Framework of Surface Water and Groundwater Legal Systems and Permitting

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Framework of Surface and Ground Water in Oklahoma and Texas: Perspectives for Oil and Gas Development

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I. IMPORTANCE OF WATER LAW FOR OIL AND GAS DEVELOPMENT

Advancements in drilling techniques have broadened possibilities for producing hydrocarbons; but the innovations of unconventional drilling have exacerbated existing threats that the oil and gas industry have posed to water resources while creating new challenges. In today's industry, conventional methods of drilling for free-flowing crude oil are playing a secondary role to unconventional oil and gas production capable of bringing hydrocarbons trapped in tight or previously inaccessible geologic formations.[1] Compared to conventional production, unconventional methods use much greater amounts of water in chemical-laden processes that can impact the availability and purity of freshwater resources in concentrated localities where those mineral reserves are clustered.[2]

A. Water use in conventional production

Water is part of conventional oil extraction primarily in two ways: during secondary recovery, in which operators inject or flood water into oil reservoirs to push out more hydrocarbons, or when water emerges alongside oil as "produced water." Commonly used secondary and enhanced recovery methods utilize about 62 gallons per 1 million Btu (MMBtu).[3] Likewise, conventional natural gas wells employ very little water in the drilling phase.[4] But over a well's lifetime, each barrel of oil produced yields an average of 10 gallons of produced water containing some of the natural chemical compounds found in the mineral reservoir, including hydrocarbons and naturally occurring radioactive materials.[5] Untreated, this produced water is typically stored as industrial waste, either in evaporation pits or in underground disposal wells.[6]

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[1] Deborah Gordon & Katherine Garner, *Texas' Oil and Water Tightrope*, CARNEGIE ENDOWMENT FOR INT'L PEACE (Mar. 11, 2014), *available at* http://carnegieendowment.org/2014/03/11/texas-s-oil-and-water-tightrope/h35x/.

[2] Erik Mielke, Laura Diaz Anadon, & Venkatesh Narayanamurti, *Water Consumption of Energy Resource Extraction, Processing, and Conversion*, HARVARD KENNEDY SCHOOL ENERGY TECH. INNOVATION POL'Y RESEARCH GROUP DISCUSSION PAPER #2010-15, 13–14 (2010) ["HARVARD RESEARCH GROUP"]; see also Gordon & Garner, *supra* note__.

[3] HARVARD RESEARCH GROUP, *supra* note 2, at 16.

[4] *Id.* at 17.

[5] *TENORM: Oil and Gas Production Wastes*, ENVTL. PROT. AGENCY, *available at* http://www.epa.gov/radiation/tenorm-oil-and-gas-production-wastes) (last accessed March 3, 2016.

[6] Nathan Bracken, *Water and Energy in the West: The Legal and Institutional Issues that Affect Water Availability for Energy-Related Activities* 3, WESTERN STATES WATER COUNCIL (2015).

B. Water for fracking

Unconventional methods like hydraulic fracturing ("fracking") are much more water-intense, using millions of gallons of water each time they are performed on a well.[7] The picture of actual water usage related to fracking is affected by other factors. First, most of the water consumed in the process is used during the first few days of well completion.[8] Second, wells use 1–5 million gallons of freshwater per frack, but multiple fracks are usually required for each well.[9] And third, fracking activities are concentrated over certain hydrocarbon plays, so when averaged into state water usage totals, the impact on those localities is underrepresented.[10]

Despite the challenges and the current industry downturn, hydraulic fracturing will probably continue to feature significantly in the future of oil- and gas-producing states like Texas and Oklahoma, where many hydrocarbon formations are stacked vertically in one location but are accessible only through fracking. For example, Texas' Permian Basin features 6 such stacked shale plays, enabling operators to produce from multiple vertical formations by drilling a single well bore. In Oklahoma, the recent exploitation of the "STACK" play in the Anadarko Basin comprises several stacked formations that, although difficult to drill, contain highly valuable natural gas liquids, making the fracking process economical and attractive.[11]

C. Waste water disposal

Most oil and gas production utilizes primarily freshwater, rather than recycled water, because it is more ideally suited to the process.[12] When water is withdrawn and "removed from the immediate water environment" through processes like evaporation, transpiration, or taken in by plants, animals, and humans, its use is considered consumptive.[13] Fracking and secondary or enhanced recovery procedures also can result in the permanent consumption of the freshwater used in the process if drillers decide not to treat or recycle produced water (wastewater resulting from the fracking process) and have no alternative but to store it permanently in deep underground formations. Because the chemical fluids, salts, and other contaminants found in produced water make that water unsuitable for plant, animal, or human consumption, produced water cannot be discharged into surface waters without extensive treatment.[14] However, once placed in permanent storage, that water is no longer a part of the hydrological cycle.[15]

[7] Chesapeake Energy, *Produced Water Reuse and Recycling Challenges Water Reuse and Recycling Challenges and Opportunities Across Major Shale Plays* (2010).
[8] HARVARD RESEARCH GROUP, *supra* note 2 at 17.
[9] *Id.* at 17 (citing Chesapeake); *see also* Gordon & Garner, *supra* note 1.
[10] HARVARD RESEARCH GROUP, *supra* note 2, at 17.
[11] *Anadarko Basin: Stacked Shale Plays Showcase Industry Ingenuity*, INDEP. PETROLEUM ASS'N OF AMER., http://oilindependents.org/anadarko-basin-stacked-shale-plays-showcase-industry-ingenuity/, last accessed March 4, 2016.
[12] Blythe Lyons & John J. Tintera, *Sustainable Management in the Texas Oil and Gas Industry* 8, ATLANTIC COUNCIL ENERGY & ENV'T PROGRAM (2014).
[13] HARVARD RESEARCH GROUP, supra note 2, at 8 (citing a 2009 U.S. Geological Survey).
[14] Gordon & Garner, *supra* note 1.
[15] *Water Quality*, INTERMOUNTAIN OIL & GAS BMP PROJECT, http://www.oilandgasbmps.org/resources/water_quantity.php (last accessed March 8, 2016).

D. Water shortages & needs for oil and gas production

Although conventional drilling still dominates in Oklahoma, the state's 2012 Comprehensive Water Plan forecasted that the amount of water used by horizontal fracturing would surpass that used in conventional production by 2060, using ten times more than in 2012.[16] The 2012 Plan further projected that water usage by the entire oil and gas sector would double from 2010 to 2060—but by 2013 it had already more than doubled 2010 levels.[17] The state has seen an increase in new permits for the oil and gas sector, the number of horizontal gas and oil wells, and the quantities of water withdrawn. Oklahoma's real vulnerability is that the areas that have recently suffered worst from drought are the same areas experiencing a boom in oil and gas drilling. In addition to endangering the state's water supply, insufficient supplies of water for oil and gas production could have an adverse impact on the state economy. The oil and gas industry is the single largest tax revenue source in Oklahoma, contributing $1.96 billion in direct taxes in 2012—more than 22% of all taxes statewide.[18]

In response to these water supply challenges, Oklahoma passed its Water 2060 Act, becoming the first state to set a goal of using no more freshwater in 2060 than it used in 2012.[19] The legislation's stated conservation goals targeted alternatives to freshwater supplies, such as wastewater, brackish water, and other non-potable supplies.[20] Guided by those goals, Water 2060 provides grants to fund innovative pilot projects and educational programs.[21]

Meanwhile, by 2060, the state of Texas expects its population to increase 82%, predicts water demand will increase by 22%, and projects a decline in water availability of about 10%.[22] While the available supply of surface water is expected to increase by 6%, ground water supplies appear likely to drop by 30%.[23] Severe drought conditions would confront the state with an immediate water deficit of 3.6 million acre-feet each year the drought continued—86% of that deficit would be borne by irrigated agriculture while 9% would be associated with municipal water uses.[24]

In 2012, the Texas Oil & Gas Association reported that the boom in fracking dramatically increased the statewide oil and gas industry's water usage, but that a trend to use brackish water in lieu of freshwater appeared strong.[25] The report found that fracking used approximately 81,500 of

[16] OKLA. WATER RES. BD., *Fracking and Oil & Gas Water Permitting in Oklahoma: Present Situation and Future Estimates* (2012).
[17] Robert Puls, *Water Use for Oil & Gas Operations in Oklahoma*, presented at the 2015 NGWA SUMMIT (May 2015).
[18] Puls, *supra* note 17.
[19] *Water for 2060*, OKLA. WATER RES. BD., https://www.owrb.ok.gov/supply/conservation.php (last accessed Mar. 8, 2010).
[20] OKLA. STAT. tit. 82, § 1088.12.
[21] *Id.*
[22] *Water for Texas 2012*, TEX. WATER RES. INSTITUTE 28, http://twri.tamu.edu/publications/txh2o/fall-2011/water-for-texas-2012/.
[23] *Id.*
[24] *Id.*
[25] Jean-Philippe Nicot & Robert C. Reedy, et al., *Oil & Gas Water Use in Texas: Update to the 2011 Mining Water Use Report* ii, prepared for the TEX. OIL & GAS ASS'N (2012), *available at*

the total 102,500 acre-feet of water used by the industry in Texas in 2011, up from 36,000 acre-feet of water for fracking in 2008.[26] Texas's 2012 State Water Plan projected that municipal water use would overtake irrigation as the state's greatest water need, with demand expected to rise from 4.9 million acre-feet a year in 2010 to 8.4 million acre-feet by 2060. Alongside urban and rural municipalities, manufacturing, steam-electric power generation, and livestock are also expected to demand greater water.[27]

