

# WASTED IN THE LONE STAR STATE

The impacts of toxic oil and gas waste in Texas

April 2021



EARTHWORKS





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*Dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions.*

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# Executive Summary

## THE IMPACTS OF TOXIC OIL AND GAS WASTE IN TEXAS



In September 2020, Texas produced more oil than the rest of the top ten U.S. oil producing states combined.<sup>1</sup> Despite the growing climate crisis and low oil prices, there is no end in sight for fossil fuel extraction in Texas. In 2019, 11,654 new drilling permits were issued in the state.<sup>2</sup> Meanwhile, Texas is permitting operations in ways that create and perpetuate environmental injustice, damage the environment, and expose industry workers, wildlife and the public to harmful toxics through improper testing, tracking, management, and disposal of oil and methane gas waste.

Oil and gas operations produce several streams of toxic waste that can contain varying amounts of carcinogens, radioactive materials, heavy metals, hydrocarbons, and undisclosed chemicals. Despite this, the oil and gas industry is exempt from complying with hazardous waste regulations in Texas. State law also prevents local governments from prohibiting oil and gas waste disposal within their communities. Other egregious oil and gas waste management practices currently employed in Texas are waste pit burial, discharge of waste to waterways, spreading waste over land, and exempting groundwater aquifers from protection in order to inject waste for underground disposal. These methods have already contaminated soil and drinking water across the nation, including Texas, and their continued use puts Texans and the environment at risk.

This report outlines the risks posed by the status quo in Texas and recommends specific policy changes to protect the health, safety, and stability of all Texans. The report features unfolding frontline stories, including a legal battle in Orange Grove, Texas over local impacts from the Blackhorn Environmental oil and gas waste facility, and the stockpiling of radioactive oil and gas waste at the Lotus, LLC facility in west Texas. The immediate harms faced by frontline communities can be mitigated by shifting power to those who bear the brunt of pollution. Texas can also create immediate improvements by protecting people, land, and water from oil and gas waste pollution in the following ways:

- Require Free Prior Informed Consent processes that give communities and residents decision-making authority in the permitting decisions that affect them
- Remove the exemption for the oil and gas industry from hazardous waste regulations
- Stop releasing radioactive materials in oil and gas waste into the environment by prohibiting onsite pit burial and discharges to land or water
- Require full disclosure of chemical additives and their concentrations used in all oil and gas operations
- Prohibit the dispersal of wastewater, treated or untreated, into the environment
- Stop permitting new oil and gas sites that create waste until harm to people and the environment can be thoroughly prevented



# TEXAS

## WASTED IN THE LONE STAR STATE

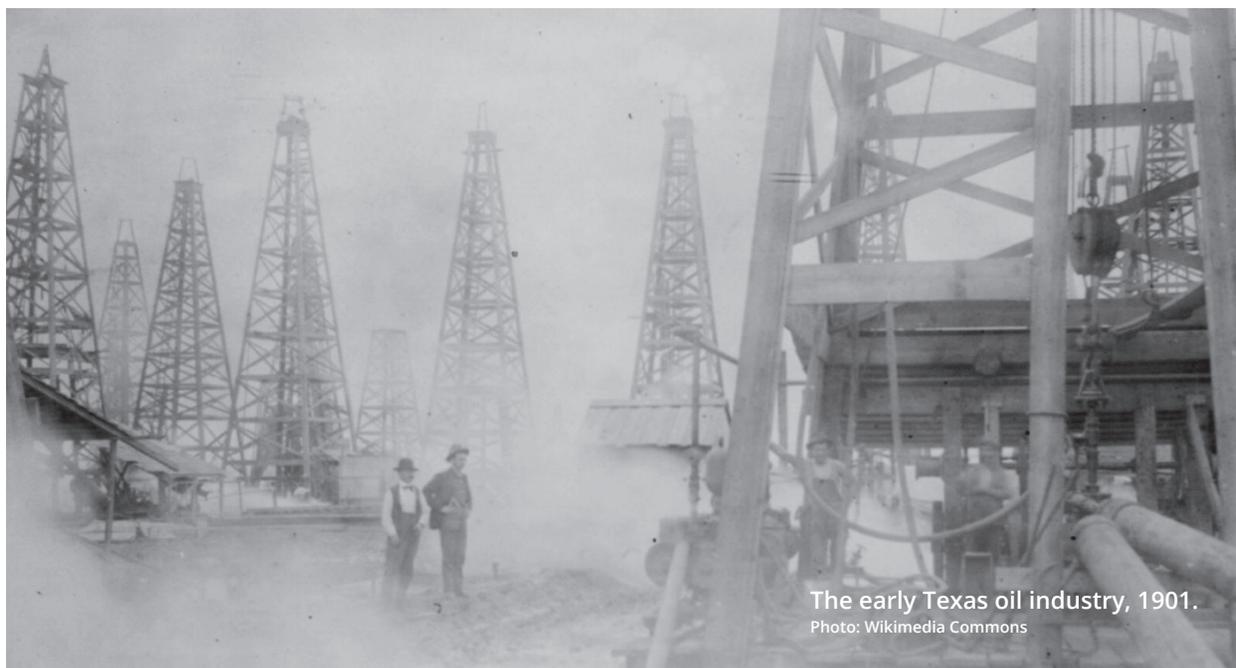


### April 2021—Introduction

In Texas, oil was discovered and used by indigenous peoples well before Europeans arrived on the scene. Native Americans accessed the oil from seeps in the ground, and Europeans learned to use it the same way for hundreds of years. Then, in 1866, the first Texas oil well was drilled.<sup>3</sup> Today, Texas is the largest oil and gas producer in the nation and a very different place from the pre-industrial, ancestral homelands of native people.

In September 2020, Texas produced more oil than the rest of the top ten U.S. oil producing states combined.<sup>4</sup> Despite the growing climate crisis and low oil prices, there is no end in sight; in 2019, 11,654 new drilling permits were issued in Texas and 9,310 new wells were drilled.<sup>5</sup> In total, as of February 2021, Texas had 293,595 active oil and gas wells.<sup>6</sup> Texas continues to permit operations that create and perpetuate environmental injustice, damage the environment, and expose industry workers, wildlife and the public to harmful toxics through improper management of oil and gas waste. Furthermore, the rising number of industry bankruptcies mean that the cost of waste management increasingly threatens taxpayers and the Texas economy.

