

Are Wilcox formation salt water disposal wells protective of Gonzales County water resources?

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Fracking has proven to be a highly successful method in obtaining oil and gas production from tight formations. This is especially true in Texas with regard to the Eagle Ford Shale in Gonzales and neighboring counties.

Fracking and drilling for oil and natural gas at depths on the order of 10,000 feet have been shown to be safe and without detrimental effects to water wells on the Texas Gulf Coast. The production of oil and natural gas from the Eagle Ford has created a need to dispose of the frack water which is produced back from the formation during the development of the oil and gas wells.

This water is for the most part salt water containing fracking chemicals. In order to properly dispose of the frack water, applications for new salt water disposal wells (SWDW's) are being filed with the Railroad Commission of Texas for locations in Gonzales County. The majority of the SWDW permit applications are applying to inject into the Wilcox Formation.

Groundwater Resources of Gonzales County

The Texas Water Development Board has identified five aquifer systems within Gonzales County: two minor aquifers, (the Sparta and Queen City) and three major aquifers, (the Gulf Coast, Carrizo and Wilcox). The Carrizo and Wilcox Aquifers are the two major water bearing aquifers in the county. There is a keen demand for the water resources in Gonzales County from the Carrizo and Wilcox Aquifers to meet the water needs of growing population centers along the I-35 corridor between Austin and San Antonio.

Water user groups are eyeing both the fresh to slightly saline water as well as the brackish water resources in these aquifers. The TWDB has developed a Brackish Resources Aquifer Characterization System (BRACS) to map and characterize the brackish aquifers of the State. The TWDB has also prepared a Brackish Groundwater Manual for Texas Regional Water Planning Groups that identifies the Carrizo-Wilcox Aquifer system as one of the best potential sources for brackish water in Texas.

In addition, several water supply companies have conducted brackish water surveys in Gonzales and neighboring counties. The majority of their data are based on geophysical log resistivity data, and further studies will be required to verify the actual water quality in the formations.

Salt Water Disposal Well Review

Given the projected increased demand for water in Texas, the authors have conducted a review of existing and proposed SWDW's in the Wilcox Formation in Gonzales County in comparison to the U.S. Environmental Protection Agency (USEPA) recommended wastewater injection standards (An Introduction to the Technology of Subsurface Wastewater Injection, EPA-600/2-

77-240, December 1977) to assess the degree of protection of the fresh and brackish water resources in Gonzales County.

The study area covers the southwest half of the county where the most favorable locations exist for future brackish water well fields in the Wilcox Formation ([Figure 1](#)).

Two existing permitted SWDW's (BES Environmental Services Inc. and Dewey Bellows Operating Company, Ltd.) and one proposed SWDW (Jemez, LLC) were reviewed for this study ([Figure 1](#)). The SWDW's are located in an area where the Carrizo-Wilcox Aquifers contain ground water ranging from less than 1,000 mg/l to a little over 10,000 mg/l of total dissolved solids (TDS).

[Figure 2](#) and [Figure 3](#) are electric logs of the three SWDW's which show: a) the permitted/proposed injection interval; b) sands and shales of the Wilcox above the injection interval; and c) depth of the base of brackish water (>3,000 – 10,000 mg/l TDS) in the Wilcox.

A comparison of the USEPA recommended wastewater injection standards to the existing and proposed SWDW's construction details, obtained from state required W14 Forms, is given in [Table 1](#).

Based on the well construction information provided in the W14 Forms and the hydrogeological information from the geophysical logs, the fresh to slightly saline water (<3,000 mg/l TDS) appears to be adequately protected through the use of surface casing which is cemented from top to bottom and adequate impervious strata occur between the injection zone and the water resource.

The deeper brackish water resources (>3,000 -10,000 mg/l TDS) appear to have much less protection.

The long string casing was only cemented to the surface in one of the wells reviewed. For the cement jobs not circulated to the surface, there was no way to verify that the cement was adequately emplaced across the required depths. No cement bond logs were conducted on any of the wells reviewed.

The amount of impervious strata between the injection zone and brackish water ranged from about 30 – 190 feet thick. Two of the three wells exceeded the maximum recommended fracture pressure of 0.8 psi/ft and no information was provided in the permit applications that would suggest a higher fracture pressure was acceptable.

No geologic structure information such as the occurrence of faulting or folding was provided in the permit applications prepared by the SWDW operators. The BES Environmental Services, Inc. SWDW is located near an area of known faulting as shown on [Figure 1](#); however it is unknown whether the operator evaluated this faulting in their geologic review.

Conclusion and Recommendations

The authors conclude that if the reviewed wells are typical, most of the saltwater injection wells in Texas do not meet all of the ideal criteria set forth in the USEPA publication.

However, special care should be given to permitting injection wells in the Wilcox Formation to protect both the fresh to slightly saline and brackish water resources.

There are five important areas where proposed Wilcox injection wells could be made safer.

1. The wells should be located a sufficient distance away from faulting.
2. The wells should be located in areas where the base of the brackish water resource (>3,000 – 10,000 mg/l TDS) in the Wilcox is sufficiently protected by the same amount of impervious strata as required to protect the fresh to slightly saline (1,000 – 3,000 mg/l tds) water resource.
3. Injection tests should be run on the well after completion to determine the actual fracture pressure gradient.
4. The long string casing should be cemented from top to bottom and a mechanical integrity test such as a cement bond log should be required to confirm an adequate cement job.
5. After completion and final testing, the findings should be evaluated, and only then, should a final permit decision be made by the permitting agency.

Utilizing an injection well to dispose of waste water requires adequate planning and investigation. The process to locate and operate a proposed SWD well should be based on the following:

- a) preliminary evaluation of the local geology;
- b) and if acceptable, a detailed examination of subsurface geology of the proposed site
- c) after construction and testing of the well, reevaluation.

Injection of large volumes of waste water in areas where low permeability subsurface reservoirs and faulting exist should be avoided.

Are there safer locations or other formations available for locating SWDW's in Gonzales County? A geologic feature in the northeast section of Gonzales County identified as the Yoakum Channel might be a much safer location for salt water disposal wells in the Wilcox Formation ([Figure 4](#)).

The Yoakum Channel is a deep channel structure that was rapidly gouged and then filled predominantly with silty shale, which is in contrast with the predominantly sandy sedimentation of the normal middle Wilcox (Hoyt, William V., 1959). Along the middle of the channel in Gonzales County, the shale in the channel ranges from 950 to 1,900 feet thick.

Injection into the lower Wilcox in this area would be a good option for locating disposal wells in the Wilcox Formation because of the thick continuous impervious strata between the injection zone and the fresh/brackish water resources.

Another option for disposal wells is to utilize the Edwards Formation. The Edwards Formation lies about 11,000 to 15,000 feet below land surface in Gonzales County and is separated from the Wilcox Formation by many layers of impervious of strata.

References

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TAKE AWAY

The production of oil and natural gas from the Eagle Ford has created a need for salt water disposal wells. Special care should be given to permitting these wells in the Wilcox Formation to protect fresh to slightly saline and brackish water resources.

About the authors

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