

Introduction to Geologic Isolation

Federal Laws

The federal [Safe Drinking Water Act](#) defines specific provisions for protecting underground sources of drinking water, including provisions for controlling underground injection practices. Congress intended that States have the responsibility for primary enforcement of the Act. Congress, during the formulation of the Safe Drinking Water Act in 1974, recognized the need to protect underground sources of drinking water from contamination by underground injection and the need for effective state regulatory measures. Therefore, it directed the federal [Environmental Protection Agency \(EPA\)](#) to develop underground injection regulations to guide states in establishing their own programs. The Act provides that if a state does not adopt a program consistent with federal requirements, the EPA shall develop and implement a program in the state. The main purposes of the EPA regulations are:

1. to identify underground sources of drinking water and define what constitutes endangerment of these sources;
2. to direct the states to set up their own underground injection control programs to protect these drinking water sources;
3. to describe the requirements of such programs and permit systems;
4. to set forth procedures to ensure enforcement of these requirements by the states or by the federal government if the states fail to do so; and
5. to list construction, permitting, operating, monitoring, and reporting requirements for specific types of wells.

State Laws

Commission Statewide Rule 13 (16 Texas Administrative Code §3.13) requires that all usable-quality water zones shall be isolated and sealed-off to effectively prevent contamination or harm, and all potentially productive formations, potential flow zones, and zones with corrosive fluids be isolated and sealed-off to prevent vertical migration behind the casing.

The adopted rule amendments specifically update those existing requirements to address areas in which the risks to groundwater may be higher. These new requirements codify many best management practices that already are being implemented by most operators.

16 TAC §3.13(A)(4) Casing and Cementing

- Casing shall be cemented across and above all productive zones, potential flow zones, and/or zones with corrosive formation fluids, and all formations permitted for injection under 16 TAC §3.9 at the time the well is completed, or cemented immediately above all formations permitted for injection under 16 TAC §3.46 at the time the well is completed, in a well within $\frac{1}{4}$ mile of the proposed well location, as follows:

(i) if the top of cement is determined through calculation, across and extending at least 600 feet (measured depth) above the permitted formations;

- (ii) if the top of cement is determined through the performance of a temperature survey conducted immediately after cementing, across and extending 250 feet (measured depth) above the permitted formations;
- (iii) if the top of cement is determined through the performance of a cement evaluation log, across and extending 100 feet (measured depth) above the permitted formations;
- (iv) across and extending at least 200 feet into the previous casing shoe (or to surface if the shoe is less than 200 feet from the surface); or
- (v) as otherwise approved by the district director.

- Cement slurry shall be designed to control annular gas migration consistent with the standards in, or equivalent to the standards in, API Standard 65-Part 2: Isolating Potential Flow Zones During Well Construction.

16 TAC §3.13(B) Casing and Cementing Requirements for Land Wells and Bay Wells (Updated in 2014)

- Requires district director approval of any proposal to set surface casing to a depth of 3,500 feet or greater. The request shall be written and shall specify how the operator plans to maintain well control during drilling, ensure successful circulation and adequate bonding of cement, and if necessary, prevent upward migration of deeper formation fluids into protected water. Allows the district director to grant approvals on an area basis.
- Obsolete language regarding field rules that proscribed surface casing requirements was deleted in 2014. The depth to which all surface casing shall be set is determined by the Commission's Groundwater Advisory Unit.
- Free water content of the cement shall be minimized to the greatest extent practicable in the cement slurry to be used in the zone of critical cement. The free water separation may average no more than two milliliters per 250 milliliters of cement tested in accordance with the current API RP 10B inside the zone of critical cement or no more than six milliliters per 250 milliliters of cement tested outside the zone of critical cement.
- Allows for equipment and procedures equivalent to those in API RP 10B-2 and references the API recommended practices and specifications for various types of centralizers and to allow equivalent practices and specifications.
- Alternative surface casing programs may be requested. Requires district director to deny the request if the operator has not demonstrated the alternative casing plan will achieve the intent of the rule.
- Requires that multi-stage tool be set at least 100 feet, rather than 50 feet below the protection depth.
- Requires integrity verification of surface casing strings, exposed to more than 360 rotating hours. The operator shall verify the integrity of the casing by using a casing evaluation tool or conducting a mechanical integrity test or equivalent Commission-approved casing evaluation method, unless otherwise approved by the district director. If a mechanical integrity test is conducted, the appropriate district office shall be notified at least eight hours before the test is conducted. Operator shall use a chart of acceptable range (20% - 80% of full scale) or an electronic equivalent approved by the district director. Surface casing shall be tested at a pump pressure in pounds per square inch (psi), calculated by multiplying the length of the true vertical depth in feet of the casing string by a factor of 0.5 psi per foot up to a maximum of 1,500 psi for a minimum of 30 minutes. A pressure test demonstrating less than a 10% pressure drop after 30 minutes constitutes confirmation of an acceptable pressure test. Requires notification of the appropriate district office within 24 hours after a failed test. Completion operations may not re-commence until the district director approves a remediation plan and the operator successfully implements the approved plan and

successfully re-tests the surface casing. (b)(2) Intermediate casing requirements for land wells and bay wells.