This report outlines the risks posed by the status quo in Texas and recommends specific policy changes to protect the health, safety, and stability of all Texans.



The early Texas oil industry, 1901.  
Photo: Wikimedia Commons



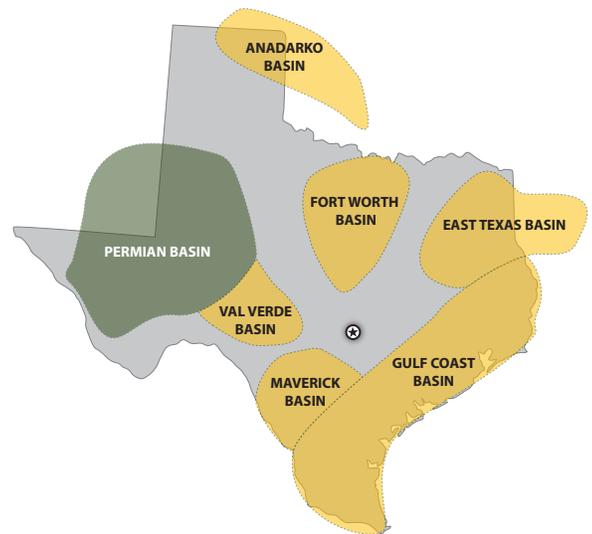
# Wasting Away in Texas

Texas is home to several of the largest shale oil and methane gas fields in the country, including the Permian Basin, which currently accounts for over half of all oil and gas production in the country.<sup>7</sup> The Permian extends beneath both Texas and New Mexico, covering approximately 75,000 square miles in Texas alone.

Wherever oil or methane gas is produced, there are also enormous amounts of waste material from drilling, fracking, and initial production. That's why, in February 2021, Texas oil and gas regulators had to suspend restrictions on liquid oil and gas waste disposal for 10 days after millions lost power due to intense winter storms. The "immediate need for increased sources of energy for power generation" also created "the necessity for additional disposal".<sup>8</sup>

All oil and methane gas waste is potentially harmful to people, land, water and climate. Exposure to contaminants from oil and gas waste occur via land, water, and air pollutants that are a problem for both health and climate. The proper management of oil and gas waste is critical to protecting frontline communities, ecosystems, and everyone downstream.

Of course, the only way to fully protect against oil and methane gas pollution is to stop creating it. But drilling in the Permian is projected to increase 60% by 2030.<sup>9</sup> This increase will mean billions more metric tons of greenhouse gas emissions, further climate destruction, and a vast amount of legacy pollution in the form of toxic oil and gas waste — unless permitting stops very soon. As detailed in the following pages, Texas is already unable to properly handle current volumes of waste.



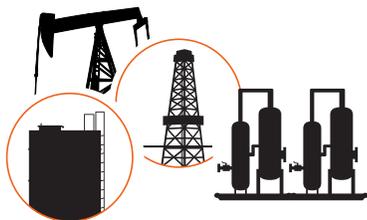
The Permian Basin accounts for over half of the states oil and gas production in the country.

Drilling in the Permian Basin is projected to increase 60% by 2030, which has huge climate implications.



# What Is Oil and Gas Waste, Exactly?

Oil and gas operations produce several streams of toxic waste that can contain varying amounts of carcinogens, radioactive materials, heavy metals, hydrocarbons, and undisclosed chemicals. EPA found that benzene, phenanthrene, lead, arsenic, barium, antimony, fluoride, and uranium in oil and gas wastes were of major concern, in particular, and present at “levels that exceed 100 times EPA’s health-based standards.”<sup>10</sup>



## Liquid Waste

Typically stored on site in pits or tanks; some is reused, but all is eventually disposed by injection underground, percolation through unlined pits, discharge to waterways after processing, or spread on roads or land.

### Wastewater

- Flowback (includes fracking additives)
- Produced Water
- Brine
- Effluent from treatment facilities

### Leachate

## In Between

### Drilling Muds, Sludge

Material is added to these wastes for “solidification” before being sent to landfills.

### Pipe Scale

Scale can either be disposed as solid waste, or dissolved and disposed of with liquid waste.

## Solid Waste

Disposed of in landfills. Drill cuttings have also been used as construction material.

- Drill cuttings (includes drilling additives)
- Fracking sand
- Fluid pit liners
- Filter socks
- Well site pad liners
- Contaminated soil
- Retired tanks and equipment

Oil and gas waste streams often contain radioactive materials, heavy metals, and carcinogenic chemicals.

Some wastes fit the general definition of “solid”, including drill cuttings, muds, and sand used for fracturing — others are generally “liquid”, like produced water, flowback, and fluids used for fracturing bedrock. Often, these wastes get mixed together during operations and may need to be separated before disposal.





Governments have exempted companies from rules governing hazardous waste.

## Hazardous

Over 30 years ago, long before the “fracking boom” started, the United States Environmental Protection Agency (EPA) reported to Congress that oil and gas wastes “contain a wide variety of hazardous constituents.”<sup>11</sup> Despite this reality, EPA succumbed to pressure from industry and granted it a massive exemption from federal rules governing hazardous waste, effectively making oil and gas waste “non hazardous” with the stroke of a pen. In doing so, the proper management of hazardous oil and gas wastes fell to state governments. But instead of creating the stringent rules needed, states incorporated the federal exemption’s language — effectively letting oil and gas companies off the hook for managing their waste under hazardous waste requirements.

