Geologic Sequestration of CO2

Overview of the Class VI UIC Permitting Process in Texas

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Railroad Commission of Texas
Oil & Gas Division Regulatory Conference

July 15, 2025

Presentation: Section 1 of 3

Class VI Overview & Geologically Oriented Permitting Process

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RRC Regulatory Conference - July 15, 2025

Presentation Outline – Section 1

Quick Overview of Class VI Projects in USA & Texas

Permit Application & General Requirements

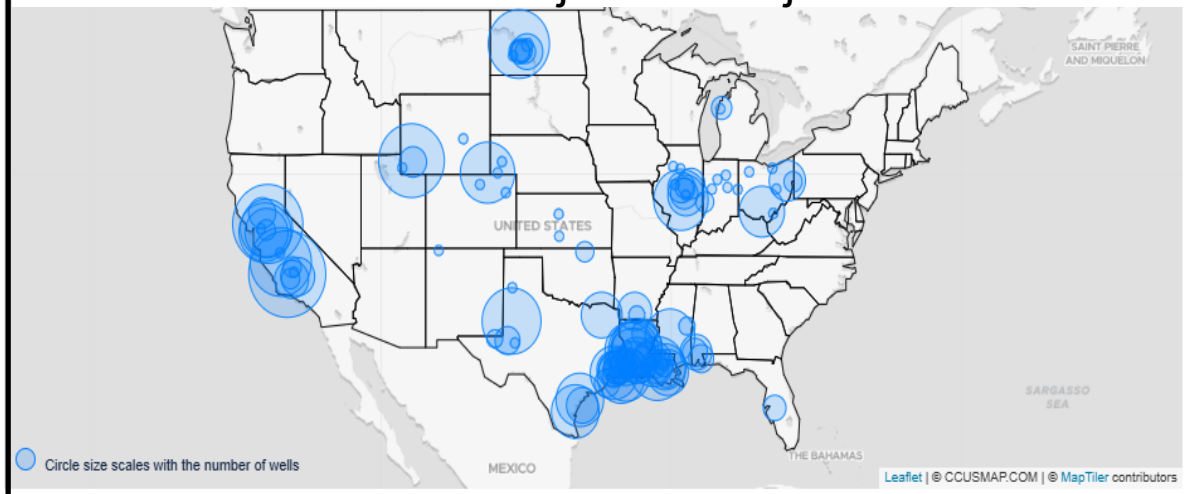
Completeness Review

Site Characterization

Area of Review & Corrective Action Plan

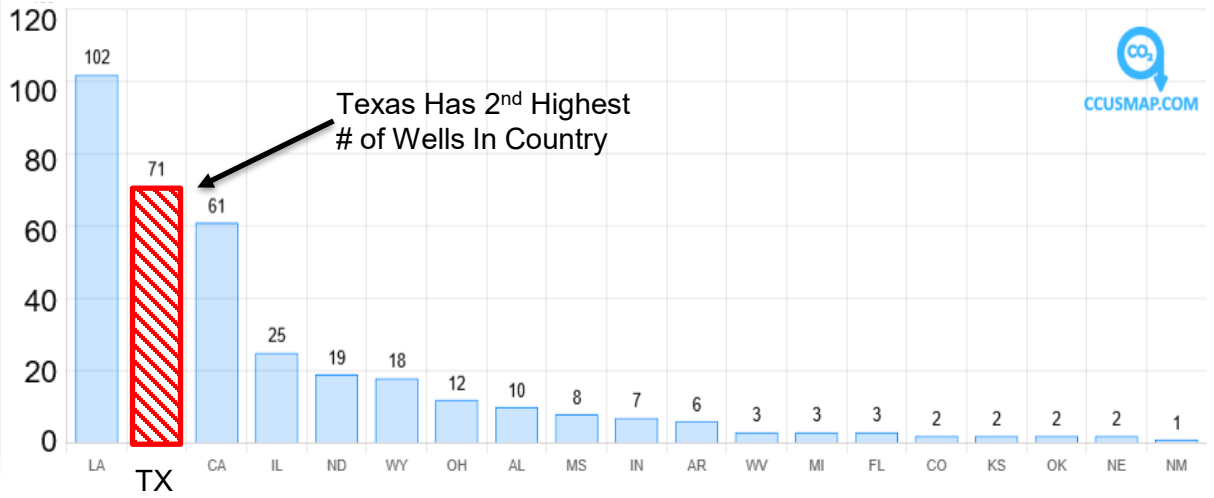
Overview of the Class VI Projects In USA

Class VI – CO2 Injection Project Location

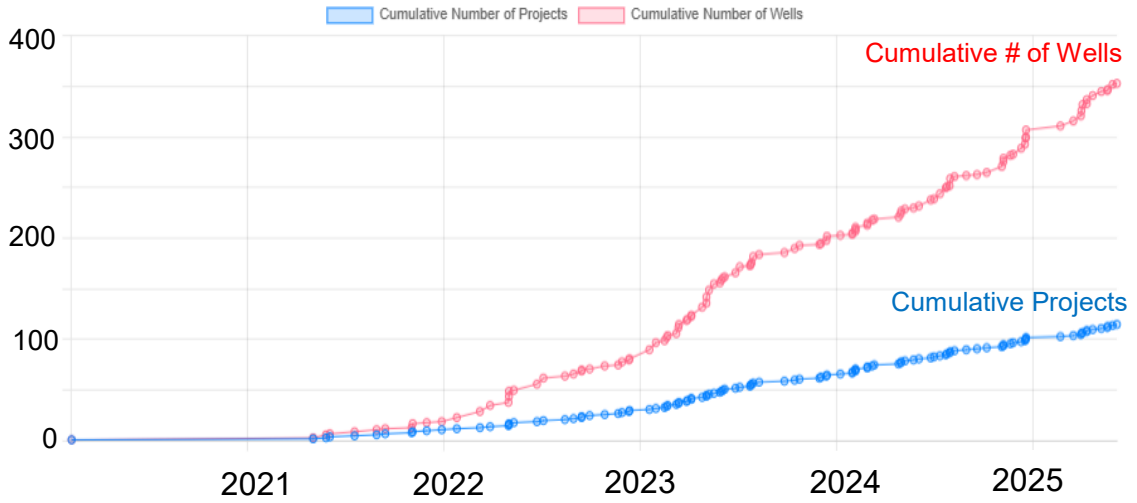


Name	# Wells	State
Bluebonnet Hub	6	TX
Bayou Bend East	6	TX
ConocoPhillips Texas Gulf Coast CCS Refugio	6	TX
South Texas Sequestration Project (Kleberg Hub)	6	TX
Sugarberry CCS Hub	5	TX
Offshore North 1 (Aves CCS)	4	TX
Pineywoods CCS Hub	4	TX
Jasper County Storage Facility	4	TX
Sunflower Carbon Storage	4	TX
Brown Pelican (Stratos)	3	TX
Rose Carbon Capture and Storage Project	3	TX
West Bay	3	TX
Caliche Beaumont Sequestration Project	3	TX
Titan Carbon Sequestration	2	TX
Loving CCS Hub Central Loving Facility	2	TX
Midland CCS Hub	1	TX