II. WATER LAW IN THE AMERICAN SOUTHWEST 101

A. Surface Water

1. Predominantly prior appropriation

Water rights in the western United States are predominately determined by the *prior appropriation* doctrine.[28] This regime operates on the principle of "first in time, first in right," establishing that the first user to divert water from its course and timely apply it to a *beneficial use* (domestic, agricultural, energy, and industrial purposes often qualify) is deemed the senior user and enjoys priority over later (junior) users of the same source.[29] When the available water is insufficient to satisfy all of the users' rights, junior users must stop withdrawing their allocation, in order of their junior status, until the senior users receive their full amount.[30] Most prior appropriation systems also set conditions under which users who do not use their right may lose their right.[31] Beneficial use is the touchstone of prior appropriations, and in addition to the "use it or lose it" scheme, the doctrine aims to prevent wasting water and to ensure water returns to the source in good condition so that it can be reused by downstream appropriators.[32] Thus, the law enables water in drought-prone areas like the western United States to be used multiple times.[33] Most western states apply this doctrine to both surface water and ground water.[34]

a. How to obtain surface water rights in each state

Oklahoma declares water flowing in a definite channel to be public "stream water" subject to appropriation. Water that flows over land but does not form a definite channel is "diffused water" and belongs to the landowner, with no statutory restrictions. The Oklahoma Water Resources Board ("OWRB") is responsible for issuing permits to use stream water. A prospective user must apply with the OWRB and demonstrate that three conditions are met: (1) The amount of water requested

http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0904830939_2012Update_MiningWaterUse.pdf.

[26] *Id.*

[27] TEX. RR. COMM'N, *Water Use in Association with Oil and Gas Activities*, http://www.rrc.state.tx.us/about-us/resource-center/faqs/oil-gas-faqs/faq-water-use-in-association-with-oil-and-gas-activities/ (last accessed Mar. 8, 2016).

[28] Bracken, *supra* note 6, at 4.

[29] *Id.*

[30] *Id.*

[31] *Id.*

[32] *Id.*

[33] *Id.*

[34] *Id.*

is unappropriated and available; (2) the user intends to put the water to a use that is beneficial; and (3) the proposed use will not interfere with existing rights or domestic uses, or other existing or proposed beneficial uses.[35] State law does not attach any hierarchy to beneficial uses in granting priority dates for surface water. It does include a "leap frog provision" that considers later-filed permits to use water within the stream system ahead of those seeking to use water outside of the basin of origin.[36] The OWRB may only grant out-of-basin permits when the proposed use will not interfere with the needs of other stream system users.[37]

Applicants must give notice of their intent to appropriate to other parties who may have interests that could be affected through publication in newspapers in the county where the proposed diversion will occur and in the adjacent county downstream.[38] If an interested party protests, the OWRB may hold a hearing and, if it grants the permit, do so subject to certain conditions.[39]

Similarly, Texas law considers water in streams, rivers, and other defined channels[40] to be property of the state that people may appropriate in certain amounts for beneficial uses based on a priority permit system: "As between appropriators, the first in time is the first in right."[41] However, Texas does attach a hierarchy to beneficial uses that the Texas Commission on Environmental Quality ("TCEQ") must prioritize when weighing competing applications.[42] Domestic and municipal uses enjoy top priority, followed by agriculture, industrial, mining and mineral recovery, hydroelectric power, navigation, recreation, public parks, and game preserves, ahead of "any other beneficial use."[43] Following a provision in the Texas Water Code that appears to establish a priority for which uses should be preserved in times of an emergency water shortage, the TCEQ in 2012 developed "Drought Rules" that allowed the executive director to "suspend a junior water right based on public health, safety, and welfare concerns."[44] However, state courts recently declared those rules invalid, thereby affirming that senior rights trump junior rights under Texas law—even in times of drought, and regardless of how "beneficial" the junior right may be.[45]

Texas law applies the same basic permit requirements as Oklahoma: unappropriated water must be available for a proposed beneficial use that will not impair existing rights or endanger public welfare. However, the law further requires that the permit be consistent with the State Water Plan

[35] OKLA. STAT. tit. 82, § 105.12(A)(2013); OKLA. ADMIN. CODE § 785:20-5-4, 5-6.
[36] OKLA. STAT. tit. 82, § 105.12(B)(1)(2013).
[37] OKLA. STAT. tit. 82, § 105.12(A)(4); OKLA. ADMIN. CODE § 785:20-1-2 ("'Stream system' means the drainage area of a watercourse or series of watercourses which converge in a large watercourse the boundaries of which have been defined and which has been designated by the Board as a stream system."); *see also* OKLA. WATER RES. BD., *Water Law Management in Oklahoma* 10 (2011).
[38] OKLA. STAT. tit. 82, § 105.11.
[39] *Id.*
[40] Texas defines "state water" as follows: "[t]he water of the ordinary flow, underflow, and tides of every flowing river, natural stream, and lake, and of every bay or arm of the Gulf of Mexico, and the storm water, floodwater, and rainwater of every river, natural stream, canyon, ravine, depression, and watershed in the state. . . ." TEX. WATER CODE ANN. § 11.021 (West 2015).
[41] TEX. WATER CODE ANN. § 11.027l; *see also* § 11.121 (permit required to appropriate state waters).
[42] TEX. WATER CODE ANN. § 11.123.
[43] TEX. WATER CODE ANN. § 11.023, 11.024.
[44] 30 TEX. ADMIN. CODE § 36.5(c) (2015).
[45] TCEQ v. Texas Farm Bureau, 460 S.W.3d 264, 271–72 (Tex. App.—Corpus Christi 2015, pet. denied).

and Regional Water Plans, that the user conserve and avoid waste,[46] and that the TCEQ consider how the use would affect bays and estuaries, as well as instream uses and water quality of rivers.[47] If no protest is filed within 30 days after circulating notice to those with a right or claim to the same source (via either publication in a local newspaper or written mailed notice), the TCEQ may without a hearing grant the permit and establish a priority date from the time of filing.[48] Applicants denied a permit may appeal the decision to the court system.

b. Permit types, requirements, and exemptions

The OWRB issues six types of permits for stream water use: (1) *Regular*, authorizing the holder to appropriate water year-round;[49] (2) *Seasonal*, allowing diversion of water for specified periods; (3) *Temporary*, authorizing water use for up to three months; (4) *Term*, spelling out water use for a given number of years; (5) *Provisional temporary*, which are nonrenewable, allowing appropriation for up to 90 days; and (6) *Limited quantity* permits, whether regular, seasonal, temporary, or term, for less than 15 acre-feet of water, for a term less than a year.[50] The provisional temporary permit is the only one that does not require a public hearing and OWRB approval because it does not vest any permanent right in the holder and is subject to cancellation at any time.[51] The executive director may grant these when a denial will cause economic hardship to a user who otherwise has permission to use the land for diverting water, and the permit will not interfere with existing uses.[52]

Generally, if within two years the permit holder does not begin constructing the diversion or for seven years fails to put the full amount of water permitted to beneficial use, the OWRB may consider the unused portion forfeited and reduce the amount permitted to return the unused portion to the public for future appropriation.[53] Water rights holders must also self-report their annual water usage each January.[54]

Texas grants several types of state water permits: (1) *Regular*, lasting for as long as the use continues; (2) *Seasonal*, limiting the use of water to certain days or months; (3) *Temporary* permits, allowing use up to three years; and (4) *Emergency* permits, issued for use up to 30 days when public health, safety, and welfare are threatened. In case of an imminent threat to public health and safety, the TCEQ may also issue an emergency permit, order, or amendment for up to 120 days but must hold a hearing within 20 days of its issuance and must compensate any person who holds rights to water that was taken in response to the emergency.[55] Like Oklahoma, Texas law requires users to begin constructing diversions within two years of receiving a permit, or the permit may be forfeited. The timeline for putting water to beneficial use, however, gives an appropriator 10 years before

[46] TEX. WATER CODE ANN. § 11.134; *see also* 11.1271 (requiring applicants to submit water conservation plans).
[47] TEX. WATER CODE ANN. § 11.147.
[48] TEX. WATER CODE ANN. § 11.132, 11.134, 11.141.
[49] OKLA. STAT. tit. 82, § 105.1.
[50] OKLA. STAT. tit. 82, § 105.13; OKLA. ADMIN. CODE § 785:20-7-1
[51] OKLA. STAT. tit. 82, § 105.1.
[52] OKLA. ADMIN. CODE § 785:20-7-1.
[53] OKLA. ADMIN. CODE § 785:20-9-1, 9-2, 9-3.
[54] OKLA. ADMIN. CODE § 785:20-9-5.
[55] *See* TEX. WATER CODE ANN. § 11.139.

