



NAVIGATING CLASS VI PERMITS:

What to Expect in Wyoming

School of Energy Resources Speakers:

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Enhanced Oil
Recovery Institute

Class VI Wells in Wyoming



UNIVERSITY
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School of
Energy Resources

THE WORLD NEEDS MORE COWBOYS.

Disclaimer

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Class VI Permitting in Wyoming

Class VI: A well permitted for long-term geologic storage of CO₂

Regulated by Wyoming DEQ

- ✓ *In September 2020, Wyoming was granted primacy under section 1422 of the SDWA; the decision was effective October 9, 2020 (85 Fed. Reg. 64053)**
- ✓ *No Class VI wells have been permitted yet in Wyoming*
- ✓ *Designed to protect Underground Sources of Drinking Water (USDW); the program is not intended to protect any other environmental or human receptors*
- ✓ *EPA continues to oversee the program in all primacy states*

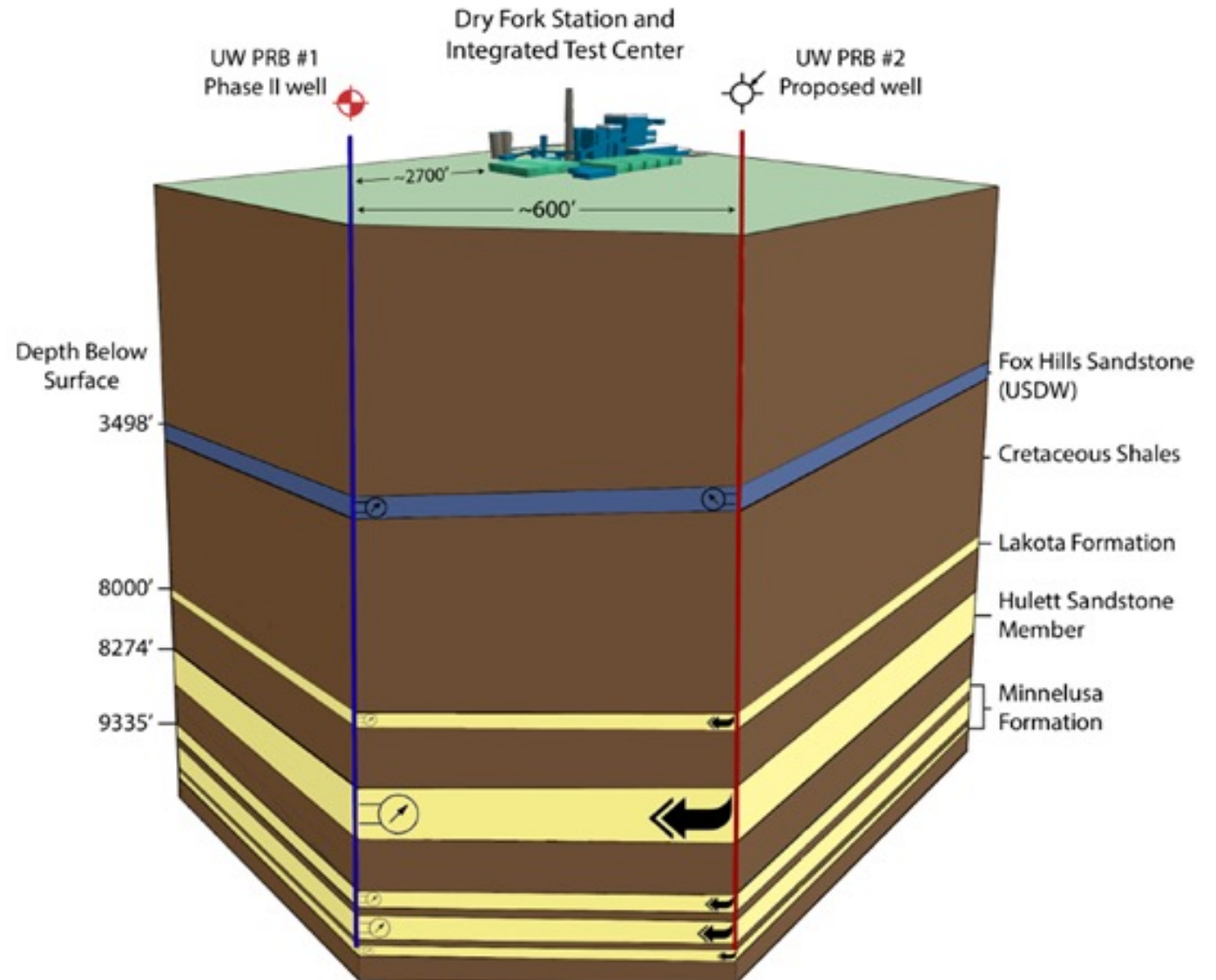
Application Requirements Fall into Two Broad Buckets