Number of Class VI Injection Wells

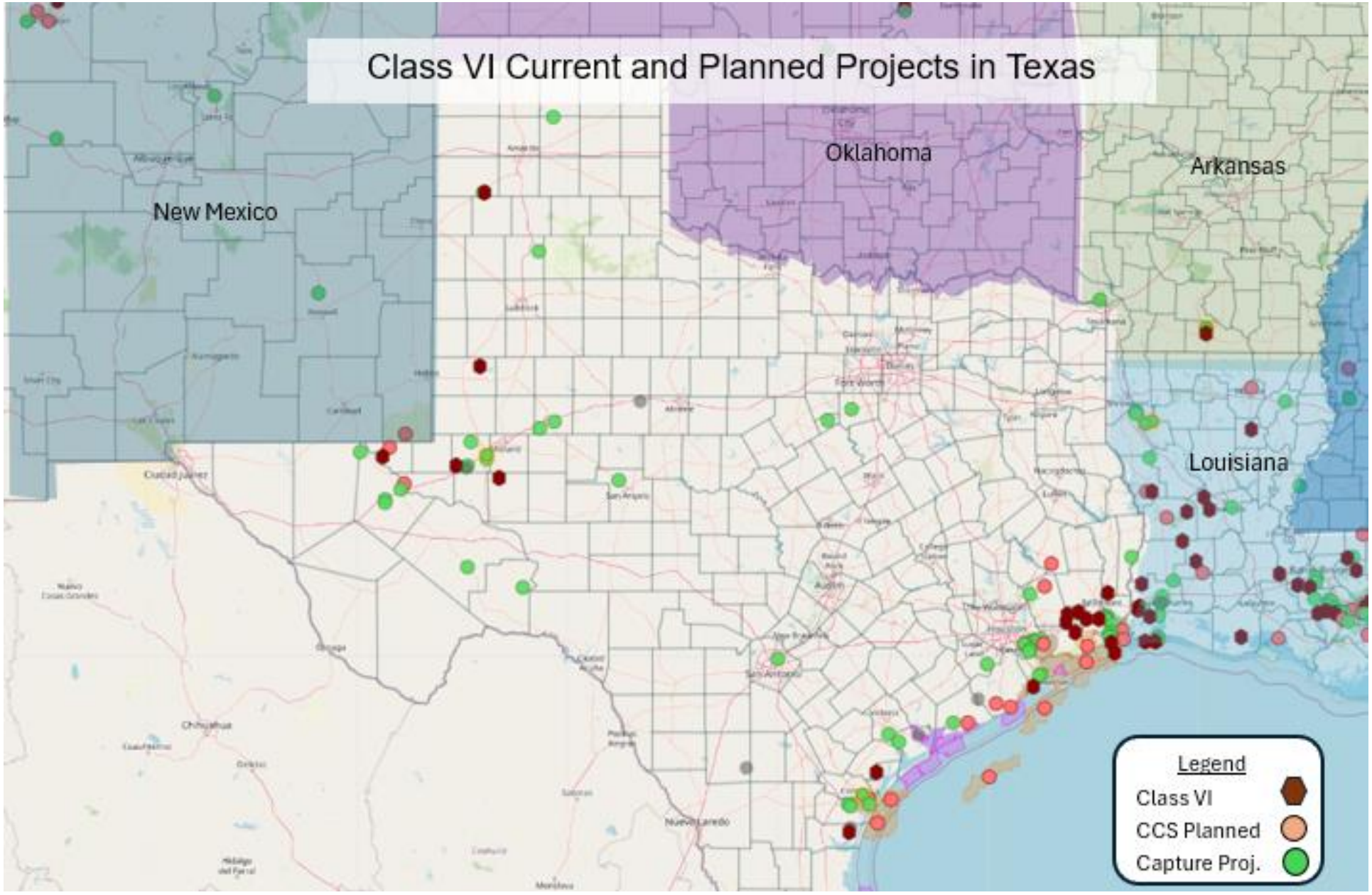


Cumulative Projects and Wells by Application Date



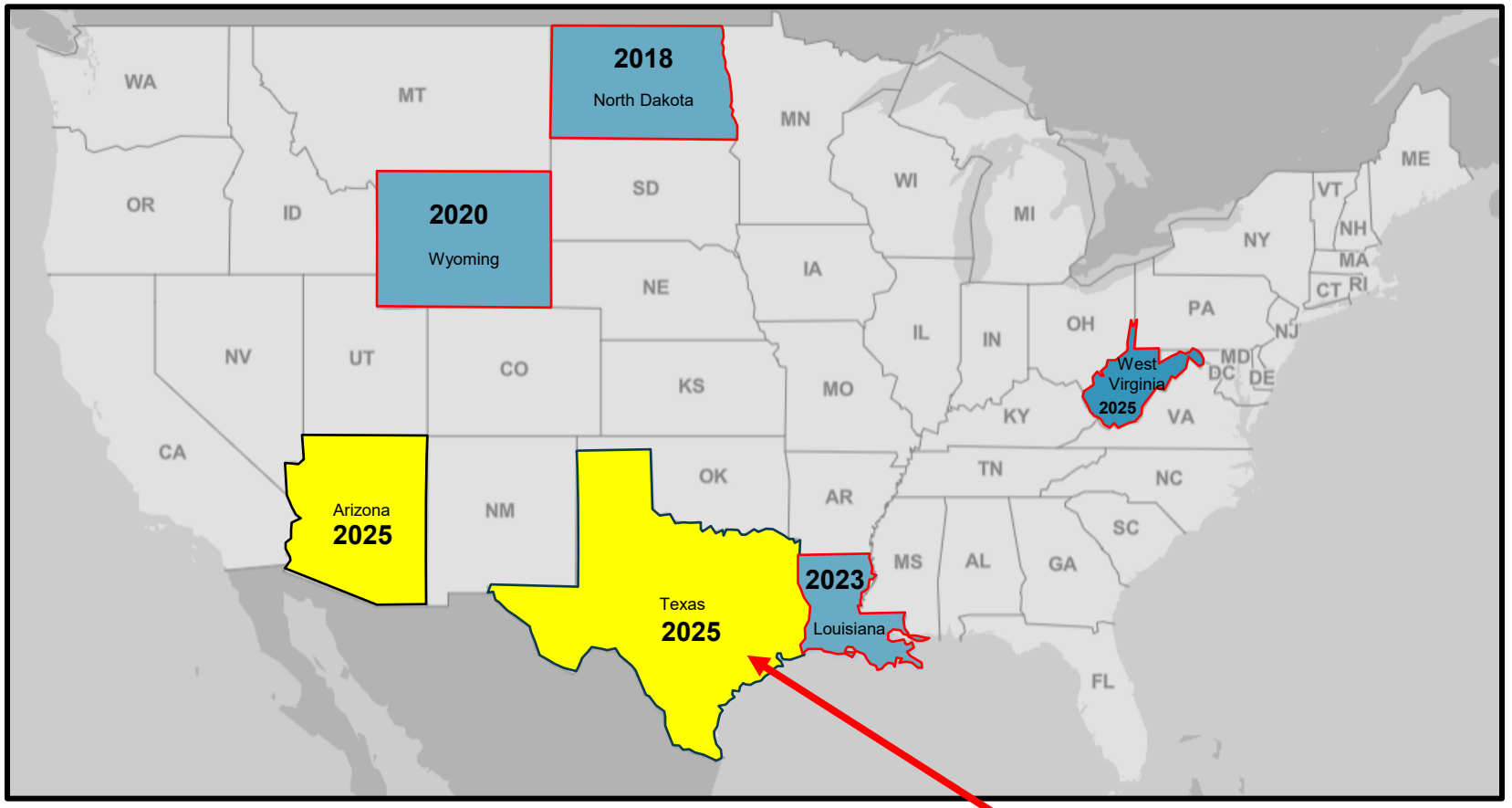
Pending Permits Data Found on EPA Website

