WATER USE IN ASSOCIATION WITH OIL AND GAS ACTIVITIES REGULATED BY THE RAILROAD COMMISSION OF TEXAS

January 10, 2012

Railroad Commission of Texas Jurisdiction

Under Texas Natural Resources Code, Title 3, and Texas Water Code, Chapters 26 and 27, the Railroad Commission of Texas (Commission) has jurisdiction over activities associated with the exploration, development, or production of oil or gas or geothermal resources, including transportation of crude oil or natural gas by pipeline. The Commission also has jurisdiction over surface mining for coal, uranium, and iron ore gravel.

Use of Fresh Water in Association with Oil and Gas Activities

Water is used in association with many oil and gas activities, mostly for drilling wells, stimulating/hydraulic fracturing of wells, and enhanced recovery processes. Overall, mining water use in Texas represents a relatively small fraction of total water use in the state. The TWDB estimated that in 2008, (the latest year with complete information), the oil and gas industry used approximately 57 thousand acre-feet (one acre-foot (AF) is the amount of water to cover one acre with one foot of water and equals 325,851 gallons). This water use included 35.8 thousand AF for hydraulically fracturing wells (mostly in the Barnett Shale/Fort Worth area) and approximately 21.0 thousand AF for other purposes in the oil and gas industry. Water use for hydraulic fracturing of shale gas wells was dominated by the Barnett Shale in 2008 at approximately 25.5 thousand AF, whereas, all tight formations across the state totaled approximately 10.4 thousand AF.

Texas Water Demand in 2010

From 2012 Draft State Water Plan- TWDB: http://www.twdb.state.tx.us/wrpi/swp/draft.asp

USE CATEGORY	ACRE-FEET
Irrigation	10,079,215
Municipal	4,851,201
Manufacturing	1,727,808
Steam-Electric	733,179
Livestock	322,966
Mining (includes oil and gas)	296,230
State Total	18,010,599

Water demands for manufacturing, steam-electric power generation, and livestock are expected to increase, while mining demand is expected to remain relatively constant. Mining water demands consist of water used in the exploration, development, and extraction processes of oil, gas, coal, aggregates, and other materials. The mining category is the smallest of the water user categories. While hydraulic fracturing and total mining water use continues to represent a small portion (less than 1 percent) of statewide water use, percentages can be significantly larger in some localized areas. In particular, the use of water for hydraulic fracturing operations is expected to increase significantly through 2020.

Fresh water is used in oil and gas well stimulation, including acidizing and/or fracturing. In order to be able to produce gas at economical volumes and rates, reservoirs with low permeability must be treated. One method of treatment to increase permeability is hydraulic fracturing, which involves pumping fluid into the target formation to create fractures that are held open by the propping agents in the hydraulic fracturing fluid. The following table indicates estimated water volumes used to perform hydraulic fracturing on wells in various Texas plays.

Estimated Water Use for Hydraulic Fracturing in Texas in 2010 From http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0904830939_MiningWaterUse.pdf	
PLAY	WATER VOLUMES (in Acre-Feet)
Barnett Shale	23,000 AF
Haynesville	2,500 AF
Eagle Ford Shale	6,000 AF

In response to House Bill 3328, which was enacted by the 82nd Texas Legislature (Regular Session, 2009), the Commission enacted new Rule 29, Hydraulic Fracturing Chemical Disclosure Requirements. In addition to requiring operators to disclosure chemicals used in hydraulic fracturing treatments, new Rule 29 requires operators to indicate the amount of water used in each treatment. Therefore, future estimates of water use in hydraulic fracturing will be more definitive.

In addition to stimulation, the oil and gas industry makes use of fresh water during waterflooding operations and the drilling of wells. Historical reports suggest that the amount of fresh water used in the oil and gas industry for enhanced recovery has been decreasing during the past few decades. Fresh-water use for enhanced recovery was reported at approximately 80 thousand AF in 1980 and 1981. A survey in the mid-1990's estimated water use in the oil and gas industry at approximately 30 thousand AF. Most waterfloods take place in the Permian Basin of West Texas, where most of the oil is produced in the state (only oil reservoirs are typically waterflooded.) Commission rules require that operators justify the use of fresh water in enhanced recovery. The TWDB estimated that the 2008 water use for enhanced recovery was approximately 13.0 and 25.5 thousand AF for fresh and brackish water, respectively. See

And, water is used to make up drilling fluid, which is a carrier fluid that removes the cuttings, dissipates heat created at the drill bit, and control formation pressure. Over the past decade, there has been a steady increase in the number of wells drilled per year in Texas, interrupted recently by the economic downturn and the decrease in the price of natural gas.

