Underground Injection Control 101

EPA's Approach to Developing Permitting Guidance for Hydraulic Fracturing Using Diesel Fuels

Webinar for Tribal Representatives

June 2, 2011

OVERVIEW

Why is Underground Injection Needed?

Key Concepts in Underground Injection Control

Why Is Underground Injection Control Needed?

Program Mission

Statutory Authority

What is Underground Injection?

Underground Injection is the practice of placing fluids underground, in porous formations of rock and/or soil, through wells.

Well

- bored, drilled, or driven shaft, or
- a dug well or dug hole where the depth is greater than the largest surface dimension; OR
- an improved sinkhole; OR a subsurface distribution system

Injection wells are used to dispose of industrial wastewaters, stormwater, hazardous waste, and to place drinking water in formations for storage and future use

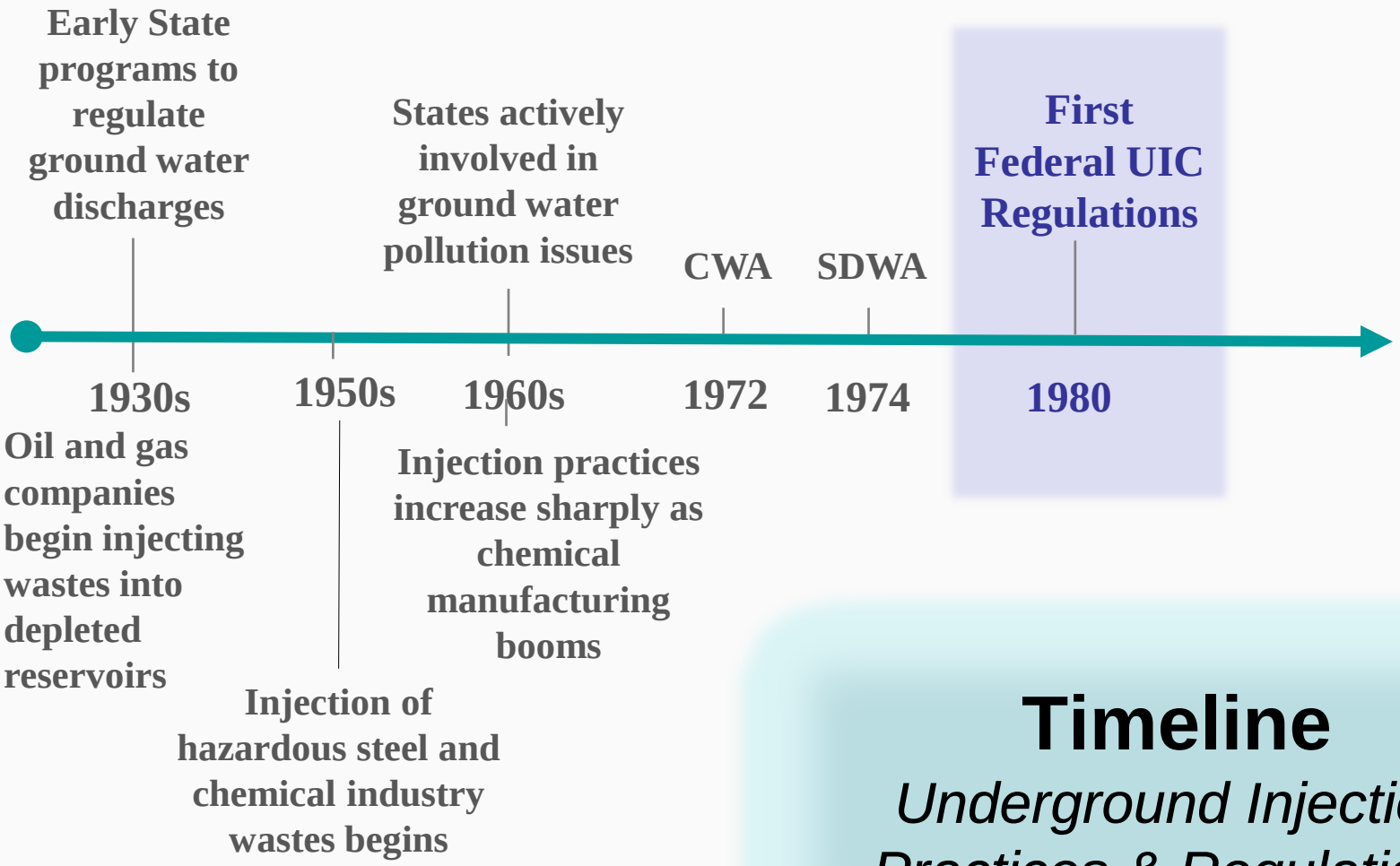
What is Underground Injection Control (UIC)?

