Economic Valuation of Water in the Permian Basin

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Please cite as:
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Twelve financial analysts came up with 12 different valuations for this company. All they had in common was their $500/hr fee.
What Are You Buying?

- Paper
- Pipe
- Water

Groundwater Rights Sales Contract

This Contract ("Contract") to buy and sell groundwater rights is between Sellers, Winkler Services and Buyer, all as identified below. Buyer must deliver the Earned Money to Escrow Agent and obtain a signature acknowledging receipt of the Earned Money before the Earned Money Deadline provided in paragraph A.1. for this Contract to be effective. For and in consideration of the mutual covenants set forth herein, and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, Sellers, Winkler Services and Buyer hereby agree as follows:

Sellers:
Roark Resources, Inc., Murray B. Roark, the Estate of Bill B. Roark, James C. Roark, George H. Roark, and Robert H. Roark (collectively, the "Roark Parties") and Winkler Land, LLC ("Winkler Land", and collectively with the Roark Parties, the "Sellers")

Roark Parties:
Address:
Phone:
Fax:
E-mail:
Roark Parties’ Attorney:
Address:
Phone:
Fax:
E-mail:
Winkler Land:
Address:
Phone:

Source: DBS&A, Garney Construction, Midland County Fresh Water Supply District No.1
How To Value It?

**Use value**
- Comparable sales
- Avoided cost
- Residual value
- Income capitalization
- Market surveys
- Land Value Method
- Willingness/Capacity to Pay
- Cash flow

**Existence value**
- Conservation

**Water as the final good.**

**Water as an intermediate input.**
Core Concept: Fair Market Value

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.”


Ibid.
Ibid.

6.04. Fair Market Value Alternative. If Lessee (i) purchases the groundwater or (ii) enters into a contract for the disposition of groundwater from the Premises with an Affiliate or which is otherwise not negotiated on an arms-length basis, Lessor shall be entitled, at Lessor’s election, to receive the fair market value of Lessor’s Royalty Share of groundwater produced and saved from the Premises as reasonably established by Lessor. For purposes of the foregoing, it shall be presumed that Lessor has reasonably established the fair market value of the groundwater if Lessor identifies three or more contracts for the disposition of groundwater from properties having reasonably similar characteristics as the Premises and then averages the price paid under the identified group of contracts.
Groundwater Valuation: Some Key Variables

- Water location, the existence of production and delivery infrastructure, and the cost of such infrastructure and cost of producing the water
- Market competition: For Water Sales and Water Purchases
- Protection from drainage by neighboring pumpers
- Political, legal, and regulatory barriers that could impede development of the resource.
- The potential buyer’s capacity to pay (economic and political dimensions, in the case of cities)
- Time sensitivity (a/k/a consumer urgency) of the water use
- Drought resistance of the resource

Reeves County
Layne Christensen
$1.09/saturated foot (est.)

Ochiltree/Roberts Counties
McCattle/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.)

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

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

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

Reeves County
Layne Christensen
$1.09/saturated foot (est.)

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

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

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

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

XTO Water Lease
$3,879/AF

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

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)

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Bell County
7KX Investments v. TX DOT
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Gonzales County
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~$1,033/acre for GW leases
Valuation of Groundwater In Place at a Texas Frac Water Supplier

Gabriel Collins, J.D., Baker Batts Fellow in Energy & Environmental Regulatory Affairs, Center for Energy Studies

Texas law recognizes the existence of a distinct groundwater estate where water is owned as real private property while still in the ground. Groundwater’s unique private property status in Texas creates incentives for business transactions, but it also potentially gives rise to damage claims by water owners who believe another party’s actions have impaired their ability to access and/or use their groundwater. To either close deals or resolve disputes, parties and courts must be able to attach a credible economic value to water. In many cases, the water at issue may still be underground in the aquifer. Accordingly, the techniques in this issue brief demonstrate how input and investment costs can be combined with hydrological data to estimate the residual value paid for water—one potential way to value groundwater in place.