- ✓ *Geologic and Technical*
- ✓ *Administrative (i.e., law, policy, financial, commercial)*

Conceptual Model-*Geologic and Technical*

Technical elements of the permit

- ✓ Subsurface
- ✓ Surface
- ✓ Operations
- ✓ Closure
- ✓ Others



Application approach – *Geologic and Technical*

General Technical Work Flow

- Legacy Data Collection and Analysis
- Underground Source of Drinking Water (USDW) Determination
- Modeling and CO₂ Injection Simulations
- Area of Review (AoR) Determination
- Risk Assessment and Corrective Action Strategy
- MVA Strategy
- Compile and Submit a Class VI Permit to Drill
- Site Specific Field Operations and Data Collection (Baseline Monitoring/Well Specific)
- Update Models and Programs with Field/Operational Data

*Can be completed
with legacy data
and expertise*

*Need new field
data to complete*

Sources of data – *Geologic and Technical (cont.)*

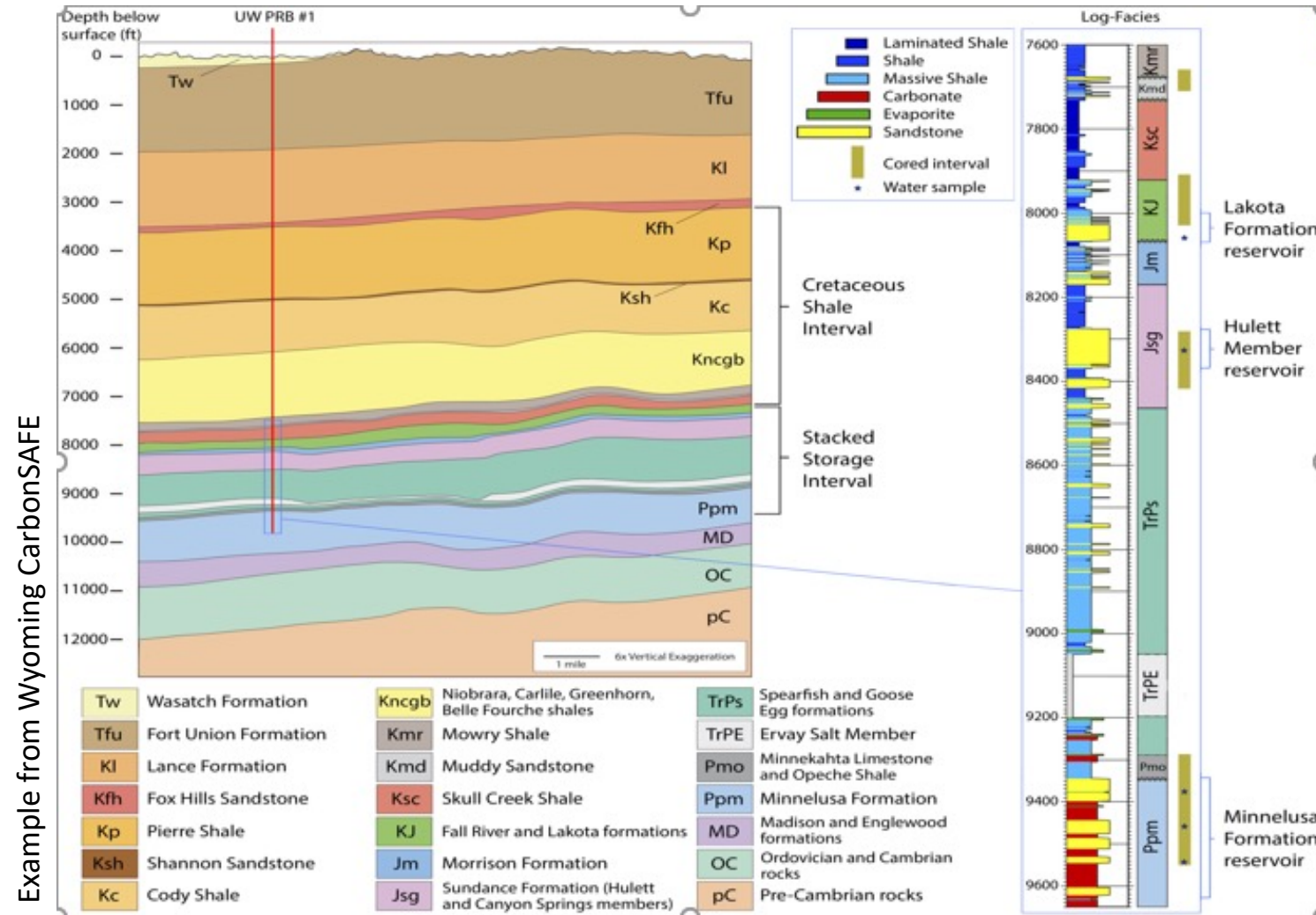
- Well Locations, Logs and Formation Tops (<http://pipeline.wyo.gov/legacywogcce.cfm>)
- Water Quality (USGS Produced Waters Database)
<https://www.sciencebase.gov/catalog/item/imap/59d25d63e4bo5feo4cc235f9>
- Seismic Data (<https://www.seismicexchange.com/>)
- Core Data (<https://www.usgs.gov/core-science-systems/nggdp/core-research-center>)
- Aquifer Descriptions (WWDC Groundwater Reports)
<https://waterplan.state.wy.us/plan/groundwater/groundwater-reports.html>)
- Groundwater Supply Wells (WY SEO <https://sites.google.com/a/wyo.gov/seo/>)
- General Spatial Data (WY GISC geology, faults/fractures, land ownership, mineral ownership, etc.)
<http://www.uwyo.edu/wygisc/>