subjecting the permit to partial or complete cancellation for nonuse.[56] Texas water rights holders also must file an annual report each March.[57]

Both Texas and Oklahoma exempt domestic uses from permitting requirements. "Domestic" in Texas water law means water for sustaining human life and the life of domestic animals.[58] The term "domestic" in Oklahoma applies to water usage for household purposes, fire protection, farm and domestic animals, and for irrigating small gardens, orchards, and lawns.[59] It also encompasses water for non-household drinking, restrooms, and lawns, if less than 5 acre-feet per year.[60] Oklahoma allows landowners to store a two-year supply of stream water on their property for domestic purposes without a permit.[61] Texas does not require a permit to store up to 200 acre-feet of water on private property for domestic, livestock, wildlife, or fishing purposes (but not for fish farming).[62] Using water from the Gulf of Mexico and its adjacent bays and arms in petroleum drilling and production is also free of permit requirements up to one acre-foot in a 24-hour period.

c. Transfers and Amendments

Oklahoma permit holders may amend the permit to allow them to use the water for a different purpose than the one for which a permit was initially acquired or may change the place or rate of diversion, or storage, provided potentially affected parties receive notice and the OWRB approves.[63] Permits for the use of stream water, other than for irrigation, may be transferred for use on other land, or assigned to another user. In order to transfer or assign a water right that is specifically designated for irrigation, the right must first be severed from the land where the right was originally appropriated to enable the transfer or assignment without losing priority. The transfer or assignment, however, will also depend on whether or not the change will be detrimental to other existing water rights.[64]

Under Texas law, "no person may take or divert any state water from a river basin in this state and transfer such water to any other river basin" until the TCEQ has approved an amendment to the permit or otherwise authorized the transfer, following proper notice to interested parties in both basins.[65] Transfers out of basin are subject to more scrutiny than the initial permit. The TCEQ must consider alternatives to the transfer; economic impacts in each basin; impacts on water quality, aquatic and riparian habitat, bays and estuaries; and proposed compensation or mitigation to the basin of origin, among other criteria.[66] Proposed transfers may be approved only to the extent that

[56] TEX. WATER CODE ANN. § 11.173.
[57] TEX. WATER CODE ANN. § 11.207.
[58] TEX. WATER CODE ANN. § 11.023.
[59] OKLA. STAT. tit. 82, § 105.1.
[60] OKLA. ADMIN. CODE § 785:20-1-2.
[61] OKLA. STAT. tit. 82, § 105.2. ("Any person has the right to take water for domestic use from a stream to which he is riparian . . . . Water for domestic use may be stored in an amount not to exceed two (2) years' supply.")
[62] TEX. WATER CODE ANN. § 11.142.
[63] OKLA. ADMIN. CODE § 785:20-9-4.
[64] OKLA. ADMIN. CODE § 785:20-9-4(b).
[65] TEX. WATER CODE ANN. § 11.085.
[66] *Id.*

benefits outweigh detriments.[67] Importantly, "any proposed transfer of all or a portion of a water right" from one Texas river basin to another causes the water right to lose its priority date.[68]

2. Vestiges of riparian rights in some jurisdictions

Many places historically attributed the right to use water to the person geographically adjacent to or touching the water source—this is the doctrine of *riparian rights*. Because riparian rights derive from the land's proximity to the source, pure riparian rights, unlike an appropriation, are not lost automatically through non-use and generally exist even when the purpose of the use changes. A few jurisdictions restrict riparian uses that limit the natural flow of the source, but most impose limitations to ensure reasonable use among riparians of the same source.[69] Riparian rights were introduced in the Republic of Texas (when an independent country) in 1840 when the Texas nation adopted English Common Law.[70] Riparian rights were first recognized in the pre-state Oklahoma Territory in 1890.[71] As populations expanded in both states, residents who were not fortunate enough to abut a water source were not allowed to obtain water under the riparian regime. As a result of necessity, prior appropriation was introduced in both states and now dominates.[72]

Some vestiges of riparian principles, however, still remain in both states, most commonly seen as exceptions to prior appropriation rights. Landowners in Texas with historic riparian rights still have the right to use state water for domestic purposes without a permit, as well as the "stock tank exemption" allowing them to impound surface water for limited purposes.[73] Although Oklahoma water law is considered to include a hybrid of riparian and appropriative concepts, the only riparian right that Oklahoma recognizes is a permit exemption allowing landowners to use water riparian to their land for domestic purposes.[74] Oklahoma's legislature amended its water law to express this limitation after the Oklahoma Supreme Court issued an opinion declaring that the permit system could not prevent landowners from reasonably using water riparian to their property—in effect, creating a super-priority for riparians.[75] Because the state's high court has not yet ruled on the effect of the legislation, many are unclear whether Oklahoma land titles carry riparian rights that trump permit requirements.

3. Relevance to oil and gas production

Most of the water in the West has already been fully appropriated. Any water that is available carries junior priority making it vulnerable to senior users and unreliable as a supply for energy production. Securing an existing water right with a senior priority date requires purchasing senior water rights through a transfer or amendment. Agricultural water rights are usually the most senior throughout the region and account for most of the West's water consumption. Permit-seekers for

[67] *Id.*
[68] TEX. WATER CODE ANN. § 11.085(s).
[69] OKLA. WATER RES. BD., *supra* note16, at 2–3.
[70] Wells A. Hutchins, THE TEXAS WATER LAW 377 (1961).
[71] OKLA. WATER RES. BD., *supra* note 16, at 1.
[72] Lawrence J. MacDonnell, *Prior Appropriation: A Reassessment*, 18 U. DENV. WATER L. REV. 228, 259–62 (2015).
[73] TEX. WATER CODE ANN. § 11.142.
[74] OKLA. WATER RES. BD., *supra* note16, at 16.
[75] Franco-American Charolaise, Ltd. v. OWRB, 855 P.2d 568 (Okla. 1990).

new activities, like oil and gas production, often aim to transfer rights from agricultural water permit holders.[76]

Most oil and gas operators in Oklahoma seek temporary provisional permits that allow operators to drill and complete wells for up to 90 days while awaiting a longer-term permit. However, as mentioned above, purchasing an existing senior right ensures a reliable supply against junior users in times of shortage.[77] Unlike with other water use permits, when operators work under provisional temporary permits, they do not have an automatic right to use the surface. As a result, operators need to obtain from the landowner a letter or deed granting the operator right-of-access, and the operator must ensure that her use will not interfere with the landowner's domestic use of stream water.[78]

Texas does not exempt oil and gas activities from the permitting regime. The "stock tank exemption" may only be used to water livestock and fish and wildlife and may not be used to supply oil and gas producers with water unless they have a permit for that prupose.[79] Mineral recovery, including oil and gas production, is listed third among beneficial uses, so producers seeking to obtain a permit enjoy priority consideration over other uses, such as hydroelectric power, recreation, and public parks.[80]

B. Ground Water

Ground water in Texas[81] famously operates according to the *Rule of Capture*—landowners have a legal property right in the water underneath their land;[82] in Oklahoma, ground water[83] is also considered private property that belongs to the overlying surface owner; however, its use is subject to reasonable regulation.[84]

1. Oklahoma ground water regulation

Under Oklahoma's modified rule of capture, landowners are entitled to a certain allotment of ground water, equal to the proportion of land they own above the basin.[85] The law in Oklahoma is generally more restrictive than in Texas—landowners must seek a permit from the OWRB to exercise their rights to their "proportionate part" of ground water.[86] The proportion is based on a Maximum Annual Yield ("MAY") that the OWRB estimates can be safely withdrawn from a basin or sub-basin over a 20-year lifespan.[87]

[76] Lyons & Tintera, *supra* note 12 at 6.
[77] Puls, *supra* note 17.
[78] OKLA. WATER RES. BD.,, *How to Obtain a Water Use Permit*, *available at* https://www.owrb.ok.gov/about/about_pdf/Fact-Permitting.pdf (last accessed Mar. 8, 2016).
[79] TEX. WATER CODE ANN. § 11.143(a).
[80] TEX. WATER CODE ANN. § 11.023.
[81] "'Ground water" means water percolating below the surface of the earth." TEX. WATER CODE ANN. § 35.002.
[82] Edwards Aquifer Authority v. Day, 369 S.W.3d 814 (Tex. 2012).
[83] Oklahoma defines ground water as "fresh water under the surface of the earth." *See* OKLA. STAT. tit. 82, § 1020.1.
[84] OKLA. STAT. tit. 82, § 1020.3.
[85] OKLA. STAT. tit. 82, § 1020.9.
[86] OKLA. STAT. tit. 82, § 1020.7, 1020.9.
[87] OKLA. STAT. tit. 82, § 1020.5.