Overview of the Class VI Projects In Texas



Pending Permits Found on EPA Website

Overview of Class VI Primacy Discussion



June 9, 2025

EPA Proposes Granting Texas Primacy For Class VI Wells

Permit Application Process

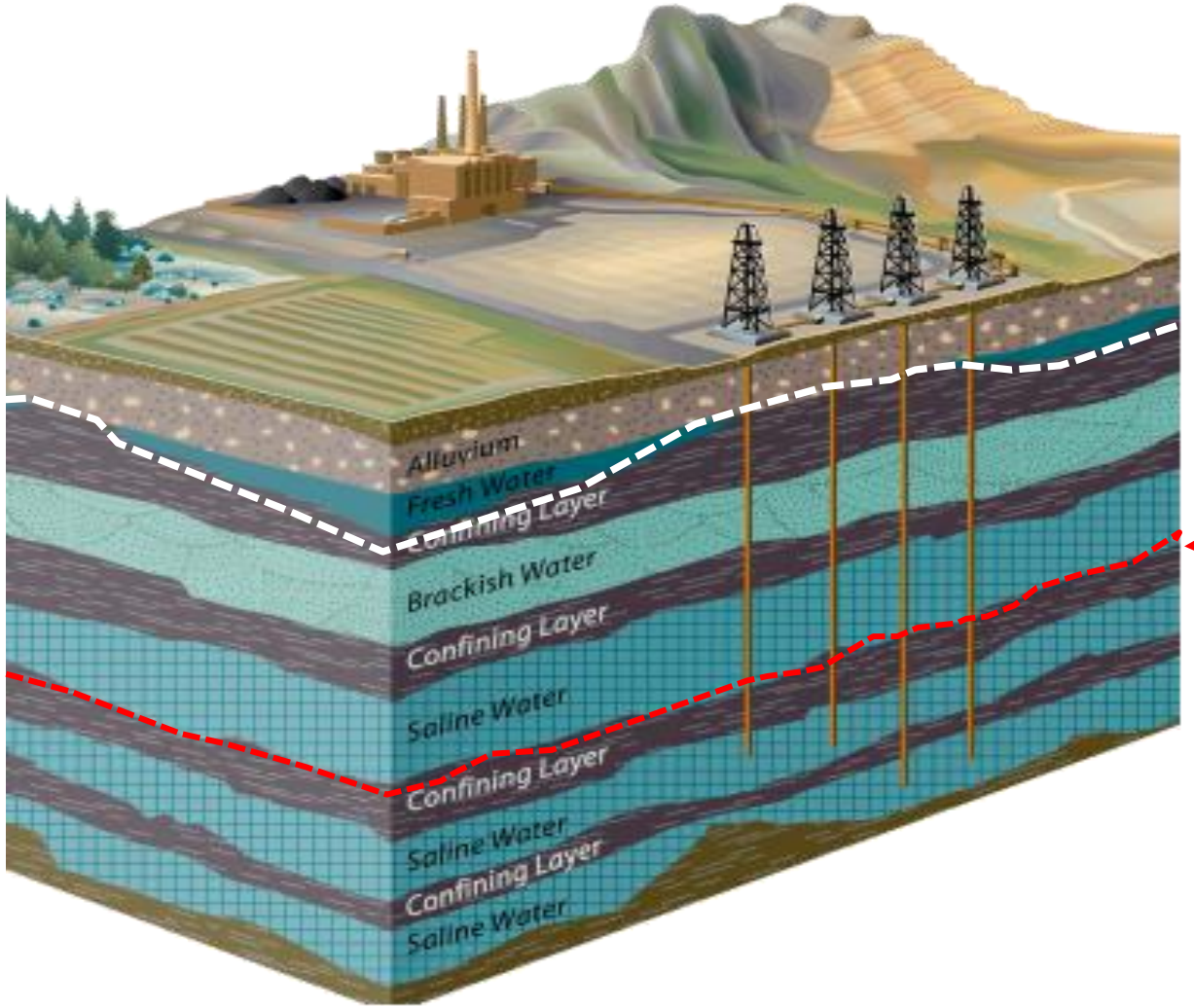
Specific Sections And Procedures Are Outlined On RRC Website

1) Project Fact Sheet & Completeness Review	7) Emergency Response & Remediation Plan
2) Project Narrative & Site Characterization	8) Well Construction Plans
3) Area of Review (AoR) & Corrective Action	9) Injection Well Stimulation Plan
4) Testing & Monitoring Plan	10) Well Plugging Plans
5) Quality Assurance & Surveillance Plan (QASP)	11) Post-Injection Site Closure (PISC) Plan
6) Summary of Operating Conditions	12) Financial Assurance Demonstration

Permit Application Process

The Fundamental Reason for a Class VI UIC Permit is Protection of USDWs

Base of Useable Quality Water
BUQW
(<3,000 ppm Salinity



Base of Underground Source of Drinking Water
USDW
(<10,000 ppm Salinity)

General Requirements (Often Missed) for Class VI Applications

Class VI Application Must Provide:

- A current / active **P-5 Number** using Organization Report (Form P-5).
- **A signed Certification** that the application was prepared under the guidance and with the full knowledge of a company officer having responsibility for the Class VI project.
- A signed statement that the applicant has **access rights to the subsurface pore space** and **surface footprint of the proposed AoR.**
- The **PE or PG seal** to application sections.