This brief analyzes a major Permian Basin oilfield water supply asset that recently came online. It leverages primary research and multiple publicly available data sets to establish what the groundwater estate purchased was likely worth in place. Layne Christensen Company, a major global water drilling services provider, disclosed in June 2017 that it had invested $8 million to create a set of infrastructure capable of delivering more than 100,000 barrels per day of frac water to customers in the Delaware Basin.

TABLE 1 — ESTIMATING THE LIKELY VALUE FOR THE GROUNDWATER ESTATE AT LAYNE’S HERMOSA OILFIELD WATER SUPPLY ASSET

<table>
<thead>
<tr>
<th>Item</th>
<th>Units</th>
<th>Number</th>
<th>Unit Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wells (new drill)</td>
<td>—</td>
<td>2</td>
<td>$127,250</td>
<td>$254,500</td>
</tr>
<tr>
<td>Wells (refurbish)</td>
<td>—</td>
<td>4</td>
<td>$65,000</td>
<td>$260,000</td>
</tr>
<tr>
<td>Storage pond (built and lined) capacity</td>
<td>barrels</td>
<td>750,000</td>
<td>$1.25</td>
<td>$975,000</td>
</tr>
<tr>
<td>Pumps (200 HP)</td>
<td>—</td>
<td>4</td>
<td>$25,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>Booster pumps on pipeline</td>
<td>—</td>
<td>3</td>
<td>$10,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>22-in high-density polyethylene pipeline</td>
<td>feet</td>
<td>107,000</td>
<td>$90.00</td>
<td>$9,630,000</td>
</tr>
<tr>
<td>Pipe fusion</td>
<td>pint welds</td>
<td>2,142</td>
<td>$150.00</td>
<td>$319,300</td>
</tr>
<tr>
<td>Trencher operation (Vermeer TR1SS)</td>
<td>feet</td>
<td>107,000</td>
<td>$7.50</td>
<td>$802,500</td>
</tr>
<tr>
<td>Right of way</td>
<td>miles</td>
<td>20</td>
<td>$71,680</td>
<td>$1,433,600</td>
</tr>
<tr>
<td>Well stations for offshore</td>
<td>—</td>
<td>13</td>
<td>$15,000</td>
<td>$195,000</td>
</tr>
<tr>
<td>Labor</td>
<td>days</td>
<td>90</td>
<td>$8,410</td>
<td>$756,900</td>
</tr>
<tr>
<td>Branch lines leading wells to central pits</td>
<td>feet</td>
<td>21,600</td>
<td>$12</td>
<td>$259,200</td>
</tr>
<tr>
<td>Electronics on wells</td>
<td>—</td>
<td>6</td>
<td>$10,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>Electrification</td>
<td>—</td>
<td>1</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Concrete</td>
<td>tonnes</td>
<td>500</td>
<td>$167</td>
<td>$83,500</td>
</tr>
<tr>
<td>Retar</td>
<td>tonnes</td>
<td>16</td>
<td>$600</td>
<td>$9,640</td>
</tr>
<tr>
<td>Roads</td>
<td>miles</td>
<td>1.50</td>
<td>$50,000</td>
<td>$75,000</td>
</tr>
</tbody>
</table>

Total (excluding land) $15,267,044

Total estimated CAPEX $18,000,000

Implied land cost (1,000 acre tract) $2,732,956

Implied land value per acre $2,733

Estimated value farm land only (farmland in Trans-Pecos region [Sabine]) $1,983

Average saturated thickness under tract (feet) (1,825)

Implied price paid for groundwater estate (Sizable saturated foot per acre) $8.69

SOURCES: Company reports, author’s interviews of relevant providers of goods and services

FIGURE 1 — APPROXIMATE LOCATION OF LAYNE’S FRAC WATER SUPPLY ASSET

SOURCE: Layne Water Multinational Presentation, Texas Department of Transportation