The permit process mirrors the surface water permitting process, requiring notice published in the county where the property lies and mailed to landowners within a quarter mile of the proposed well location.[88] "[T]he Board shall approve the application and issue the appropriate permit" if it meets 4 criteria: (1) the applicant owns or leases a property; (2) that overlies a fresh ground water basin or sub-basin; (3) the proposed use is beneficial; and (4) it will not cause waste by depletion or pollution.[89] If the application is protested, the OWRB holds an administrative hearing on the matter.[90]

The OWRB issues four types of ground water permits: regular, temporary, special and provisional temporary.[91] Apportioning an amount of water to a landowner requires a hydrologic survey to gain information about the basin that the OWRB uses to set safe limits for withdrawal.[92] Temporary permits allow a permit holder to withdraw two acre-feet of water per year per acre owned or leased for a basin where maximum annual yield studies have not yet been completed.[93] Special permits extend temporary or regular permits six months and are renewable three times.[94] Finally, provisional temporary permits, frequently sought by oil companies requiring water for the drilling of oil and gas wells, allow use for up to 90 days and, like their surface water counterparts, may be approved by the executive director of the OWRB without public notice and hearing.[95]

Like surface water permits, ground water permits in Oklahoma may be either transferred or assigned.[96] The same exemption from permit requirements for domestic surface uses applies to ground water, so long as it is put to beneficial use and not wasted.[97] Further, the domestic well exemption absolves landowners of any well-spacing restrictions.[98]

2. Texas ground water regulation

Often referred to as the "law of the biggest pump," the Rule of Capture allows landowners to withdraw as much water as they wish, even if it causes neighboring wells to dry up, because the law affords those landowners the same right to pump water freely.[99] There are a few exceptions to this rule, such as prohibiting a land owner from causing waste, maliciously draining water, or negligently causing subsidence to a neighboring property.[100] But these exceptions are not often successful at preventing a landowner from exercising his strongly-protected right to pump ground water.

[88] OKLA. STAT. tit. 82, § 1020.8.
[89] OKLA. STAT. tit. 82, § 1020.9.
[90] OKLA. STAT. tit. 82, § 1020.8.
[91] OKLA. STAT. tit. 82, § 1020.11.
[92] OKLA. STAT. tit. 82, § 1020.4.
[93] OKLA. STAT. tit. 82, § 1020.11.
[94] *Id.*
[95] *Id.*
[96] OKLA. ADMIN. CODE 30 § 785:30-7-7.
[97] OKLA. STAT. tit. 82 § 1020.3.
[98] *Id.*
[99] Houston & T.C. Ry. Co. v. East, 81 S.W. 279, 281 (Tex. 1904).
[100] TEX. WATER CODE ANN. § 36.002.

The primary limitations to the unfettered pumping right in Texas are imposed by Groundwater Conservation Districts ("GCD"s) empowered by the state as its preferred method of ground water management. GCDs serve three primary functions: "permitting water wells; developing a comprehensive management plan; and adopting the necessary rules" for implementation.[101] As part of those duties, GCDs also "impose reasonable limitations upon the production of ground water and may do so by setting spacing and tract size requirements, regulating production, and allocating a given share of water in an aquifer to a landowner on a proportionate basis."[102] Still, landowners may have legal recourse against GCDs when the regulations they impose effectively deprive landowners of the use of their property. In recent years, Texas courts have held that, because a GCD is a regulatory body, when a GCD's regulations too severely restrict ground water usage, constitutional protections may require the governmental entity to pay just compensation for taking private property.[103]

4. Relevance to oil and gas production

Certain features of Oklahoma's ground water permitting regime affect mineral producers directly. The 90-day provisional temporary permit that mineral producers may obtain to use ground water during drilling operations is subject to the same requirements for stream water, including the need to first gain right-of-access from the landowners.[104] Oklahoma requires additional information from applicants seeking to use fresh ground water in enhanced oil and gas recovery.[105] This includes disclosing the amount of fresh water the company uses annually in recovery activities and submitting an economic study analyzing feasible alternatives and evaluating the economic costs and benefits of those alternatives.[106] State law currently facilitates the use of underground saline resources as an alternative to freshwater reserves for mineral production by explicitly exempting salt water from its scope.[107]

Although GCDs play a significant role in governing Texas ground water, certain types of ground water uses—including ground water used for oil and gas exploration and drilling—are exempt from GCD permitting.[108] Wells must still be registered and comply with drilling rules, and oil and gas developers are supposed to disclose the volume of water used in drilling and completion.[109] Texas law prohibits GCDs from requiring permits for water wells used solely to "supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas provided that the person holding the permit is

[101] TCEQ, *Summary Description of GCDs* (2016), *available at* http://www.tceq.state.tx.us/assets/public/permitting/watersupply/groundwater/maps/gcd_text.pdf.
[102] Tiffany Dowell, *Texas Water: Groundwater Conservation Districts (Part II),* TEX. AGRIC. L. BLOG (Nov. 10, 2013), http://agrilife.org/texasaglaw/2013/11/10/texas-water-goundwater-conservation-districts-part-ii/; *see also* TEX. WATER CODE ANN. § 36.002.
[103] Bragg v. Edwards Aquifer Authority, 421 S.W.3d 118, 146 (Tex. App.—San Antonio 2013, pet. denied).
[104] OKLA. ADMIN. CODE 30 § 785:30-5-4.
[105] OKLA. ADMIN. CODE 30 § 785:30-3-2.
[106] *Id.*
[107] OKLA. STAT. tit. 82, § 1020.2(B).
[108] TEX. WATER CODE ANN. § 36.117.
[109] TEX. WATER CODE ANN. § 36.117(b)(3); 16 TEX. ADMIN. CODE § 3.29.

responsible for drilling and operating the water well and the water well is located on the same lease or field associated with the drilling rig."[110]

Moreover, GCDs are divided on their approach to applying this rule to water wells drilled for fracking. The Railroad Commission and the GCDs themselves interpret the rules differently;[111] even two GCDs within the same Eagle Ford Shale employ conflicting interpretations of the law.[112] The Winter Garden GCD views fracking as a drilling or exploration technique that state law exempts from permitting;[113] meanwhile the Evergreen GCD labels fracking a production technique subject to the district's water regulations.[114] The upshot is that, without clarification from the legislature, oil and gas producers must make decisions based on somewhat tenuous information.

A recent Texas case illustrates a current divide in how the state views underground resources.[115] Under Texas law, the mineral estate is dominant over the surface estate, and ground water is part of the surface estate. In the oil and gas context, the mineral lessee steps into the shoes of the owner and has an "implied right to use as much of the surface as reasonably necessary to produce" its underground resources.[116] That gives the oil and gas lessee the implied right to use as much ground water, as part of the surface estate, as is "reasonably necessary." Where ownership of the ground water is sold apart from the land, the interest is severed. Yet, under the current incarnation of Texas law, the ground water owner—unlike the mineral estate owner—has no implied right to use the surface in order to access the water underneath, unless the terms of the lease say otherwise.[117]

C. Water Supply Contracts

Texas upholds contracts for the sale of surface water, ground water, and reclaimed water.[118] Water supply contracts can enable mineral producers to obtain from water rights holders or ground water owners water to use in production, and to arrange a person to take possession of water reclaimed from the process. All water supply contracts must consider the quantity needed; whether the quality is adequate for the buyer's purpose; how to apportion costs of delivery, transportation, and fees; how to provide reliable amounts; the method of transportation (whether truck, pipeline, or ditch); and any easements needed to access the supply. With few exceptions, surface water supply

[110] TEX. WATER CODE ANN. § 36.117(b)(2).
[111] Mary Sahs, a Texas attorney, noted at least five other conflicting GCD opinions in her speech *Frac Water–Regulation of Quantity and Quality, and Reporting by Texas Groundwater Conservation Districts*, presented at the State Bar conference "The Changing Face of Water Rights" (Feb. 23, 2012); *see also* John McFarland, *Groundwater Districts' Regulation of Water Supply Wells—What Landowners Should Know*, Oil and Gas Lawyer Blog (May 8, 2012), http://www.oilandgaslawyerblog.com/category/water-rights.
[112] Kate Galbraith, *Fracking Groundwater Rules Reflect Legal Ambiguities*, TEX. TRIBUNE (Mar. 13, 2013), http://www.texastribune.org/2013/03/13/fracking-groundwater-rules-reflect-legal-ambiguiti/.
[113] *Id.*
[114] John Kemp, *Don't Mess with Texas Water, Frackers Warned*, REUTERS: MONEY (May 1, 2013 9:12am). http://www.reuters.com/article/us-column-kemp-texas-fracking-idUSBRE9400HB20130501
[115] City of Lubbock v. Coyote Lake Ranch, LLC, 440 S.W.3d 267 (Tex. App.—Amarillo 2014, pet. granted).
[116] Tarrant Cnty. Water Control & Improvement Dist. No. One v. Haupt, Inc., 854 S.W.2d 909, 911 (Tex.1993); Getty Oil Co. v. Jones, 470 S.W.2d 618, 621 (Tex.1971).
[117] *Coyote Lake*, 440 S.W.3d at 274–75.
[118] TEX. WATER CODE ANN. § 11.036.