General Requirements - Class VI UIC Application Data Sheet

https://www.rrc.texas.gov/oil-and-gas/oil-and-gas-forms/

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RAILROAD COMMISSION OF TEXAS
OIL AND GAS DIVISION
SPECIAL INJECTION PERMITS UNIT

Form Name	PDF Form
Class VI Data Sheet	

GEOLOGIC STORAGE OF CO_2 DATA SHEET (Class VI)

1. Operator Name _____ 2. Operator P-5 No. _____
3. Operator Addess _____
4. What type of Entity is the operator? ☐ Federal ☐ State ☐ Public ☐ Private ☐ Other _____
5. Facility Name _____
6. County(s) of Injector(s) Locations _____ , _____ , _____ 7. RRC District No. _____
8. Primary Facility is ____ miles in a ____ direction from _____ center of nearest town
9. Any Facility located on Indian Land ☐ Yes ☐ No If yes, specify _____
10. Source(s) of CO_2 _____ , _____ , _____
11. Formation Names of Injection Zones _____ , _____ , _____
12. New Permit: ☐ Yes ☐ No 13. If no, amendment of Permit No. _____
14. Reason for amendment: ☐ Pressure ☐ Volume ☐ Interval ☐ Data Change
☐ Other (explain) _____
15. Depth to base of BUQW (ft) _____ 16. Depth to base of USDW (ft) _____
17. No harm letter from TCEQ ☐ Yes ☐ No 18. No harm letter from GAU ☐ Yes ☐ No

19. Inj Well Name and No. (Use Additional Wells page as needed)	20. Inj Rate (MT/Day)		21. Surf Inj Press (psig)		22. Surface Hole Loc NAD:		23. Injection Interval TVD (ft)	
	Avg.	Max.	Avg.	Max	Latitude	Longitude	Top	Bottom

24. Est. Storage Volume of injected CO_2 (MMT) _____ 25. Injection Period (yrs) _____

CERTIFICATE

As prescribed by TAC §5.203(a)(1)(C), I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment forknowing violations.

Signature _____ Date _____

Name of person (type or print) _____

Phone _____

email _____

FOR RRC USE ONLY | REGISTER NO. | PERMIT AMOUNTS ($)

Rev. 03 01/30/2025 | SIP

Completeness Review

A Class VI UIC permit application must be submitted in its entirety / fully complete before technical review by the RRC can begin. Components of the application include:

- Fees, (for example, $50,000 for a new geologic storage facility)
- Project Narrative & Site Characterization
- Pre-Operational Testing Plan
- Well Construction Plan
- Well Stimulation Plan
- Operating Plan
- Area of Review (AOR) & Corrective Action Plan (CAP)
- Testing & Monitoring Plan (incl. MIT)
- Quality Assurance and Surveillance Plan (incl. seismicity)
- Well Plugging Plan
- Emergency & Remedial Response Plan
- Post-Injection Site Care (PISC) & Site Closure Plan
- Financial Assurance & Responsibility Demonstration
- Freshwater "No Harm" Letter from RRC's Groundwater Advisory Unit
- Class I "No Harm" Letter from the Texas Commission on Environmental Quality (TCEQ)

A “detailed” copy of the ‘**Class VI Permit Application Completeness Checklist**’ can be found on the RRC Website and/or is available from the RRC SIP Team.

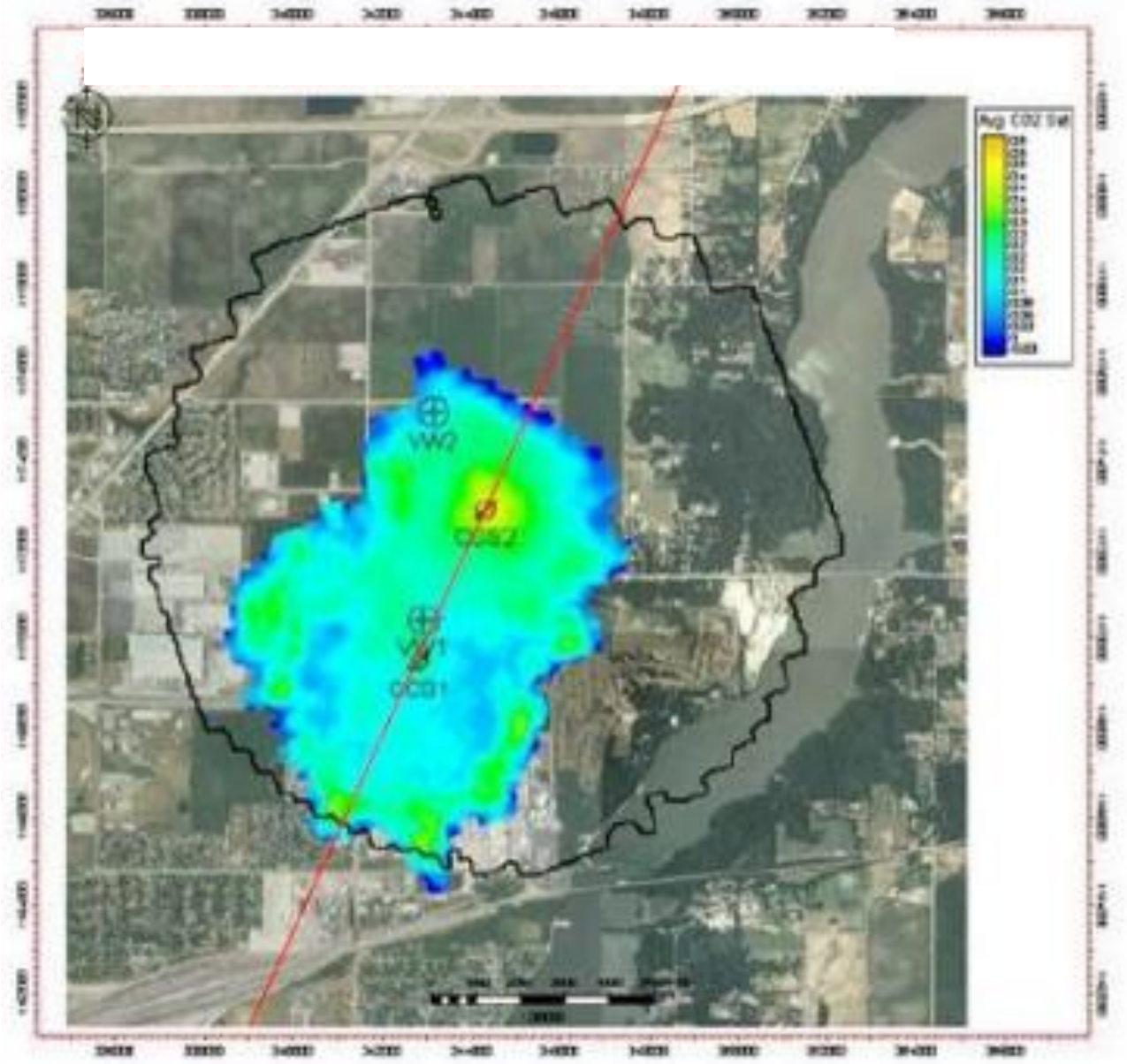
Site Characterization

- A licensed PE or PG must conduct the geologic and hydrologic evaluations…and must affix the appropriate seal on the resulting reports…

- "A **letter from the Groundwater Advisory Unit (GAU)** with **depth of deepest base of USDW** in the AoR.
- Provide a **project overview** / **surface map** showing:
  - all known artificial penetrations through the confining zone
  - cathodic protection holes
  - subsurface cleanup sites
  - bodies of surface water
  - springs
  - surface and subsurface mines & quarries
  - water wells
  - other pertinent surface features, including pipelines, roads, and structures intended for human occupancy
  - any known or suspected faults expressed at the surface
  - injection wells
  - outline of the maximum predicted areal extent of the AOR
  - indicate the coordinate system used.