BREAKING DOWN THE TRANSACTION

Surface land in Texas includes the groundwater estate unless the groundwater has been sold separately, reserved by the seller, or otherwise split from the surface. This makes acquiring the surface tract in effect, a purchase of both the “dirt” and the water beneath it. "Unbundling" the value of the surface alone can thus shed light on the likely value of the groundwater beneath.
Groundwater Valuation: Some Key Variables

- Water location, the existence of production and delivery infrastructure, and the cost of such infrastructure and cost of producing the water
- Market competition: For Water Sales and Water Purchases
- Protection from drainage by neighboring pumpers
- Political, legal, and regulatory barriers that could impede development of the resource.
- The potential buyer’s capacity to pay (economic and political dimensions, in the case of cities)
- Time sensitivity (a/k/a consumer urgency) of the water use
- Drought resistance of the resource
Proximity to Markets Influences Water’s In-Situ Value and Cash Flow Generation Potential

- **Seawolf Resources**
  - Est. productive capacity = 300-350 kbd from ~70 wells

- **Winkler Water Solutions**
  - Productive capacity = 250 kbd from 6 wells, soon to be 325 kbd from 8 wells

- **Layne Water Midstream**
  - Productive capacity = 175 kbd

- **Wolfcamp Water Partners**
  - Potential productive capacity = 200-400 kbd

- **Pecos SS**
  - Productive capacity = 357 kbd from 6 wells
Proximity to Market, Depth, and Quality Influence Water’s Economic Value

What does this mean for entities looking to acquire water and landowners who might be considering selling it?

- Capital requirements
- Risk/Reward
  - Price
  - Contract structures

Source: SAWS, Author’s Analysis
Groundwater Valuation: Some Key Variables

- Water location, the existence of production and delivery infrastructure, and the cost of such infrastructure and cost of producing the water
- Market competition: For Water Sales and Water Purchases
- Protection from drainage by neighboring pumpers
- Political, legal, and regulatory barriers that could impede development of the resource.
- The potential buyer’s capacity to pay (economic and political dimensions, in the case of cities)
- Time sensitivity (a/k/a consumer urgency) of the water use
- Drought resistance of the resource
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.
Above Ground” Risks Are The Most Significant Valuation Wild Card

CliffNotes Version:

We can overcome Mother Nature much more easily than human nature!
“I thought it would be interesting to show I could grow rice in the Chihuahuan Desert, but I can’t sell water to people who really need it.” —Jeff Williams, Williams Farms & Ranches
Restrictions on Water Trade & Transport in Texas

Surface Owner Challenges

Some examples of barriers to trade:

- Crossing or “trespass” fees
- Surface use agreements that require E&Ps to use the surface owners’ water for all on-tract activities.
- No forced pooling of water rights

Being in the Right Place Makes Surface Incredibly Valuable: TX Example

Average price of $7,143/surface acre or nearly 10X the 2018 median price for rangeland in Trans-Pecos Texas.
Cross-Border Water Arbitrage between TX and NM

Where politicians see theft...

“Texas is stealing New Mexico’s water...If you put a whole bunch of straws in Texas and you don’t have any straws in New Mexico, you’re sucking all the water from under New Mexico out in Texas and then selling it back to New Mexico.” --Aubrey Dunn, New Mexico State Land Commissioner (June 2018)

Businesspeople see opportunity...

Solaris Water Midstream Acquires New Mexico Water Supply Business from Vision Resources, Inc. and Launches Major Expansion in the Delaware Basin

Jan 5, 2018, 9:50am EDT

Major Expansion to Pecos Star System

Solaris Water also announced that it has started construction of a new 11-mile water supply line that will connect into its Pecos Star System. The high-capacity pipeline will add crucial, permanent water supply infrastructure to one of the most prolific areas in the Permian Basin and will be capable of transporting approximately 150,000 barrels of water per day from Loving County, Texas, to Eddy County, New Mexico. Construction of this strategic pipeline is underway. The line is expected to come into service in July 2018.

