

HEI Energy

UOGD Operations Overview: Water and Produced Water Management

May 18, 2021

Agenda

- Types of Sourcing
- Types of Storage
- Produced Water Management
 - Logistics
 - Storage
- Groundwater Protections
 - Well Integrity
 - Monitoring Programs

Water Sourcing

Types of Sourcing:

- Groundwater (fresh and/or brackish)
- Surface water (rivers, lakes)
- Reused produced water
- Comingled stream – blended non-produced with reused produced water.
- Municipal wastewater (grey water)



Example of a non-produced impoundment in Appalachia Region.



Example of a non-produced water impoundment in South Texas.

Storage

Types of Storage:

- Impoundments
 - Range in size from 30k bbls to over 2.5MM bbls in capacity
 - Set up for produced or non-produced use
- AST (Above-Ground Storage Tank)
 - Range in sizes from 10k-60k bbls
 - Steel walled open tops with liner installed
- Minion Tanks
 - Range in sizes from 3,500-10,600 bbls
 - Fully contained bladder system
- Frac Tanks
 - 500 bbl tanks
 - Fully contained



Minion – 6k bbl

AST – 60k bbl

Frac Tank – 500 bbl



AST

Frac Tanks



Produced Water Management

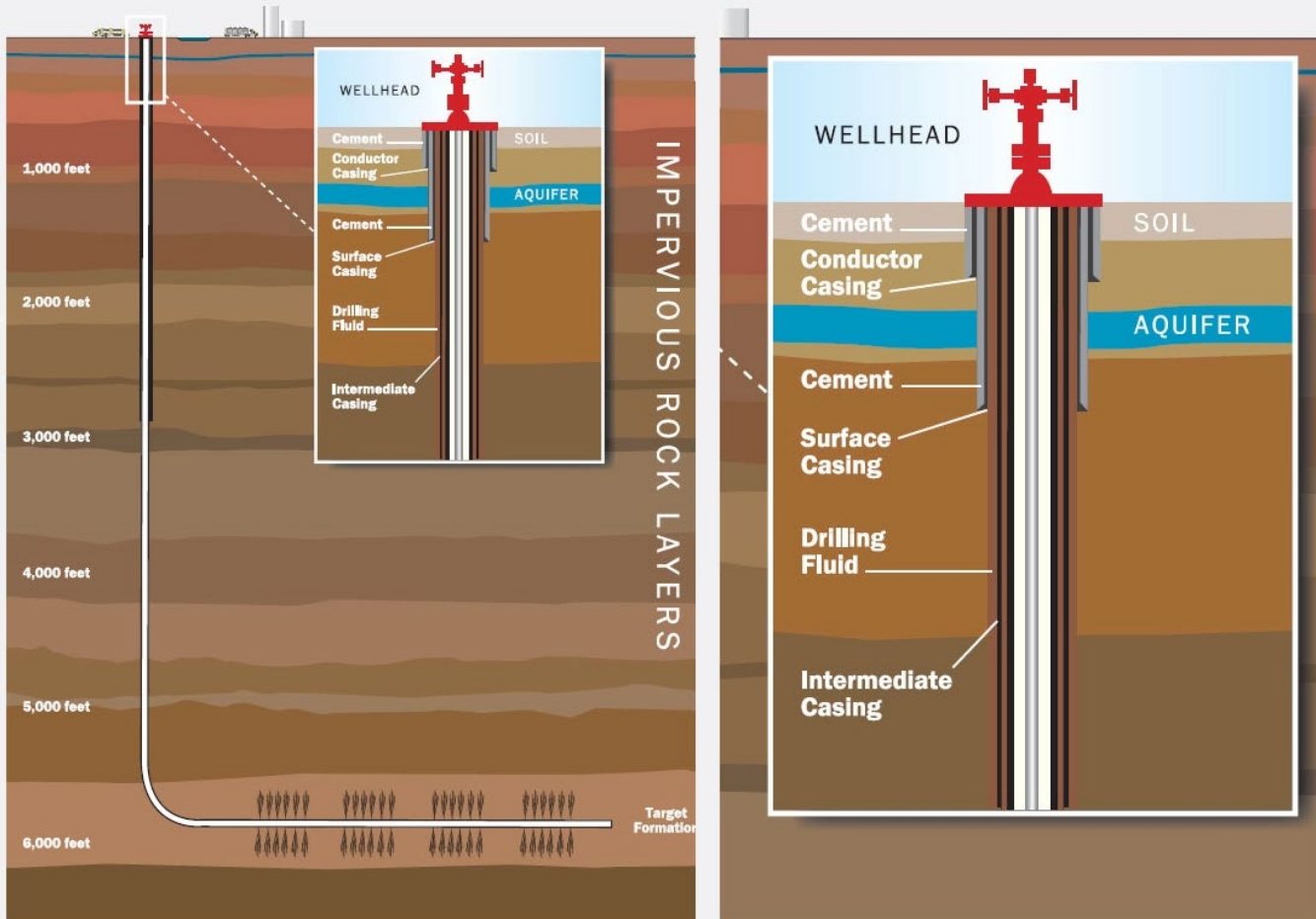
- Transportation:
 - Temporary above ground lines
 - Below ground pipelines
 - Trucking where pipeline infrastructure is not feasible.
- Reuse:
 - Reuse within oil and gas operations – Clean brine within operations to offset sourcing needs
- Storage:
 - Tanks on facility pads – Temporary or Permanent.
 - Impoundments – Produced Water is mainly stored in double lined engineered ponds with leak detection capabilities.
 - Centralized Tank Farms
- Disposal:
 - UIC Class II – Deep well injection.