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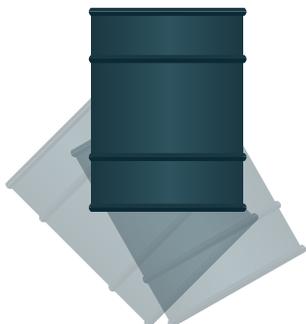
**Instead of keeping disposal expenses within the industry as a cost of doing business, governments have exempted companies from that responsibility and shifted the burden onto frontline communities in the form of pollution and onto taxpayers in the form of clean up costs.**

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Though Texas exempts oil and gas waste from hazardous waste law, some oil and gas wastes are considered “special waste” and require approval for certain kinds of disposal.<sup>12</sup> However, even when testing protocols are recommended prior to disposal, at municipal landfills for example, testing is not always required. Furthermore, the currently recommended testing processes do not account for all of the harmful effects of oil and gas wastes. For instance, Texas does not require companies to test liquid waste for radioactive and carcinogenic radium-226 before spreading the liquid across land for “disposal”.<sup>13</sup> These weak standards create the perception that the waste is regulated — meanwhile, fenceline communities remain exposed to the air pollution and ground-water contamination with little legal recourse to prevent permits from being approved

Texas produces far more oil and gas than any other state, which strongly suggests that Texas produces more oil and gas waste than any other state, and adopting the industry’s federal exemption from hazardous waste law means that Texas is also a national leader in the mismanagement of these potentially dangerous waste streams. That’s why Earthworks recommends that Texas remove the hazardous waste exemption for the oil and gas industry.

**Texas is the leader of mismanagement of oil and gas waste**



1

**Close the hazardous waste loophole: Treat the industry’s hazardous waste for what it is — “hazardous” — when it meets hazardous waste criteria. Removing the hazardous waste exemption means that dangerous materials will be tested, tracked, handled, and disposed of based on scientific integrity.**



# Radioactive

The presence of radioactive elements in oil and gas waste has been documented for decades, but both industry and government have repeatedly stated that the levels present are not of concern. However, documents unearthed in a January 2020 investigation published in *Rolling Stone* reveal that:

- a) the industry has known about the real risks of radioactivity within the industry for decades, and
- b) there is a direct link between radioactivity on the job and cancer in oil and gas workers.<sup>14</sup>

In fact, in 1982, a report prepared for the American Petroleum Institute found that “[a]lmost all materials of interest and use to the petroleum industry contain measurable quantities of radionuclides that reside finally in processing equipment, product streams, or waste. In addition, groundwater used for waterflood or brine solutions from operating wells contain biologically significant quantities of Radium 226 and Radon 222.”

***“It is concluded that the regulation of radionuclides could impose a heavy burden on API member companies, and it would be prudent to monitor [regulatory actions] closely.”<sup>15</sup>***

— American Petroleum Institute



There is a direct link between radioactivity on the job and cancer in oil and gas workers.



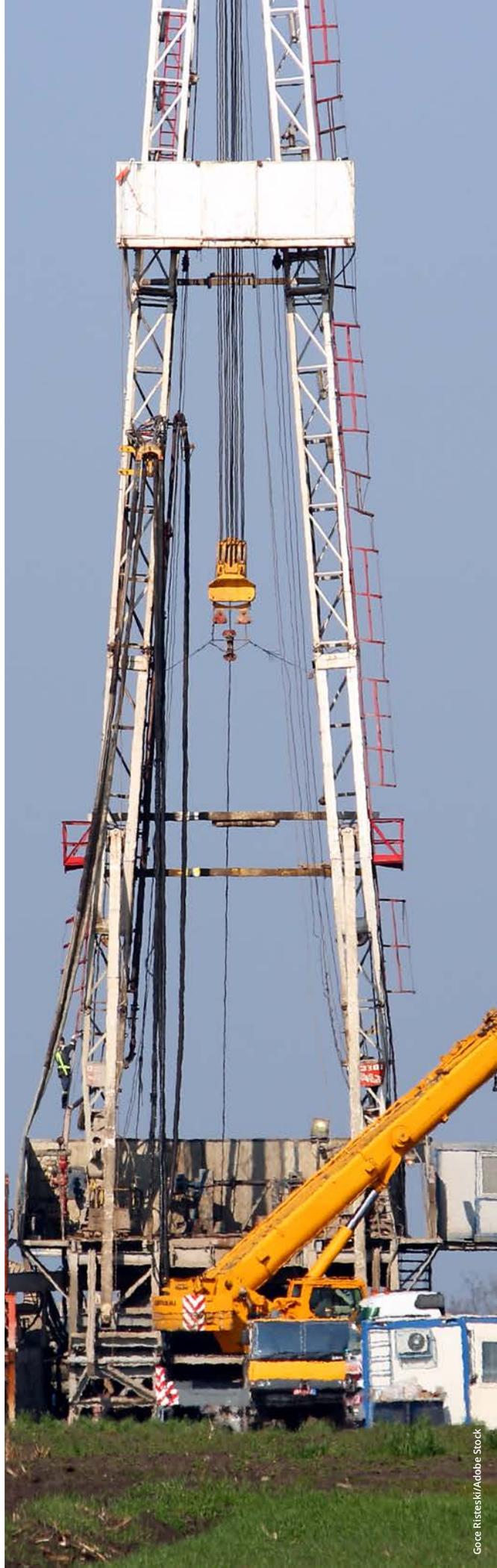
Radioactive material produced by the oil and gas industry is normally referred to as NORM — or naturally occurring radioactive material. The contaminants are “naturally occurring” in the earth, safely underground, until they are unnaturally removed by companies during oil and natural gas operations. In some states, and at the EPA, NORM that is altered by industrial operations is called TENORM — technically enhanced naturally occurring radioactive material. Texas does not, however, have rules for oil and gas TENORM.

**Liquid waste is spread over land by companies with a permit, but the permit does not require testing for radioactive materials first.**

In Texas, in order for oil and gas companies to dispose of waste in municipal landfills, NORM concentrations must be below 30 picocuries per gram. The trouble with any limit on NORM is that some naturally-occurring radioactive materials persist and accumulate over time. For example, radium 226, found in most oil and gas waste, has a half-life of 1,600 years. This means that, even though each load may only contain a limited amount of NORM, the amount of total radioactivity, where load after load upon load is dumped, adds up.

