

**Purpose: Characterize current produced water reuse practices and future opportunities in unconventional plays by the upstream oil and gas industry**

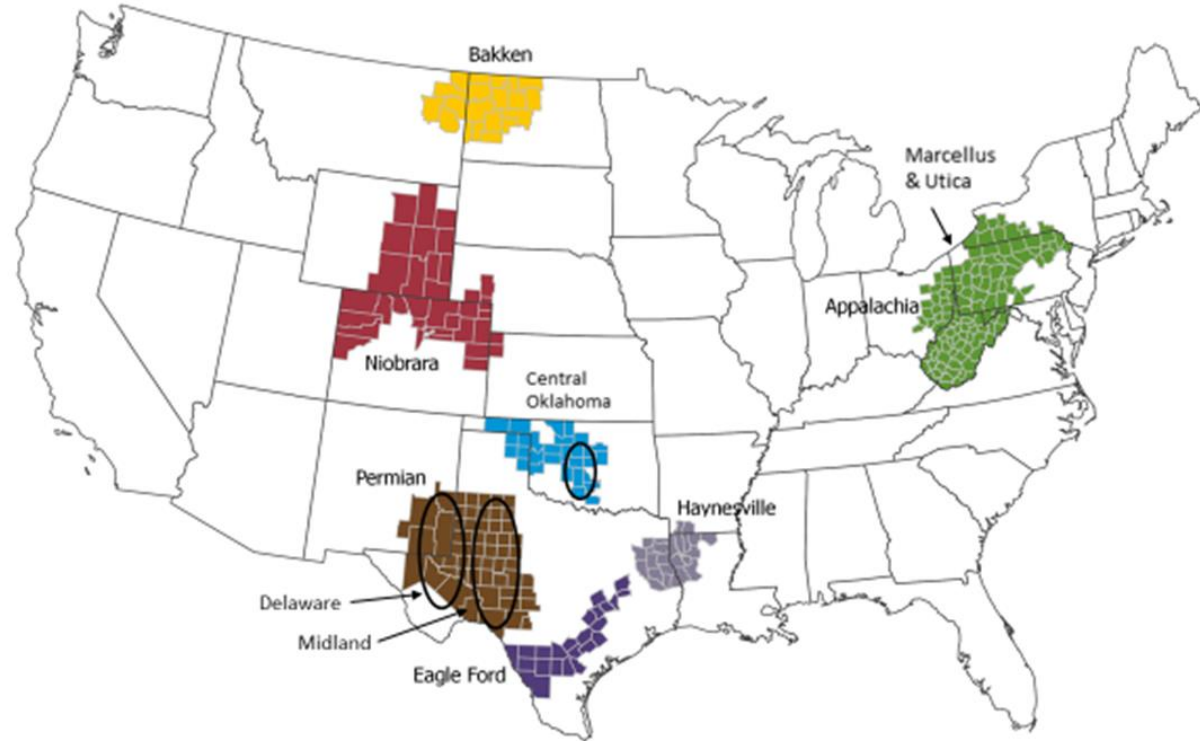
# Module 2- Objectives

- Describe produced water management practices, especially reuse, in upstream unconventional oil and gas operations;
- Gather data on produced water volumes, produced water quality, and reuse volumes;
- Describe the challenges and limitations of reusing produced water;
- Describe stakeholder opportunities to encourage produced water reuse;
- Compare practices in top producing unconventional play regions;
- Highlight water management innovations and emerging trends using case studies.

