The Importance of Pipelines in Water Management for Onshore Unconventional Development*

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Abstract

This presentation will build on the study by the Ground Water Protection Council on water reuse and experience with midstream and upstream companies. Water infrastructure, once installed, greatly reduces the cost to move water from its source to the hydraulic fracturing site. This allows water from more distant sources, including brackish sources, municipalities and produced water, to be used in hydraulic fracturing. This presentation will contrast the water challenges of various onshore basins and analyze how the problems are being solved by upstream and midstream companies.
The Importance of Pipelines in Water Management for Onshore Unconventional Development

AAPG

Michael Dunkel - May 20, 2019
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Agenda

• Water Management

• Pipelines

• Costs

• GWPC report
Connecting Water Pipelines to Seismicity

Induced Seismicity → Produced Water Disposal

Pipelines needed for reuse → Reuse instead of disposal
Water Cost Drivers

- Limited source water & high demand
- Potential limits on disposal & increasing water costs
- Concentration of drilling activity
- Water system integration via pipelines
Water Management Component Costs

Water Supply/Treatment: $0.4 - $1.0/BW
Drilling/Completions: $0.2 - $0.8/BW
Distribution: $0.4 - $1.0/BW
Storage/Impoundments: $0.2 - $0.8/BW
Gathering: $0.3 - $1.0/BW
Separation: $0.3 - $1.0/BW
Residuals Management: $0.3 - $1.0/BW
Produced Water Recycling: $0.3 - $1.0/BW
Beneficial Reuse/Disposal: $0.3 - $1.0/BW

Trucking: $1.5 - $3/BW

IHS estimates total Permian Water Costs will increase from $12 B in 2018 to $22 B in 2022.
## Combined Water Costs

<table>
<thead>
<tr>
<th>Traditional Nearby Sourcing &amp; Disposing</th>
<th>Reuse without Pipelines (with trucking)</th>
<th>Reuse with Pipelines (no trucking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sourcing</td>
<td>Treatment</td>
<td>Treatment</td>
</tr>
<tr>
<td>Disposal</td>
<td>Storage</td>
<td>Storage</td>
</tr>
<tr>
<td></td>
<td>Trucking</td>
<td>Pipeline</td>
</tr>
<tr>
<td>0.4 – 1.0 Sourcing</td>
<td>0.2 – 0.8 Treatment</td>
<td>0.2 – 0.8 Treatment</td>
</tr>
<tr>
<td>0.3 – 1.0 Disposal</td>
<td>0.05 – 0.1 Storage</td>
<td>0.05 – 0.1 Storage</td>
</tr>
<tr>
<td></td>
<td>1.5 – 3.0 Trucking</td>
<td>0.2 – 0.5 Pipeline</td>
</tr>
<tr>
<td>$0.7 – 2.0/BW Total</td>
<td>$1.75 – 3.9/BW Total</td>
<td>$0.45 – 1.4/BW Total</td>
</tr>
</tbody>
</table>

Notes: Pipeline & storage per barrel costs assume substantial volumes of water over a period of years. Costs do not include temporary (layflat) lines that may be necessary in most cases.
• More deep SWDs ($10+ million) being permitted in the Permian...will this increase seismicity?
• Texas RRC reducing injection pressures on new SWD permits
• Expect more delays and challenges from regulations
Impoundments

- Two side-by-side 500k barrel PW impoundments now common
- Cost: ~$2 million
- Producers and Midstream companies are increasingly developing PW impoundments for reuse.
The Rise of Produced Water Reuse in 2019 in Permian

- Cimarex: water reuse 53% in 2018; saving ~$1.20/BW
- Devon, Oxy and Cimarex - water reuse 80+% in 2019
- Pioneer – 30% reuse by end of 2019
- Concho – Reusing water in all development areas
Water Reuse & Treatment Costs

• Treatment levels vary:
  – Bacteria kill
  – TSS/O&G
  – Iron / hardness

• Treatment costs range from $0.2 to $0.8/BW
• Few producers operate their own treatment plants
Multiple Small Systems vs. One Large System

Legend: Tank battery ■ Water Pipeline / Salt water disposal well
Larger SWD Systems Gain Cost Efficiency

- Peak water demands can be spread across a linked network of SWDs
- Example: save the cost of 3 SWDs, or potentially ~$25 to $30 million
- Multi-producer systems can have even higher average capacity utilization

![Graphs showing 26% and 67% utilization of SWD systems]
Advent of Water Midstream

**Water Midstream**: Own & operate water pipelines to deliver source water or take-away & dispose of produced water. May involve treatment & reuse.

### Operator Positives
- Reduce costs
- Minimize Capex for producers
- Allow producers to complete more wells
- Balance water supply and demand better

### Operator Concerns
- Potential concern over control
- Commitment needed from producers
- Water mixing/Source water criteria
- Complexity of system
Regulations, Current Practices & Research Needs
Developing Solutions: Modular Approach

**MODULE 01**

Regulatory & Legal Frameworks

This module describes the current legal and regulatory frameworks that address produced water. It also addresses changes that may need to occur to facilitate the use of produced water.

**Leadership:**
John Baza, Utah Division of Oil, Gas & Mining
Shellie Chord: Oklahoma DEQ, Water Quality

**MODULE 02**

Produced Water Use in the Oilfield

This module describes the current uses and potential future uses of produced water inside the oilfield. It defines the existing constraints of use and identifies the opportunities and challenges of expanded use.

**Leadership:**
Tom Kropatsch: Wyoming Oil & Gas Commission
Scott Kell: Ohio Department of Natural Resources

**MODULE 03**

Produced Water Use & Research Needs Outside the Oilfield

This module describes current and potential use of produced water outside the oilfield and identifies the research needs that will need to be addressed to facilitate expanded use.

**Leadership:**
Ken Harris: California Department of Conservation
Nichole Saunders, Environmental Defense Fund
Economics of Reuse

Water Costs without Reuse

Source Water Cost + Source Water Transport + Produced Water Transport + Produced Water Disposal = Total Water Costs

Water Costs with Reuse

Produced Water Treatment + Produced Water Storage + Produced Water Transport = Total Water Costs
Trends in Water Management

**Sourcing**
- Fresh ➸
- Brackish ➹
- Reuse ➹

**Treatment**
- Mobile Unit —
- Fixed Plant —
- Wellsite bacteria —

**Storage**
- Frac Tanks ➸
- Impoundments ➹
- Above-ground ➹
- Storage Tanks ➹

**Transport**
- Trucking ➸
- Permanent Pipelines ➹
- Temp. Lines ➹

**Disposal**
- Saltwater Disposal Wells ➹
- Reuse in new Frac Wells ➹
- Reuse outside O&G ➸
Produced Water Reuse In Unconventional Oil and Gas Operations: Regional Studies

Seven basins profiled

- Appalachia
- Bakken
- Eagle Ford
- Haynesville
- Niobrara/DJ
- Oklahoma
- Permian
Challenges & Opportunities of Water Management

• Adapting state regulatory frameworks
• Transport
• Storage
• Underground Injection
• Treatment
• Spill Management and Mitigation
• Treatment Residuals Management
• Air Emissions
• Wildlife Protection
Future for Water Infrastructure

- More water pipelines for sourcing & produced water
- Key drivers: cost, reduce trucking, increase reuse, disposal limits
- Each basin/county has different water factors for infrastructure
- Large & small producers installing water infrastructure
- Water midstream companies: growing role