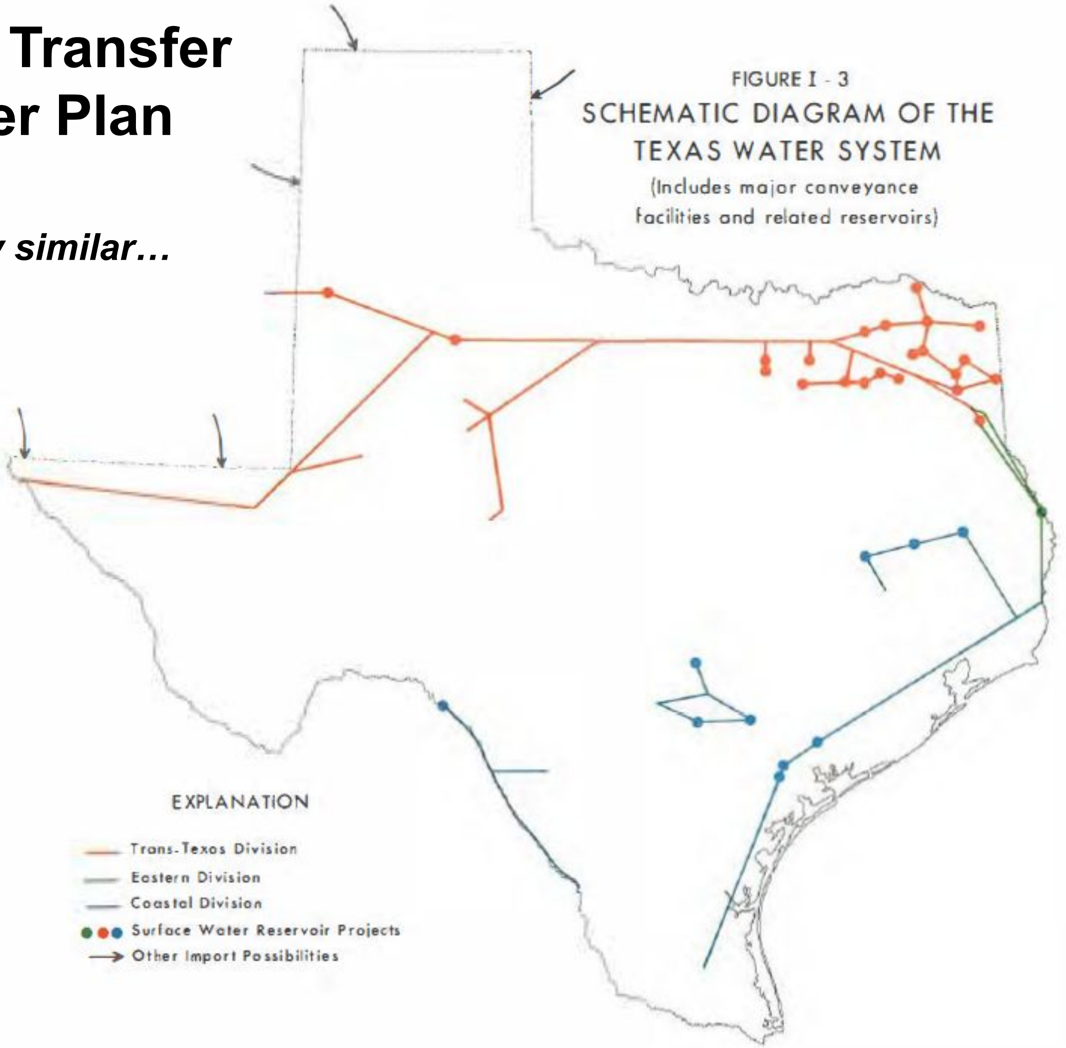
Texas 1968 Water Plan contemplated a far bigger set of projects that would deliver nearly 10X as much water over a transport grid several times longer.

Sources: Johnson, Lyndon B. "Remarks Upon Signing the Colorado River Basin Project Act." September 30, 1968. https://www.presidency.ucsb.edu/documents/remarks-upon-signing-the-colorado-river-basin-project-act.; Thomas W. McGann, "Arizona's Water & Power Plan: CAP and Hoover," Central Arizona Project, 5 April 2013, http://2017.powerauthority.org/wp-content/uploads/2013/03/CAP.pdf

Texas Contemplated Big Transfer Projects in the 1968 Water Plan

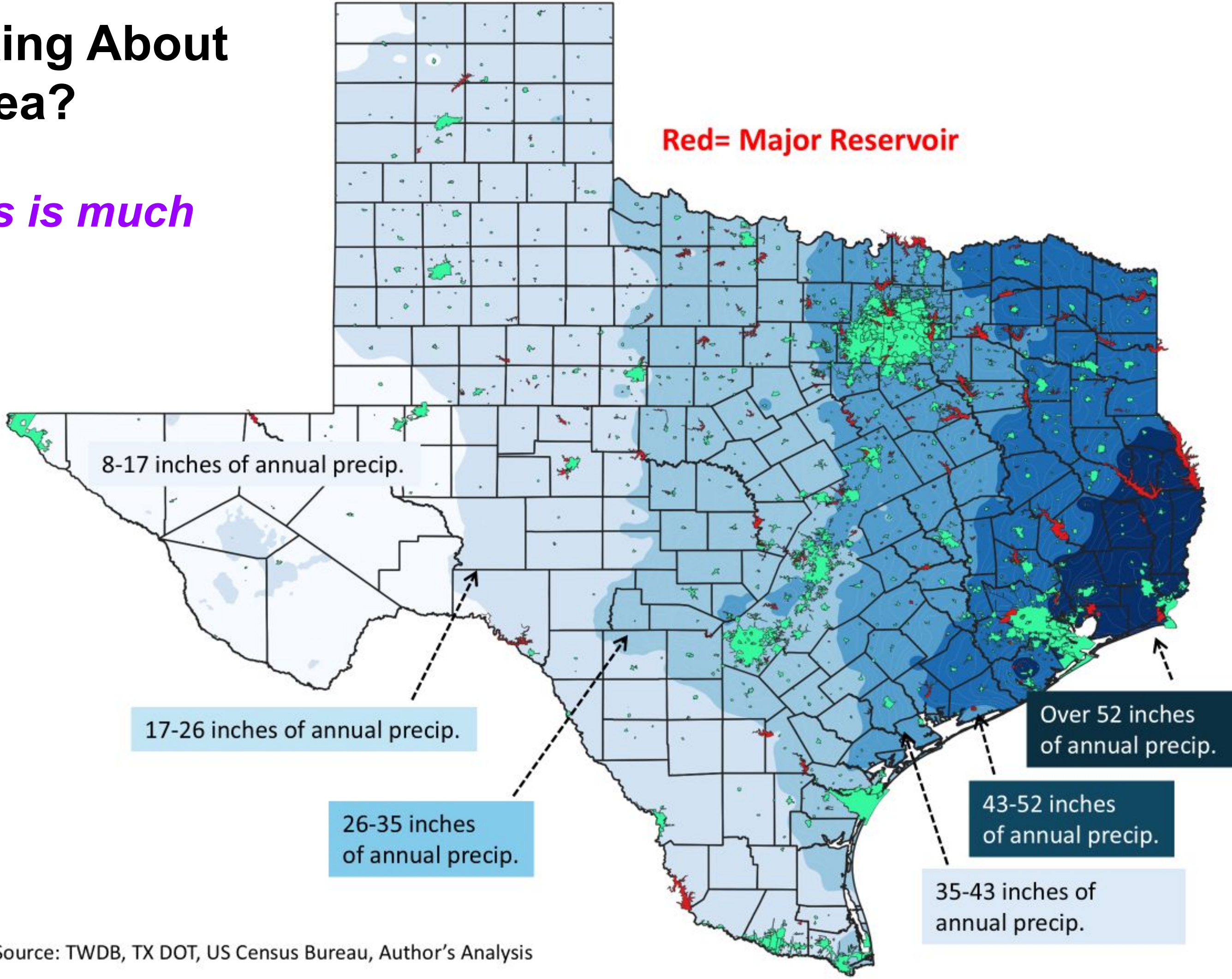
And the current concept looks awfully similar…

