



# NAVIGATING CLASS VI PERMITS: *What to Expect in Wyoming*

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Enhanced Oil  
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# Class VI Wells in Wyoming



UNIVERSITY  
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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 CO<sub>2</sub>

## 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

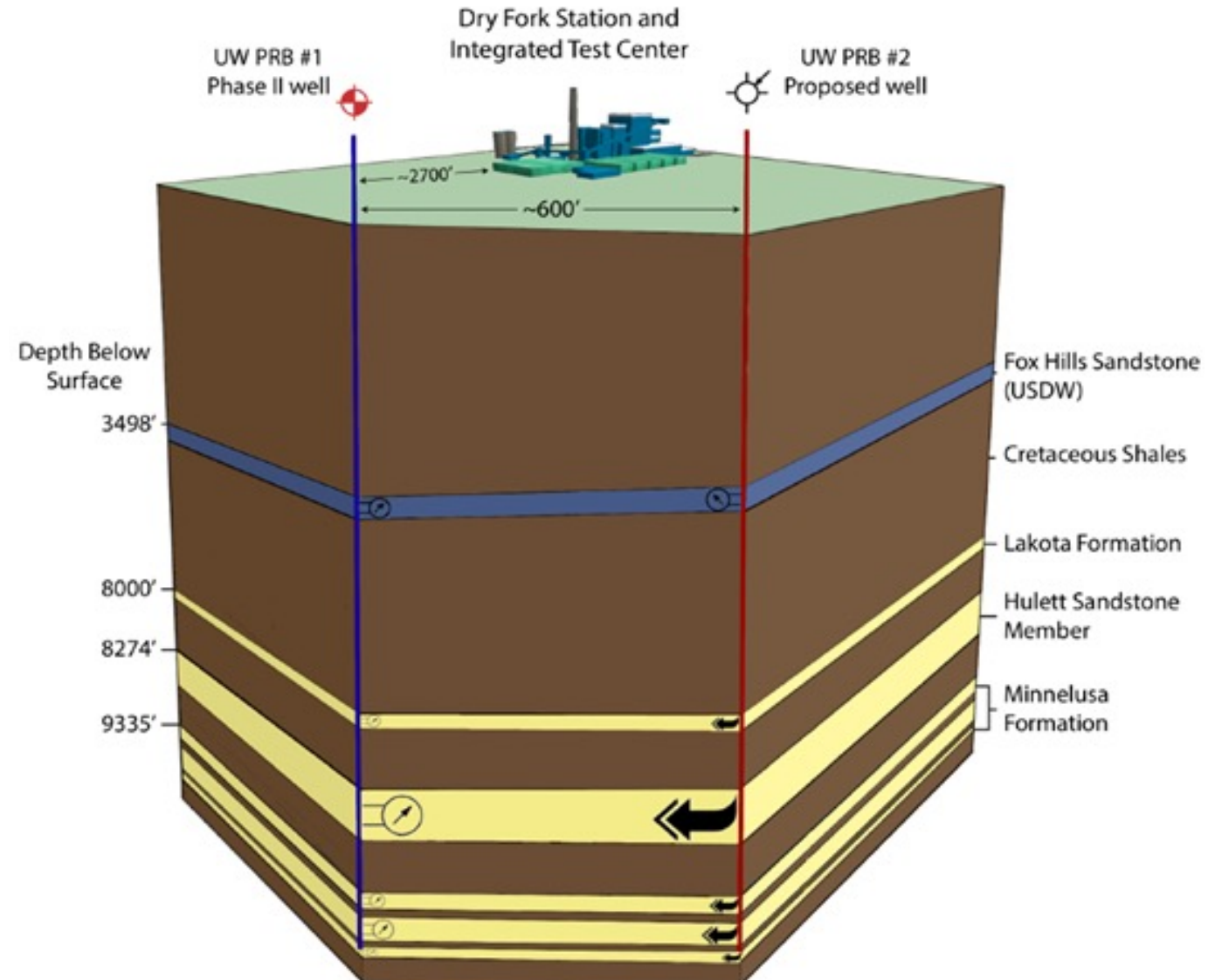
- ✓ *Geologic and Technical*
- ✓ *Administrative (i.e., law, policy, financial, commercial)*