Application Requirements – *Geologic and Technical (cont.)*

General and Site Geology

- Geologic report from available sources
 - Injection and confining zones
- Structural and isopach maps, cross sections
- Faults and fractures: location and extent
- Seismic history
- Geomechanical and geochemical analysis

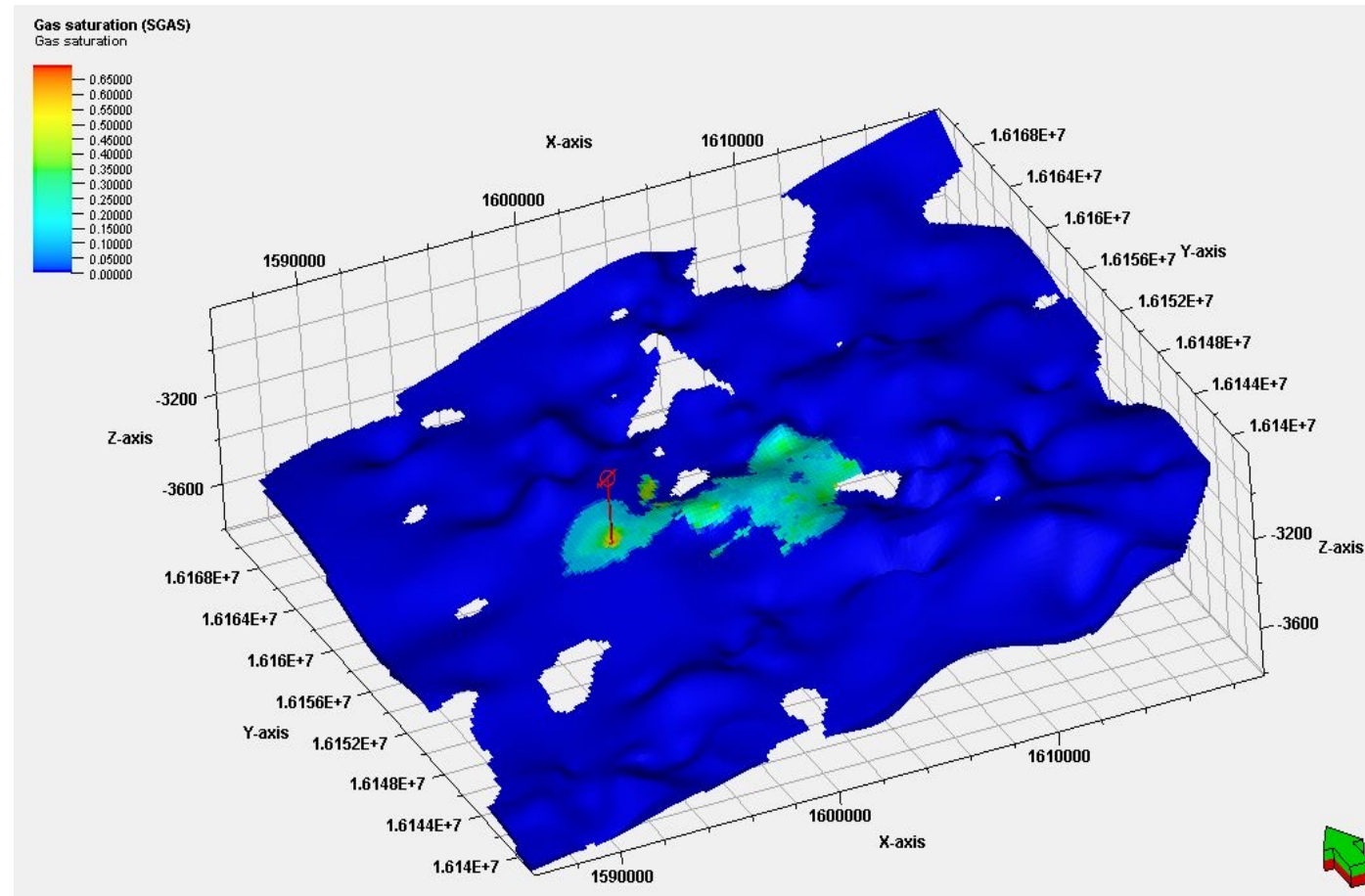
Data sufficient to demonstrate effectiveness of the injection and confining zone



Application Requirements – *Geologic and Technical (cont.)*

Modeling and Simulations

- Life-cycle injection simulations (each well)
- Proof of confinement
- AoR (CO₂ and pressure plumes)
- Effects of pressure management
- Modeling and simulations through the project life-cycle
 - Updated with site well, MVA data
- Software not specifically stipulated
- Enough geologic data (legacy or new) to characterize the injection/confining and other zones
 - Certified by P.G. and P.E.