Area of Review and Corrective Action Plan (1 of 2)

- The **pressure-front** of the AoR is the area around a UIC well where, during injection, the pressure of the **formation fluid** in the injection zone is high enough to **displace the hydrostatic column of fluid in an out-lying wellbore** and **flow upward into overlying USDWs.**



This section **must be sealed** by a **P.G.** having direct knowledge of the technical evaluation and work documented in this section of the application.

* Figure from Illinois Industrial Carbon Capture & Storage Project Overview

Area of Review and Corrective Action Plan (2 of 2)

- The pressure-front component of the AoR is the area around an UIC well where, during injection, the pressure of the formation fluid in the injection zone is high enough to **displace the hydrostatic column of fluid in an artificial penetration and flow upward into overlying USDWs.**

- Zone of Endangering Influence (ZEI) **pressure-front boundary around injectors** beyond which fluids do not have enough pressure to reach upward to USDWs, may be calculated.

- In potential injection reservoirs **where the injection zone is already over-pressurized** and thus subject to potential fluid leakage from the injection reservoir to a USDW **even prior to the planned GS project**, ground water modeling (e.g. MODFLOW) may be conducted for the USDW to **estimate how hypothetical additional fluid leakage from a potential artificial penetration caused by the injection project, is diluted within the USDW and attenuated.**

- An additional pressure increase in the injection reservoir **may be allowable if negligible degradation of the USDW** would result from increased fluid leakage rates into a USDW.

Presentation: Section 2 of 3

Class VI Engineering Review Permitting Process

Leo Castro

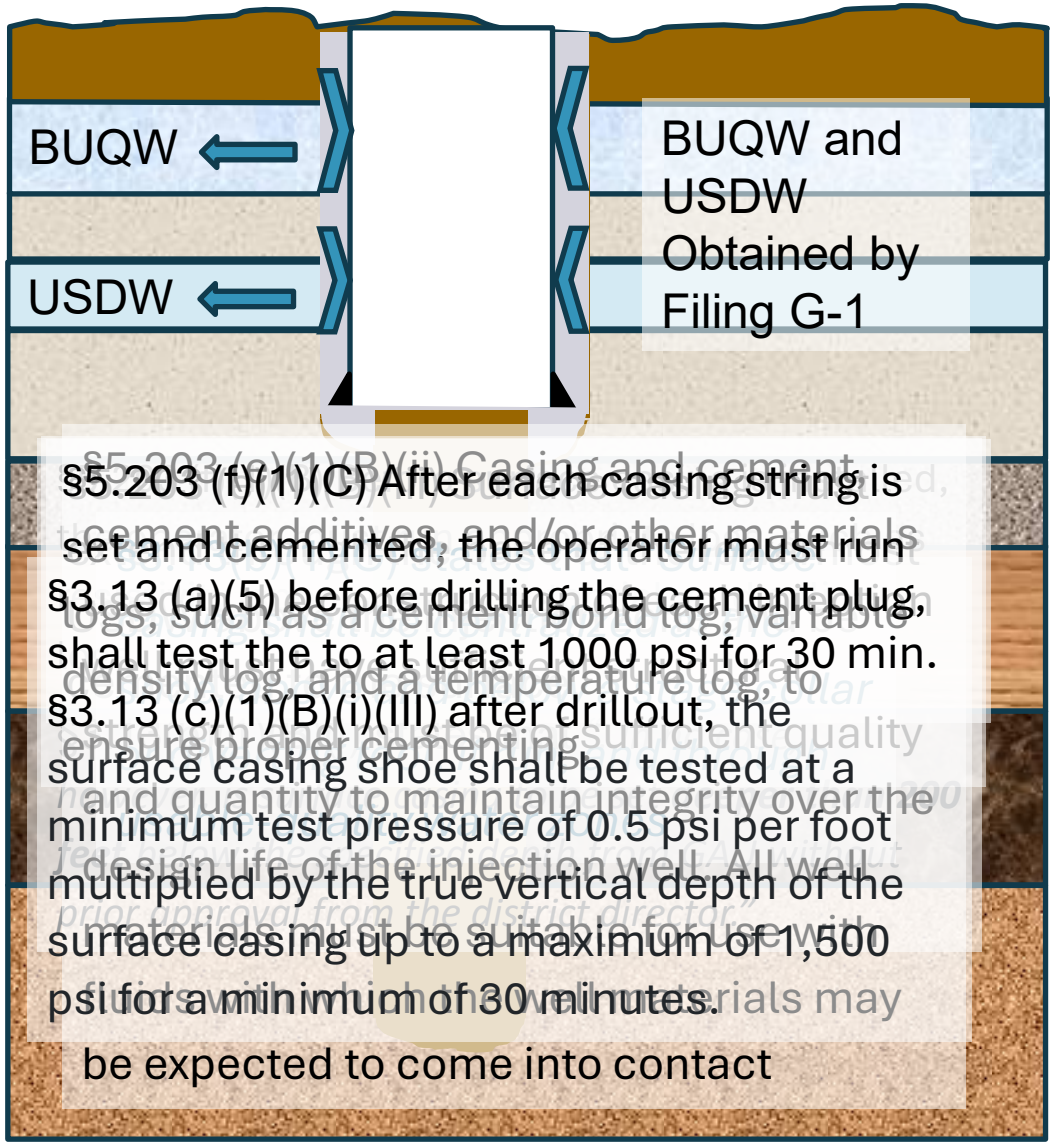
RRC Regulatory Conference - July 15, 2025

Well Construction (1 of 4)

- Well Construction Governed By
  - Title 16 Part 1 Chapter 5 Subchapters A & B, §§5.101, 5.102, 5.201, 5.202, 5.203, 5.204, 5.205, 5.206, 5.207 and 5.208