Source: Dallas Business Journal

Source: Texas Tribune
In New Mexico, Oilfield Water Issues Make Border Ranches a Generational Asset Class

- Buying these ranches gives NGL 122,000 acres and 32 thousand bpd of freshwater rights, plus at least 20 SWD locations.
- NGL paid $93 million for these ranches in 3Q2018.
- Meanwhile, Intrepid Potash paid $65 million for the nearby Dinwiddie Ranch in 1Q2019.

Source: NGLP March 2019 Investor Presentation, Company Disclosures
X-Factor: Drought & Climate
Fear, Need, and Perhaps a Little Greed

Human emotions react far faster than the water levels in an aquifer.

On an inflation-adjusted basis, Amarillo frequently paid much more for water around the time of the 1950s drought than it has in the past decade.

Source: City of Amarillo (October 2018), FRED St. Louis (CPI data)
Oilfield Water In The Permian Basin: Valuing a Flow of Water Over Time
Frac source water: 76,000 metric tons
Produced water: Over 250,000 metric tons
Crude oil and liquids: 68,000 metric tons
Pipe, sand, misc. consumables: Approx. 10,000 metric tons

Long-Lateral Permian Oil Well Inputs and Outputs Weigh ~405,000 metric tons

Empire State Building Weighs ~340,000 metric tons

~400-450 wells completed/month

Water will likely account for approximately 80% of lifetime “mass moved” for many Permian Basin wells.

Source: CME Group, Empire State Realty Trust, FracFocus, TexasBrine.com

This analysis assumes 500,000 barrels of oil produced, with a water-to-oil ratio of 3:1. In many cases, wells will ultimately produce more oil and at a higher water cut.
Valuing Produced Water Assets: Developers’ Seeking Liquidity Events

### Simple rule of thumb:
- at $0.75/bbl of revenue, 475 kbd of produced water flows could potentially justify a billion dollar valuation. (**7.0X EBITDA**)
- For premium price sales into NM, 425 kbd sold at $1.25/bbl could justify a billion-dollar valuation (**5.5X EBITDA**)

### What Does it Take to Create a Billion Dollar Oilfield Water Midstream Company?

<table>
<thead>
<tr>
<th>Announced Date</th>
<th>Basin</th>
<th>Acquirer</th>
<th>Asset</th>
<th>Seller</th>
<th>Price (Million USD)</th>
<th>EV/EBITDA Multiple</th>
<th>Contract Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2015</td>
<td>Appalachia</td>
<td>Antero Midstream</td>
<td>integrated water services system, dropdown</td>
<td>Antero Resources</td>
<td>$1,050</td>
<td>8.5-9.0X</td>
<td>20 yrs + MVC+ ROFR on future drilling areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partners, L.P.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 2017</td>
<td>DJ, Permian</td>
<td>NBLX/affiliated DevCos</td>
<td>multiple asset dropdown</td>
<td>NBL</td>
<td>$270</td>
<td>8.2-9.2X</td>
<td>15-yr fee-based</td>
</tr>
<tr>
<td>July 2017</td>
<td>Multiple</td>
<td>Select Energy</td>
<td>Rockwater</td>
<td>SCF Partners</td>
<td>$516</td>
<td>7.2X</td>
<td></td>
</tr>
<tr>
<td>February 2018</td>
<td>Permian</td>
<td>TETRA Technologies</td>
<td>SwiftWater Energy Services</td>
<td>SwiftWater</td>
<td>$85 (including $15 million in potential earnout payments)</td>
<td>4.3-5.3X (based on NTM expected EBITDA)</td>
<td></td>
</tr>
<tr>
<td>October 2018</td>
<td>Permian</td>
<td>Waterbridge</td>
<td>Halcón Delaware water infrastructure</td>
<td>Halcón</td>
<td>$200 million (not counting potential $125 million of incentive payments)</td>
<td>~9X</td>
<td></td>
</tr>
<tr>
<td>March 2019</td>
<td>Bakken/Eagle Ford/Permian</td>
<td>TPG Capital</td>
<td>Majority stake</td>
<td>Goodnight Midstream</td>
<td>$930 million</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Oilfield Water Valuation Adjustment Factors