Oil and gas waste can also be buried right at oil and gas sites if it contains no more than 30 picocuries per gram of NORM, but this limitation only applies to a single burial site, and testing has little oversight. It does not take into account the total number of burial sites above a specific groundwater aquifer or within a whole watershed, where toxics from many collective pits may leak into the same drinking water source. In Texas, liquid waste called “produced water” is spread over land by companies with a permit to do so, but the permit does not require testing for radioactive materials first.<sup>16</sup> Failure to test before dispersing liquid waste into the environment is the status quo in Texas, despite regulators knowing that produced water contains radioactive materials.<sup>17</sup>

As if these risks aren't enough, U.S. and Texas law both allow companies to accept imported radioactive oil and gas waste from overseas.



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TEXAS OIL AND GAS WASTE REPORT  
*The failure to safely manage oil and gas waste*  
[earthworks.org/wasted-in-TX](http://earthworks.org/wasted-in-TX)

# IMPORTING RADIOACTIVE WASTE

Companies are allowed to accept radioactive waste from overseas

On April 22nd, 2021 a year-long DeSmog investigation of Lotus, LLC, an oilfield waste facility in the west Texas desert, revealed that the company accepted 750 barrels of oilfield waste from Australia between May 2017 and November 2019. Not only has the RRC been aware, but files from the agency reveal that some of the Australian oil waste contained carcinogenic, radioactive radium at concentrations of 2,095 picocuries per gram, over 400 times the limits that U.S. Environmental Protection Agency (EPA) places on toxic Superfund sites and uranium mills for nuclear bomb fuel.<sup>18</sup>

An industry whistleblower shared photos with Earthworks from Lotus in 2015-2016 showing rusted and bent tanks marked as radioactive waste, some of them open to the elements –

rain, wind, etc. Aerial photography from April 2021 revealed that the waste is still stockpiled despite poor operations, including spills of radioactive material and at least two RRC inspectors' concerns regarding drinking water contamination.<sup>19</sup> In March 2021, an RRC inspection found "no violations."<sup>20</sup>

According to the DeSmog investigation, Lotus also imports oil gas waste from neighboring states like New Mexico, Oklahoma, and Louisiana, as well as states as far away as Alaska and Pennsylvania, and "virtually every major operator in the oil and gas industry has sent their waste to Lotus, including ExxonMobil, BP, Chevron, Occidental, Anadarko, ConocoPhillips, Chesapeake, as well as midstream companies like Kinder Morgan and ONEOK."



Photos sent to Earthworks in 2020 from an industry insider (who wishes to maintain anonymity) show the Lotus LLC oilfield waste facility, 19 miles west of Andrews, Texas, stockpiled with radioactive oilfield waste in rusted containers. A recent investigation revealed that RRC inspected the Lotus site in March 2021 and determined it is operating in compliance with state law.

Because radioactive materials present in oil and gas waste accumulate in the environment, limitations on individual loads or sites are not sufficient to protect public health from cumulative impacts. Therefore, Texas must prohibit the burial, release or dispersal of any oil and gas waste containing radioactive materials.

2

**Stop releasing radioactive materials into the environment via oil and gas waste:** Current disposal methods for oil and gas waste do not account for cumulative impacts of radioactive materials. Therefore, Texas must stop the burial and release of oil and gas waste in the environment by requiring comprehensive testing and treatment.



# Who's in Charge?

In Texas, regulation of the oil and gas industry's waste is shared between two state agencies: the Railroad Commission (RRC) and Commission on Environmental Quality (TCEQ). **Currently, Texas law prevents communities that are directly impacted by oil and gas operations from stopping harm before it occurs.**

## DESPITE RISKS Regulators are required to approve permits



When a massive oil and gas waste dump was proposed on the outskirts of the small, rural town of Nordheim, the community organized one of the first resistance campaigns against oil and gas activity in the Eagle Ford Shale region of southeast Texas.<sup>21</sup> At the time, Nordheim hadn't reaped the benefits of the shale oil boom but was slated to become its dumping ground. Because the facility was sited just outside city limits, the operator, San Antonio-based Petro Waste Environmental, did not have to share their plans directly with the community. Luckily, the town's mayor still read the newspaper and learned about the waste proposal there.

Over the course of three years, over 200 residents, including DeWitt County Judge Daryl Fowler and Republican State Representative Geanie Morrison, supported the community's opposition of the permit. Environmental scientist Wilma Subra<sup>22</sup> read the facility's plans and

told the media that "toxic heavy metals including arsenic, cadmium, lead and chromium" emitted from the facility would be carried off-site by the wind and "affect an area from five to seven miles away."<sup>23</sup>

In spite of overwhelming opposition by those most directly impacted, the Texas RRC unanimously approved the facility's permit in 2016. Despite voting to approve, RRC Commissioner Ryan Stitton stated, "I'll be candid — I don't like the site," adding that he had no choice but to approve the permit.<sup>24</sup> Regulators had determined that groundwater would likely be protected and could not weigh in on other matters, such as air pollution, truck traffic, or noise. In other words, under current Texas law, regulators are required to approve permits that meet current requirements, even when additional health and environmental risks remain.



## Local elected officials ARE POWERLESS



Just outside of Corpus Christi, residents of Orange Grove, Texas filed a lawsuit against Blackhorn Environmental claiming foul odors, health impacts and diminished quality of life since the company started operations in 2019 at its oil and gas waste facility just a few miles from Orange Grove High School.

In December 2020, an air pollution investigation by TCEQ found “offensive sour petroleum waste odors from Blackhorn Services Disposal Facility...in sufficient frequency, intensity, duration and offensiveness to interfere with normal use and enjoyment of property as well as adversely affect human health.”<sup>25</sup>

The disposal facility specializes in the handling of non-hazardous<sup>26</sup> oil and gas waste and serves the Eagle Ford, Texas Gulf Coast Southern Region, and users of the Port of Corpus Christi.