# 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 CO<sub>2</sub> 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.)*

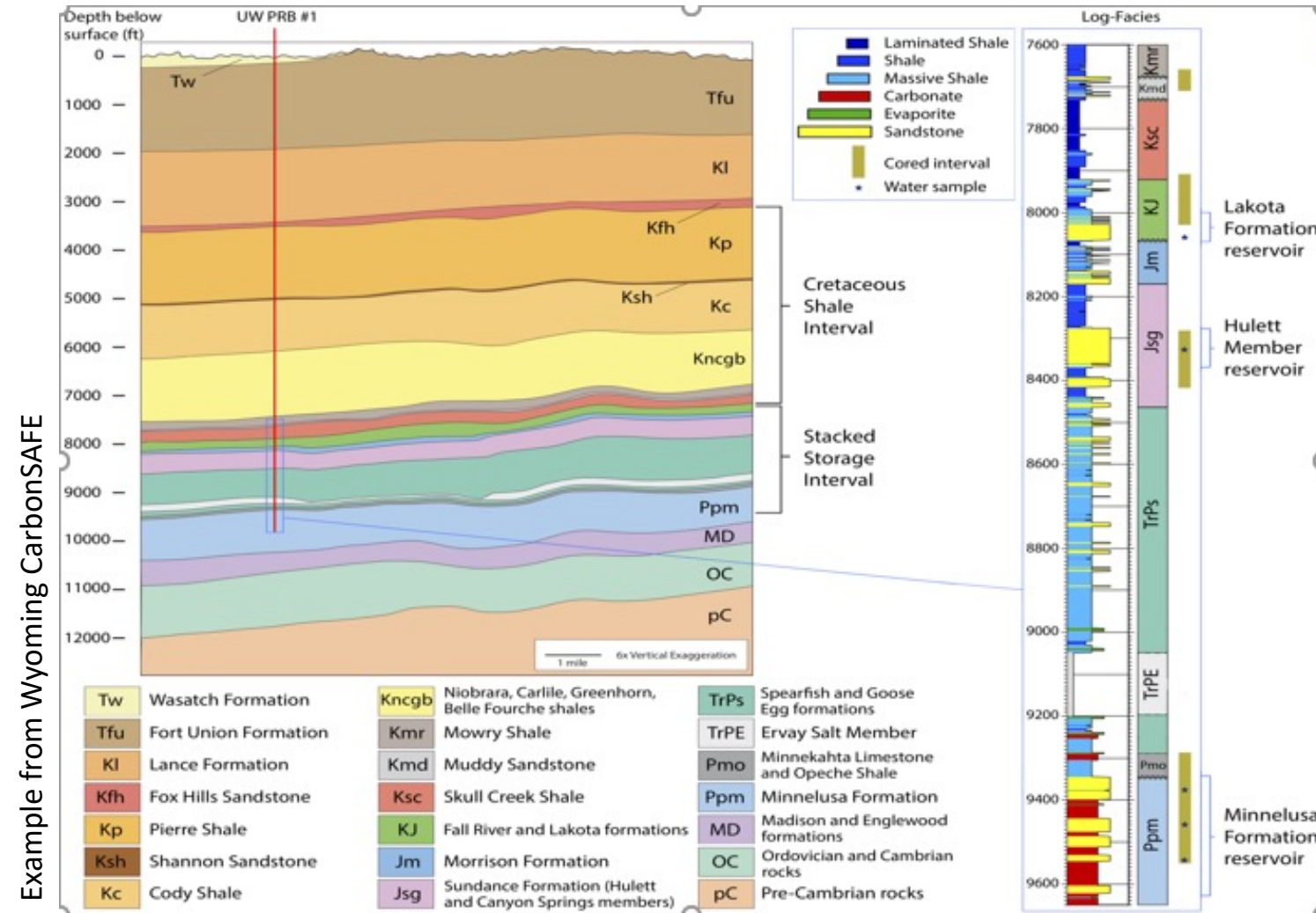
- Well Locations, Logs and Formation Tops (<http://pipeline.wyo.gov/legacywogcce.cfm>)
- Water Quality (USGS Produced Waters Database)  
<https://www.sciencebase.gov/catalog/item/imap/59d25d63e4bo5feo4cc235f9>
- Seismic Data (<https://www.seismicexchange.com/>)
- Core Data (<https://www.usgs.gov/core-science-systems/nggdp/core-research-center>)
- 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*