- The UIC program protects underground sources of drinking water (USDWs) by setting requirements for injection activities

- Underground sources of drinking water supply more than 90% of all public drinking water systems

Safe Drinking Water Act

- Authorizes EPA to develop minimum federal regulations for state and tribal Underground Injection Control (UIC) programs to protect underground sources of drinking water
- Mandates EPA to regulate underground injection of *all* fluids – liquid, gas, or slurry
- Establishes a process for approving primary enforcement authority to states and tribes
- Authorizes EPA to provide grants to states and tribes in support of essential UIC program functions
- Provides states with flexibility to establish effective Class II (oil and gas) programs



Timeline

Underground Injection Practices & Regulations

KEY UIC CONCEPTS

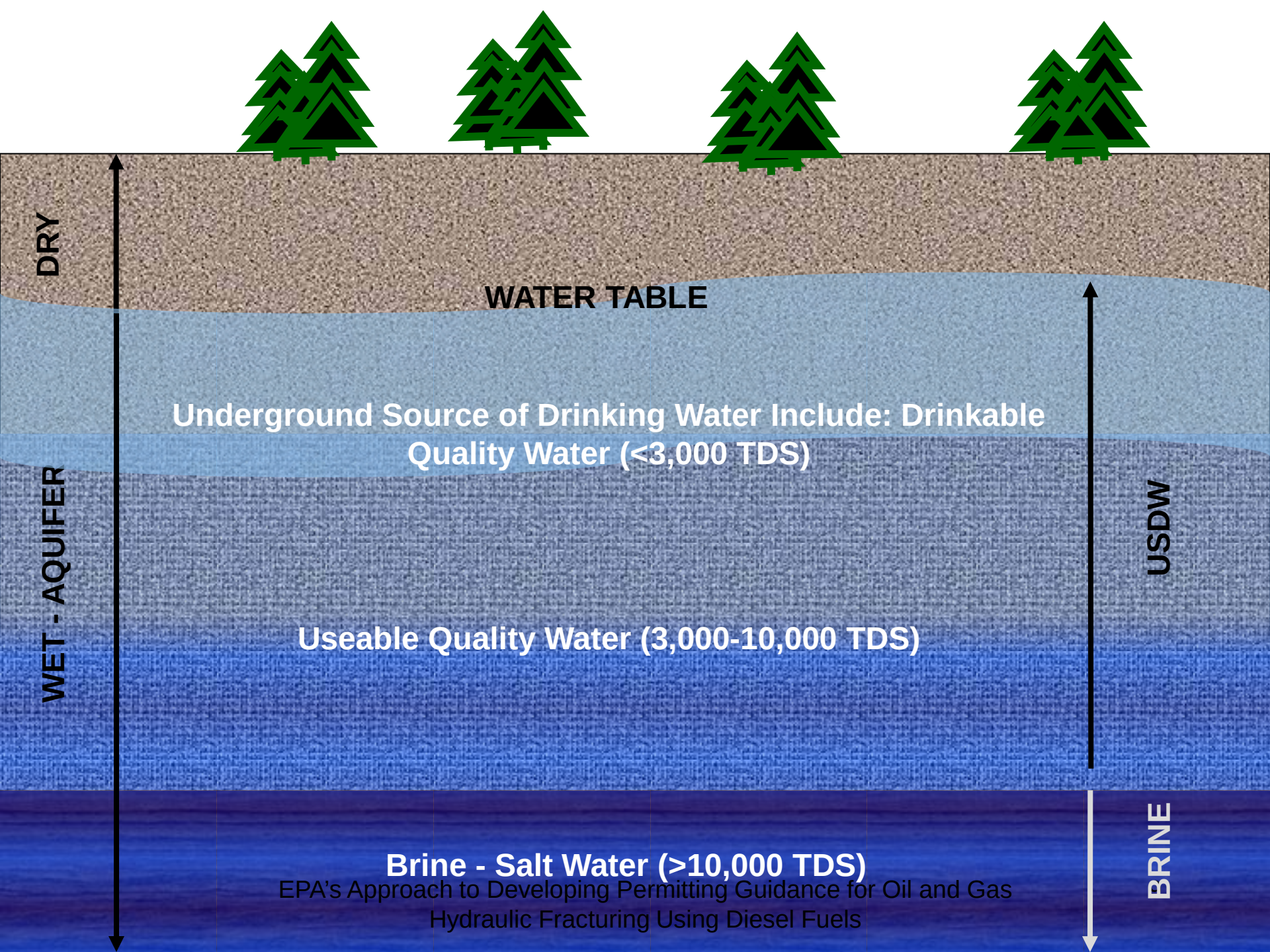
Preventing Endangerment to USDWs

Potential Fluid Migration Pathways

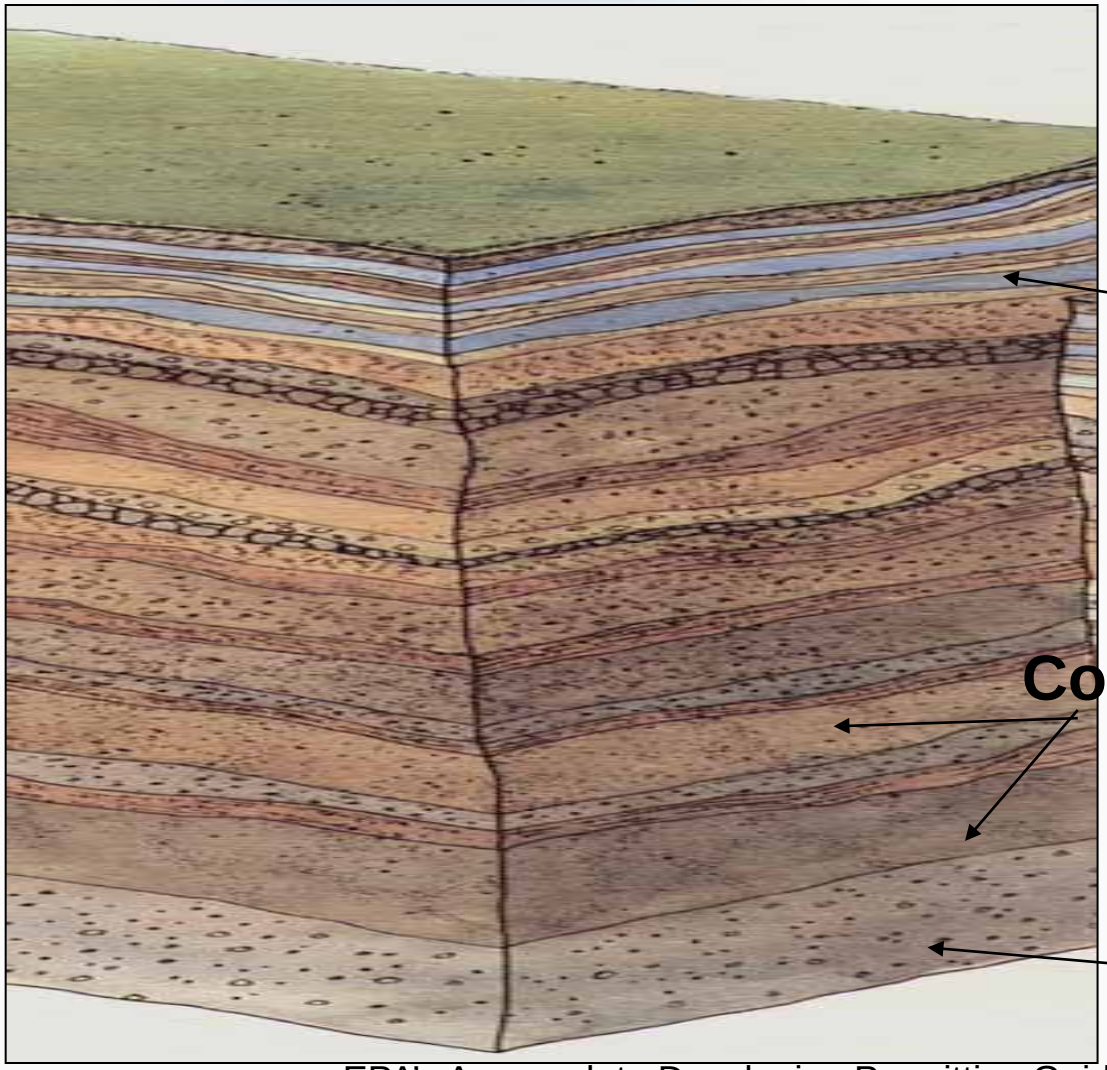
Well Classification

Program Implementation

Technical Requirements


DRY
WATER TABLE
Underground Source of Drinking Water Include: Drinkable Quality Water (<3,000 TDS)
WET - AQUIFER
USDW
Useable Quality Water (3,000-10,000 TDS)
Brine - Salt Water (>10,000 TDS)
BRINE
EPA's Approach to Developing Permitting Guidance for Oil and Gas Hydraulic Fracturing Using Diesel Fuels