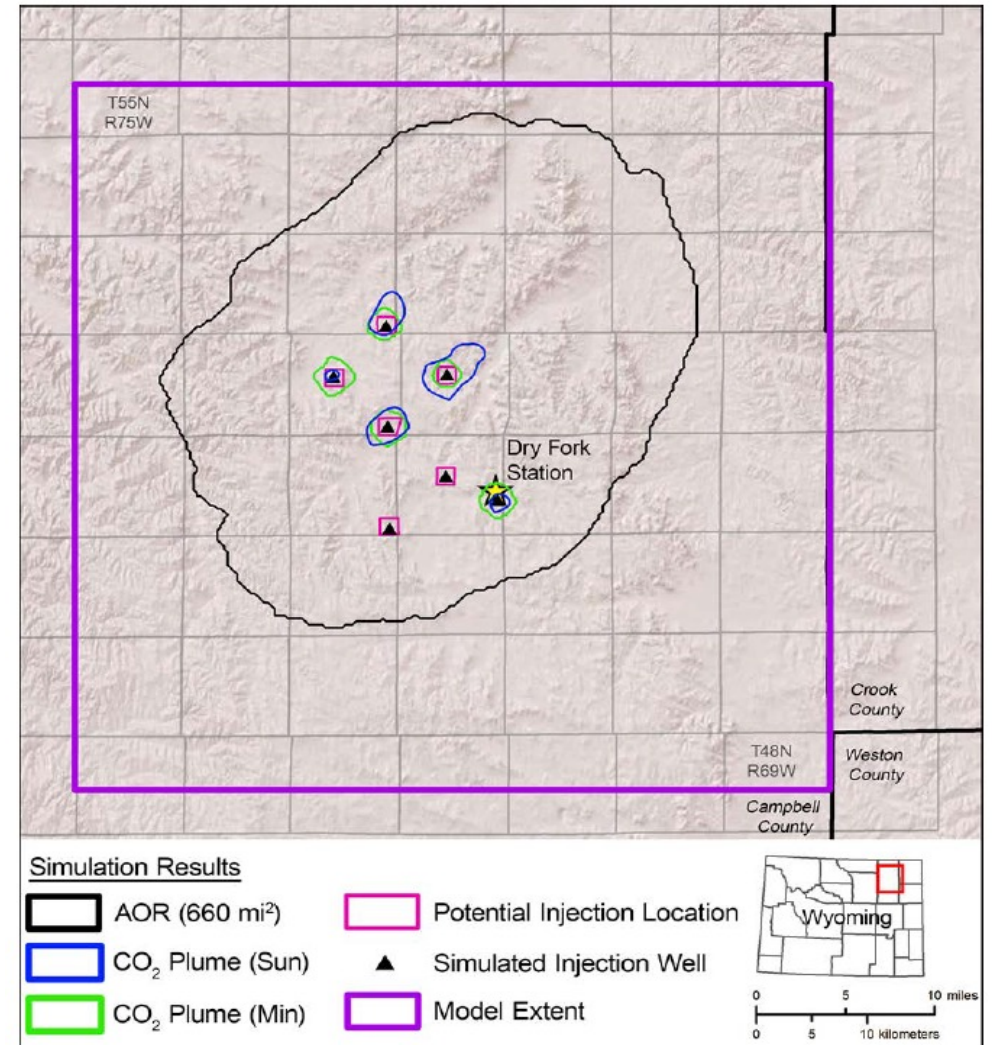


Application Requirements – *Geologic and Technical (cont.)*

Determining Area of Review:

- Subsurface 3-D extent of CO₂ plume, pressure front, and displaced fluids
- Include all available data from logging and testing (within 1 mile) of the AoR
- Based on modeling