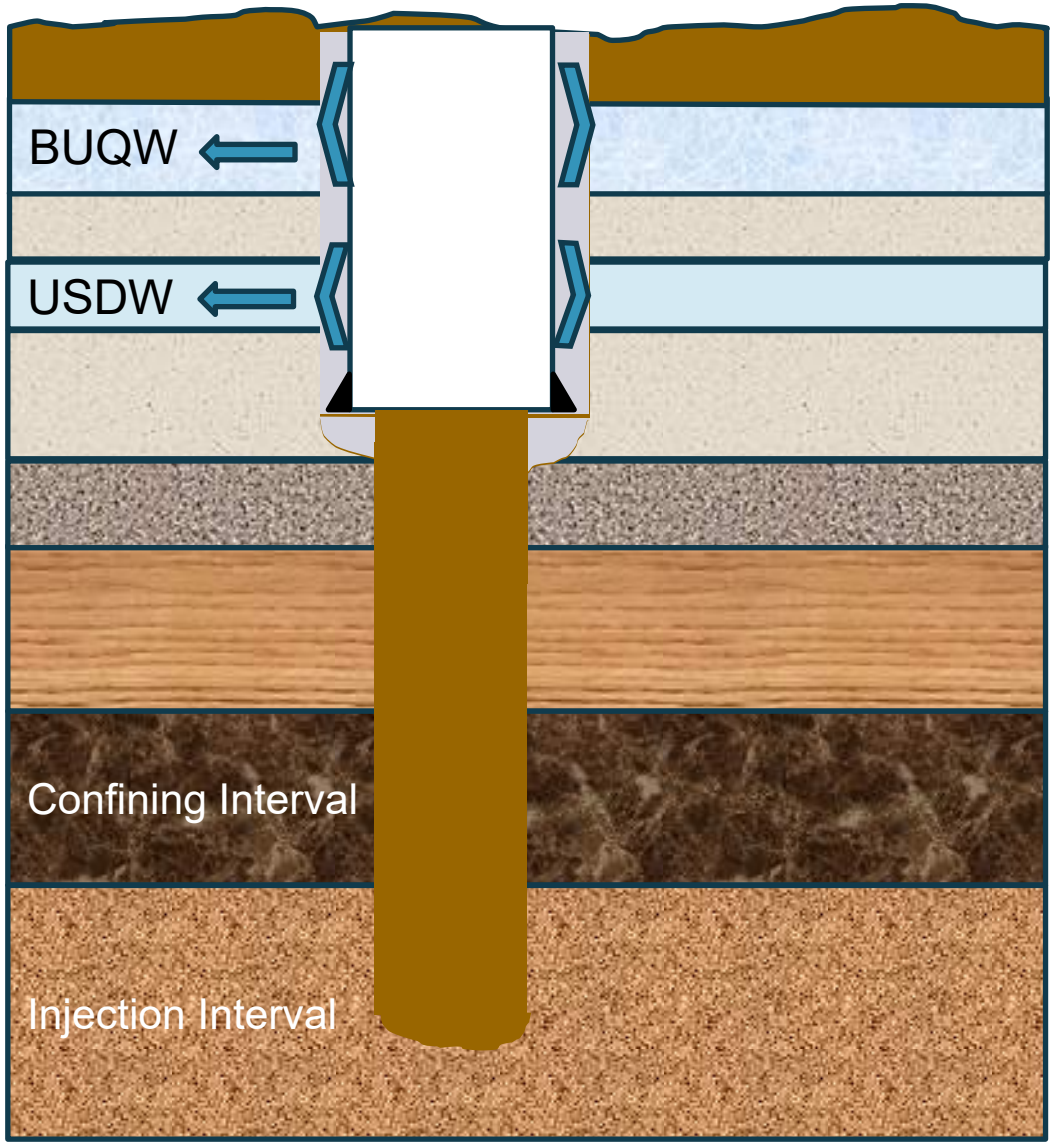
- Major Tripping Point
  - 16 TAC Chapter 5 §5.203 (e)(1)(B)(i) which states that, *"(i) The operator must ensure that injection wells are cased and the casing cemented in compliance with **§3.13** of this title (relating to Casing, Cementing, Drilling, Well Control, and Completion Requirements), in addition to the requirements of this section."*

Well Construction (2 of 4)



- Base of Usable Quality Water (BUQW)
- Underground Source of Drinking Water (USDW)
- Surface Open Hole Logging
- Casing Setting Depth
- Centralizers
- Cement Type
- CBL
- MIT
- Production Logging

Well Construction (3 of 4)



- Production Logging
- Casing String Installation

§5.203 (f)(1)(D) Before **long string** casing is installed, the operator must run logs appropriate to the geology, such as resistivity, spontaneous potential, porosity, caliper, gamma ray, and fracture finder logs, to gather data necessary to verify the characterization of the geology

§5.203 (e)(1)(B)(ii) Casing and cement, cement additives, and/or other materials used in the construction of each injection well must have sufficient structural strength and must be of sufficient quality and quantity to maintain integrity over the design life of the injection well. All well materials must be suitable for use with fluids with which

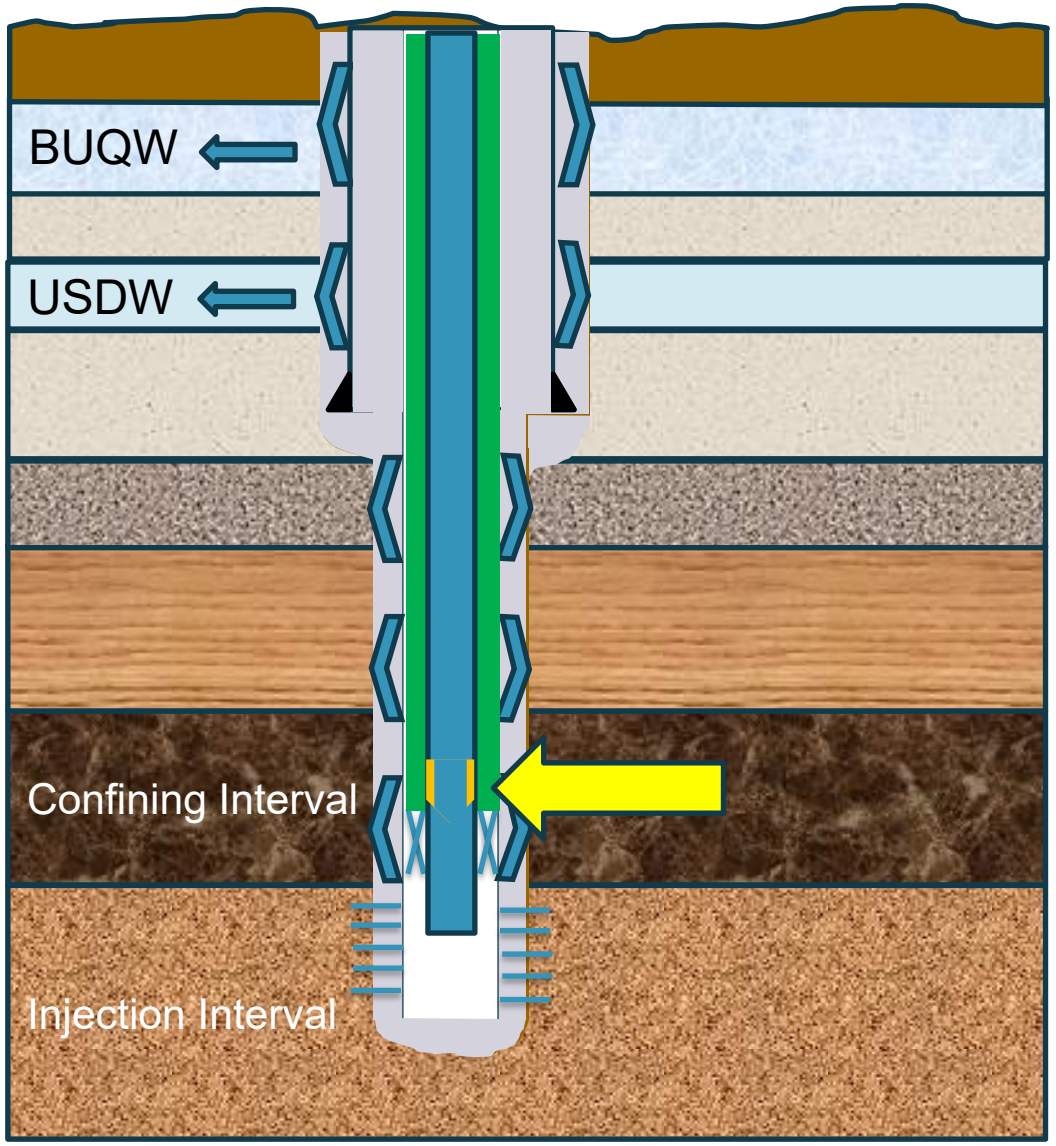
§5.203 (f)(3)(B) The operator must submit analyses of whole cores or sidewall cores representative of the injection zone and confining zone and formation fluid samples from nearby wells or other data