- **‘68 plan intended to move 16 million acre-feet/year combined through the Trans-Texas and Coastal Systems shown in the schematic**
- **Almost 7 million AF/yr would be intended for West Texas, primarily for irrigation in the South Plains**
- **Even contemplated diversion of flood flows from Mississippi River into NE Texas**



Why Are We Even Talking About This Water Transfer Idea?

Hint: Because East Texas is much wetter than the West!



Source: TWDB, TX DOT, US Census Bureau, Author's Analysis

Note that the precipitation gradient only reflects cumulative annual averages and does not capture increasing rainfall volatility.

It is Good That Key Policymakers are Thinking Big About Water…The Stakes Are Existential For Texas

If recent experience is any guide, major Texas metro areas typically produce about $1 in economic activity per gallon of local water supply. At that ratio, every 100,000 AF of incremental water supply can potentially underwrite more than $30 billion' worth of economic activity.*

*Collins, Gabriel. "Prospective Costs and Consequences of Insufficient Water Infrastructure Investment in Texas." Texas 2036, November 19, 2024. https://texas2036.org/wp-content/uploads/2024/11/Prospective-Costs-and-Consequences-of-Insufficient-Water-Infrastructure-Investment-in-Texas_11182024_FinalCover.pdf (52)

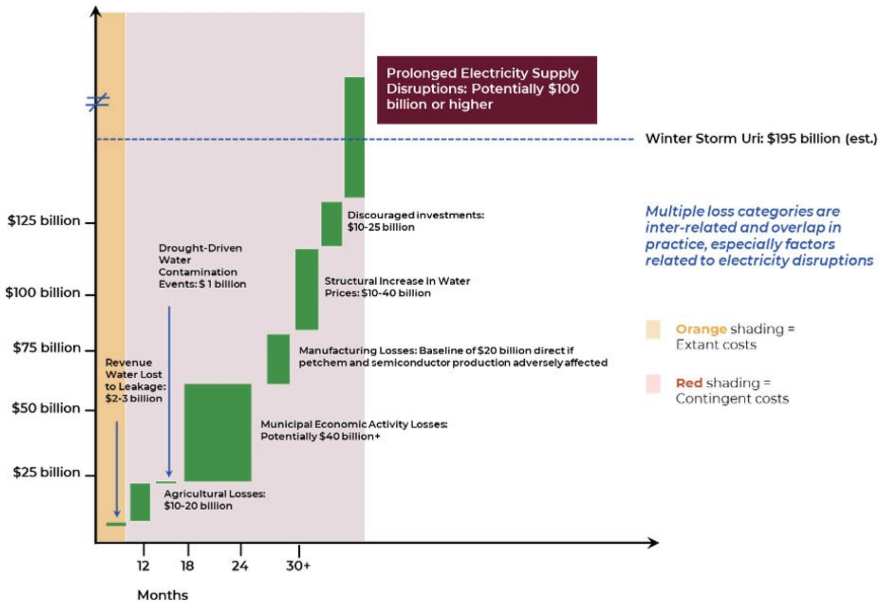
Despite Challenges, Reflects Important Attention to Infrastructure

More folks are finally thinking big about water infrastructure in Texas–good!

The costs of a prolonged drought could existentially threaten our growth, prosperity, and security. Infrastructure investments are needed to pre-empt these risks.

Potential Annual Costs of Severe Drought in Texas, Billion USD

Note: Impacts shown in approximate order they would be expected to manifest



Source: Author's Estimates based on data from US BEA, EIA, ERCOT, SAWS, Texas Municipal League, TWDB. Municipal economic activity loss assessment is based on Wichita Falls' annual GDP loss estimates from 2011-2015. Discouraged investment assumes that two Micron or Samsung-sized firms each year choose to invest somewhere else due to water concerns. Manufacturing losses: assumes $50 million/day of losses sector wide. Value of lost electrical load assumes that 1/8 of dispatchable power base derates by 50% and that it would have run at 40% nameplate utilization, 6-mo timeframe, Value of Lost Load over long-duration assumed to be $13.5k per MWh based on Brattle Study on Value of Lost Load in Texas, 22 August 2024,

But The Challenges Are Huge and a Cross-Texas Water Grid Is Likely Not The Best Approach

5 Critical Challenges

1. Distance & Elevation
2. Massive Electricity Demand
3. Interbasin Transfer rules
4. Incongruent With Locations of Highest Prospective Future Demand Growth
5. <u>Cost of the water–who pays and how much?</u>