The RRC granted a permit to Blackhorn in 2015 to operate on 232 acres despite local opposition that included State Senator Juan “Chuy” Hinojosa (D-District 20), who told the media that he opposed the waste disposal facility on behalf of his constituents. But when it came time for RRC’s decision, “I was powerless to stop it once they satisfied all the criteria set forth by the Railroad Commission,” he said.<sup>27</sup>

Former Jim Wells County Commissioner Carlos “Coach” Gonzalez (D-Precinct 3) says he tried his

best as well. “It just seemed like as soon as everything went to Austin, we got lost in the shuffle, and no one listened to us,” said Gonzalez.<sup>28</sup>

On April 7, 2021, RRC sent Blackhorn a Notice of Violation letter stating that RRC “staff is unable to determine if all permit conditions have been met for the incoming waste streams.”<sup>29</sup> Despite this, RRC unanimously voted to approve a renewal of Blackhorn’s permit less than a week later, on April 13th. As if this wasn’t enough to upset locals, RRC Commissioner Jim Wright, who lives in Orange Grove, voted to approve the facility amidst continuing opposition from his own community. The same week, an investigative report from KRIS 6 NEWS uncovered that Wright is part owner of two companies that haul oil and gas waste, some of which is dumped at Blackhorn’s facility.<sup>30</sup>

There are many more communities in Texas living near toxic oil and gas waste operations, where polluters and the regulators who permit them still hold all final decision-making power. Residents and elected officials in San Augustine County are currently opposing a proposed 256.7-acre oil and gas waste facility, including San Augustine County Judge Jeff Boyd, the County Commissioners’ Court, State Senator Robert Nichols and State Representative Trent Ashby.<sup>31</sup>

Residents’ only recourse is private, out-of-pocket litigation after harm has already occurred, if they can afford legal services. This paradigm is undemocratic and discriminatory, not to mention environmentally unjust. That’s why the most important policy recommendation in this report is:

3

**Let communities protect themselves:** When a company wants to bring toxic material into a community, that community deserves the right to say ‘yes’ or ‘no’ to the risks that come with it, because forcing risk on communities without their consent is unjust. Texas law should require the Free Prior Informed Consent<sup>32</sup> of communities.



For now, approval of oil and gas operations in Texas lies solely in the hands of industry and state government, and knowing which agency regulates which parts of the industry's operations is challenging. For example, if a resident suspects their drinking water has been contaminated by oil and gas operations, they must contact the RRC if it's a private water supply, but they must call TCEQ if it's a public water supply.<sup>33</sup>

If residents have a complaint about a nearby facility, they must first determine which regulatory agency to call. While RRC permits cover the waste impacts to land and some water pollution, TCEQ manages complaints related to air quality. In general, the RRC manages most wastes from oil and gas operations, but TCEQ manages some as well. "Who manages what" is outlined in the table below:

WHO MANAGES WHAT?	
The RRC has jurisdiction over	
1	Hazardous and non-hazardous wastes associated with the exploration, development, or production of O&G
2	Injection wells to dispose of O&G wastes
3	Naturally Occurring Radioactive Material waste from O&G activities (Oil and Gas NORM)
4	Wastes from transportation by pipeline and storage of crude oil (including tank bottoms) before it enters a refinery
5	Wastes from the transportation of natural gas by pipeline prior to use in the manufacturing process or residential/industrial use
6	Non-hazardous wastes from natural gas processing plants
7	Wastes such as vacuum truck rinsate and tank rinsate generated at facilities operated by oil and gas waste haulers permitted by the RRC
For more information on RRC regulated waste, call 877-228-5740.	
The TCEQ has jurisdiction over	
1	Waste associated with transportation of crude oil and natural gas by railcar, truck, barge, or oil tanker and refined petroleum products by pipeline
2	Wastes generated at oil field service facilities that provide equipment, materials, or services to the O&G industry
3	Wastes from O&G activities that are processed, treated, or disposed of at a solid waste management facility authorized by the TCEQ
4	Residential-like waste generated from the living quarters located on the lease
For more information on TCEQ regulated waste, call 512-239-6412.	

Source: TCEQ Fact Sheet, "Who Regulates Oil and Gas Activities in Texas?"



Until recently, the federal government had shared oversight of oil and gas wastewater discharges to land and rivers along with the Texas Railroad Commission. But in January 2021, the U.S. EPA backed away from managing these discharges, granting sole regulatory authority to TCEQ. Five days after EPA granted TCEQ its authority, the agency advertised it was “ready to receive and process individual permit applications from oil and gas facilities” that want to treat waste and put it in waterways or on land.<sup>34</sup> Industry, and some legislators,<sup>35</sup> hope that treating oil and gas waste can create a viable source of water in water-scarce regions, but experts warn against it due to problems, including the ones in the following table.

DANGERS OF DISCHARGING “TREATED” OIL AND GAS WASTEWATER	
The Problem	The Solution
We don’t know everything that is in the industry’s wastewater, often called “produced water,” because operators are allowed to keep the chemicals they use a “trade secret.” This chemical cocktail ends up in wastewater and makes it impossible to guarantee adequate treatment before spreading the waste through the environment.	Require oil and gas companies to disclose the specific chemicals and the concentrations they use in their operations. This way, regulators and the public will know exactly what must be tested for to see whether wastewater treatment is working.
Existing standards used to measure whether treated waste is safe for discharge are grossly inadequate. For many toxic materials that could be in waste, there is no standard at all.	After the state requires companies to disclose all chemicals and concentrations used by companies, standards for treatment of waste for discharge into the environment must include limits for all chemicals present in order to prevent pollution.

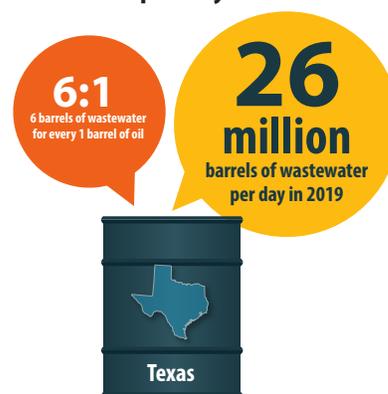
## Volumes of Oil and Gas Waste

Every oil and gas well produces waste, and in Texas, the total volume of all oil and gas wastes generated is unknown. While the volumes of some solid wastes are reported, the RRC was not able to provide total volumes and directed Earthworks to submit an Open Records Request for individual permits, wherein volumes are reported. That kind of data analysis takes a lot of time for the public to gather, however, and it would be far more transparent and facilitate the public’s oversight of public agencies for the RRC to require digital reporting that aggregated that data for industry, the agency, and the public.