contracts require amending the water right and complying with procedures required by the TCEQ but are often fairly straightforward.[119] Contracts often specify a storage source from which the supplier will release water to a downstream buyer. But if the contract obligates a supplier to provide water to the purchaser from another source to which the purchaser or the supplier do not hold a water right, then one of the parties must obtain a permit or amend the water right that forms the basis of the contract.[120] Contracts for diverting water upstream of the storage point require the purchaser to get a permit if it exceeds the supplier's water right.[121]

Forming good ground water supply contracts may be much less straightforward. Unless a buyer contracts with a third party to purchase ground water that is already legally secured, the contract will often be with the landowner or owner of the ground water estate. Because Texas ground water is a property right that may be severed from the landowner's rights, the buyer will first need to review deed records to ensure the owner has rights to the water source. If a well is not already drilled, a buyer may need to hire a hydrogeologist to determine what ground water is available. The accommodation doctrine has not yet been applied to water in underground reserves, so apart from water used in mineral production, when the surface estate is owned by a different person, a surface use agreement will need to be signed to permit access to explore and drill water wells. Importantly, if the water supply is in a GCD, the supplier and purchaser must comply with any GCD regulations and obtain applicable permits. Reclaimed water supply contracts can provide for wastewater from domestic or municipal effluent to be treated to a particular quality suitable for a specific use, including many oil and gas applications. However, producers may not employ Type I or II reclaimed water before installing surface casing, because ground water could be harmed;[122] "[o]nce surface casing is in place and ground water is protected, the TCEQ may approve reuse of municipal reclaimed water in oil and gas operations."[123]

III. OIL AND GAS WASTE WATER: DISCHARGE AND DISPOSAL

Ensuring sufficient water supplies for the processes involved in producing hydrocarbons involves more than procuring freshwater: the current practices of disposing of wastewater in the oil and gas industry make vast amounts of water unavailable for subsequent use. In response to federal water quality laws, wastewater disposal techniques aim to properly dispose of water produced or contaminated through oil and gas processes. Pumping that water into disposal wells for deep underground storage is one of the most effective ways to insulate the environment from saltwater,

[119] 30 TEX. ADMIN. CODE § 297.101–297.108.
[120] Martin Rochelle & Cristina Ramage, *Water Supply and Water Quality Issues in Oil and Gas Development*, Presentation given at the Texas Journal of Oil & Gas Law Symposium (January 20, 2011).
[121] 30 TEX. ADMIN. CODE § 297.104.
[122] 30 TEX. ADMIN. CODE § 210.22(d), 210.5(b).
[123] TEX. COMM'N ON ENVTL QUALITY, *Requirements for Reclaimed Water*, http://www.tceq.state.tx.us/assistance/water/reclaimed_water.html/#drilling (last accessed Mar. 8, 2016).

toxic drilling fluid, and other hazardous substances found in oilfield waste.[124] However, doing so effectively removes that water from the hydrocycle permanently.

A. Discharge Under the Clean Water Act

The Federal Clean Water Act ("CWA") governs pollutant discharges into the navigable "waters of the United States" (a category of surface waters whose definition is in a current state of flux), but it does not govern ground water discharges.[125] Section 402 of the CWA prohibits people from adding to these surface waters pollutants, including any type of industrial, municipal, or agricultural waste, without a National Pollutant Discharge Elimination System ("NPDES") permit.[126] The NPDES permit sets out the activities or allowable levels of discharge the user can make into these surface waters.[127]

Federally, the Environmental Protection Agency and the Corps of Engineers established the permitting program, but the EPA delegates the program's administration to qualifying states.[128] Oklahoma administers its "OPDES" program through its Department of Environmental Quality ("DEQ").[129] The TCEQ's Texas franchise of the program ("TPDES") has federal authority to regulate pollutant discharges into Texas surface water, except that the Railroad Commission of Texas has enforcement authority over discharges relating to oil, gas, and geothermal exploration and development activities.[130]

B. Disposal Wells Subject to the Safe Drinking Water Act

Oil and gas wastewater's high salinity usually renders it incapable of meeting NPDES standards for discharging the water into rivers and lakes without substantial treatment or recycling. Consequently, injecting the fluids into deep geologic formations presents the most viable option for permanent disposal. "Deep well injection of water represents consumptive use of water, which is no longer available to the hydrological cycle."[131]

The goal of the federal Safe Drinking Water Act ("SDWA") is to prevent "any physical, chemical, biological, or radiological substance or matter" from contaminating public drinking water supplies.[132] The SDWA authorizes EPA to set the maximum contaminant levels allowable for chemicals that it determines adversely affect human health.[133] Integral in protecting the public water

[124] Joe Wertz, *Oklahoma Oil and Gas Regulator Uses Red Tape, Not Rules, to Manage Disposal Wells in Earthquake Country*, NAT'L PUBLIC RADIO, STATE IMPACT: OKLA. (Apr. 17, 2014, 6:43a.m.), https://stateimpact.npr.org/oklahoma/2014/04/17/oklahoma-oil-and-gas-regulator-uses-red-tape-not-rules-to-manage-disposal-wells-in-earthquake-country/.
[125] 33 U.S.C. § 1362(7) (current through 2015)
[126] 33 U.S.C. § 1342.
[127] *Id.*
[128] 33 U.S.C. § 1342(b).
[129] OKLA. DEPT. OF ENVTL. QUALITY, *Wastewater Permits*, http://www.deq.state.ok.us/wqdnew/opdes/ (last accessed Mar. 8, 2016).
[130] TEX. WATER CODE ANN. § 26.131(b).
[131] Barbara Hadley & Tom Rennell, FRACKING: RISKS AND REWARDS 77 (2105).
[132] 42 U.S.C. § 300f.
[133] 42 U.S.C. § 300h.

supply from contamination is protecting ground water reservoirs into which many different users dip their straws.

This is the sort of vulnerability that the SDWA's Underground Injection Control program is intended to mitigate. The permitting regime establishes categories of injection wells that place fluids underground for storage or disposal, imposing varying levels of restrictions on the construction, operation, permitting, and closure of injection wells.[134] Wastewater from oil and gas operations, particularly fluids used in enhanced and secondary recovery, are stored in Class II wells, rather than more reinforced Class I hazardous waste wells.[135] This is lawful because oil and gas waste is exempt from hazardous waste regulations that would require constructing Class I wells.[136] Notably, the Energy Policy Act of 2005 amended the SDWA to exempt most fluids used in hydraulic fracturing from regulation restricting their underground injection.[137]

C. State-Specific Issues

The Oklahoma Corporation Commission, the counterpart to Texas's Railroad Commission, requires oil and gas operators to obtain a permit before constructing a pit intended to temporarily store more than 50,000 barrels of produced water to be reused for hydraulic fracturing.[138] Whether located onsite or offsite of a well drilling location, the rule imposes permitting, construction, operation, and closure requirements, including requiring a bond to cover closure costs. Permits to build pits with capacities greater than 100,000 must also go through a notice and hearing process similar to water use permits. This could deter mineral producers like Oklahoma's Devon Energy,[139] who seek economic ways to reuse produced water, from attempting the reuse, because without a way to store produced water before treating or reusing it, the endeavor would likely be impossible.

In Texas, one particular challenge to ensuring that well-injected fluids are kept away from drinking water supplies arises when operators fail to plug wells in an injection zone, creating the risk that pressure will build up and flow out of unplugged wells. Although the law requires that anyone disposing wastewater into Class II wells to survey for improperly plugged wells within a one-quarter-mile radius of their proposed site before injecting,[140] there are many old, abandoned wells not listed on the state's database, leaving operators unable to verify that their injection does not pose such a

[134] *Water Quality*, INTERMOUNTAIN OIL & GAS BMP PROJECT, *supra* note 15.
[135] "Industry injects hazardous waste through Class I wells, as defined by the Resource Conservation and Recovery Act (RCRA)." *Class I Industrial and Municipal Waste Disposal Wells*, ENVTL. PROT. AGENCY, UNDERGROUND INJECTION CONTROL (UIC), https://www.epa.gov/uic/class-i-industrial-and-municipal-waste-disposal-wells (last accessed Mar. 8, 2016).
[136] *Hydraulic Fracturing*, INTERMOUNTAIN OIL & GAS BMP PROJECT, http://www.oilandgasbmps.org/resources/fracing.php (last accessed Mar. 8, 2016).
[137] 42 U.S.C. § 300h. (Diesel fluids used in fracking injection are now subject to Class II permit requirements).
[138] OKLA. ADMIN. CODE § 165: 10-7-16(f).
[139] *See* discussion in PART IV(C), infra.
[140] 16 TEX. ADMIN. CODE § 3.9(7)(A).

risk.[141] As a result, in areas where drilling has historically been prolific, a failure to plug all related holes can turn drinking water wells salty.[142]

IV. UPCOMING CHALLENGES

A. Competition for dwindling water supplies

New production technologies like hydraulic fracturing have taken hold in the West, prompting conflicts over water usage. When natural gas companies in Colorado began purchasing water rights that farmers previously claimed, questions about the impacts of fracking on agriculture emerged. The town of Greeley had for years sold water to farmers for $30 an acre-foot; but oil and gas companies' $3,300 per acre-foot offers led the town to choose industry over agriculture.[143] Periods of high production, like Texas saw in 2013, can spark rapid drawdowns of aquifers and skyrocket the price that oil and gas developers are willing to pay.