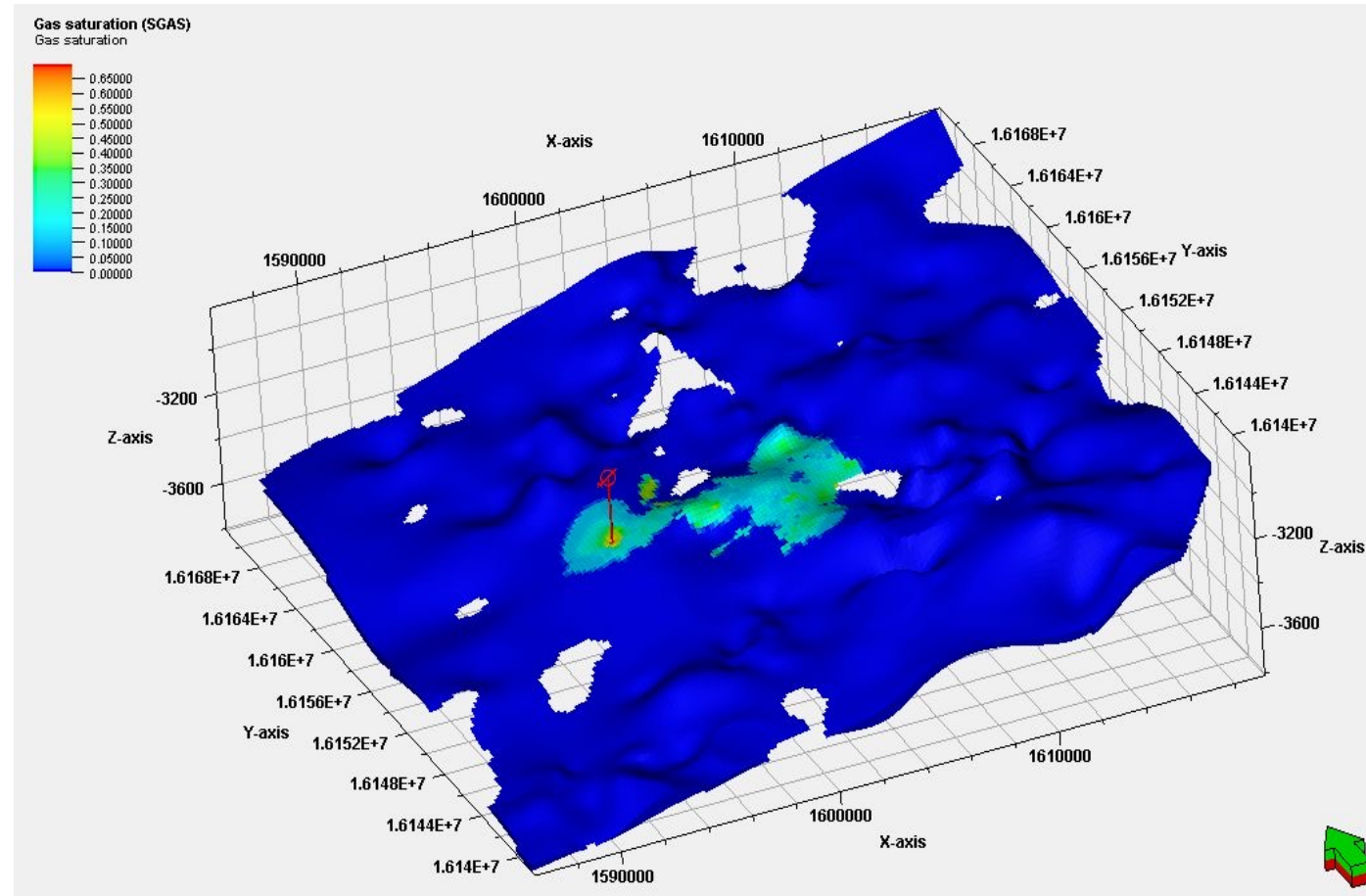




# Application Requirements – *Geologic and Technical (cont.)*

## Modeling and Simulations

- Life-cycle injection simulations (each well)
- Proof of confinement
- AoR (CO<sub>2</sub> 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.