# Module 2 – Selected Regions

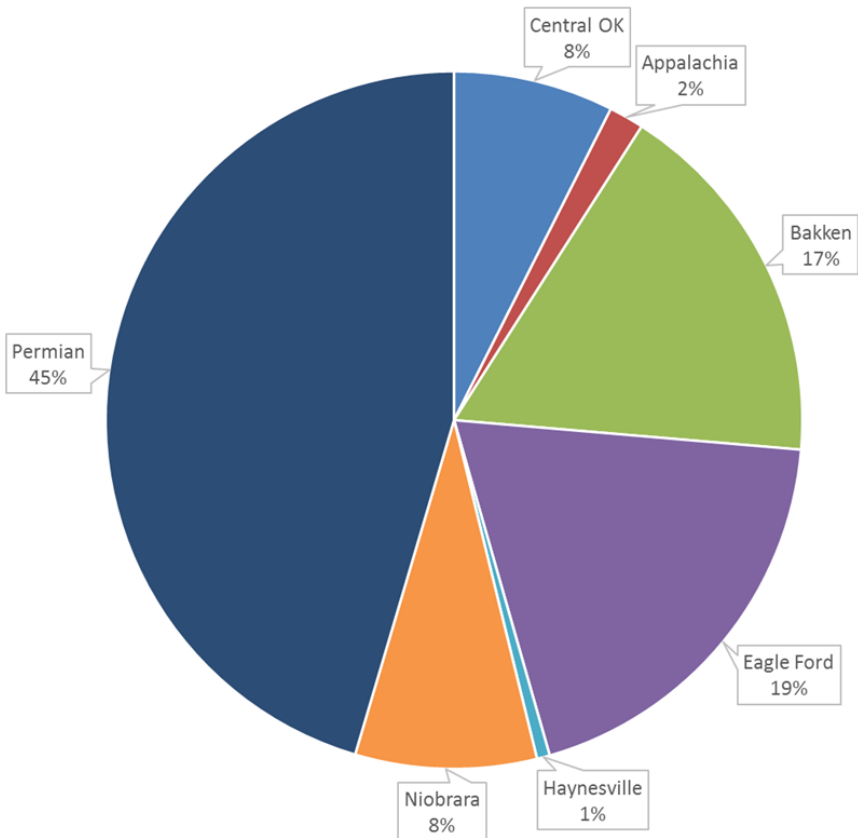
## Regional Summaries

- A. Permian
- B. Appalachia
- C. Eagle Ford
- D. Oklahoma
- E. Niobrara/DJ
- F. Bakken
- G. Haynesville