The regions that have been experiencing the greatest hydrocarbon boom have, in many cases, been the areas under the most severe water stress. For example, Ceres reported in 2014 that almost half of the hydraulically fractured wells drilled since 2011 were in areas of high or extreme stress.[144] Many times, over 80% of both the surface and shallow ground water available annually is already being put to municipal, industrial, and agricultural uses. Many of the western states where oil and gas development is occurring are experiencing prolonged drought while forecasting population explosions—Texas's population, for instance, is expected to grow 82% by 2060.[145] Oil and gas activities use less than 2% of the water used statewide, but at local levels the percentage used by the industry can rise into the double digits. A similar picture exist in Oklahoma, where the oil and gas sector uses 5% statewide, but localities like Alfalfa County use 20% of their water on oil and gas.[146]

Forty major aquifers in the United States are continually being over-exploited, with withdrawals greatly exceeding natural recharge rates.[147] The Ogallala Aquifer that stretches across parts of both Texas and Oklahoma is one of the nation's most stressed aquifers.[148] It supplies the ground water relied upon for 27% of the nation's agriculture, and although the norther portion may recharge somewhat, the southern portion across Texas and Oklahoma does not. Some portions of

[141] Gordon & Garner, *supra* note 1.
[142] Kate Galbraith and Terrence Henry, *As Fracking Proliferates in Texas, So Do Disposal Wells*, TEX. TRIBUNE (Mar. 29, 2013), http://www.texastribune.org/2013/03/29/disposal-wells-fracking-waste-stir-water-concerns/.
[143] Jack Healy, *For Farms in the West, Oil Wells are Thirsty Rivals* (Sept. 5, 2012), http://www.nytimes.com/2012/09/06/us/struggle-for-water-in-colorado-with-rise-in-fracking.html?_r=0.
[144] Monika Freyman, *Hydraulic Fracturing & Water Stress: Water Demand by the Numbers* 5, CERES (2014).
[145] The Texas Water Development Board, as part of its 2016 Regional Water Plan assessments, has predicted that the state's population will reach over 46 million by 2060. 2016 REGIONAL WATER PLAN—POPULATION PROJECTIONS FOR 2020–2070: STATE, REGION AND COUNTY SUMMARY, TEX. WATER DVLPT. BD. (2015), *available at* http://www2.twdb.texas.gov/ReportServerExt/Pages/ReportViewer.aspx?%2fProjections%2fpop_region&rs:Command=Render.
[146] Puls, *supra* note 17.
[147] CERES, *supra* note 148, at 36 (citing Leonid Konikow, U.S. GEOLOGICAL SURVEY, *Groundwater Depletion in the United States (1900-2008)*, Scientific Investigations Report 2013-5079 (2013).
[148] Puls, *supra* note 17 (citing the USGS, GROUNDWATER DEPLETION IN THE U.S. (2013)).

the aquifer could run dry in 30 years.[149] Yet heavy production areas like the Permian Basin, in which over 70% of the water wells are under extreme stress and fracking water use expected to double by 2020, also overlie the Ogallala.[150] Aquifers like Oklahoma's Salt Fork of the Arkansas alluvial aquifer can also experience stress when over-pumping induces saline water from nearby high salt-content zones to intrude into the aquifer, disrupting water quality.[151]

B. Quality Issues Related to the Industry

Various stages of the hydraulic fracturing process, in particular, have the potential to bring contaminants in contact with freshwater supplies: mixing the fracking chemicals with water and transporting the fluid, injecting the fracking fluid into the well, handling the frack fluids and produced water that flow back up the well, and disposing of or treating the wastewater afterward.[152] In recent years, news stories have animated concerns that hydraulic fracturing fluid might contaminate drinking water supplies. Whether drilling in a geologically unstable area or improperly casing, cementing, or managing pressure can cause those fluids to migrate into drinking water aquifers is hotly disputed. The disagreement arises in part because thousands of feet of impermeable rock strata usually separate fresh ground water from target shale formations; but a lack of peer-reviewed research is also to blame.[153]

The EPA raised some alarms in 2010 when it issued an endangerment order against Range Resources. Texas Railroad Commission investigations discovered other potential causes for the residential well contamination that the EPA had attributed to Range Resources' hydraulic fracturing efforts in Parker County, Texas. In particular, they pointed to water wells in the Barnett Shale that had evidenced natural gas contamination prior to gas development, possibly caused by wells penetrating a natural gas-bearing formation.[154] Alternative possibilities emerged in studies that have attributed contamination to defective wellbore casing instead of the fracturing process itself.[155] Short of establishing a clear connection between hydraulic fracturing chemicals and water contamination, draft reports from the EPA have since pointed to limited instances of confirmed methane contamination in drinking water and the proximity of underground hydrocarbon reserves to drinking water sources as signals of a potential systemic problem.[156]

Chemicals contained in the frack fluid often go undisclosed, making it difficult for EPA and other agencies to categorize the fluid and resulting wastewater for the purposes of determining how

[149] Dennis Dimick, *If You Think the Water Crisis Can't Get Worse, Wait Until the Aquifers Are Drained*, NAT'L GEOGRAPHIC (Aug. 21, 2014), http://news.nationalgeographic.com/news/2014/08/140819-groundwater-california-drought-aquifers-hidden-crisis/; *see also* Brett Walton, *Groundwater Depletion Stresses Majority of World's Largest Aquifers*, CIRCLE OF BLUE (June 16, 2015), http://www.circleofblue.org/2015/world/groundwater-depletion-stresses-majority-of-worlds-largest-aquifers/.
[150] CERES, *supra* note 148, at 9.
[151] Puls, *supra* note 17.
[152] ENVTL. PROT. AGENCY, ASSESSMENT OF THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING FOR OIL AND GAS ON DRINKING WATER RESOURCES (External Review Draft) (2015), *available at* https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=244651.
[153] *Hydraulic Fracturing*, INTERMOUNTAIN OIL & GAS BMP PROJECT, *supra* note140.
[154] *Id.*
[155] *Id.*
[156] ENVTL. PROT. AGENCY, *supra* note 156.

best to handle it throughout the process. The lack of information also causes concern for members of the public. Organizations such as Physicians for Social Responsibility suggest a moratorium on hydraulic fracturing until certain questions can be answered: "What are the effects of injecting these chemicals into the earth? Are local aquifers endangered—and drinking supplies? What is to be done with the astounding amounts of polluted water and mud that result, requiring treatment and/or storage?" Groups like these worry that frack fluids might contain carcinogenic or otherwise toxic chemicals requiring higher level regulatory protection, and that oil and gas companies usually invoke trade secret protections that result in inadequate state and federal regulations. In 2012, the Texas Railroad Commission implemented the Hydraulic Fracturing Chemical Disclosure Rule ("Rule 29"), making Texas one of the first states in the nation to require oil and gas operators to disclose the chemicals they use in hydraulic fracturing fluid.[157] Oklahoma soon followed suit. But many of these rules still allow producers to invoke trade secret protections, frustrating people who see disclosure as one way to protect water resources from industrial contamination.[158]

C. Reuse and Recycling

As the industry increases the water volumes it uses in arid zones like the American Southwest, drought, population growth, and public perception combine with higher costs to prompt the oil and gas industry has begun to search for ways to reduce freshwater consumption.[159] Some ground water has a saline content too high to classify as freshwater, but is less saline than seawater—this brackish water is often suitable for drilling and hydraulic fracturing and gaining utility as a new water supply. In order to be used as potable water, brackish water must be desalinated or diluted to reduce its salt concentration for many industry purposes. Many states have vast reserves of brackish water that could substitute for freshwater, including Texas with 2.7 billion acre-feet of brackish ground water.[160] And once water is used and transformed into reclaimed water or effluent, that wastewater may still be treated and used for energy production or other uses.[161] Between 2008 and 2011, Texas saw a 21% increase in the use of recycled and brackish water for fracking operations.[162]

Produced water, however, is emerging as an advantageous freshwater alternative, because keeping the water in the use cycle avoids discharging or disposing of it in places where it could potentially cause negative environmental impacts. Even when using treatment methods to separate the contaminants from the water, the separated waste product is highly concentrated with harmful substances which, if they migrated to ground water supplies, could detrimentally impact these reserves. As a result, environmental concerns, combined with dwindling freshwater resources and the possibility that increased seismic activity is linked to disposal wells, are incentivizing the industry

