Economic Valuation of Groundwater in Texas

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This presentation draws heavily upon the author’s recent article in the Texas Water Journal:

Key Concept:
Water values and prices in Texas are literally all over the map, but there are reasons for that and things are less chaotic than they might seem.

Let’s walk through some analytical frameworks to help us think more systematically about this challenge.
Reeves County
Layne Christensen
$1.09/saturated foot (est.)

Ochiltree/Roberts Counties
Mc Cattle/Amarillo
$1.16/saturated foot (per contract)

Burleson County
SAWS Vista Ridge
$460/acre-foot (per contract)

Winkler County
Midland County Fresh Water District #1
$0.83/saturated foot (est.)

Hudspeth County
CL Ranch/El Paso, $1,889/surface acre (~$689/acre for GW estate)

Roberts County, CRMWA/Mesa Water, $488/acre (GW estate)

Reagan County
XT0 Water Lease
$3,879/AF

Martin County
PXD Water Lease
$2,482/AF (potable)/ $1,552/AF (brackish)

Bell County
7KX Investments v. TX DOT
$196,000/surface acre (per settlement)

Hudspeth County
Edwards Aquifer Authority v. Bragg
$25,000/surface acre (jury award)

Medina County
GBRA/Texas Water Alliance
~$1,033/acre for GW leases

Gonzales County
GBRA/Texas Water Alliance
$488/acre (GW estate)

Martin County
PXD Water Lease
$2,482/AF (potable)/ $1,552/AF (brackish)
Why Does Valuation of Groundwater Matter: Macro-Level

Texas Reservoirs: Capacity vs. Actual Storage

- Roughly 21 million Texans
- Roughly 28 million Texans
- Roughly 6 million Texans

Groundwater Balances the System During Droughts

Source: US Census Bureau, TWDB

Source: TWDB, Author’s Analysis
Why Does Valuation of Groundwater Matter: Property Owner Level

1. Groundwater is a natural capital asset
2. Pricing can incentivize conservation
3. Value quantification can facilitate more effective resource management.

Let’s imagine what selling 1,000 AF/yr would mean in economic terms to a landowner:

- 1,000 AF/yr sold
- $X100/AF royalty
- X 30 year contract term
- $3 million of cumulative income

That is the same as selling nearly 370 thousand bbl of crude oil at a 1/8 royalty, assuming an average price of $65/bbl.

Put differently, that’s enough oil to fill a tanker roughly twice as long as the Frost Bank Building here in Austin is tall.
Valuation Methods

Use value
- Comparable sales
- Avoided cost
- Residual value
- Income capitalization
- Market surveys
- Land Value Method

Existence value
- Conservation

Water as the final good.

Water as an intermediate input.
Comparing Transactions Method Historically Dominates

**Making Sense of “Fair Market Value” a/k/a Comparable Transactions:**

1. **Level 1:** “Quoted prices in active markets for identical assets or liabilities.”

2. **Level 2:** “Inputs other than Level 1 that are observable, either directly or indirectly, such as quoted prices for similar assets or liabilities; quoted prices in markets that are not active; or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the assets or liabilities,” and

3. **Level 3:** “Unobservable inputs that are supported by little or no market activity and that are significant to the fair value of the assets or liabilities.”

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Ibid.
This is not as bad as it might appear, contingent upon the responses to two key questions:

1. How widely did the estimates vary?
2. What methodologies and assumptions did the analysts use to reach their valuations?

Whether we are valuing a business, and oil & gas property, or a groundwater asset, there is generally going to be a degree of subjectivity, fact-specific analysis, and professional judgment that each analyst applies.
Groundwater Valuation: Ten Key Variables

1. Location (relative to end users and competing water sources)
2. Existence of infrastructure
3. Infrastructure cost
4. Quality
5. Extraction & treatment costs
6. Political & regulatory barriers
7. Protection from drainage
8. Intended use of the water
9. Time sensitivity of the end use
10. Resource dependability/drought resistance
1. Location (relative to end users and competing water sources)
2. Existence of infrastructure
3. Infrastructure cost
4. Political and regulatory barriers
Proximity Matters A LOT For Water Supply Economics

FIGURE 1 — VISTA RIDGE DELIVERED WATER COST

- Infrastructure debt service and finance cost: $1,146/AF
- Water purchase price: $460/AF
- O&M: $196/AF
- Electricity: $191/AF

**Percentage of total water supply capacity (San Antonio area)**

**Percentage of total delivered water price ($1,993 per acre-foot)**

**SOURCE** San Antonio Water System
Water’s Logistics Cost/Underlying Value Ratio Poses Economic Challenges

- Water moving 142 miles
- Soybeans moving nearly 1,400 miles
- Crude oil moving about 500 miles

Source: Bloomberg, SAWS, Texas RRC
Economic Value of Groundwater in Place: Is There a “Distance Discount?”