Example from Phase II Wyoming CarbonSAFE

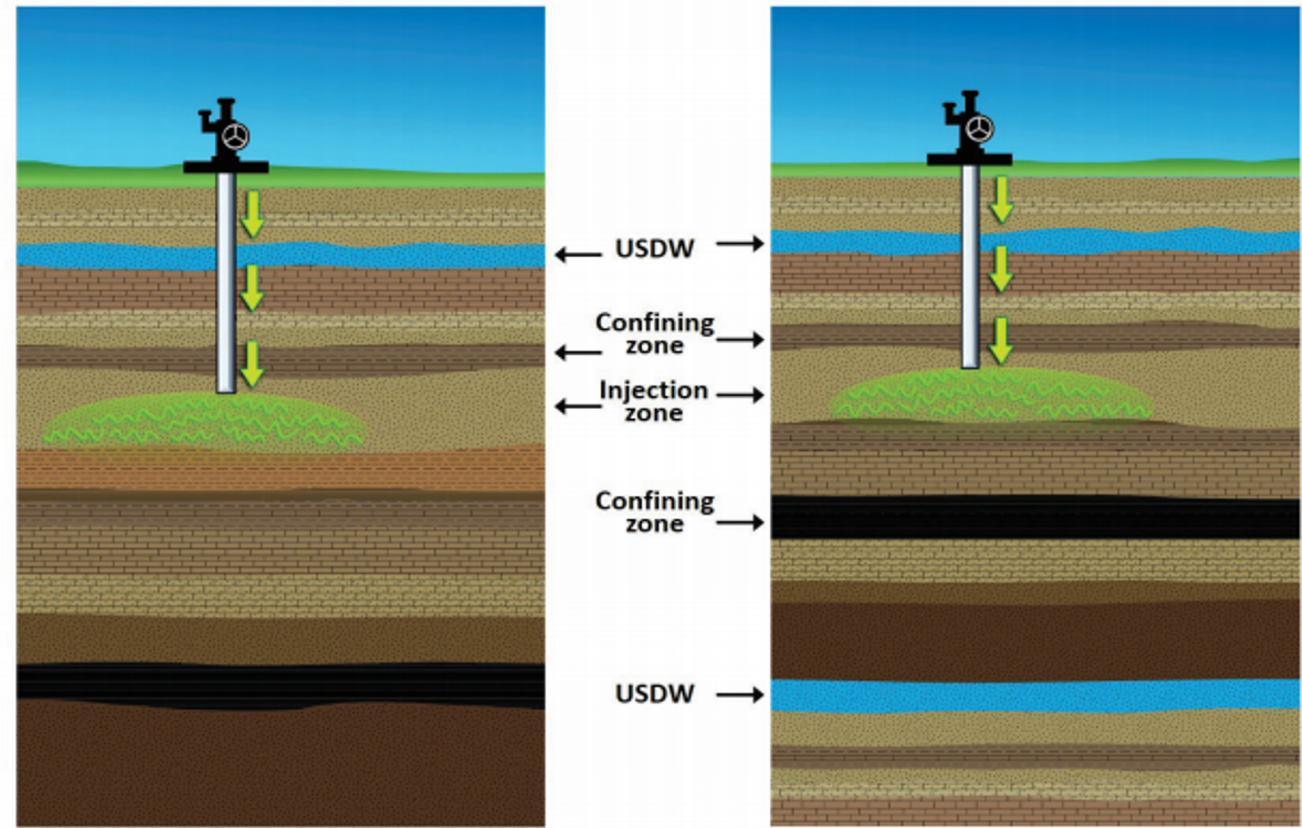


Courtesy of N. Bosshart et al., EERC

Application Requirements – *Geologic and Technical (cont.)*

Groundwater/Aquifer Characterization

- Characterization of the injection zone and aquifers above and below
- Baseline geochemical data on subsurface formations, including all USDWs
- Identifying the lowermost USDW
- Injection Depth Waiver
 - ✓ Requires a supplemental report



Typical Class VI Well

Class VI Well
Operating Under an
Injection Depth Waiver

Note: Figure not to scale

Application Requirements – *Geologic and Technical (cont.)*

Monitoring, Verification and Assessment

- ✓ MVA for environmental surveillance and excursion detection, prevention, and control programs
 - Lifecycle MVA to include post-injection phase
 - During operations monitoring needs to focus on both injection zone(s) and USDW(s)
 - i. Injection zone(s): direct or indirect measurement of the plume extent
 - ii. USDW(s): direct monitoring of groundwater quality, geochemical changes and pressure
 - iii. Injection pressure: direct measurement of rate and volume, pressure on the annulus between the tubing and casing, corrosion monitoring of the well materials, and other in-situ well tests
 - iv. Could include soil gas and surface air monitoring

Application Requirements – *Geologic and Technical (cont.)*

Risk Assessment and Corrective Action