1. Strength of contracts
2. Diversity of customer base
3. Drilling plans in area
4. Watercut trends in market area
5. Potential for tie-ins with other pipeline operators’ systems
6. Surface damage schedules—are they perpetual or 10-year renewable?
   A. $200/rod for a 20-mile pipeline renewed every 10 years is equivalent to $130k/yr in cost.
7. Infrastructure integrity
   a. In particular, what are the SWDs’ downhole conditions like?
   b. Potential buyers of water midstream firms would be wise to conduct full downhole and engineering diligence to make sure they aren’t buying a set of components intended for 5 years of use that are now in their 4th year of operation.

If SWD components in a well using 5.5 inch tubing with packer set at 15,000 ft must be replaced...

- $650k for tubing
- $150k for CR alloy packer
- $500k for drilling rig
- $300k in additional miscellaneous costs
- 10-14 days offline X 15k bbl/day X ($0.50 foregone injection fee/bbl + $2.50/bbl in trucking cost and injection charge at backup disposal) means as much as $630k in lost revenue + incurred costs

Total tab per well could exceed $2.2 million
Pricing Produced Water Disposal Contracts: How to Rank

- **Exclusive acreage dedication**
- **Spot water taker:** via truck, pipe, or some combination of the two
- **Firm Service:** Guaranteed capacity, minimum volume commitment
- **True “take-or-pay” agreement**

**Current Prevalence**

**Cash Flow Stability and Revenue Predictability**

Source: https://digital.lib.uh.edu/collection/p15195coll18/item/33
Takeover Logic Hypothetical Example: Why Drilling Plans and Geographic Position Matter

1. Potential Acquirer is Scaling Up
Lateral Length, ft

2. Potential Acquiree (Ideally Adjacent) Has Proven Acreage But Not Yet Scaled Up

Source: NM OCD, Author’s Analysis (Research assistance provided by Nosa James)
Valuing Produced Water Assets From An E&P Perspective

Key Issues to Consider:

- Third-Party CAPEX + Return+ OPEX vs. CAPEX + OPEX
- In a “live within cashflow” world, E&Ps may have to think of water system investments at least partially in terms of “wells that could have been.” That calculation is rife with uncertainty, as it requires estimates of forward commodity prices, but it is real.
- Even if internal teams within an E&P don’t see the full cycle cost of water, that full cycle cost is real and will ultimately affect the bottom line in potentially material ways.
- There is not an easy answer to this fundamental question—it will be company and asset specific.

Sourcing → Transfer → Storage → Flowback → Disposal/Treatment

For Big, Blocky Acreage Firms, In-House Water Systems May Offer Market Optionality

Even in a pipeline-centric world, this full cycle cost can exceed $2.00/bbl
Oilfield Water Wear & Tear: Effects of OPEX and Depreciation

Key Points

- Even if an oilfield water company bills itself as a “utility” asset, depreciation timetables suggest significant distinctions that valuation professionals and investors should be aware of.

- Foremost among these is the reality that saltwater disposal wells make up a big portion of total system cost and will likely need to be replaced/worked over much more often than the pipes and pumps in a “traditional” water utility model.