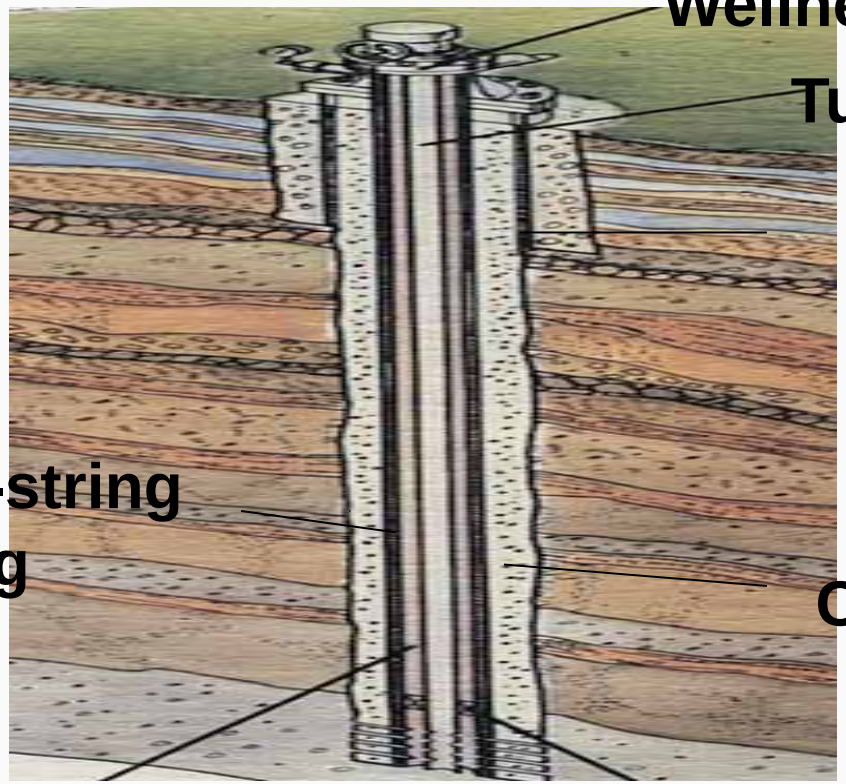
Underground Sources of Drinking Water



Preventing Endangerment

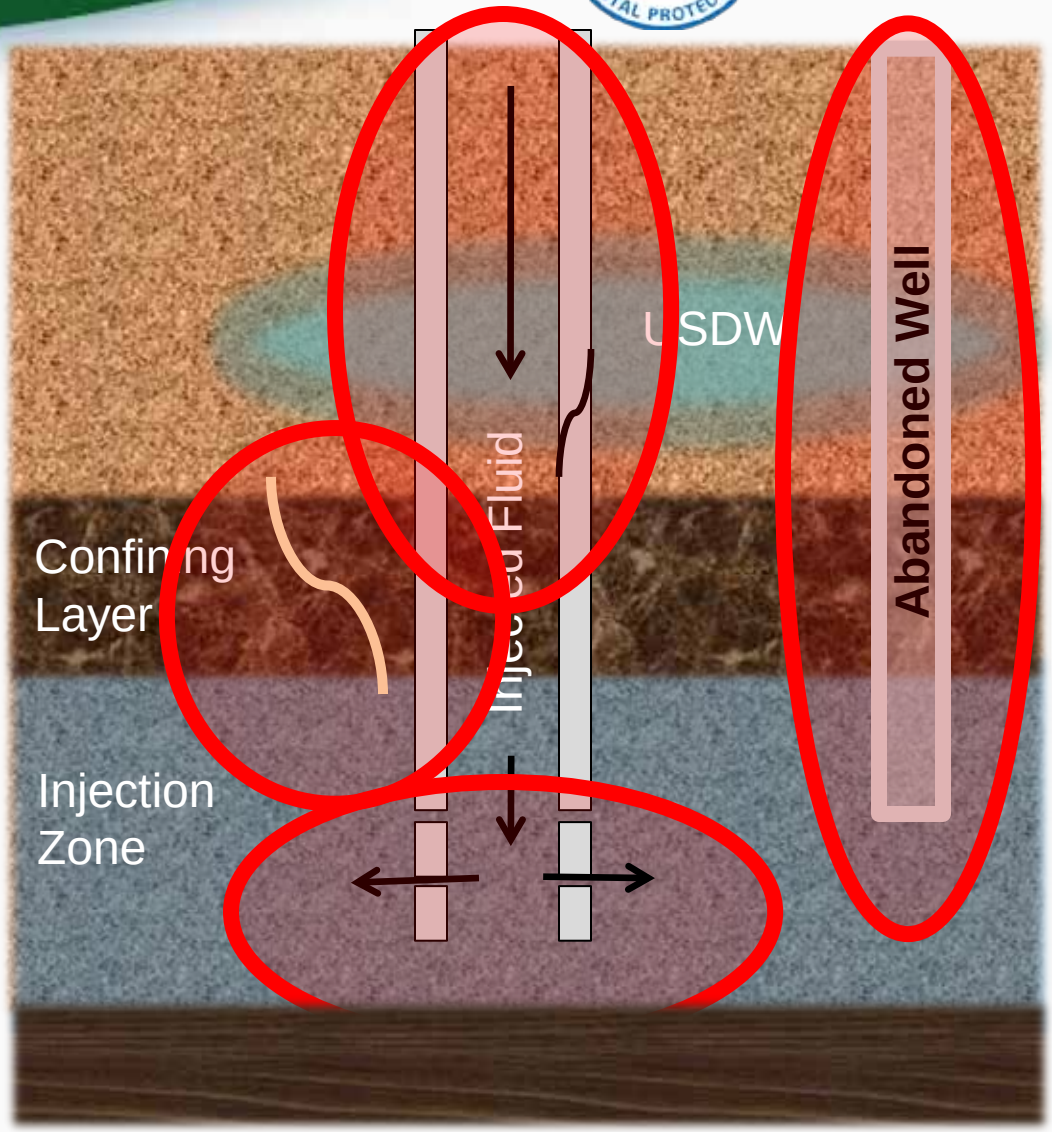
- Underground injection endangers drinking water sources if such injection
  - may result in any contaminant being present in underground water that supplies, or can be reasonably expected to supply, any public water system, and
  - if the presence of such contaminant may result in such system' not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons. (SDWA 1421)
- Applies to USDWs that are currently public supply and may become future public supply

Typical Well Construction



Preventing Endangerment: Pathways of Migration

1. Faulty injection well casing
2. Annulus between casing and wellbore
3. Migration through confining layers from injection zone
4. Vertical migration through improperly abandoned and completed wells
5. Lateral migration from within injection zone into a protected portion of USDW
6. Direct injection of fluids into or above a USDW