Challenge #1: Distance & Elevation

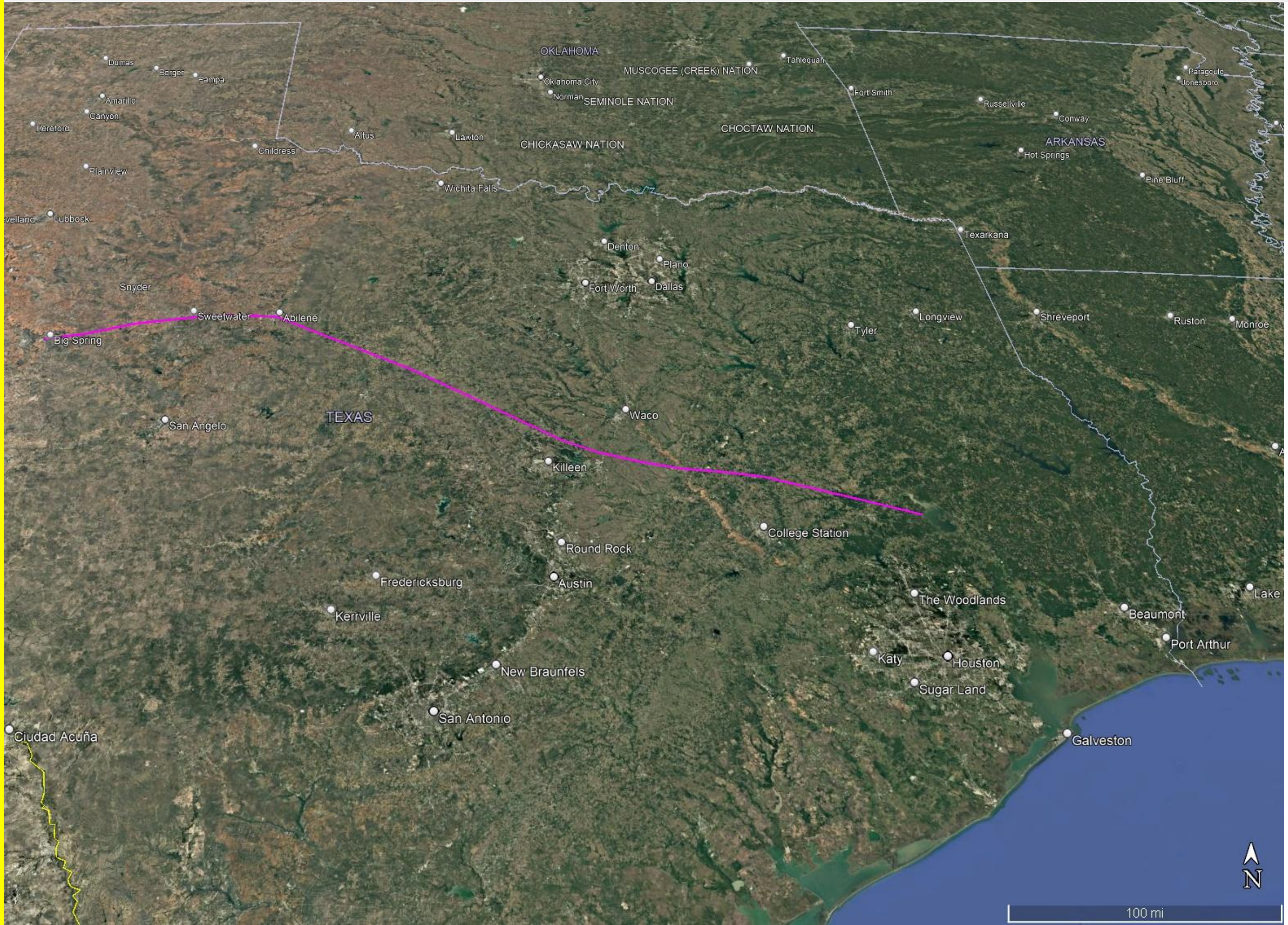
One Possible Route

- **<u>Why this one?</u>**

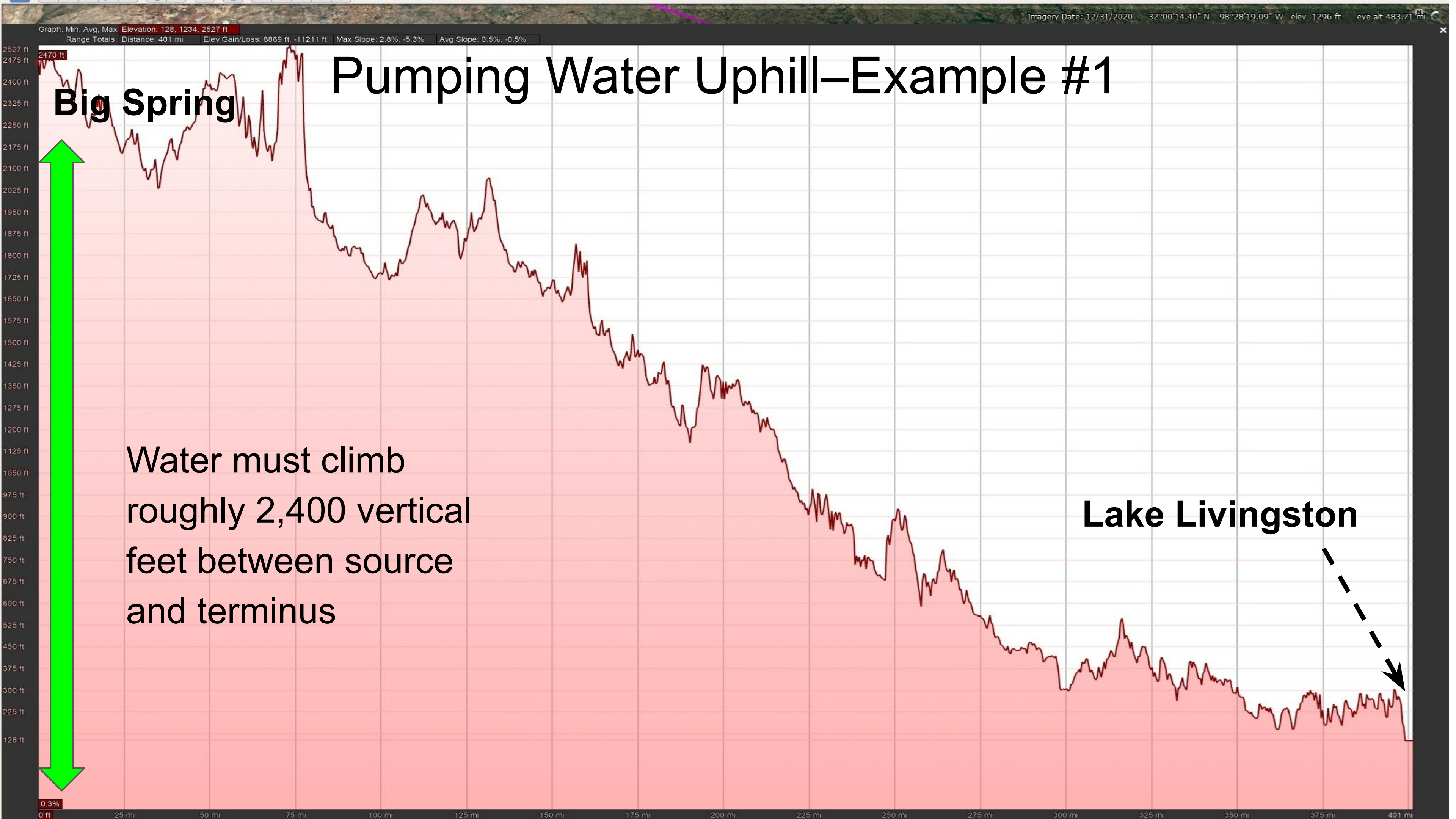
Lake Livingston is Houston's largest water rights pool