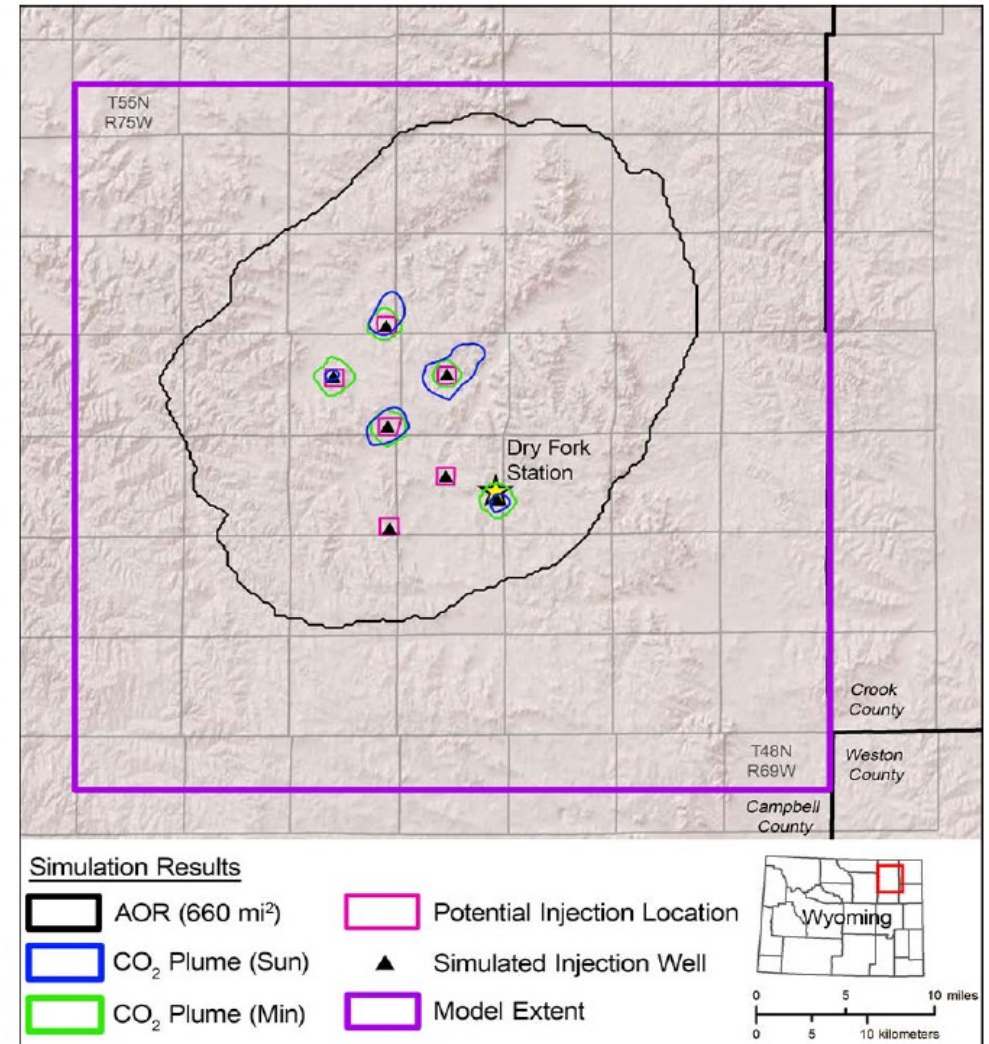


# Application Requirements – *Geologic and Technical (cont.)*

## Determining Area of Review:

- Subsurface 3-D extent of CO<sub>2</sub> 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