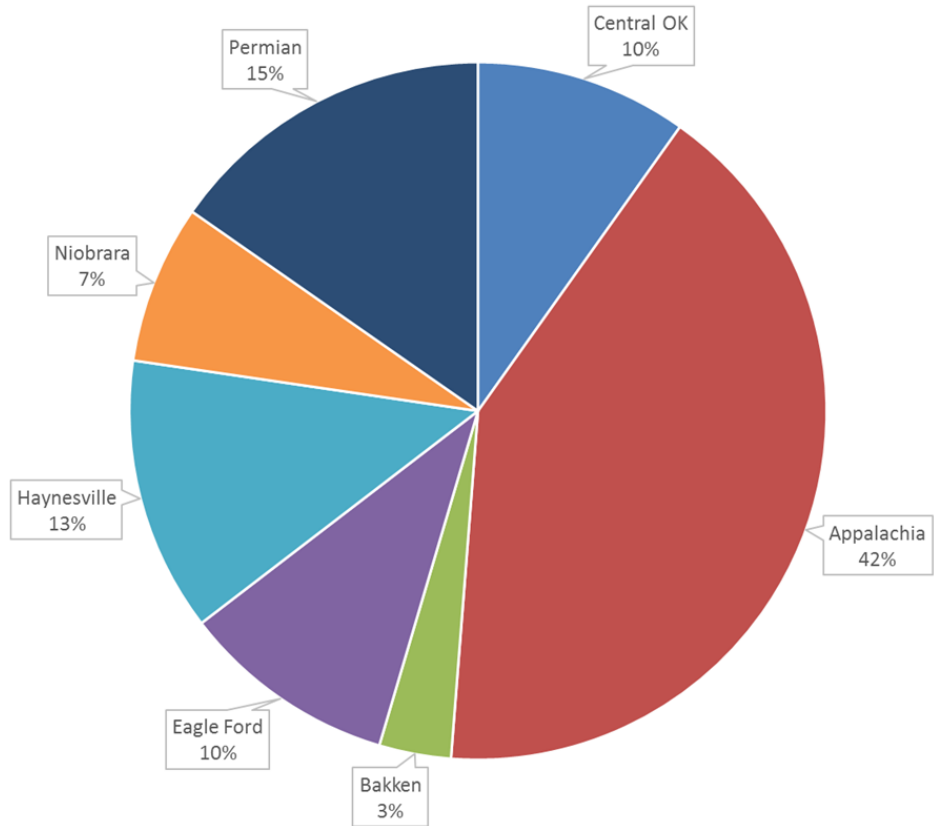


# Regional Comparisons: Oil & Gas Production

## US Onshore Oil Production by Basin

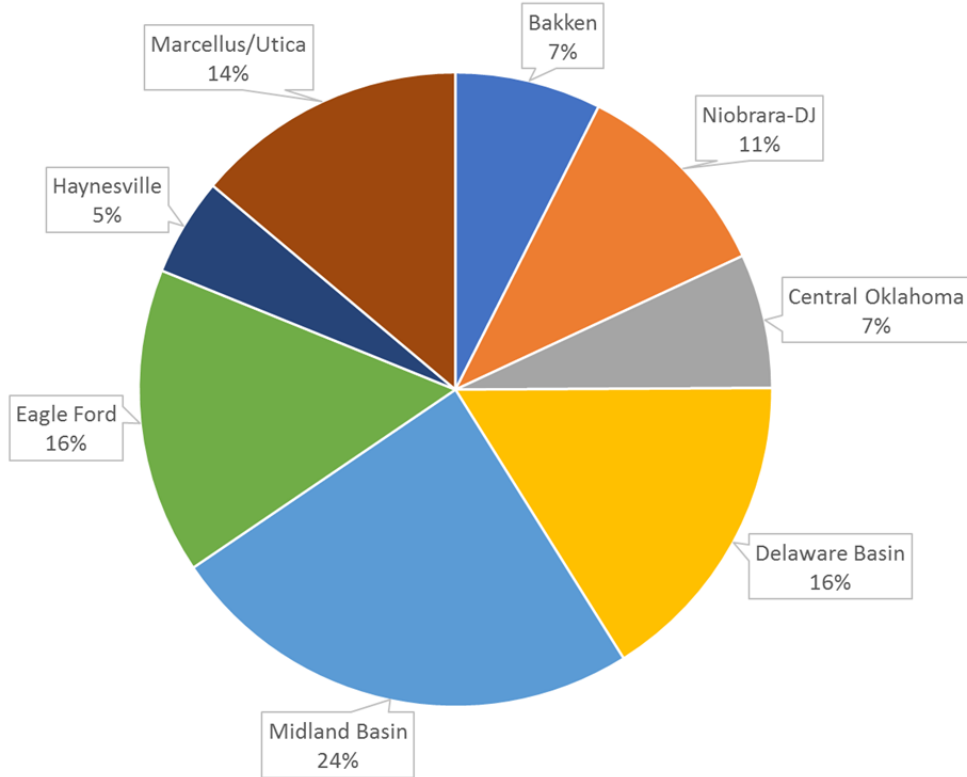