Implied water value in North Texas Panhandle based on land value method

Change in trend primarily appears driven by higher dryland farm valuations in Eastern Panhandle.

Source: ASFMRA, Author’s Analysis
Risks Related to our Other Operations

Our water interests may require governmental permits, the consent of third parties and/or completion of significant transportation infrastructure prior to commercialization, all of which are dependent on the actions of others. Many jurisdictions require governmental permits to withdraw and transport water for commercial uses, the granting of which may be subject to discretionary determinations by such jurisdictions regarding necessity. In addition, we do not own the executory rights related to our non-participating royalty interest, and as a result, third-party consent from the executor rights owner(s) would be required prior to production. The process to obtain permits can be lengthy, and governmental jurisdictions or third parties from whom we seek permits or consent may not provide the approvals we seek. We may be unable to secure buyers at commercially economic prices for water that we have a right to extract and transport, and transportation infrastructure across property not owned or controlled by us is required for transport of water prior to commercial use. Such infrastructure can require significant capital and may also require the consent of third parties. We may not have cost effective means to transport water from property we own, lease or manage to buyers. As a result, we may lose some or all of our investment in water assets, or our returns may be diminished.
Can Water Get to Market? If Not, Valuation Suffers

- Does the infrastructure exist?
- Who pays for it and how?
- Can a prospective water seller and purchaser obtain access period? If they can, what are the economic terms?
8. Intended uses

9. Time sensitivity

10. End users
Value Generated is a Proxy for Capacity to Pay

**Figure 2 — Economic Value Generated Per Acre-Foot of Water Used**

<table>
<thead>
<tr>
<th>Item</th>
<th>Value 2016 USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peanuts (in shell)</td>
<td>$196</td>
</tr>
<tr>
<td>Rice</td>
<td>$227</td>
</tr>
<tr>
<td>Coffee (green)</td>
<td>$228</td>
</tr>
<tr>
<td>Eggs</td>
<td>$270</td>
</tr>
<tr>
<td>Refined sugar</td>
<td>$293</td>
</tr>
<tr>
<td>Cotton (West Texas)</td>
<td>$480</td>
</tr>
<tr>
<td>Alfalfa (Pecos Valley)</td>
<td>$935</td>
</tr>
<tr>
<td>Avocados</td>
<td>$1,401</td>
</tr>
<tr>
<td>Flood-irrigated pecans (Pecos Valley)</td>
<td>$2,026</td>
</tr>
<tr>
<td>Drip-irrigated pecans (Pecos Valley)</td>
<td>$2,630</td>
</tr>
<tr>
<td>Chicken meat</td>
<td>$5,573</td>
</tr>
<tr>
<td>Levi's 501 jeans</td>
<td>$14,826</td>
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<tr>
<td>Beer</td>
<td>$31,669</td>
</tr>
<tr>
<td>Steel (ArcelorMittal)</td>
<td>$31,869</td>
</tr>
<tr>
<td>Pork</td>
<td>$36,261</td>
</tr>
<tr>
<td>Ford Focus</td>
<td>$101,953</td>
</tr>
<tr>
<td>Pickup truck (low)</td>
<td>$151,416</td>
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<tr>
<td>Houston Metropolitan Statistical Area</td>
<td>$318,401</td>
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<tr>
<td>Semiconductors</td>
<td>$381,226</td>
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<tr>
<td>Crude oil (Delaware Basin)</td>
<td>$551,187</td>
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<tr>
<td>Pickup truck (high)</td>
<td>$601,255</td>
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<tr>
<td>Morphine</td>
<td>$927,745</td>
</tr>
<tr>
<td>Natural gas (Marcellus Shale)</td>
<td>$1,239,417</td>
</tr>
</tbody>
</table>

**Sources** Agricultural Extension data, company reports, FracFocus, Mekonnen and Hoekstra, U.S. Census Bureau, U.S. Department of Agriculture, and author’s estimates.
Key themes moving forward:

1. Changing composition of demand
2. Pressure comes from demand side, short-term shocks more from the supply side


Thank you!

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Appendix
Can Water Get to Market? The “Hydrovascular” System

The idea of a “hydrovascular network” to facilitate water marketing raises fascinating public policy questions, including: (1) What are the terms of user access? (2) Who gets priority? And (3) How would the system be funded and what would the first corridors of development be?

Issue first raised in 2015.