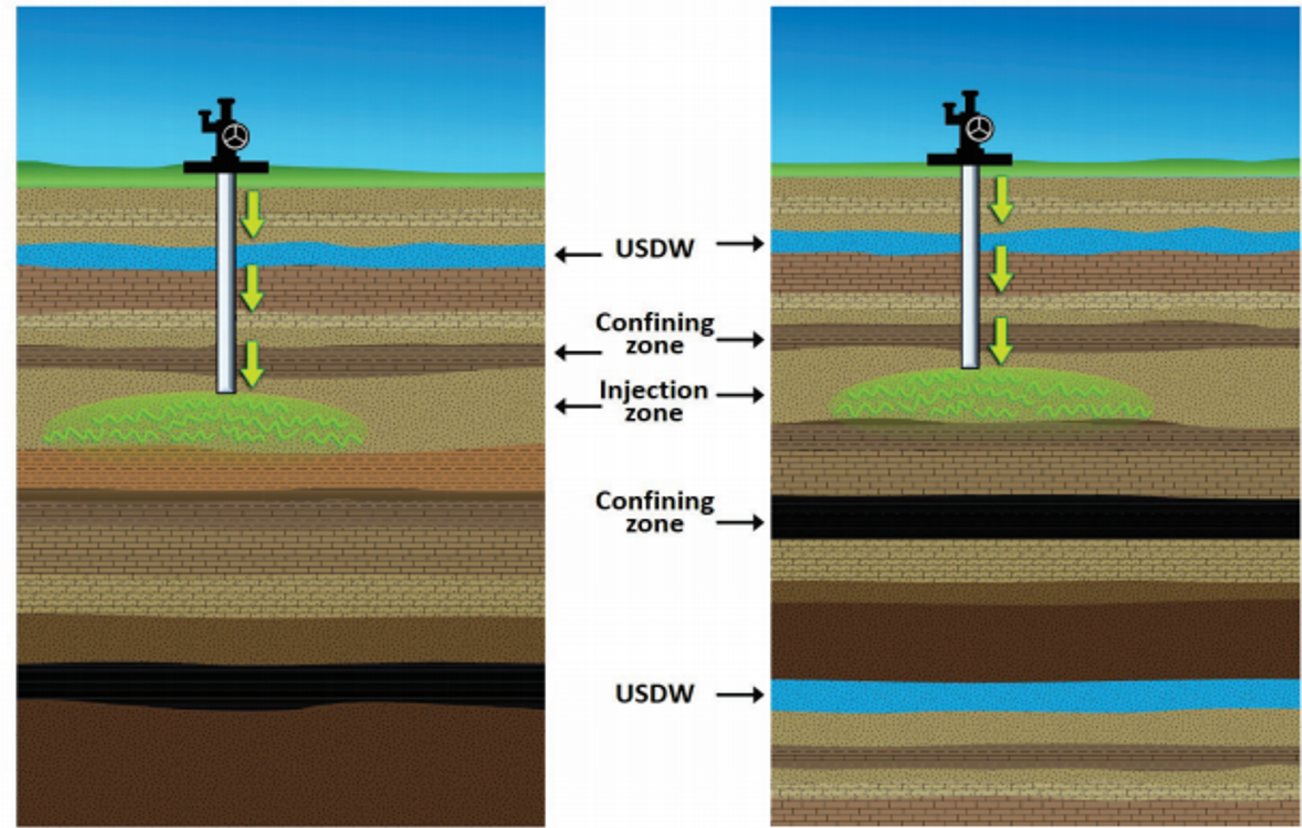


Courtesy of N. Bosshart et al., EERC

# 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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