[157] TEX. RR. COMM'N, *Hydraulic Fracturing*, http://www.rrc.state.tx.us/about-us/resourcecenter/faqs/oil-gas-faqs/faq-hydraulic-fracturing/ (last accessed March 4, 2016).
[158] Susan Carroll & Matt Dempsey, *Texas law shields companies from disclosing fracking chemicals*, SAN ANTONIO EXPRESS NEWS (Feb. 7, 2016 10:54p.m.), http://www.expressnews.com/news/local/article/Texas-law-shields-companies-from-disclosing-6813995.php.
[159] Danielle Kalisek & Leslie Lee, *The Energy-Water Tug of War*, published in TEX. WATER RES. INST., TX: H20 22 (Fall 2011), *available at* http://twri.tamu.edu/newsletters/txh2o/txh2o-v7n1.pdf.
[160] Bracken, *supra* note 6, at 2.
[161] *Id.*
[162] Lyons & Tintera, *supra* note 12, at 8.

to begin reusing the water that is otherwise a waste by-product of oil and gas production operations.[163]

Reusing or recycling water can reduce and prevent water pollution and depletion, and several basins are successfully employing these techniques:

- In 2015, the wastewater recycling rate in the Eagle Ford was 30%. It is estimated that by 2019, Eagle Ford operators will be able to recycle half of the wastewater generated during the fracking process. In addition, the use of brackish ground water as an alternative to freshwater is gaining popularity and in 2015 provided an estimated 20% of the water being used in the Eagle Ford.
- Using a combination of brackish ground water and wastewater, Apache Corporation reports that it is no longer using fresh water at a 35,000 acre field in the Wolfcamp shale of west Texas, one of the Permian region's hottest oil plays. Water there is so scare that residents in nearby Barnhart, Texas saw their town well go dry in 2013.[164]
- In 2012, Oklahoma's Devon Energy built a facility that allowed it to reuse more than 260 million gallons of produced water. Devon built a pond that held up to 21 million gallons of water that the company was then able to share between its various production areas across the same formation via a pipeline. As a result, the company had to purchase less fresh water to meet its needs.[165]

The Texas Railroad Commission recently amended its rules to facilitate wastewater recycling without a permit. Operators can even accept water from other locations or companies, as long as the recycling occurs on land leased by the operator so that the operator can oversee the process, and the reclaimed water is used in the wellbore of an oil or gas well.[166] Texas was responsible for generating 44% of the total produced water in the United States in 2010. This new rule also allows oil and gas operators with recycling capacity to repurpose and sell that water to other operators. [167]

D. Local Restrictions

Companies seeking to produce oil and gas in the American Southwest will have to navigate a patchwork of local ordinances applying distinct sets of rules for acquiring, using, and disposing of water in the oil and gas context. For instance, in Oklahoma:

- The City of Norman, Oklahoma, does not allow drilling within 300 feet of any producing freshwater well.[168]

[163] Lyons & Tintera, *supra* note 12, at 12.
[164] *Hydraulic Fracturing*, INTERMOUNTAIN OIL & GAS BMP PROJECT, *supra* note 140.
[165] Adam Wilmoth, *Oklahoma energy companies work on water recycling*, NEWSOK (Mar. 30. 2014), http://newsok.com/article/3948370
[166] TEX. RAILROAD COMM'N, *Recycling*, http://www.rrc.state.tx.us/oil-gas/applications-and-permits/environmental-permit-types-information/recycling/
[167] Gordon & Garner, *supra* note 1.
[168] *Norman Updates, OKs Oil, Gas Law*, NAT'L PUBLIC RADIO, STATE IMPACT: OKLA. (Jul. 16, 2015, 12:03p.m.) https://stateimpact.npr.org/oklahoma/jp/norman-updates-oks-oil-gas-law/.

- Oklahoma City requires 660-foot setbacks between wells or storage and any streams or reservoir, in addition to detailed specifications for well casings and other equipment.[169]

Similarly, hundreds of cities in Texas have restricted oil and gas drilling to various degrees over the years.[170] The following provides a few notable examples of Texas cities with water-related restrictions:

- In the Eagle Ford shale region, cities in Lavaca and DeWitt counties can refuse to supply oil and gas producers with water, as a result of municipal needs and drought conditions.
- Grand Prairie, Texas, was the first municipality in the state to ban the use of city water for fracking in August 2011.
- Also in August 2011, the City of Arlington cited Chesapeake for using city water to frac a well in a different location than the permitted drill site.
- Fort Worth, Texas, prohibited saltwater disposal wells in April 2012.
- The City of Denton prompted strong reactions when in January 2013 it imposed a moratorium on issuing new drilling and production permits, but it has since replaced it with rules requiring closed-loop drilling systems and "green" completions.
- And Flower Mound, Texas, regulates "freshwater wells setbacks; floodplain setbacks; pre-drilling, post-drilling, and post-fracturing water analyses; pre-drilling, post-drilling, and periodic soil sampling."[171]

The Texas Legislature in 2015, however, enacted House Bill 40, designed to "expressly preempt the regulation of oil and gas operations by municipalities" in areas the Railroad Commission has already regulated.[172] The Bill effectively prohibits a local regulation "that bans, limits, or otherwise regulates an oil and gas operation" but provides a narrow exception for regulations aimed at above-ground activities, if the restriction is commercially reasonable and will not effectively prohibit oil and gas operations. At the same time that HB 40 was adopted in Texas, Oklahoma mineral producers also pushed for limitations on the ability of municipalities to restrict oil and gas production and succeeded in having Senate Bill 809 adopted in the state.[173]

Notwithstanding, with the recent slowdown in the industry, many of these restrictions remain on the books and have yet to be challenged in court. Accordingly, it is unclear to what extent local community restrictions will fall afoul of the two states' restrictions in their efforts to manage how the oil and gas industry operates and uses water within municipal boundaries.

[169] OKLA. CITY, *Water Utilities Trust Rules: Controlling Drilling Operations* (Jan. 17, 2001), available at http://www.okc.gov/pw/pdf/ocwut.pdf.
[170] Jim Malewitz and Ryan Murphy, *See How Local Drilling Rules Vary Across Texas*, TEX. TRIBUNE (Mar. 27, 2015), https://www.texastribune.org/2015/03/27/see-how-local-drilling-rules-vary-across-texas/ (citing a 2015 survey by the Texas Municipal League, which found that at least 337 cities had some form drilling regulations. *See* TML SURVEY, TEX. MUN. LEAGUE, *available at* https://docs.google.com/spreadsheets/d/1sdhqvZy-nBUSQrisgFGiOFYOinIms2vmlLOlKcnSHDU/pubhtml?gid=714180743&single=true.
[171] Gabriel Eckstein, *Water Use in Oil and Gas Production: Legal Challenges and Opportunities*, presented to AAPG GEOSCIENCE TECH. WORKSHOP (Feb. 26–27, 2013).
[172] H.B. 40, 84th Leg. (Tex. 2015).
[173] S.B. 809, 55th Leg. (Okla. 2015).

V. CONCLUSION

While Oklahoma and Texas expect to experience sustained growth over the next half-century, their economies continue to heavily rely on both water and oil. Advancements in drilling techniques have broadened possibilities for producing hydrocarbons; but the innovations of unconventional drilling have exacerbated existing threats that the oil and gas industry have posed to water resources while creating new challenges. Hydraulic fracturing, in particular, poses several unique challenges to fresh water resources at various stages of the process, from frack fluid preparation and transport, to production, through handling the resulting wastewater. As the industry increases the water volumes it uses in arid zones, such as the American Southwest, drought, population growth, public concerns about water quality and quantity, and higher costs are prompting the oil and gas industry to search for ways to reduce freshwater consumption.

Companies seeking to produce in the Oklahoma will need to know what is required for its permit systems for both surface water and ground water, while Texas-bound producers will still have a difficult time acquiring surface water permits but may find it easier to access ground water. The biggest concern in Texas is the strain that such ready access to ground water places on aquifers. And operators in both states will need to be aware that, even though sufficient water may exist statewide, the concentration of drilling operations over specific mineral formations may lead to water competition in localized clusters. Obtaining sufficient water for oil and gas production means considering the quality of water available for use, as well as how to regain usable quality after use, in order to provide the quantity required for a successful, sustainable industry.