Groundwater/Surface Water Protection

- Shale Gas/Oil Well Design (Preventive Measure)
- Spill/Leak Management (Preventive Measures)
 - Pad Design and Construction
 - Primary/Secondary Containment
 - Regulatory requirements
- Monitoring/Sampling Programs (Assurance Measures)

Well Design and Construction

Proper well construction provides groundwater protection.



- All wells designed to protect deepest potable groundwater
- Installation of surface and in some cases intermediate casings to seal off potable groundwater
- Casings are cemented in place to eliminate the potential for gas and fluids to migrate from depth to shallow groundwater zones

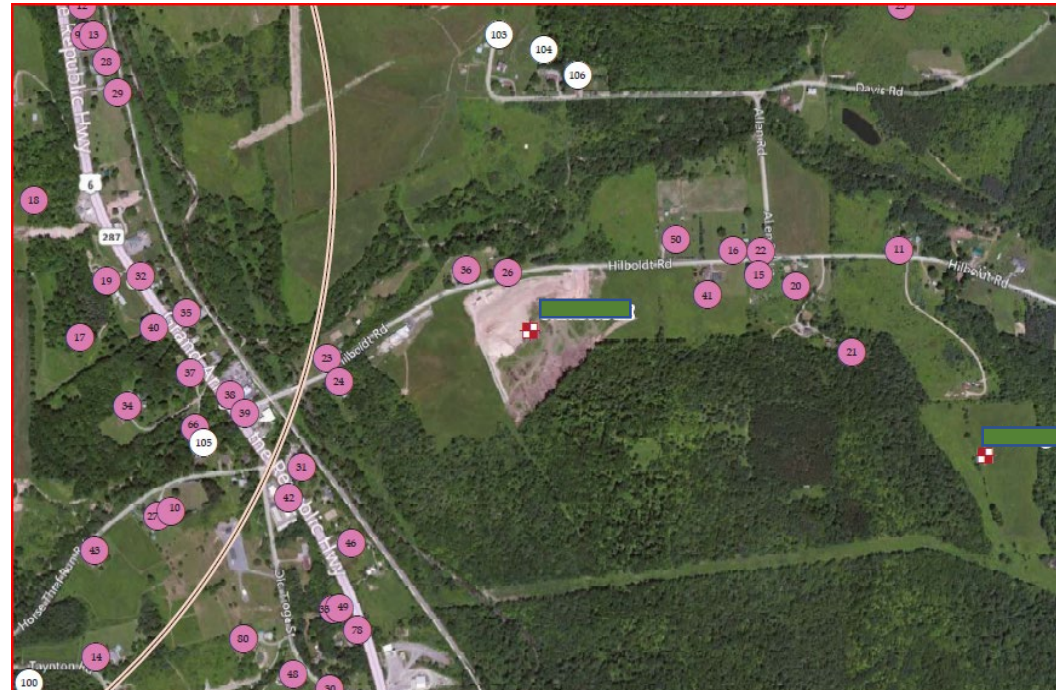
Spill/Leak Management

- Basin/Asset specific based on regulatory requirements, surface/subsurface risk profile and operator internal guidance
- Pad Design and Construction
- Secondary Containment
- Operator Response



Water Monitoring/Sampling Programs

- Degree and extent of water monitoring programs are state specific and can significantly vary within basins
- Programs include groundwater/surface water sampling from private water wells and/or water supply wells installed by operators
- Some states provide specific regulatory requirements for monitoring
- Some states collect regional groundwater and surface water data on a routine basis
- USGS, Academia and other organizations have also implemented water studies in several basins



Thank You