Devon Energy’s 2015 Delaware Basin Water Management Program

GWPC UIC Conference
Denver, Colorado
February 24, 2016
Agenda

• Introduction – Devon Overview
• Past Water Management Case Studies
• 2015 Water Management Case Study
  – Strategic Drivers
  – Regulatory Considerations
  – Water Infrastructure
  – Water Treatment
  – Timeline
• Continued progress
• Preparation for the future
Introduction
2015 Devon Overview

Total Company Key Stats

- Net acres: 6,200,000
- Gross producing wells: ≈ 29,900
- Production (Q3 net): 680 MBOED
- Reserves (12/31/14): 2.8 BBOE
- 2015e E&P CapEx: ≈ $3.8 - 4.0 billion
- 2015e Drilling plans: ≈ 720 gross wells
- Operated rigs (9/30/15): 18
Water Stress Map

Red areas on the baseline water stress map are places where a large portion of available water supply is already being used. The gray areas are dry and undeveloped. Black dots on the map represent wells hydraulically fractured.

For interactive map, see ceres.org/shalemap.

Case Study 1 – North Texas

- Drivers – Disposal capacity, water scarcity
  - Chemical pretreatment – clean brine
    - Remove solids, iron, oil, polymer
    - 10,000 bpd capacity per unit
- Distillation
  - Vaporizes water and condenses it - clean, distilled water
  - Remaining concentrate removed for disposal or utilized for as “kill fluid”
  - 2,500 bpd capacity per unit
- Regulatory engagement - RRC
- Multiple sites over nearly a decade of activity through 2013
Case Study 2 - Anadarko

- Drivers – drought, truck traffic
- High quality produced water
- Settling, Disinfection
- Centralized facility
  - Saltwater Disposal Well
  - 500,000 bbl storage pond
- Automated monitoring
- Pipeline network
  - 8”-12” fiberglass
  - Approximately 35 miles
- Regulatory engagement
- Maintained operations during dry periods
  - 2012-2014
Case Study 3 – Midland PBTX East

- **Drivers** - Water scarcity, disposal capacity
- Brackish groundwater wells
- ClO$_2$ treatment of produced water
- Covered brackish frac ponds
- 42,000 bbl ASTs for recycle
- Layflat hose for transfer
- Some permanent collection added
- Automated monitoring
- Data management pilot
- Near zero fresh water demand 2013-2014
2015 Case Study – Drivers

Delaware Basin New Mexico

• High Cost and Risk
• High Water Demand
• Freshwater Scarcity
  – No Surface Water Available
  – High Competition for Groundwater
• High Cost of Trucking and Disposal
Recycling Regulations
Delaware Basin New Mexico

• NMOCDD Rule 34
  – Developed to encourage the recycling and reuse of produced water, drilling fluids, and other liquid oil field waste.
  – Authorizes the storage of produced water in double lined earthen impoundments.
  – Permit by Rule
  – Before Rule 34, large ASTs required lengthy permitting process to store produced water.
Environmental Protection
Delaware Basin New Mexico

- Pre-Construction Environmental Site Assessments
- Double-lined Impoundments
- Real-Time Leak Detection Between Liners
- Hydro Test all Primary Liners Before Initial Use
- Bird Deterrents
Water Storage Comparison
ASTs vs Impoundments for reuse

**ASTs**

**Pros**
- Modular Storage Layout
- Fast Deployment

**Cons**
- Low Storage Volume Per Tank
- More Connections and Failure Points
- Large Expense per Barrel Stored

**Impoundments**

**Pros**
- Allows Steady State Treatment
- Lower Cost of Storage per Barrel
- Smaller Overall Footprint

**Cons**
- More Difficult to Construct
- Large Upfront Capital Requirement
2015 - Infrastructure
Delaware Basin New Mexico

- 6 Completed Impoundments
- 7 Proposed Future Locations
- Permanent pipeline infrastructure being developed
  - 3rd party and Devon-owned
Water Treatment

*Clean Brine Standard*

- Removal of oil residual
- Removal of TSS
- Removal of Iron
- Bacteria Reduction
- Turbidity <10 NTU

Waste Sludge

- Treatment Targets Vary Depending on Use and Storage Method
- Waste is Either Pressed into Solids for Landfill or Disposed into SWD
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2012</td>
<td>Devon begins permitting for initial reuse pilot in Delaware basin and runs initial reuse pilot</td>
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<td>December 2013</td>
<td>Devon runs 2nd reuse pilot</td>
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<td>February 2014</td>
<td>Devon’s 1st full scale reuse project, using large AST’s</td>
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<td>2014</td>
<td>Devon reused 67 million gallons (1.6 mm bbl)</td>
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<td>March 2015</td>
<td>New Mexico allows produced water storage in impoundments (NMOCDO rule 34)</td>
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<td>May 2015</td>
<td>Devon applied for first permit for produced water storage impoundment under rule 34</td>
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<td>August 2015</td>
<td>1st reuse project started using impoundments</td>
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<td>November 2015</td>
<td>Devon had 5 water treatment facilities (capacity &gt; 50,000 bwpd)</td>
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<td>2015</td>
<td>Devon reused 145 million gallons (3.5 mm bbl)</td>
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<td>2016</td>
<td>Devon will continue to reuse water and pilot new technologies where feasible</td>
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## Closing Thoughts

EWI 2014 Case Study findings still relevant

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<thead>
<tr>
<th>INDUSTRY TRENDS</th>
<th>BENEFITS</th>
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<tbody>
<tr>
<td>Improving Fracturing Chemistry</td>
<td>Increasing use of non-fresh water</td>
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<tr>
<td>Innovation in Treatment Technology</td>
<td>Increasing feasibility of produced water reuse</td>
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<tr>
<td>Increasing Water Conveyance Systems</td>
<td>Reducing truck traffic</td>
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<tr>
<td>New Water Storage Designs</td>
<td>Provides flexibility and reliability when using non-fresh water</td>
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<td>Increasing Transparency</td>
<td>Improves relationships with stakeholders</td>
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<tr>
<td>Dedicated Water Staff</td>
<td>Improves water management, planning technical support and performance</td>
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Devon Water Management Team
Preparing for the future

• Dedicated Staff – Operations Excellence Water Team
• Tactical and strategic goals
• Focus areas to reduce cost and risk
  – Stakeholder Engagement
  – Standards
  – Technology
  – Planning
Thank you