Beneficial Use of Produced Water
Indian Basin Field

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Agenda

- Site Background
- Groundwater Resource
- Drilling Operation
- Indian Basin Produced Water
- Produced Water Treatment System
- Beneficial Use of Produced Water
Site Background

- Indian Basin Field
- Natural Gas Production
- Southeast New Mexico
- Chihuahua Desert
- Annual Rainfall – 10 inches
Chihuahua Desert

Indian Basin Field
Groundwater Resource

- Regulated by the New Mexico Office of the State Engineer
- Groundwater is a scarce resource
  - Residential
  - Ranching
  - Agriculture
  - Industrial – 3 acre feet per year (23,286 barrels)
- Queen Groundwater Aquifer
  - Indian Basin Field
  - High Quality – Low TDS
  - Regional Aquifer – discharges to the Pecos River
Drilling Operations

- Groundwater is used as the drilling fluid
  - Surface Casing ~ 1,500 feet below surface
- Lost Circulation results in 25,000 barrels per well
  - Lost Circulation ~ 8,000 feet below surface
  - Industrial Groundwater Rights - 3 acre feet per well = 23,286 barrels
- Transportation of groundwater to drilling pits – Safety Hazard
Indian Basin Produced Water

- Use Produced Water for Drilling Operations
  - Scarce Supply of Groundwater
- 100,000 BPD of Produced Water
  - Natural Gas Production
  - Reinjected into non producing formation
- Produced Water contains Dissolved Hydrogen Sulfide (H$_2$S) Gas
  - Acutely Toxic to Human Health
  - Corrosive to drilling operations
### Produced Water Analysis

#### Indian Basin Field

<table>
<thead>
<tr>
<th><strong>Indian Basin Produced Water Analysis</strong></th>
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<tbody>
<tr>
<td><strong>Dissolved Gases</strong> mg/l</td>
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<tr>
<td><strong>Hydrogen Sulfide</strong> 422.00</td>
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<tr>
<td><strong>Cations</strong></td>
</tr>
<tr>
<td>Calcium 522.60</td>
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<tr>
<td>Magnesium 122.00</td>
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<tr>
<td>Sodium 1,892.35</td>
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<tr>
<td><strong>Anions</strong></td>
</tr>
<tr>
<td>Bicarbonate 1,026.48</td>
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<tr>
<td>Sulfate 2,200.00</td>
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<tr>
<td>Chloride 2,002.20</td>
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<tr>
<td><strong>Total Iron</strong></td>
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<tr>
<td>0.11</td>
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<tr>
<td><strong>Total Dissolved Solids</strong> 8,187.74</td>
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<tr>
<td><strong>Total Hardness</strong> 1,806.70</td>
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<td><strong>pH</strong> 7.06</td>
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Produced Water Treatment System

Sour Natural Gas
1.3 MM cubic feet per day

Sour Produced Water
(H₂S = 422 ppm)

Sweet Natural Gas

Treated Produced Water
(H₂S < 10 ppm)

Sulfuric Acid
16 gallon/1,000 barrels

9,000 barrels per day
Produced Water Treatment System

- Sulfuric Acid lowers the pH of the water
  - Lowers the pH to 5 before the stripping tower
  - Releases Dissolved H$_2$S Gas
- Treated water pH ~ 7
  - Dissolved H$_2$S gas is released
- Stripping Tower - 3” Jaeger Tri-Packs
- Batch Process for each Drilling Project
- Operating Cost = $0.05/barrel
Beneficial Use of Produced Water

- Beneficial Use of Produced Water
  - Normally an E&P Waste
- Annual Groundwater Conservation
  - 4,000,000 gallons = 12 acre feet
- Eliminate Unnecessary Highway Traffic