- Requires cementing of intermediate casing above any potential flow zone or zone with corrosive formation fluids. If the top of cement is determined through calculation, cement shall be placed from the shoe up to a point at least 600 feet (measured depth) above the top of the shallowest productive zone, potential flow zone, or zone with corrosive formation fluids; if the top of cement is determined through performance of a temperature survey, cement shall be placed from the shoe up to a point at least 250 feet (measured depth) above the top of the shallowest productive zone, potential flow zone, or zone with corrosive formation fluids; if the top of cement is determined through performance of a cement evaluation log, cement shall be placed from the shoe up to a point at least 100 feet (measured depth) above the top of the shallowest productive zone, potential flow zone, or zone with corrosive formation fluid; or cement shall be placed to a point at least 200 feet (measured depth) above the shoe of the next shallower casing string that was set and cemented in the well (or to surface if the shoe is less than 200 feet from the surface); or as otherwise approved by the district director.
- Requires that the calculated or measured top of cement be indicated on the appropriate completion form.
- Allows the use of a multi-stage tool to isolate potential flow zones and/or zones with corrosive formation fluids.

Underground Injection Control

State of Texas Injection-Storage Permits and Support Program

On January 2, 1980, the Underground Injection Control Section (now called the Technical Permitting Section) of the Oil and Gas Division was created to administer an underground injection control (UIC) program consistent with state and federal law, including:

1. oversight of the injection, disposal, and hydrocarbon storage well permits already issued;
2. processing new permit applications; and
3. coordination with EPA and other federal and state agencies in a concerted program to protect fresh water in Texas.

EPA approved the Commission's UIC program for Class II injection wells on April 23, 1982.

Class II injection wells include:

1. injection wells used to dispose of "oil and gas waste," a term that is defined to cover salt water and other produced fluids, wastes associated with the underground storage of hydrocarbons, and wastes arising out of, or incidental to, the operation of gasoline plants, natural gas processing plants, and pressure maintenance or repressuring plants ([Chapter 27, Texas Water Code](#));
2. injection wells used to enhance recovery of oil and gas ([§91.101, Natural Resources Code](#)); and
3. underground hydrocarbon storage wells ([§91.201 et.seq., Natural Resources Code](#)).

The Railroad Commission also regulates brine mining injection wells under Chapter 27 of the [Texas Water Code](#). Brine mining injection operations produce brine by injecting fresh water, dissolving salt strata, and producing the brine, usually through the same well. This type of well is classified by

EPA as a Class III injection well, or one which injects for the extraction of minerals. EPA approved the Commission's UIC program for these wells on February 26, 2004.

Underground Injection Control (UIC) Isolation Requirements (1 of 2)

- Protection depth – depth to which usable-quality water shall be protected, as determined by the Groundwater Advisory Unit (GAU), which may include zones that contain brackish or saltwater if such zones are correlative and/or hydrologically connected to zones that contain usable-quality water (SWR 13(a)(2)(C)). This is also referred to as the Base of Usable-Quality Water (BUQW) or the “Surface Casing Depth”.
- The Base of Usable-Quality Water (BUQW) is defined as water containing less than 3,000 Parts Per Million (PPM) Total Dissolved Solids (TDS)
 - May include higher levels of TDS if zone is identified as currently being used. TWC Sec. 27.002. (8) "Fresh water" means water having bacteriological, physical, and chemical properties which make it suitable and feasible for beneficial use for any lawful purpose.
 - Identified by the Texas Water Development Board as a source of water for desalination.
 - The protection depth may include groundwater based on potential hydrological connectivity to base of usable-quality water. SWR 30(e)(7)(B)(i).
- The Underground Source of Drinking Water (USDW) is defined as groundwater containing less than 10,000 Parts Per Million (PPM) Total Dissolved Solids TDS and is not an exempted aquifer. This is a Federal Standard 40CFR§146.
- Class II Injection into a productive reservoir within the Underground Source of Drinking Water (USDW) is not allowed. When injecting into this type of reservoir the Aquifer must be exempted, and as such, it is not classified as a USDW. To reclassify a zone containing less than 10,000 PPM one shall obtain an Aquifer Exemption for that zone from the USEPA.
- Isolation interval and/or zone is defined as clay or shale or other impermeable strata having permeabilities less than .01 Millidarcies.

Underground Injection Control (UIC) Isolation Requirements (2 of 2)

- The Underground Source of Drinking Water (USDW) includes the Usable-Quality Water (UQW). The Usable-Quality Water (UQW) contains the higher quality water.
- 50 feet of continuous isolation (uninterrupted) is required between the USDW and Injection into a Non-Productive Zone (W-14) and Injection into Productive Zone (H-1/H-1A)
- 250 feet of cumulative isolation (accumulated) is required between BUQW and Injection into a Non-Productive Zone (W-14) and Injection into Productive Zone (H-1/H-1A)
- 100 feet of continuous isolation (uninterrupted) must also be present between the BUQW and Injection into a Non-Productive Zone (W-14) and Injection into Productive Zone (H-1/H-1A)
- The term Base is used to mean the bottom part of the zone i.e. Base of Usable-Quality Water (BUQW) and Base of Underground Source of Drinking Water (BUSDW)

See Injection Well Geologic Isolation Example in Figure 1.