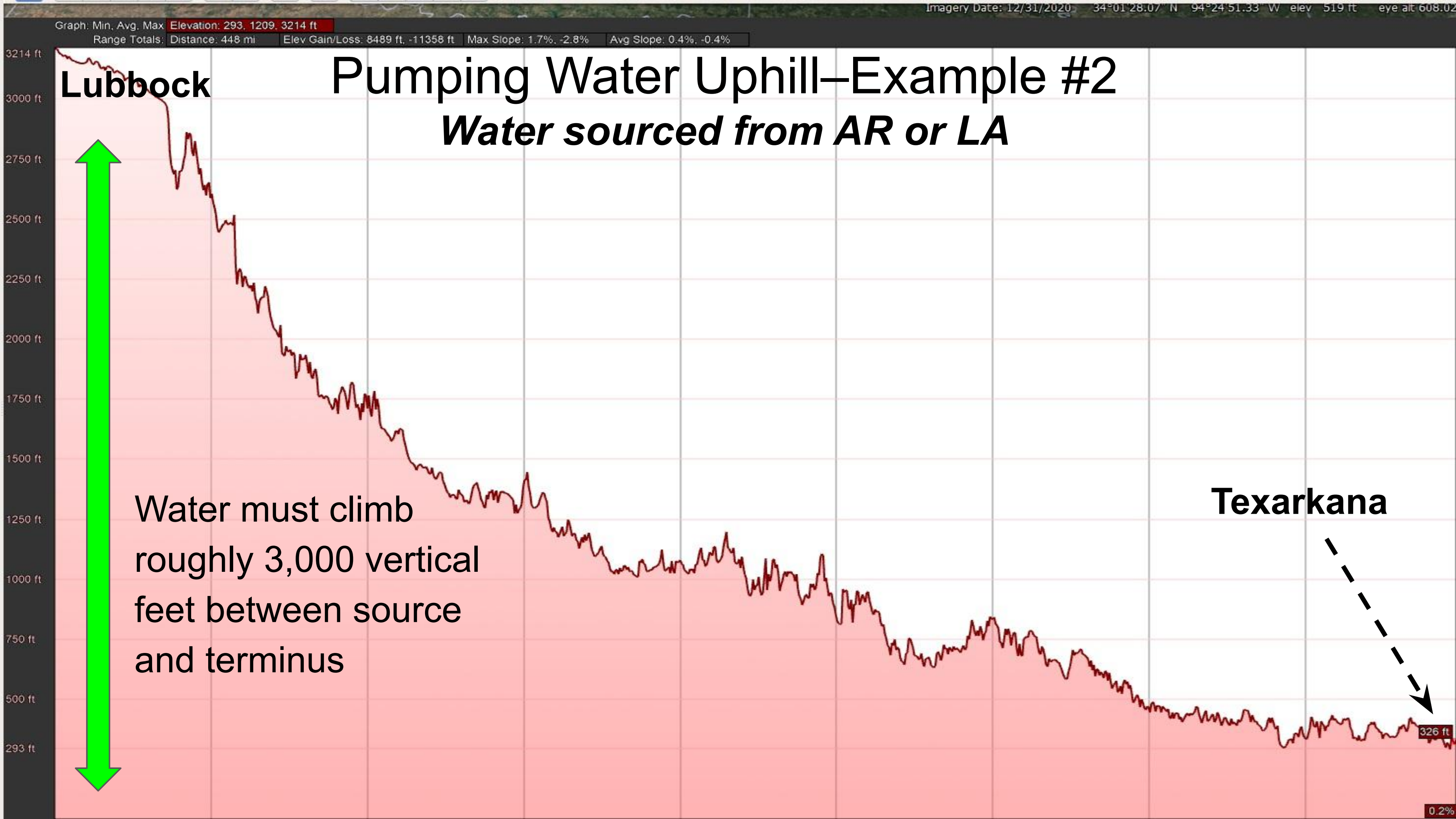
Can roughly follow the contours of Texas Hwy 36 and IH-20

Optimized for municipal and industrial supply: Terminus at Big Spring would allow interconnection with the 600 route mile CRMWD pipeline system that already extends to Midland, Odessa, and San Angelo

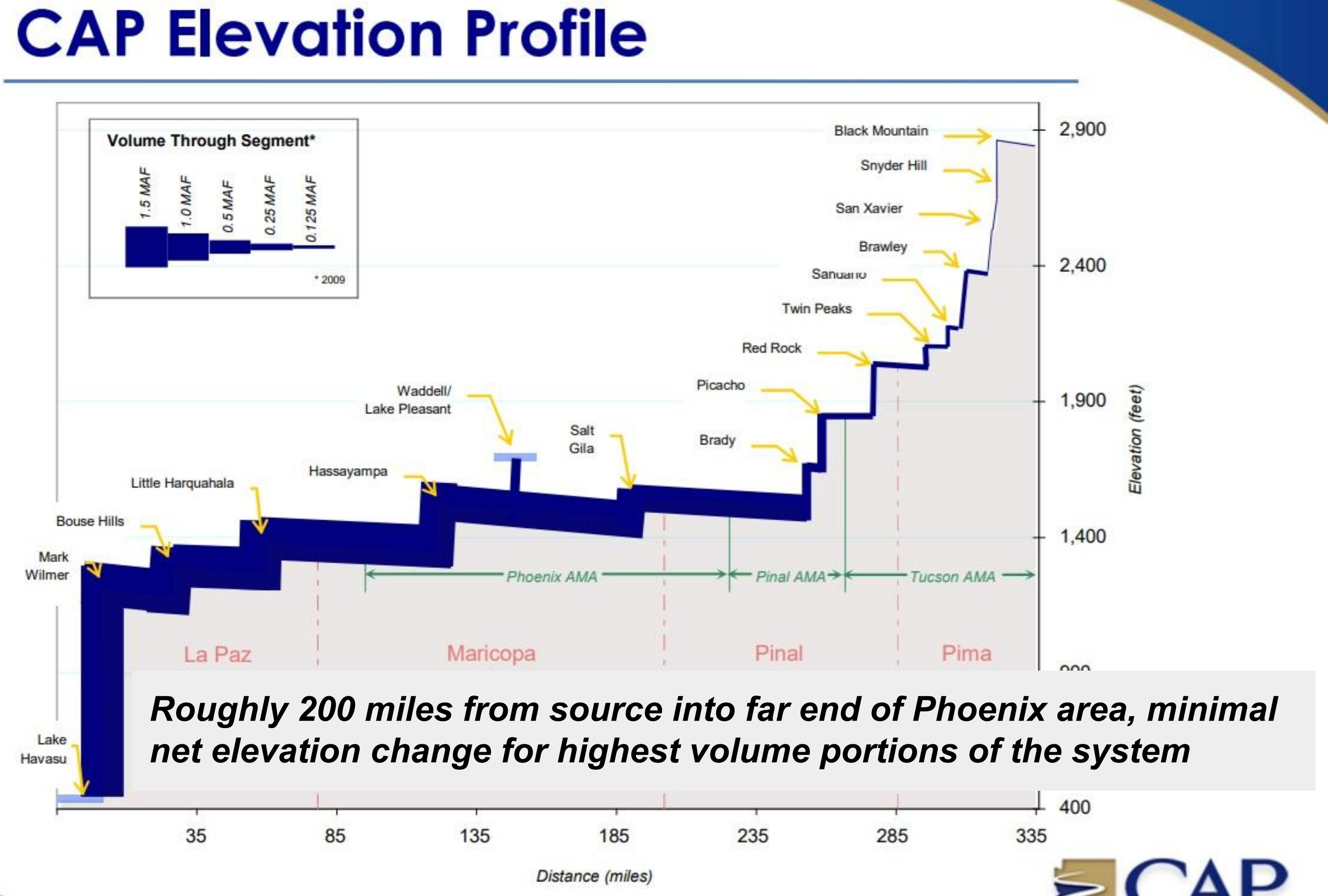


Pumping Water Uphill–Example #1




Pumping Water Uphill–Example #2
Water sourced from AR or LA
Imagery Date: 12/31/2020 34°01'28.07" N 94°24'51.33" W elev 519 ft
Graph: Min, Avg, Max Elevation: 293, 1209, 3214 ft
Range Totals: Distance: 448 mi Elev Gain/Loss: 8489 ft, -11358 ft Max Slope: 1.7%, -2.8% Avg Slope: 0.4%, -0.4%
3214 ft
3000 ft
2750 ft
2500 ft
2250 ft
2000 ft
1750 ft
1500 ft
1250 ft
1000 ft
750 ft
500 ft
293 ft
Lubbock
Water must climb roughly 3,000 vertical feet between source and terminus
Texarkana
326 ft
0.2%