## US Onshore Gas Production by Basin

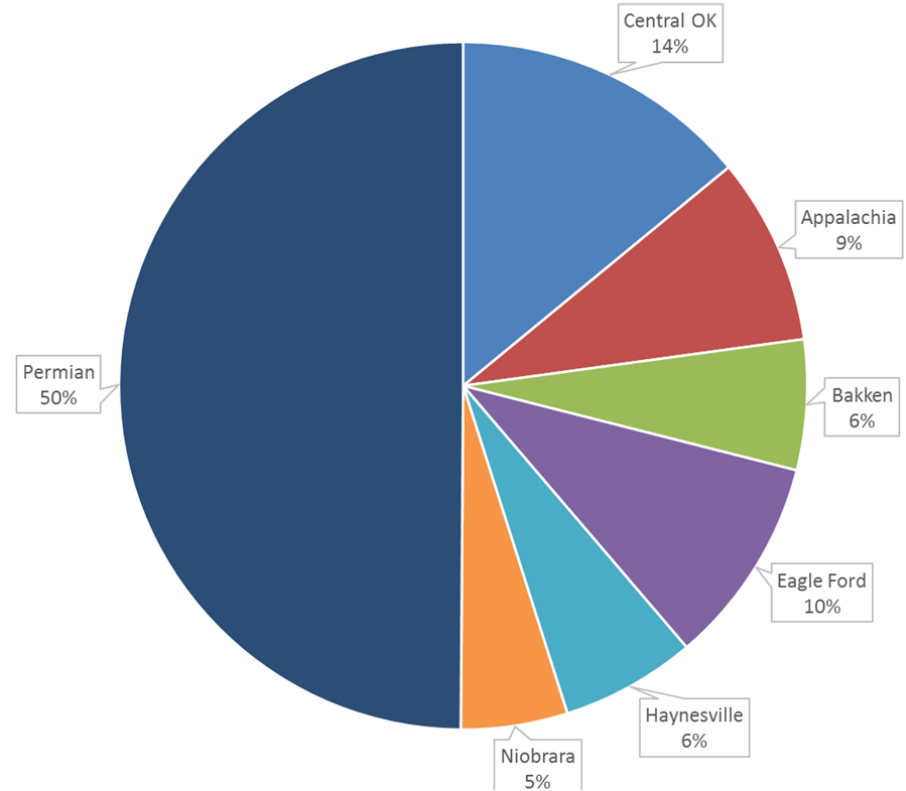


# Regional Comparisons: Water used & Rig Count

## Water Used in Hydraulic Fracturing for Top Basins/Regions