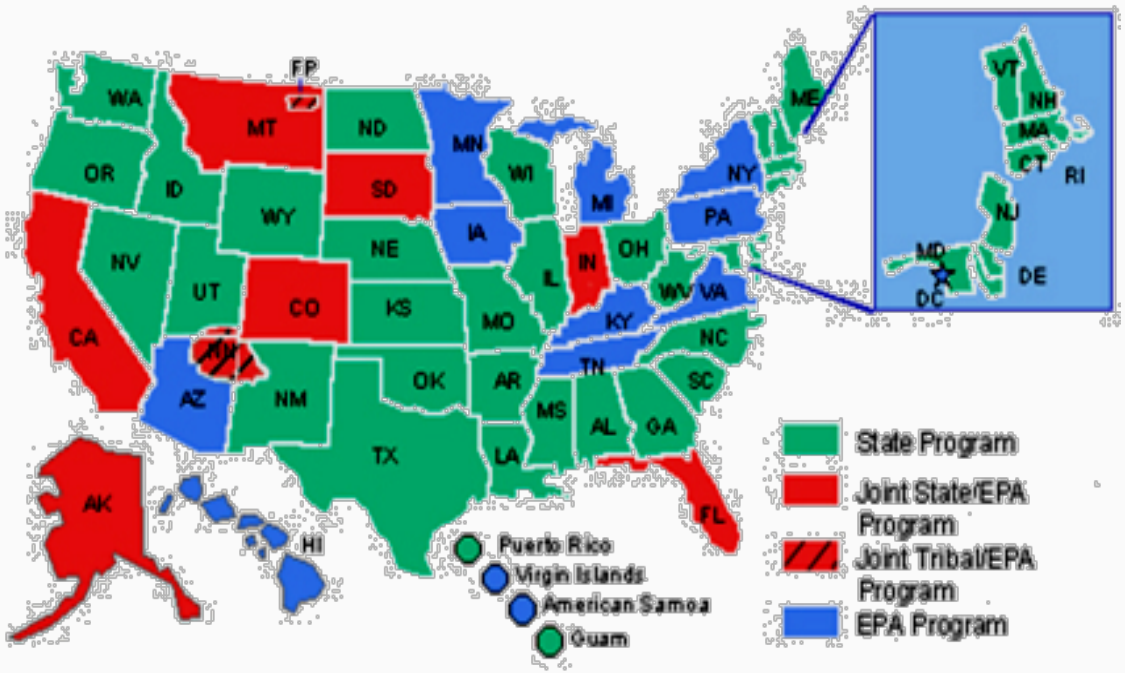
UIC Well Classification

Well Class	Function	Inventory
Class I	Hazardous industrial and municipal wastes	650
Class II	Fluids related to oil and gas production	151,000
Class III	Solution mining (e.g. salt, uranium)	21,400
Class IV	Shallow hazardous waste – only used for remediation activities	24 sites
Class V	Shallow injection of nonhazardous fluids	500,000 – 650,000 (Estimate: precise inventory is unknown)
Class VI	Geologic sequestration of carbon dioxide	N/A

Program Implementation

- Law encourages states to seek “primary enforcement authority” for the UIC program (SDWA 1422 and 1425)
- Depending on the well types being regulated, states have to meet specific minimum federal requirements or demonstrate that their programs are “effective”
- States can be, and often are, more stringent than minimum federal requirements
- EPA is responsible for implementing the program when a state chooses not to, or is unable to obtain federal approval, to do so

Program Implementation



- 33 States have primary enforcement authority (primacy) for the UIC program
- 2 Tribes (Fort Peck and Navajo) have primacy for Class II
- EPA and States share program implementation in 7 States
- EPA directly implements the entire UIC Program in 10 states