A More Desirable Elevation Profile For a Long Distance Water Transfer Project

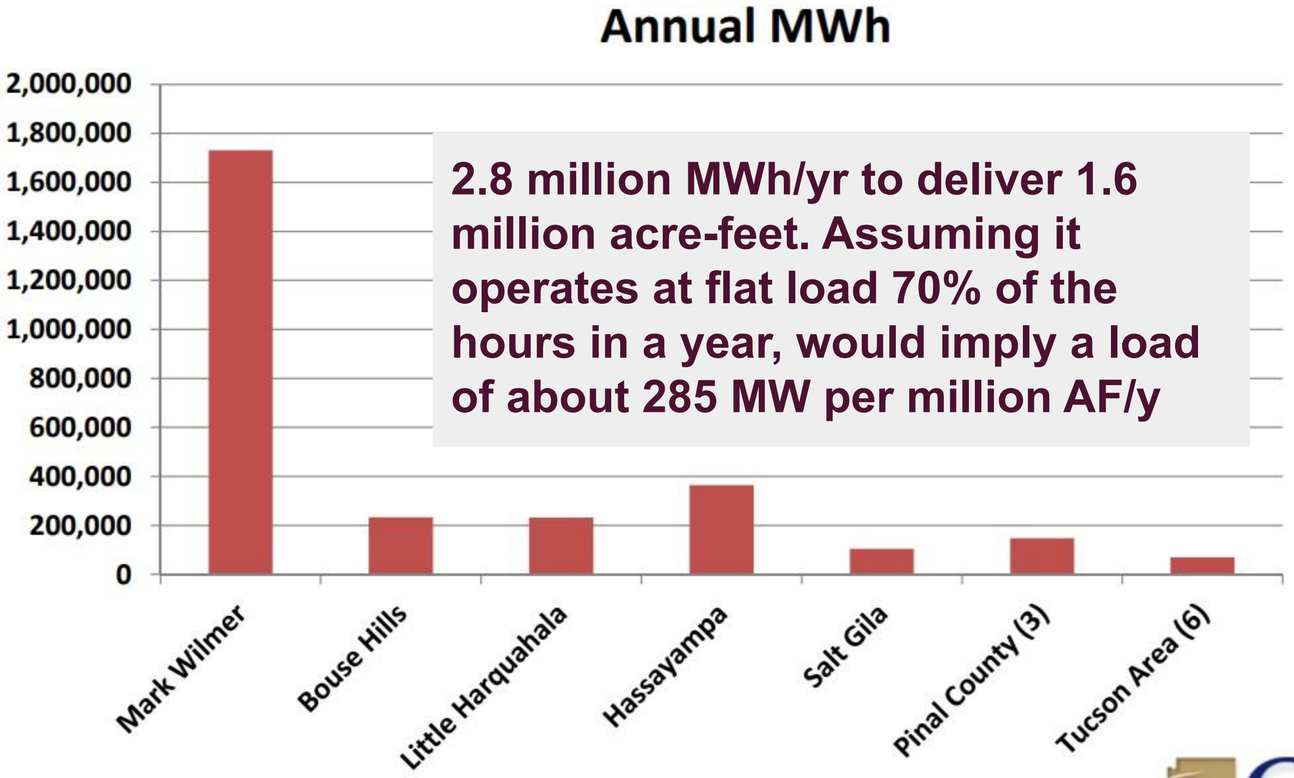


Source: http://2017.powerauthority.org/wp-content/uploads/2013/03/CAP.pdf

Challenge #2: Electricity Demand

Energy Use by Pumping Plant

Central Arizona Project is Likely the State's Single Largest Power User



2.8 million MWh/yr to deliver 1.6 million acre-feet. Assuming it operates at flat load 70% of the hours in a year, would imply a load of about 285 MW per million AF/y

A Cross-Texas Water Grid Would Likely Be the Largest Single Power User in Texas

CAP CENTRAL ARIZONA PROJECT

Potential Electricity Needs

1968 Plan Estimates

> Thus, the Texas Water System would require a total of approximately 6.9 million kilowatts of electrical power when fully operational. These estimated power requirements for various segments of the System are given in Table I-3. This projected total requirement for the System represents about 37% of the present (1967) electrical power generating capacity of the State.

6.9 Gigawatts

A Contemporary Cross-Texas Water Grid

I do not conclusively know but suspect they would be at least as large. Adding 7 GW of firm power to the Texas grid would be a major undertaking.

It's enough electricity to power 70 steel mills (worth thinking about in a state where manufacturing is expected to grow) or a similar number of high-performance computing data centers (worth thinking about in a state that is also a digital economy champion).

The power generation CAPEX would be at least $5.3 billion if natural gas power plants filled the need, based on latest available EIA data of $764/kW construction cost for gas combined cycle plants (https://www.eia.gov/electricity/generatorcosts/)

Challenge #3: Interbasin Transfer Rules

Surface Water Sent East-to-West Would Instantly Make Its Rights Holders the Most Junior in That River Basin

Sec. 11.085. INTERBASIN TRANSFERS. (a) No person may take or divert any state water from a river basin in this state and transfer such water to any other river basin without first applying for and receiving a water right or an amendment to a permit, certified filing, or certificate of adjudication from the commission authorizing the transfer

…

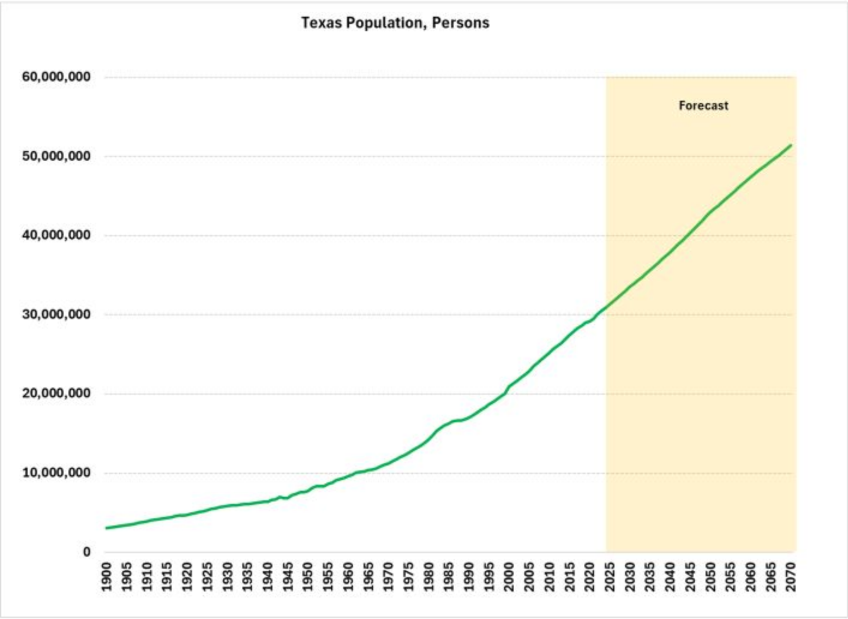
(s) Any proposed transfer of all or a portion of a water right under this section is junior in priority to water rights granted before the time application for transfer is accepted for filing.