§5.203 (f)(2)(C) The operator must determine or calculate the fracture pressures for the injection and confining zone. The Commission will include in any permit it might issue a limit of **90% of the fracture pressure** to ensure that the injection pressure does not exceed the fracture pressure of the injection zone

§5.203 (e)(2)(A) Depth to the injection zone(s);

§5.203 (e)(2)(H) Lithology of injection and confining zone(s)

Well Construction (4 of 4)



- Casing String Installation
- Centralizer Installation
- CBL, VDL Temp Logs
- Tubing String & Packer

§5.203 (e)(1)(B)(v) long string casing, using a sufficient number of centralizers, must extend to the injection zone cemented by circulating cement to the surface in one or more stages. Must isolate the injection zone

§5.203 (f)(1)(C) After each casing string is set and cemented, the operator must run logs, such as a cement bond log, variable density log, and a temperature log to ensure proper cementing

§5.206 (d)(2)(D) The owner or operator must fill the annulus between the tubing and the long string casing

§5.206 (d)(2)(F)(i) The operator must install and use alarms and automatic shut-off systems

Prior to perforating, a Mechanical Integrity Test (MIT) must be performed

5.203(e)(4) Well stimulation plan. The applicant must submit a description of the proposed well stimulation program

Other Key Requirements

- §**5.203(e)(2)(G)** Down-hole temperatures and pressures
- **§5.203(e)(2)(K)** Schematics of Downhole AND Surface Equipment
- **§5.203(j)(2)(A)** Analysis of the CO2 stream prior to injection
- **§5.203(j)(1)** The applicant must submit a monitoring, sampling & testing plan
- **§5.203(a)(4)** Must include in the application a quality assurance and surveillance plan for all testing & monitoring plan
- **§5.203** The applicant must submit an emergency & remedial response plan

Presentation: Section 3 of 3

Geologic Sequestration of CO2: Overview of Class VI Injection Well Permitting Process

Atia Rahman

RRC Regulatory Conference - July 15, 2025

Presentation Outline – Section 3

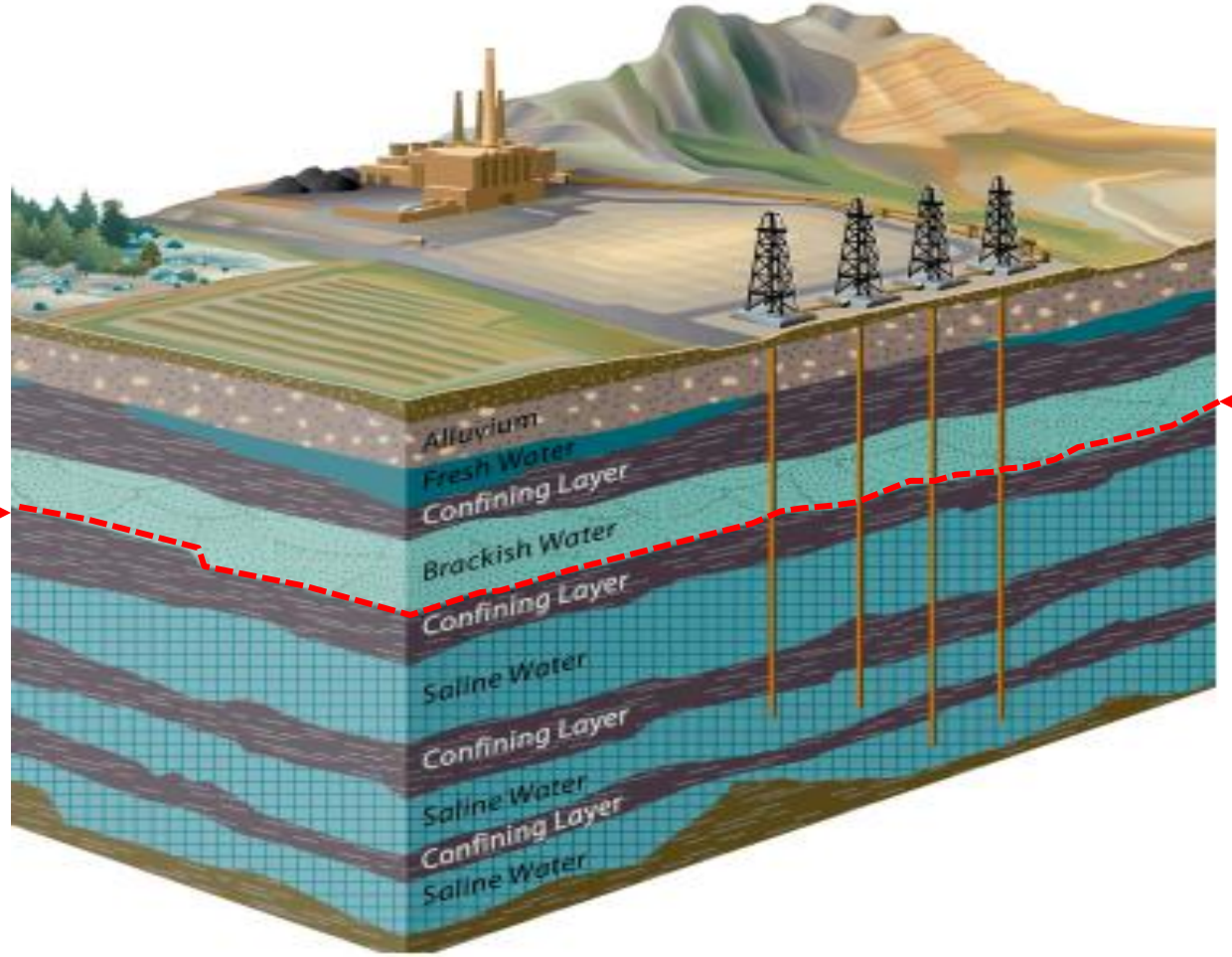
Well Plugging Plan (Rule §5.203 (k) & §3.14)

Post Injection Site Care and Closure Plan (Rule §5.203 (m))

Financial Assurance Demonstration (Rule §5.205)

Well Plugging Plan (1 of 5)

Base of Underground Source of Drinking Water (USDW)