As for liquid waste, an average of six barrels of wastewater is produced for every barrel of oil.<sup>36</sup> In fact, before the price of oil fell in March 2020, Texas wells produced more than 26 million barrels of wastewater every single day.<sup>37</sup>

In the nine years between January 2012 and December 2020, over 676 million barrels of fracking flowback waste was injected into underground disposal wells in Texas. Additionally, over 73 billion barrels of “salt water” or produced wastewater and 7.9 million barrels of liquid, radioactive waste was also injected underground.<sup>38</sup>

**In 2019 Texas produced more than 26 million barrels of wastewater per day.**

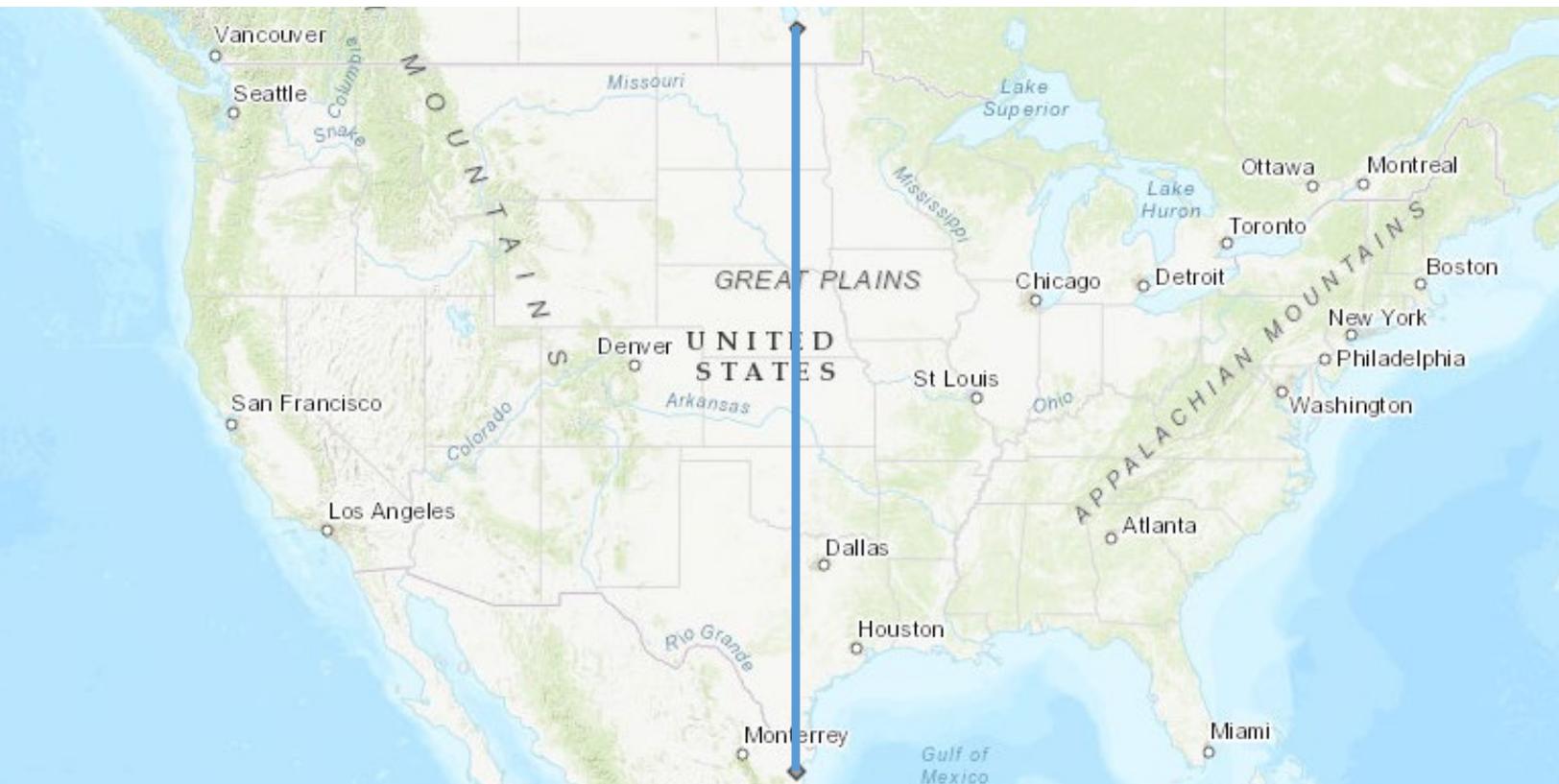


# What Happens to Oil and Gas Waste?

Texas is home to hundreds of waste facilities that are needed to manage the enormous amounts of waste generated by the oil and gas exploration and production sector. It's also home to tens of thousands of injection wells and waste pits. Oil and gas waste is also spread over leased land, discharged into rivers, and taken to municipal landfills or commercial waste disposal facilities.

Cutting through the heart of Texas, just west of Austin, is the 98th meridian — a longitudinal line used by federal and state environmental regulators to delineate between where oil and gas wastewater called “produced water” can be discharged to land and waterways and where it cannot. East of 98° longitude, companies are prohibited from dumping produced water into rivers or onto croplands, but west of the 98th the practice is still permitted under certain criteria.<sup>39</sup> But these criteria do not account for all of the toxic materials that can be present in wastewater. This automatically creates environmental inequity in Texas, where communities and ecosystems west of the 98th meridian are more susceptible to potential exposures to toxic materials in dispersed oil and gas waste.