TECHNICAL REQUIREMENTS

Well Construction

Area of Review

Operation & Monitoring

Mechanical Integrity Testing

Well Closure

Authorization to Inject

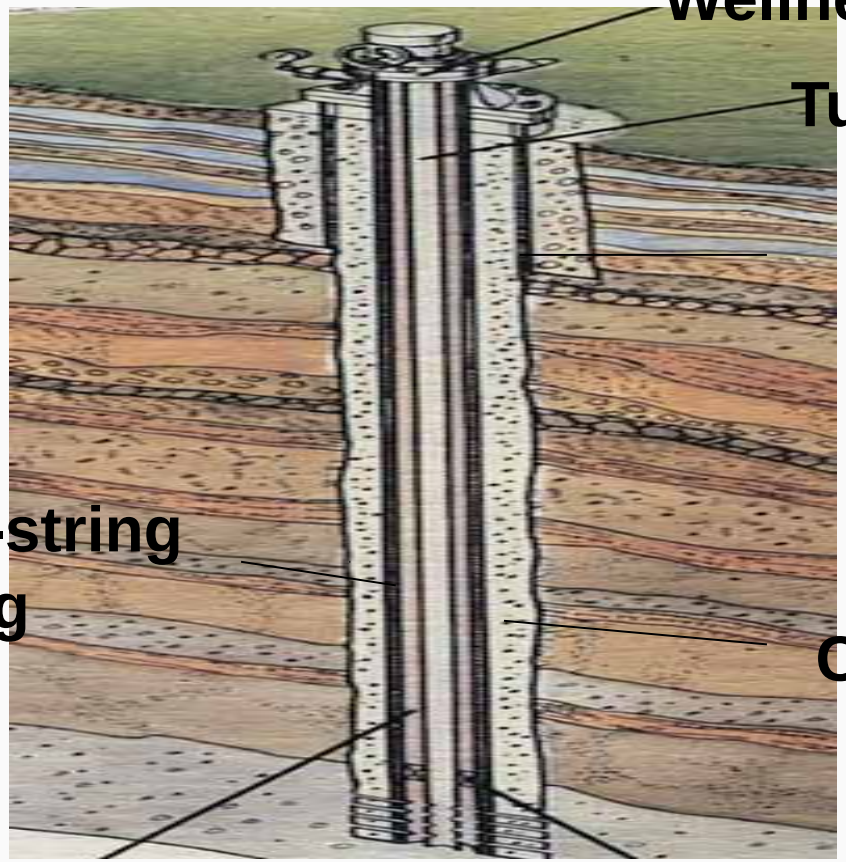
Technical Requirements

- Based on:
  - Descriptive data on injection and confining zones
  - Local & regional geologic maps & cross sections
  - Well logs and tests
  - Geomechanical data
- Operators submit this data with permit applications; permitting authorities review to evaluate whether injected fluids can be confined
- The purpose of this evaluation is to address potential migration via faults and fractures or lateral fluid displacement

Well Construction

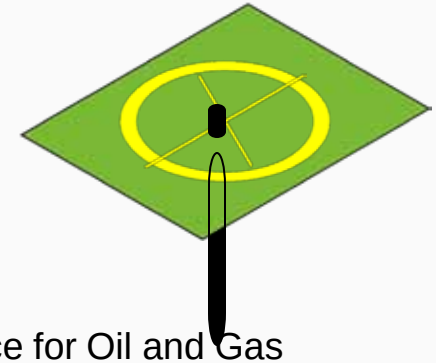
- Multi-layer design: pipe-within-a-pipe
- Well materials and cements should be compatible with the injectate
- Some wells have sophisticated metallurgy and cements
- Each component protects USDWs by:
  - Delivering injected fluids to the intended injection zone
  - Preventing migration of fluids from injection zone to USDWs along the borehole

Typical Well Construction



Area of Review (AoR)

- Area surrounding an injection well that may be affected by the injection activity
- May be determined by:
  - Fixed radius (around injection well)
  - Mathematical modeling to determine the Zone of Endangering Influence
- Operators must submit maps of the AoR with the permit application showing:
  - Location of all wells, faults, mines/quarries, and surface features (e.g. roads and residences)
- Corrective action options within the AoR
  - Monitoring in the injection interval
  - Remedial cementing
  - Plugging or re-plugging
  - Reduce injection pressure



Operation & Monitoring

- Requirements vary according to well class, examples are:
- Limits on injection pressure to prevent:
  - Initiating new fractures or propagating existing fractures in the injection zone or confining zone
  - Causing movement of injection or formation fluids into USDWs
- Continuous pressure monitoring
- Automatic shut-off devices to stop injection at established limits, or to prevent flow from injection zone