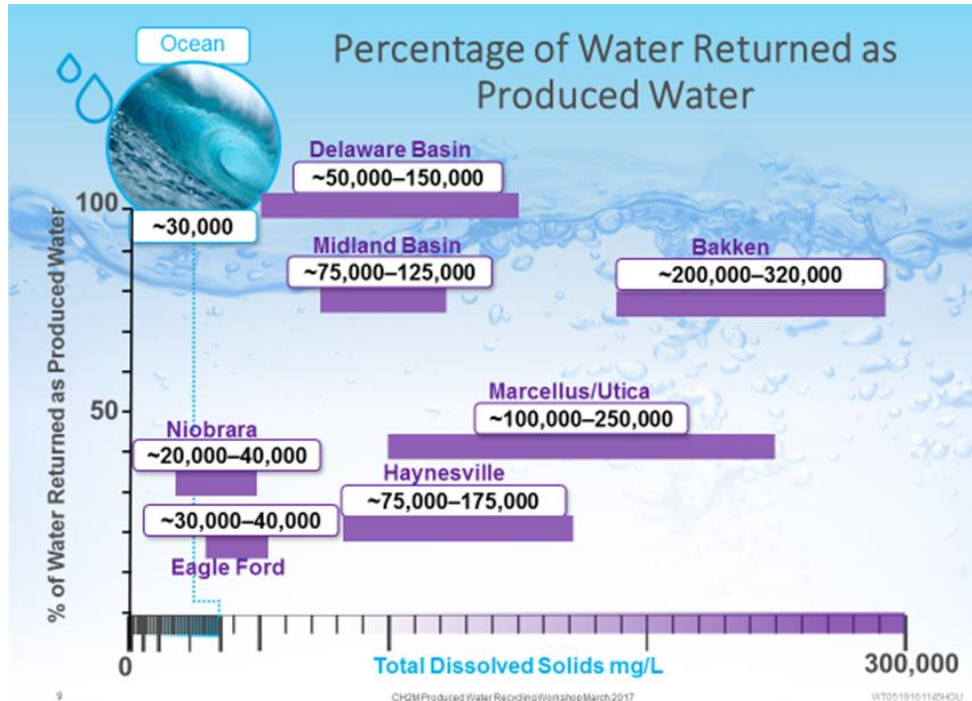


## US Onshore Rig Count by Basin



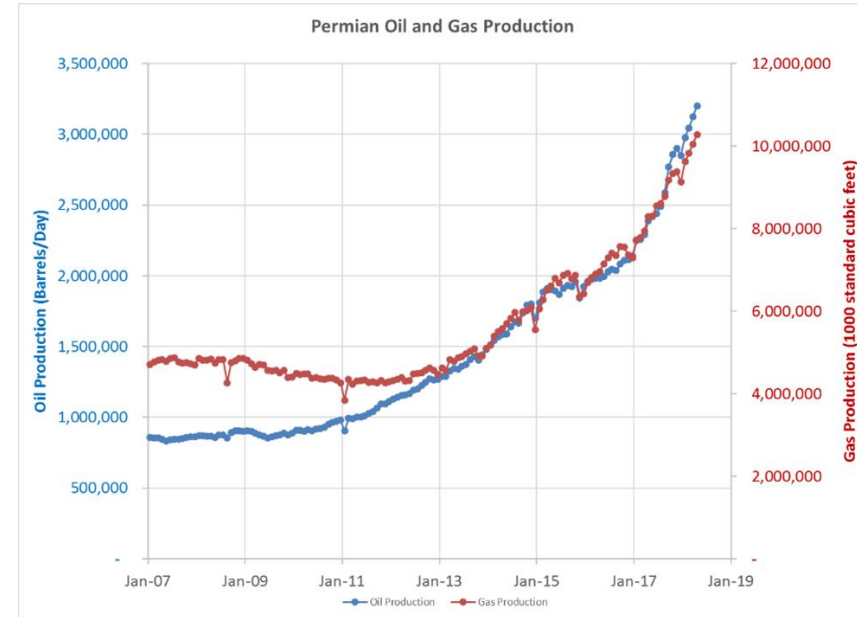
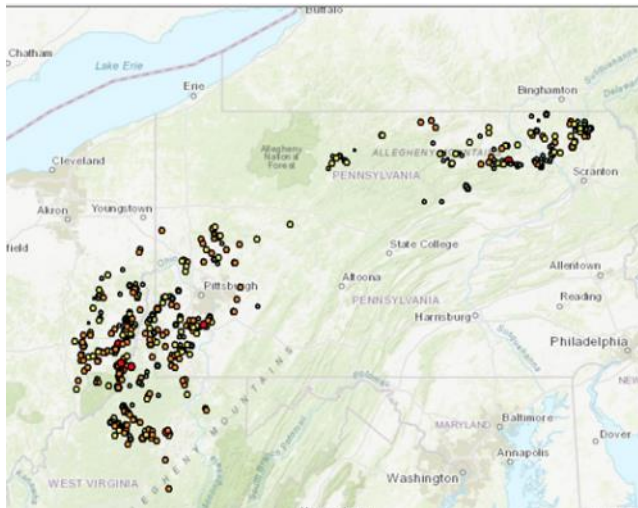
# Produced Water Quality