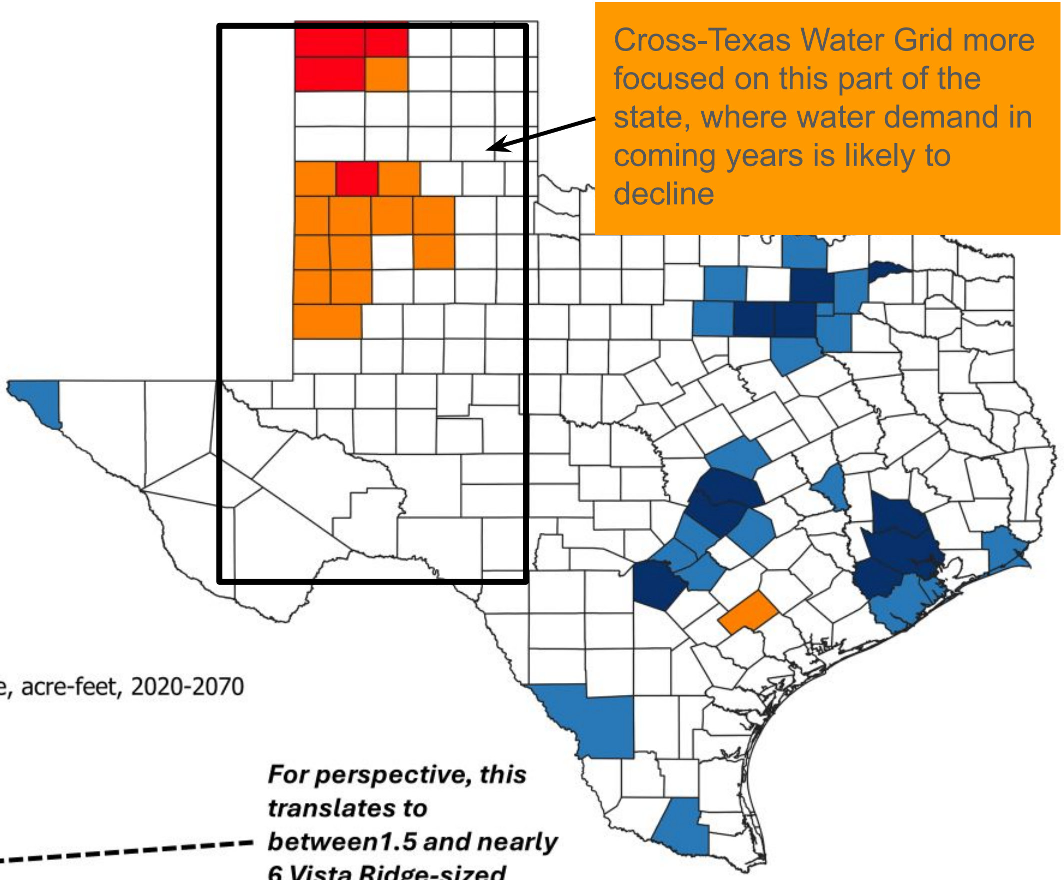
Key poison pill to discourage such transfers because the senior rights holders are often the ones with large enough and sufficiently dependable rights positions to actually supply a long-distance transfer project

Is the Legislature ready to revisit interbasin transfer rules for surface water? This could get very interesting…

Challenge #4: Emphasis Not On Core Demand Growth Areas

Water Demand Growth Concentrated in About 15 Core Counties—Primarily in the Triangle





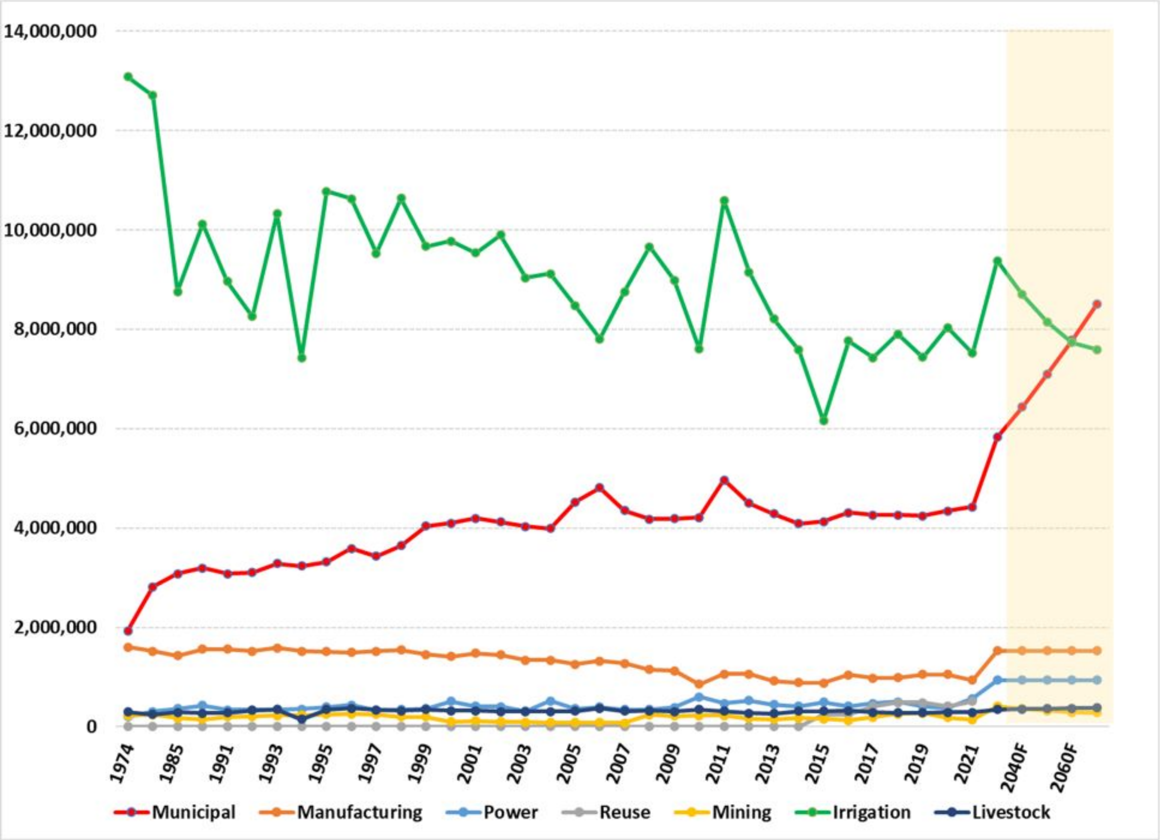
County Water Demand Change, acre-feet, 2020-2070