<table>
<thead>
<tr>
<th></th>
<th>Original CAPEX</th>
<th>Depreciation Period, Yrs.</th>
<th>Annual Depreciation Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Pipe</td>
<td>$103.0</td>
<td>25</td>
<td>$4.12</td>
</tr>
<tr>
<td>SWDs</td>
<td>$79.5</td>
<td>7</td>
<td>$11.36</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$18.5</td>
<td>7</td>
<td>$2.64</td>
</tr>
<tr>
<td>Pits</td>
<td>$2.3</td>
<td>10</td>
<td>$0.23</td>
</tr>
<tr>
<td>Layflat</td>
<td>$1.1</td>
<td>7</td>
<td>$0.16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$204.3</strong></td>
<td></td>
<td><strong>$18.5</strong></td>
</tr>
</tbody>
</table>

Source: Reuters (February 2019)

Consider contrast with municipal systems. City of Midland, TX reported owning about $484 million worth of water and sewer infrastructure in 2017. Depreciation for that fiscal year was just under $14 million.
Thank You!

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Cutting-Edge Texas Groundwater and Oilfield Water Research

Reference Slides
Groundwater is Texas’s Primary Supply-Side Drought Hedge

Texas Reservoirs: Capacity vs. Actual Storage

Groundwater Balances the System During Droughts

Variance from Prior Year, Acre-Feet

Source: US Census Bureau, TWDB

Source: TWDB, Author’s Analysis
Valuing Water: Unique Aspects

- No substitutes in certain applications.
- Must be removed for production process to continue in other instances.
- It is immutable and can potentially be indefinitely recycled.
- Cost-effectiveness looms in virtually all of these situations.
- Distinct “flow” vs. “stock” aspects since surface and many groundwater sources are fundamentally rechargeable.
- Water is sometime valued as an intrinsic natural capital asset, and other times is being evaluated much more on its capacity to generate cash flow in a given application (for instance, utilities or oilfield water disposal operations).
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
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
How Will Demand Shifts Potentially Affect Water Valuations?

Key themes moving forward:

1. Changing composition of demand
2. Pressure comes from demand side, short-term shocks more from the supply side
Value Generated is a Proxy for Capacity to Pay

**FIGURE 2 — ECONOMIC VALUE GENERATED PER ACRE-FOOT OF WATER USED**

<table>
<thead>
<tr>
<th>Product</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>$6,573</td>
</tr>
<tr>
<td>Levi’s 501 jeans</td>
<td>$14,826</td>
</tr>
<tr>
<td>Beer</td>
<td>$13,669</td>
</tr>
<tr>
<td>Steel (ArcelorMittal)</td>
<td>$13,889</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 tire (low)</td>
<td>$531,416</td>
</tr>
<tr>
<td>Houston Metropolitan Statistical Area</td>
<td>$2,328,401</td>
</tr>
<tr>
<td>Semiconductors</td>
<td>$3,812,226</td>
</tr>
<tr>
<td>Crude oil (Delaware Basin)</td>
<td>$5,551,187</td>
</tr>
<tr>
<td>Pickup truck tire (high)</td>
<td>$6,012,255</td>
</tr>
<tr>
<td>Morphine</td>
<td>$9,277,455</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
Can Water Get to Market? If Not, Valuation Suffers

--$18 million entry price in 2017
--Purchased by Post Oak Capital for $200 million in April 2019
**Volume Diversity Reduces Water Midstreams’ Cashflow Risk**

<table>
<thead>
<tr>
<th>NGL Permian Water Solutions 2018 YTD Volumes Received, By Well (Mmbbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source: Texas RRC</td>
</tr>
</tbody>
</table>

- Greater volume stability is a key value driver
- A smaller midstream whose portfolio consists of a relatively few wells that are high-quality and attract large volumes is likely worth more as part of a bigger midstream firm. There is potential for a natural value uplift.
- In other words, the post-M&A whole can be worth more than the sum of the individual parts.
Recycled Water Could Now Account for Close to 10% of Permian Frac Sourcewater Supplies

Methodology: Take management statements to investors, any other corporate communications I could locate detailing produced water re-use intentions or actual volumes/proportions, and a Credit Suisse research report on the same topic, apply these numbers to frac water usage data each operator reported to FracFocus and estimate recycling volumes for 2Q2018 and 3Q2018.