Water Required to Drill a Well http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0904830939_MiningWaterUse.pdf.	
PLAY	WATER USED PER WELL
Barnett Shale	150,000 – 400,000 gallons
Haynesville Shale	600,000 gallons
Eagle Ford Shale	125,000 gallons
Permian Basin	75,000 – 250,000 (6,000-ft deep)

Recycling

One way that operators are stretching fresh water supplies is to recycle the hydraulic fracturing flowback fluid. Recognizing the concerns with water use in the area, over the past few years several companies have applied for, and the Commission has approved, recycling projects in the Barnett Shale to reduce the amount of fresh water used in Barnett Shale development activities. Water recycling projects are being explored in South Texas and East Texas, as a result of development in the Eagle Ford Shale and the Haynesville Shale, respectively. See http://www.rrc.state.tx.us/barnettshale/wateruse_barnettshale.php.

The amount of water ultimately flowing back from a hydraulically fractured gas well is a function of the formation. Generally, only the water flowing back in the first days is reusable, when water infrastructure is still in place. In addition, the quality of the flowback water is variable. Some of the initial flowback water can be reused with little treatment (filtration or/and mixing). Other flowback would require more advanced and expensive treatment. Water re-use is contingent on the price of oil and gas.

New Technologies Could Reduce Fresh Water Use

Industry is currently testing new technologies that could further decrease the need for fresh water in hydraulic fracturing. These include use of fluids other than water (propane, nitrogen, carbon dioxide), sonic fracturing with no added fluid, and other waterless techniques with special drilling tools. As the cost of water increases, these more expensive technologies could become more attractive. The TWDB indicated that some companies already may be using carbon dioxide fracturing treatments in the Barnett and Eagle Ford shales. See Recognizing the concerns with water use in the area, over the past few years several companies have applied for, and the Commission has approved, recycling projects in the Barnett Shale to reduce the amount of fresh water used in Barnett Shale development activities. Water recycling projects are being explored in South Texas and East Texas, as a result of development in the Eagle Ford Shale and the Haynesville Shale, respectively. See http://www.rrc.state.tx.us/barnettshale/wateruse_barnettshale.php. In addition, other technologies limit the amount to be disposed of but do not necessarily reduce the demand on local water resources, for example, using waste heat from compressors to evaporate (but not recover) water.

Shale Gas is a Water Efficient Energy Source

As noted above, deep shale natural gas requires water during drilling and stimulation. However, a natural gas well produces a large amount of energy over its approximate 20-year lifespan. And, although water is removed from the effective hydrologic cycle, more than an equivalent amount of water (as vapor) is generated when the natural gas produced from the well is combusted. When natural gas is combusted with oxygen (air) it forms carbon dioxide and water vapor. Chesapeake Energy has calculated that approximately 10,675 gallons of water vapor are produced with the combustion of one MMCF of natural gas. When deep shale natural gas is used for power generation, it is among the most water efficient at generating electricity. Natural gas still ranks among the most water efficient energy resources available.

Raw Fuel Source Water Use Efficiency

From: http://www.naturalgaswaterusage.com/Pages/information.aspx

Energy Resource	Range of gallons of Water Used per MMBTU of Energy Produced	Data Source
Deep Shale Natural Gas *	0.84 – 1.61 Includes: Drilling and Hydraulic Fracturing	Source: Chesapeake Energy 2010b
Natural Gas	1-3	Includes: Drilling and Processing Source: USDOE 2006, p. 59
Coal (no slurry transport) (with slurry transport)	2 – 8 13 – 32	Includes: Mining, Washing and Slurry Transport as indicated Source: USDOE 2006, p. 53-55
Nuclear (processed uranium ready to use in plant)	8 – 14	Includes: Uranium Mining and Processing Source: USDOE 2006, p. 56
Conventional Oil	8 – 20	Includes: Extraction, Production and Refining Source: USDOE 2006, p. 57-59
Synfuel - Coal Gasification	11 – 26	Includes: Coal Mining, Washing and Processing to Synthetic Gas Source: USDOE 2006, p. 60
Oil Shale Petroleum	22 – 56	Includes: Extraction/Production and Refining Source: USDOE 2006, p. 57-59
Oil Sands Petroleum	27 – 68	Includes: Extraction/Production and Refining Source: USDOE 2006, p. 57-59
Synfuel - Fisher Tropsch (coal)	41 – 60	Includes: Coal Mining, Washing and Coal to Gas to Liquid Conversion Processing Source USDOE 2006, p. 60
Enhanced Oil Recovery (EOR)	21 – 2,500	Includes: EOR Extraction/Production and Refining Source: USDOE 2006, p. 57-59
Fuel Ethanol (from irrigated corn)	2,510 – 29,100	Includes: Feedstock Growth and Processing Source: USDOE 2006, p. 61
Biodiesel (from irrigated soy)	14,000 – 75,000	Includes: Feedstock Growth and Processing Source: USDOE 2006, p. 62

**Does not include processing which can add from zero to two gallons per MMBTU.*