- Expect water quality data from API coordination
- Other public produced water quality data is limited

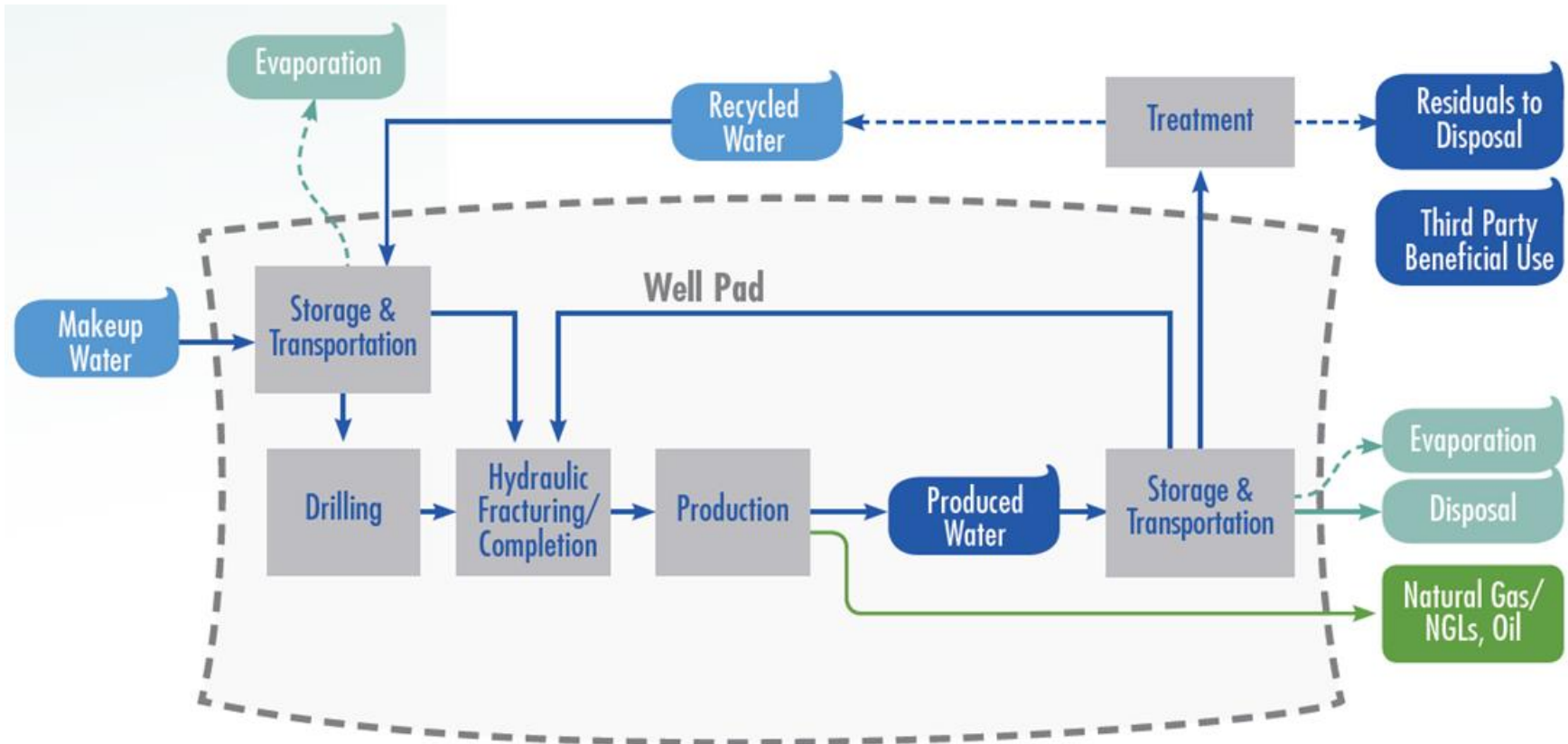


# Regional Summaries Include:

- Brief history
- Recent production chart
- GIS of well locations
- Summary of regional discussions
- Summary of reuse projects



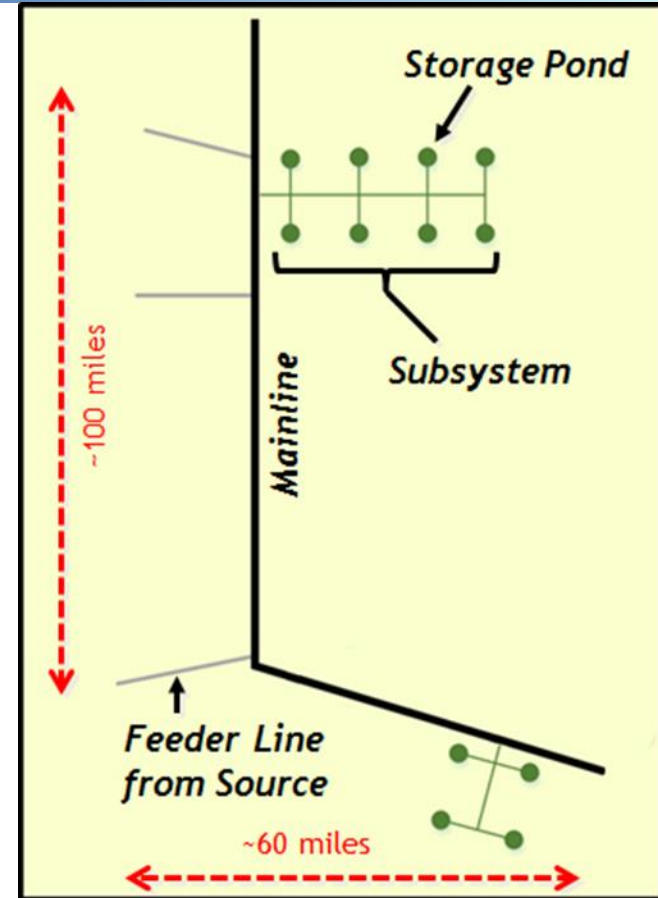
# Water lifecycle





# Operational Challenges & Opportunities

- Transportation is critical factor
- Storage rules and practices vary
- Disposal well capacity varies greatly



# Environmental (Challenges & Opportunities)

- Minimizing spills and leaks
- Remediation of spills
- Residuals management
- Air Emissions
- Wildlife



# Regulatory and Legal Challenges and Opportunities

- Water ownership
- Reuse water reporting/tracking
- Produced water storage facilities (impoundments, large capacity tanks)
- Pipeline transport
- Site remediation standards
- Bonding and insurance considerations

# Current and Evolving Trends and Business Models

- Multi-Company sharing & Midstream
- Potential Basin-to-Basin Produced Water Transfer
- Interest in Reuse Outside of the Oilfield

## Trends in Water Management

<u>Sourcing</u>	<u>Treatment</u>	<u>Storage</u>	<u>Transport</u>	<u>Disposal</u>
Fresh ↓	Mobile Unit	Frac Tanks ↓	Trucking ↓	Saltwater Disposal Wells ↓
Brackish ↑	Fixed Plant	Impoundments ↑	Permanent Pipelines ↑	Reuse in new Frac Wells ↑
Reuse ↑	Wellsite bacteria only	Above-ground Storage Tanks (ASTs)	Temporary Lines ↑	Reuse outside oil & gas

# Overview of Findings

- **Reuse varies by Regions**
- **Cost is the Key Driver for Water Management and Reuse**
- **Water Management and Water Reuse are Evolving**
- **Risks in Water Management and Reuse**
- **Midstream Solutions and Producers Cooperating**
- **Data on reuse is not widely available**
- **State Regulation Variations Impact Reuse Practices**