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FRAMEWORK OF SURFACE AND GROUND WATER LAWS IN OKLAHOMA & TEXAS:

Perspectives for Oil & Gas Development

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Water Acquisition and Management for Oil & Gas Development Conference
Houston, TX
April 7–8, 2016

OUTLINE

1. Relevance of Water for Oil & Gas Development
2. Water Law in Oklahoma and Texas and its Interplay with the Oil & Gas Industry
   - Surface Water
   - Ground Water
3. Oil & Gas Wastewater: Discharge & Disposal
4. Challenges & Opportunities

RELEVANCE OF WATER FOR OIL & GAS DEVELOPMENT

Water Use in Fracking

- 1 to 5 M gal. of freshwater per frack (*Chesapeake*)
- Multiple fracks often necessary for each well
- While between 1-5% of water used statewide goes to oil/gas activities, percentages at local levels have exceeded 40%

Fracking Effects on Freshwater Quality

- Freshwater usually most feasible option for most oil/gas processes
- Water used in fracking is used "consumptively" when injected into permanent storage and not recycled/ treated
- Securing sufficient quantity means ensuring quality is usable for its purpose

RELEVANCE OF WATER FOR OIL & GAS DEVELOPMENT

Oklahoma Water Use

- 2012–2060, state wide water demand to increase 28%
- Between 2010 and 2013, water usage by oil/gas sector doubled
- By 2060, water used for fracking is projected to be 10 times amount used in 2012
- Oil & gas booms in OK occurring in same areas recently afflicted by drought
- 2013, oil and gas sector used ~5% of water used state wide

Texas Water Use

- 2012–2060, state wide water demand to increase 22%
- 2012–2060, ground water supplies to decline 30%
- Without corrective action, state-wide water deficit will be 4.8 MAF in 2020, and 8.9 MAF in 2070
- In 2011, of >102,000 acre-feet of water used by oil/gas industry, fracking used 80%

WATER LAW 101: SURFACE WATER

Riparian Rights

- Historically, land owner of property touching a natural water body has the right to use that water
- As populations expanded Westward where water was more scarce, the riparian rights system left many without access

Prior Appropriation

- Dominates water law in the West
- Principles of:
  - "first in time, first in right" — the first to divert surface water and put it to beneficial use becomes obtains a senior priority over later users
  - "use it or lose it" — if water right is not continually used, it is lost and returned to the state for distribution under the appropriation system

WATER LAW 101: SURFACE WATER

Oklahoma

- Users obtain rights to use State "stream water" with a permit from the OWRB when:
  1. There is unappropriated water available
  2. The intended use is beneficial
  3. And the use will not interfere with existing rights
- Types of Permits: (1) Regular, (2) Seasonal, (3) Temporary, (4) Term, (5) Provisional Temporary, and (6) Limited Quantity
- Landowners do not need a permit to use water riparian to their land for domestic purposes or to store up to 2 years' domestic supply of stream water
- Permits may be transferred or amended for a different purpose or place of diversion or storage

WATER LAW 101: SURFACE WATER

Texas

- Surface "state water" permits issue from the TCEQ when:
  1. There is unappropriated water available
  2. The intended use is beneficial
  3. The use will not interfere with existing rights or cause waste
  4. And the permit is consistent with state and regional water plans
- Types of Permits include: (1) Regular, (2) Seasonal, (3) Temporary, and (4) Emergency
- Texas exempts domestic uses from permit requirements and allows landowners to store up to 200 acre-feet of surface water on private property for livestock purposes
- Transfers are permitted with proper procedures
- Out-of-basin uses are heavily scrutinized by TCEQ and only approved when their benefit outweighs their detriment, and transferred water rights lose their priority date

WATER LAW 101: SURFACE WATER

Most of water in the West is already fully appropriated, and available new rights would be far junior to others. The most reliable surface supply for oil & gas operations is to obtain existing senior rights (particularly agricultural, which are usually the most senior)

Oklahoma

- Most oil & gas operators obtain 90-day provisional temporary permits that allow them to use water for drilling
- But these permits do not allow surface access, so operators must make agreements with landowners

Texas

- Most oil & gas operators obtain water through temporary permits or contract purchases
- Some seek water permits as mineral recovery is considered a beneficial use
- NOTE: The livestock tank exemption does not permit operators to use water stored in stock tanks

WATER LAW 101: GROUND WATER

Oklahoma

- Ground water belongs to landowners, but they need a permit to use it; permits entitle landowners to a certain allotment of groundwater, equal to the proportion of land they own above the basin
- The OWRB may approve permits if:
  (1) The applicant owns or leases a property;
  (2) That overlies a fresh ground water basin or sub-basin
  (3) The proposed use is beneficial
  (4) And it will not cause waste by depletion or pollution
- There are four permit types issued: (1) Regular, (2) Temporary, (3) Special, and (4) Provisional Temporary
- The same exemption for surface water domestic uses applies to ground water

WATER LAW 101: GROUND WATER

Texas

- *Rule of Capture*: The "law of the biggest pump"
- Landowners have property rights in the water under their land and may withdraw as much water as they wish, even if it causes neighboring wells to dry up; their remedy is to dig a deeper well
- Some limits imposed by Groundwater Conservation Districts (GCDs), regulatory bodies with 3 main functions: (1) permitting water wells; (2) developing a comprehensive management plan; and (3) adopting rules necessary for implementation

Oklahoma requires additional information from applicants seeking to use fresh groundwater in enhanced oil and gas recovery

WATER LAW 101: GROUND WATER

Oklahoma

- The OWRB requires additional information from applicants seeking to use fresh ground water in enhanced oil and gas recovery
- Using saline ground water for mineral production is expressly exempt from permit requirements

Texas

- Ground water used for exploration and drilling for oil & gas is exempt from GCD rules. But state authorities are divided on whether this applies to water for fracking.
- Unlike mineral rights holders, ground water rights holders do not have an implied right to use the surface to access water

OIL & GAS WASTEWATER: DISCHARGE & DISPOSAL

Current practices of disposing of wastewater in the oil and gas industry make vast amounts of water unavailable for use in exploration and production

Federal Safe Drinking Water Act (SDWA)

- Regulates ground water used as potable water sources, setting maximum allowable levels for contaminants to protect the public water supply
- Underground Injection Control program restricts various classes of underground injection wells
- Oil & gas wells are typically Class II, but 2005 Energy Policy Act exempt most fracking fluids from underground injection regulation

Federal Clean Water Act (CWA)

- Requires NPDES (OPDES in OK; TPDES in TX) permits to discharge pollutants into navigable "waters of the United States," but does not govern ground water

OIL & GAS WASTEWATER: DISCHARGE & DISPOSAL

Oklahoma

- Permit required to build a pit to store more than 50,000 barrels of produced water
- Storage pits holding more than 100,000 barrels must undergo a similar notice and hearing procedure as water use permits
- Earthquakes
- Water quality concerns

Texas

- Many wells left unplugged from former wildcatting days, often in unknown locations; injection in vicinity creates risk of outflow from unplugged wells and ground water contamination
- Earthquakes
- Water quality concerns

CHALLENGES & OPPORTUNITIES

Competition for Resources

- Almost half of the hydraulically fractured wells drilled since 2011 are in areas of high or extreme water stress
- Withdrawals exacerbate over-exploitation of forty major U.S. aquifers
- Ogallala Aquifer, in Western Oklahoma and Texas and watering 27% of U.S. agriculture, is one of the most stressed aquifers; in some sections of the aquifer (e.g., Permian Basin where 70% of water wells are under extreme stress), water use by fracking is expected to double by 2020
- High oil/gas production demand draws down aquifers rapidly while raising the price water rights holders are willing to sell their water—farmers and municipalities often cannot compete with oil/gas companies for the water

Whether drilling in a geologically unstable area or improperly casing, cementing, or managing pressure can cause those fluids to migrate into drinking water aquifers is hotly disputed.

CHALLENGES & OPPORTUNITIES

Local Concerns & Restrictions

- Norman, OK, prohibits oil & gas drilling within 300 feet of a freshwater well, and Oklahoma City requires 600-foot well and storage setbacks away from streams and reservoirs
- Hundreds of Texas cities restrict oil & gas activities
- In Texas, HB 40, enacted in response to Denton, TX moratorium on new drilling, expressly preempts Texas cities from regulating oil & gas operations, though it does allow a commercial exception. Oklahoma adopted similar rules. But …
- Oklahoma enacted strict regulations to address seismic activity caused by underground injection

Water Quality Issues

- Still hotly disputed whether drilling in a geologically unstable area or improper casing, cement jobs, or pressure management can cause fracking fluids to migrate into drinking water aquifers (*see* recent Stanford study on ground water contamination in Pavillion, WY)
- Texas and Oklahoma both require companies to disclose chemicals used in fracking, but ongoing efforts to remove trade secret protections continue

Whether drilling in a geologically unstable area or improper casing, cementing, or managing pressure can cause those fluids to migrate into drinking water aquifers is hotly disputed.

CHALLENGES & OPPORTUNITIES

Reuse and Recycling

- Challenges
  - Competition for limited freshwater resources
  - Potential for contamination of freshwater resources
  - Potential regulatory requirements
- Alternative options needed including reuse and recycling
  - TX fracking operations between 2008-2011 increased recycled and brackish water use by 21%
  - Operators on the Eagle Ford shale in Texas recycled 30% of their wastewater in 2015
  - Apache Corp. in the Permian Basin now uses 100% brackish ground water and wastewater on one of their 35,000 acre production site
  - Devon Energy facility in Oklahoma reuses more than 260 million gallons of produced water by using holding ponds and pipelines to share water with its other sites
- Texas now permits wastewater recycling without a permit and allows the sale of recycled water to other operators

THANK YOU!

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