Base of Underground Source of Drinking Water (USDW)

- The Primary Goal of Regulating Class VI Well is to Protect USDWs
- USDW (salinity/TDS ≤10,000 ppm/mg per L)
- BUQW (salinity/TDS ≤ 3,000 ppm/ mg per L)

Well Plugging Plan (2 of 5)

Type of Cement

- Portland Cement
- CO2 Resistant Cement
  - EverCrete (Schlumberger)
  - CorrosaChem (Halliburton)
  - PermaSet (Baker Hughes)

Type of Plug

- Balanced Cement Plug
- Bridge Plug (Mechanical Plug)
- Retainer (Mechanical Plug)
  - ➢ Above Injection Perf's *(if at all)*

Mixing of Cement

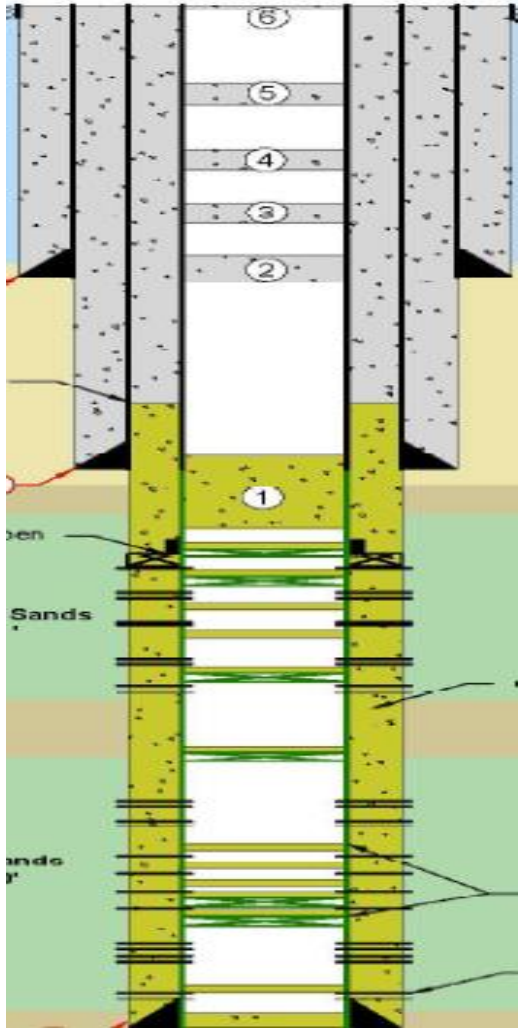
Well Plugging Plan (3 of 5)

Requirements Before P&A :

- No Pulling of any Casing (Cemented to the Surface)
- Flush with Buffer Fluid (aka Kill Weight Fluid)
- Determine Bottomhole Reservoir Pressure (Tests or Measures)
- Assess External Mechanical Integrity (MIT)
  - Oxygen Activation Log (Tracer Survey)
  - Temperature Log
  - Noise Log

Well Plugging Plan (4 of 5)

After P&A'd Wellbore Schematic



Plugging Intervals

- **Across:** (Minimum 50 ft. below and 50 ft. above)
  - Water Zone (USDW & BUQW)
  - Surface Shoe Depth
  - Intermediate Casing Shoe Depth
  - Confining Zone
- **Above:**
  - Perforated Interval (usually 50 to 100 feet above)
  - Productive or Corrosive Formations
- A 10-foot cement plug placed at the top of the well
- Casing shall be cut off 3 feet below the ground surface
- Plugs must be 100 feet minimum plus 10% (of 100) for every 1,000 feet of depth = 10 feet for every 1,000 feet depth

Well Plugging Plan (5 of 5)

Notification and Reporting (wells penetrate the BUQW):

- Notify District Office at least 60 days before plugging
- Can revise Well Plugging Plan
- File Form W-3A at least 5 days prior to plugging
- Give 4 hours notice for P&A operation
- File Form W-3 within 30 days after plugging
- Retain well plugging reports for 10 years following storage facility closure
- Water Well Drillers and Water Well Pump Installers
  (wells do not penetrate the BUQW, 16 TAC Chapter 76)

Post Injection Site Care and Closure Plan (1 of 2)

Collection of Site-Specific Data and Information:

- Pre and Post Injection Pressure Differential in the Injection Zone
- Position of the CO_2 plume and Associated Pressure Front at Site Closure
- Post-injection Storage Facility Care Timeframe *(50-year default by EPA)*
- Post-Injection Monitoring Plan
- Schedule for Submission of Monitoring Results
- Plugging Monitoring Wells

Post Injection Site Care and Closure Plan (2 of 2)

Storage Facility Closure Notification and Report :

- Notification in Writing at least 120 Days Before Closure
- Submission of Closure Report within 90 Days
- Documentation of Injection and Monitoring Well Plugging
- A Copy of a Survey Plat
- Records Reflecting the Nature, Composition, Volume and Mass of CO_2
- Retain Records for 10 Years Following Site Closure

Financial Assurance Demonstration (1 of 4)

Evidence of Financial Responsibility :

- **An Annual Update**
  - Most Recent Audited Annual Report Filed with the U.S. SEC
  - Most Recent Quarterly Report Filed with the U.S. SEC
  - Most Recent Audited Financial Statement (Private Entity)
- **Responsible Activities**
  - Corrective Action (Legacy Well)
  - Injection/Monitoring Well Plugging
  - Post-Injection Storage Facility Care and Storage Facility Closure
  - Emergency and Remedial Response

Financial Assurance Demonstration (2 of 4)

Estimate of Cost :

- ❑ Detailed Estimate in Current Dollars
- ❑ Shows all Assumptions and Calculations
- ❑ Equal to or Greater than the Maximum Amount Necessary
- ❑ Based on the Costs to the Commission of Hiring a Third Party
- ❑ Under Seal of a Licensed Qualified Professional Engineer (PE)
- ❑ Annual Update of the Cost Estimate (Life of the Project)

Financial Assurance Demonstration (3 of 4)

Financial Instruments :

- ❑ Surety Bond
- ❑ Letter of Credit
- ❑ Additional Options by EPA
  - Trust Fund
  - Insurance
  - Financial Test and Corporate Guarantee
  - Escrow Account

Financial Assurance Demonstration (4 of 4)

Financial Instruments :

- Copy of the Form of the Bond or Letter of Credit
  - Sample Form Commercial Facility Bond (CF-1)
  - Sample Form Commercial Facility Irrevocable Standby Letter of Credit (CF-2)
- Authorized to do Business in Texas
- Protective Conditions of Coverage
  - Minimum Cancellation, Renewal, and Continuation Provisions
- No Injection begins until a Bond or Letter of Credit has filed
- Commission may use the Proceeds of Financial Assurance

QUESTIONS?

RAILROAD COMMISSION OF TEXAS

Contact Information

Special Injection Projects (SIP) Team
Carbon Sequestration / Class VI UIC Group | Oil and Gas Division
Railroad Commission of Texas
512-463-6703 / SIP E-mail address: SIP@rrc.texas.gov