Operation & Monitoring

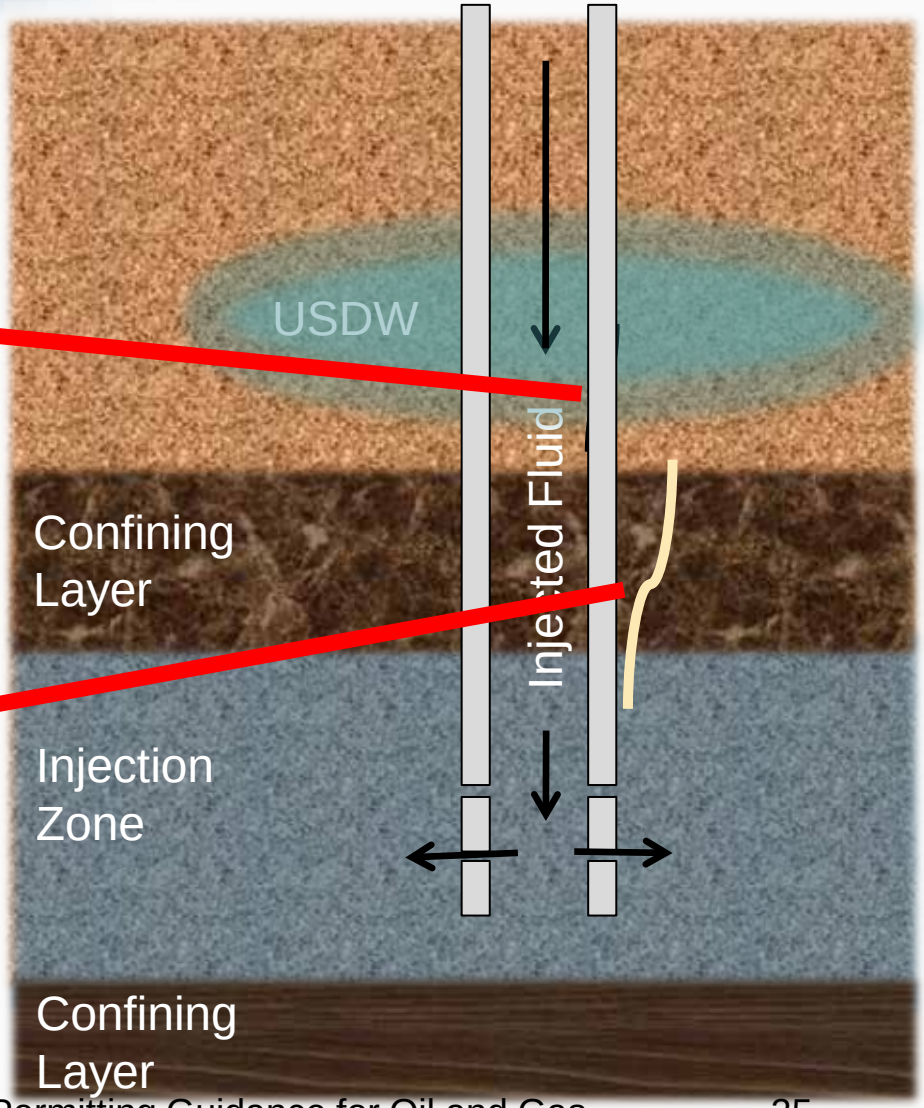
- Monitoring and Testing may also include:
  - Injectate monitoring
  - Ground water monitoring
  - Mechanical Integrity Tests (MITs)
- Operators report the results to the permitting authority on a regular basis specified in regulations or the permit
- Monitoring Injectate
    - Injection rate
    - Injection pressure
    - Monthly and cumulative injected volume
    - Annulus pressure and volume
    - Injectate characteristics such as density, pH, and other parameters

Operation & Monitoring

- Ground water Monitoring
  - Provides early warning of unauthorized or unanticipated fluid movement
  - Potential locations:
    - Within the injection zone
    - Above and below the confining zone(s)
    - Within USDWs

Mechanical Integrity Testing (MIT)

- Internal: to demonstrate no significant leak in the casing, tubing, or packer
- External: to demonstrate no significant fluid movement into USDW through channels adjacent to injection well bore



Injection Well Closure

- Proper closure care and monitoring assures that the well will not be a conduit for future fluid movement
- Plug with cement
- Conduct post-closure monitoring
- Up front, a well owner/operator must demonstrate financial responsibility (FR) – in other words, have adequate resources to close the well

Authorization to Inject

By Permits	By Rule
• Individual • Area – multiple wells	• Certain well types • Low risk to USDWs

- o Field inspections and monitoring submissions are used to identify non-compliance (violations)
- o States and EPA may impose administrative, civil, and criminal penalties for significant non-compliance

More Information About the UIC Program

EPA Website: http://water.epa.gov/type/groundwater/uic/index.cfm

Code of Federal Regulations: Underground Injection Control Regulations

40 CFR 144-148: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?sid=d6ee71a544eca89c533c825135913f13&c=ecfr&tpl=/ecfrbrowse/Title40/40cfrv22_02.tpl