The blue line is the 98th meridian, west of which oil and gas companies are permitted to discharge wastewater called “produced water” that meets certain criteria into rivers or over land for agricultural purposes. Source: U.S. EPA<sup>40</sup>



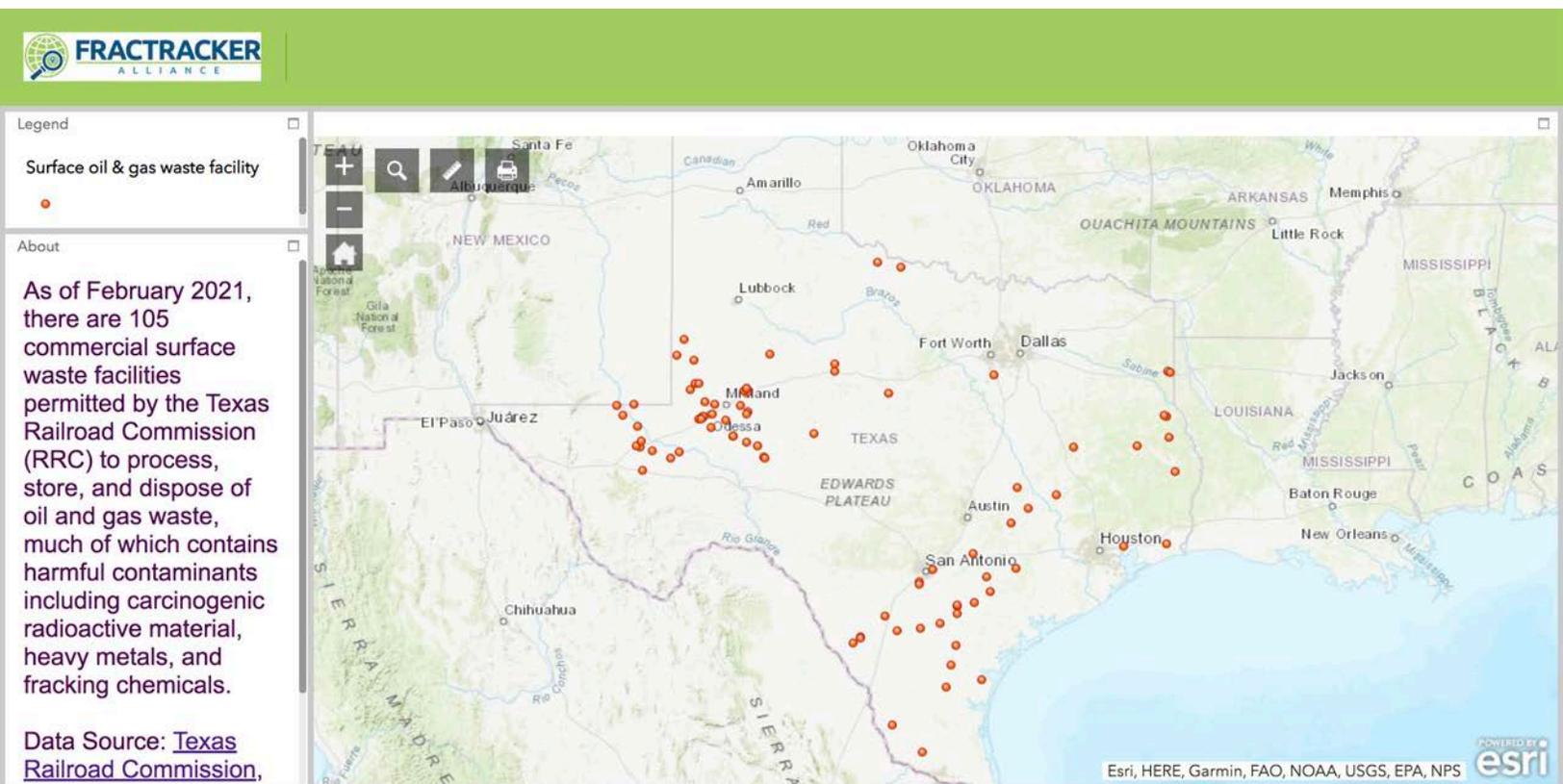
## Commercial Surface Waste Management Facilities

Commercial waste disposal facilities are owned and operated by a third party as a stand-alone business that services oil and gas operations for profit, as opposed to a waste facility managed by an operator to serve its own wells. There are 105 commercial oil and gas surface waste facilities permitted by the Railroad Commission of Texas.<sup>41</sup> In Texas, these facilities can include reclamation plants, waste separation facilities, disposal pits, land farms, land treatment facilities, recycling facilities, and other waste disposal facilities.

Waste separation facilities separate oil and gas waste into liquids and solids, and the components are then disposed of separately.<sup>42</sup> Commercial recycling facilities process drilling fluids and muds for reuse in other wells. Drill cuttings can be recycled as road building material,<sup>43</sup> and reclamation plants process tank bottoms to extract remaining crude oil.<sup>44</sup>

A commercial site may have more than one type of facility. Depending on the permits for each site, the waste types they accept can include tank bottoms, drilling mud or other drilling fluids, drill cuttings, reserve pit water, fracking flowback, contaminated soils, other wastes contaminated with reclaimable crude oil, pit liners, produced water, or residual solids. In addition to fixed locations, there are eight mobile recycling and disposal facilities that accept drilling fluids and drill cuttings and process them for reuse.<sup>45</sup>

Earthworks partnered with FracTracker Alliance to map RRC permitted surface waste facilities handling oil and gas waste in Texas. These are only some of the facilities handling oil and gas waste in the state — others not mapped here include municipal landfills and injection wells. This online, interactive map displays location, name of surface waste facility operator, facility phone number, types of waste handled, and a link to the detailed permit. [Visit map here.](#)



## Landfills

There are several landfills permitted by the RRC to accept oil and gas waste as well. The landfills may have pits, injections wells, and/or other waste disposal methods in addition to landfill operations. Municipal landfills managed by TCEQ are also permitted to accept oil and gas wastes.