- -176,882-to- -120,626
- -120,626 -to -30214
- -30,214 -to +22,161
- 22,161 -to- 79360
- 79,360 -to- 283,426

For perspective, this translates to between1.5 and nearly 6 Vista Ridge-sized supply projects

Source: Texas Demographic Center, State Water Plan 2022, Author's Analysis

Water Consumption Becoming Far More "Firm" As Municipal Share of Demand Increases



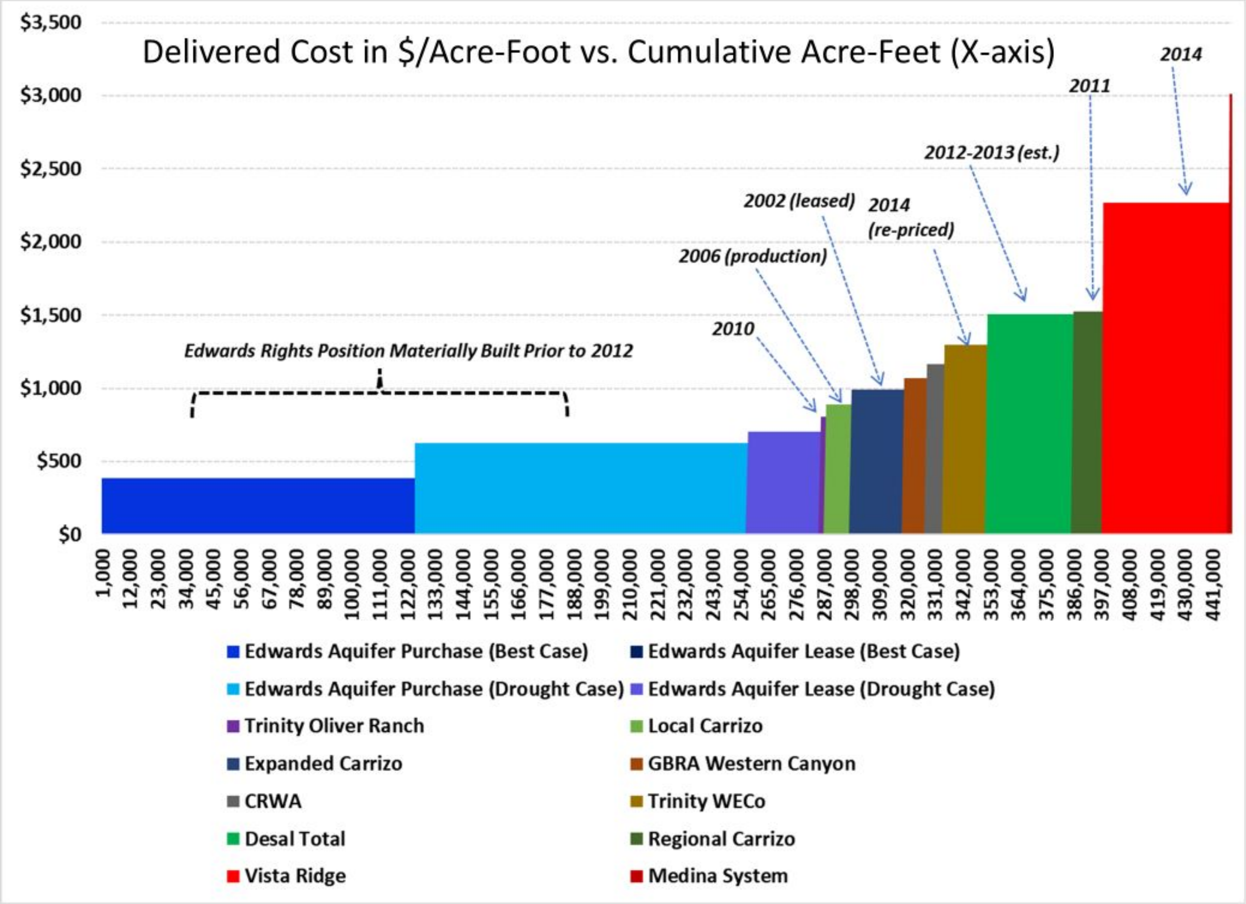
- Agricultural Use Falls While Municipal Use Projected to More Than Double by 2070
- "Municipal" usage also almost certainly includes a fair degree of commercial and industrial usage since such users in many cases draw water from city systems.

Challenge #5: Cost

Water From a 600 mile pipe moving 400,000 Acre-Feet Year Could Cost Approximately $4,000/AF Delivered to Customers–Likely The Most Expensive Bulk Water in Texas

	Payback Amount	Water Volume Delivered, AF	Capital Cost/AF		Transfer System Capital Cost			Interest Rate	Term (Yrs)
Year-1	-$1,453,489,383	0	#DIV/0!		Miles	600		6.50%	30
Year-2	-$1,453,489,383	0	#DIV/0!		$/mile	$22,235,817			
Year-3	-$1,453,489,383	0	#DIV/0!		Total est project cost	$13,341,490,206			
Year-4	-$1,453,489,383	0	#DIV/0!						
Year-5	-$1,453,489,383	200,000	-$7,267		Houston Gulf Desal Capital Cost				
Year-6	-$1,453,489,383	400,000	-$3,634						
Year-7	-$1,453,489,383	400,000	-$3,634		**De-salination offset capital cost**	Corpus Christi Inner Harbor			
Year-8	-$1,453,489,383	400,000	-$3,634		33,604	AF/Y			
Year-9	-$1,453,489,383	400,000	-$3,634		$758,000,000	capital cost			
Year-10	-$1,453,489,383	400,000	-$3,634		$22,557	$/AFY			
Year-11	-$1,453,489,383	400,000	-$3,634		$5,639,156,575	cost for 250 KAFY offset capacity			