- ✓ Wyoming DEQ provides a Risk Activity Matrix (Environmental Quality, Dept. of Water Quality, Chapter 24: Class VI Injection Wells and Facilities Underground Injection Control Program Appendix A)
 - Legacy wells, geologic structure, confining zones, ownership, operations, etc.
 - Corrective action strategy to include remediation strategies for risk(s)
 - Possibly prior to injection or phased

Application Requirements – *Geologic and Technical (cont.)*

Additional Requirements

- ✓ Operational data
- ✓ Testing and Monitory Requirements
- ✓ Completion Requirements
 - Exceed standards developed for such materials by the American Petroleum Institute, ASTM International, or accepted by the Administrator
- ✓ Plugging and Abandonment

Application Requirements – *Administrative (i.e., law, policy, financial, commercial)*

- Separate statutes/others laws continue to apply to projects
 - ✓ Class VI is focused on USDWs
- Class VI permitting requires a variety of plans
 - ✓ Corrective Action Plan
 - ✓ Testing & Monitoring Plan
 - ✓ Well Plugging Plan
 - ✓ Emergency & Remedial Response Plan
- Financial responsibility considerations
- Reporting considerations
- Permit timing considerations
- Public notice/public participation considerations
- Commercial considerations
 - Project finance (e.g., California's Low Carbon Fuel Standard; section 45Q; other)

For More Information –

- EPA's Class VI Website, Regulations & Voluminous Guidance Documents
- Wyoming's Class VI Regulations (Wyoming Administrative Rules; DEQ; Water Quality Chapter 24)



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