Water Getting More Expensive: SAWS Water Sourcing Price and Vintage Curve



Source: San Antonio Water System, Author's Analysis

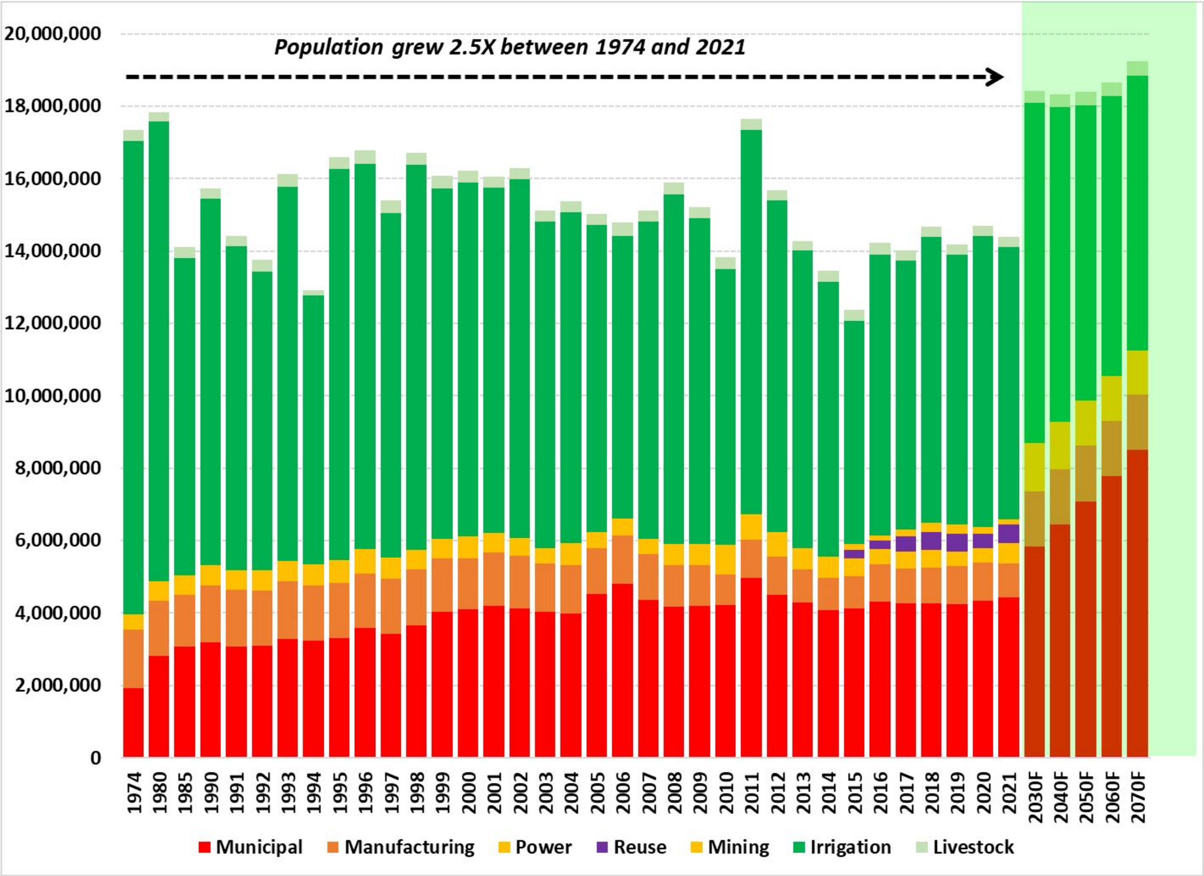
- Water is becoming more expensive for San Antonio as it seeks water sources further afield or through higher cost local sources such as brackish desalination
- Distance and the associated infrastructure costs play a major role in cost inflation.
- **This trend is likely to repeat for other cities in the Texas Triangle.**
- **If, for instance, Austin and its suburbs had to revise water sourcing approaches due to prolonged drought amidst continuing robust growth, it would face the prospect of moving from low-cost Colorado River legacy rights to much more expensive alternatives like imported groundwater and desalination.**

1968 Water Plan Was Shelved, Yet Texas Became an Economic Superpower

The 1968 Water Plan Was Shelved and Yet Texas Succeeded. Why?

- We used water better
- Texas industrialized
- Farmers switched crops and improved water efficiency
- The 1970s energy price spikes made groundwater pumping more expensive
- The Edwards Aquifer and Lower Rio Grande Valley marketized their water allocation systems

Annual Water Use, Acre-Feet



Water Security Alternatives to a Cross-Texas Grid

Water Recycling and Reuse

*San Antonio Water System. "Recycled Water Program." San Antonio Water System. Accessed July 28, 2024. https://www.saws.org/your-water/management-sources/recycled-water-program/

Water recycling or re-use represents another low-cost option. The San Antonio Water System proactively pursued water recycling beginning in the mid-1990s now runs one of the largest direct water recycling systems in the United States, capable of supplying 25,000 AF/year.*

As treatment technologies improve, oilfield produced water may also become an additional unconventional supply source. The Legislature could accelerate this process by encouraging more comprehensive analysis of oilfield waters–perhaps by a consortium of Texas universities–and making data available to the public. These are the first steps to building public support and voter buy-in for potentially incorporating treated oilfield waters for at-scale use beyond the oilfield.

Possible Alternative: Regionalized Water Grids

This approach would especially make sense in the Triangle and also the Lower Rio Grande Valley

Texas Water Resources Institute
Texas Water Journal
Volume 11, Number 1, February 25, 2020
Pages 15-31

Oilfield Water Infrastructure Connectivity: The Case for a 'Hydrovascular' Network in the Permian Basin

Gabriel Collins[1], *, **, ***

Abstract: The current phase of oilfield water infrastructure buildout in the Permian Basin generally emphasizes each operator or midstream provider building its own water transportation and disposal systems. Accordingly, the overall market is balkanized and inefficient compared to the performance a more interconnected system could achieve. A hydrovascular grid in the Permian Basin could lower oil and gas production costs, conserve scarce freshwater by promoting greater recycling and reuse of produced water, help mitigate seismicity risks, and facilitate movement of produced water at large scale for use outside the oilfield. This paper assesses the barriers to such integration. It concludes by offering a set of practical ideas to overcome these barriers and help transform oilfield water into a resource for West Texas and Southeast New Mexico.

Keywords: hydrovascular grid, oilfield, produced water, market, infrastructure

Combine Regional Water Infrastructure Densification With Greater Development of Drought-Resistant Supplies Like Desalination

Leverage the fantastic examples El Paso Water and San Antonio Water System offer through years of live and ongoing operational desalination experience

An amount of electricity only 1/10th of that needed to power a Cross Texas Water Grid could likely desalinate enough water to supply more than ¼ of total Texas water needs

Desalination

- Desalinating seawater using reverse osmosis requires 3.5-to-4.5 kWh of electricity per M^3. There are approximately 1,234 M^3 per acre-foot. Thus, desalinating an acre foot of seawater requires between 4,319 and 5,553 kWh of electricity.
- Using the mid-range of those numbers suggests desalinating a million acre-feet of seawater via RO requires 4.9 million MWh of electricity. If the plant runs at a steady rate 24-7 (allowing a week each year for maintenance), that means 8,592 run hours per year. This in turn yields an average electricity load of about 570 MW.
- That is roughly the grid load of 5-to-6 hyperscale data centers
- **Put differently, adding a single additional reactor apiece at the South Texas Project and Comanche Peak nuclear power stations could potentially provide carbon-free support for desalinating about 4 million acre-feet per year of seawater via reverse osmosis. That is equal to about half of total projected Texas municipal water use in 2070.**

Four Key Action Areas

- **Leak less in the big cities**
- **Move water better and further with regional grids**
- **Access unconventional water resources through expanded desalination and recycling**
- **Embrace water markets**

Marketization can drive innovation, incentivize greater water use efficiency, and catalyze infrastructure buildouts as parties pursue arbitrage opportunities…we have a Texas water markets report coming in June/July 2025, so stay tuned!

Thank You!

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