## Pits

In Texas, some wastes may be disposed of by burial on the well pad or other surface areas that are covered by an oil and gas lease,<sup>46</sup> including some used drilling fluids, drill cuttings, sands, dewatered spent completion fluids, workover waste, and other wastes. Texas rules authorize 16 different kinds of pits for use in the oil and gas production sector, including sediment pits, drilling fluid disposal pits, completion/workover pits, flare pits, saltwater disposal pits, and more. Each pit type can have different requirements for liners, with some pits not requiring any liner at all.<sup>47</sup> This creates the risk of groundwater contamination from leaking pits.

In May 2020, the RRC suspended pit remediation and other oil and gas rules to help industry during a crash in oil prices and the global COVID-19 pandemic.<sup>48</sup> Public Citizen and two landowners sued, and in December 2020, a state judge barred RRC from waiving these environmental rules.<sup>49</sup>

## Land Application

So-called “land application” or land spreading of oil and gas waste can involve spraying or spreading wastewater or solid waste on the ground as a form of permanent disposal. This presents risks to groundwater, surface water, and air quality. The waste can seep into the ground, run off into a stream or river, and be blown into the air as dirt dries and becomes dust.

In Texas, operators can also use oil and gas waste to build well pads and lease roads. Other forms of land application permitted in Texas include landfarming, land treatment, and sprinklers or other forms of irrigation. Landfarming of drill cuttings and water-based drilling fluids is even allowed on a lease site without a permit if the surface owner has provided written consent. However, the consent of neighbors who may be impacted by waste spreading is not required.



Texas rules authorize 16 different kinds of pits for use in oil and gas production.



## Surface Water Discharge

Oil and gas operators are permitted to discharge wastewater into both onshore and offshore surface waters in Texas, subject to state or federal permits.

Offshore discharges are allowed in three areas of the Gulf of Mexico: the Outer Continental Shelf (OCS), state territorial seas, and coastal waters. There is a prohibition on discharging any waste into bays, estuaries, or tidal areas.<sup>50</sup> The federal government has issued general permits for each of these three offshore areas.<sup>51</sup> Offshore oil and gas companies in the OCS are permitted to discharge drilling fluids, drill cuttings, and liquid wastes like produced water that contain chemicals used for fracking and other well operations. It sets standards for monitoring and testing the wastewater being discharged for toxicity and establishes limits for allowable discharges, but only for certain contaminants. For example, there are no limits on radioactive material that can be discharged.<sup>52</sup>

Companies drilling in territorial seas can obtain permits to discharge produced water, treatment fluids, completion fluids, and workover fluids, with limited restrictions on toxicity.<sup>53</sup> It prohibits discharges of drilling fluids or drill cuttings except for de minimis discharges such as minor drips and splatters.

Onshore, the RRC has issued dozens of permits to discharge into multiple surface waters of the state, including the Atascosa River, Goose Creek, Pin Oak Creek, Buckners Creek, and more.

**Oil and gas operators are permitted to discharge wastewater into both onshore and offshore surface waters in Texas.**



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## Underground Injection

Oil and gas wastewater can be injected underground in three primary ways: in an Underground Injection Control (UIC) disposal well; in an enhanced oil recovery (EOR) well, also permitted under UIC, where wastewater is used to increase formation pressure and oil production; or in a well being fracked, where wastewater is mixed with fracking fluid. The first two categories are regulated under the Safe Drinking Water Act's Underground Injection Control (UIC) program, where they are considered Class II wells.

As of July, 2015, Texas had approximately 34,200 active oil and gas UIC wells, including about 8,100 disposal wells and about 26,100 EOR wells.<sup>54</sup> The RRC does not have updated total numbers available on its website, only a database with county by county numbers.<sup>55</sup>

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**The underground injection of oil and gas waste poses two major threats —  
groundwater contamination and seismic activity.**

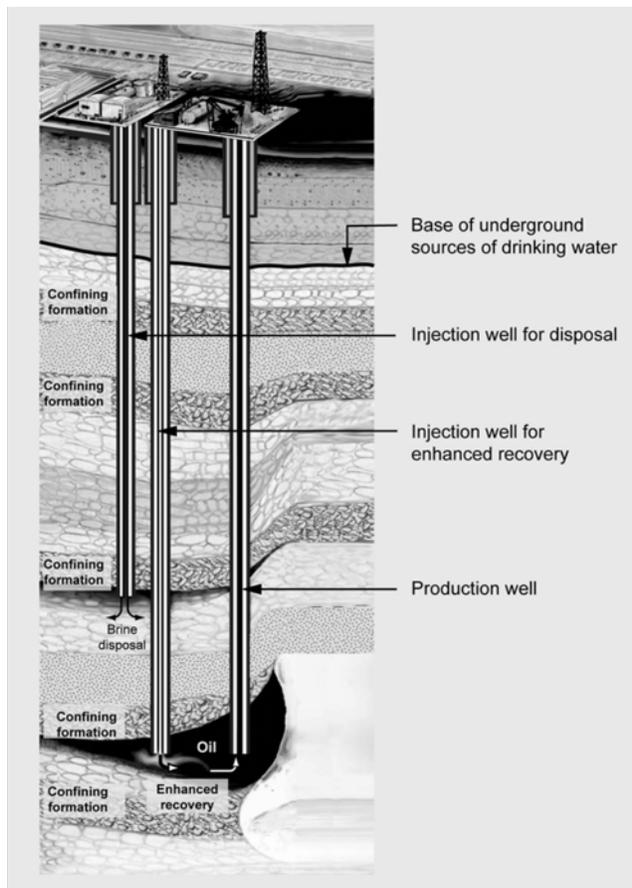
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## Aquifer Exemptions for Waste Injection

Federal regulations allow certain aquifers to be removed from protections under the Safe Drinking Water Act, based on claims that these aquifers cannot provide the quality or quantity of water that is necessary to make them a viable source of drinking water. Through this process, the EPA has exempted thousands of aquifers across the country from protection. Once these aquifers are used for oil and gas waste disposal, they can never be used for drinking water or agricultural uses. There are 2,815 exempt groundwater aquifers in Texas, more than any other state in the country.<sup>56</sup>

**In Texas, 2,815 groundwater aquifers are exempt from protection in order to inject oil and gas waste.**

At right, an injection well, drawing by EPA, 2012.

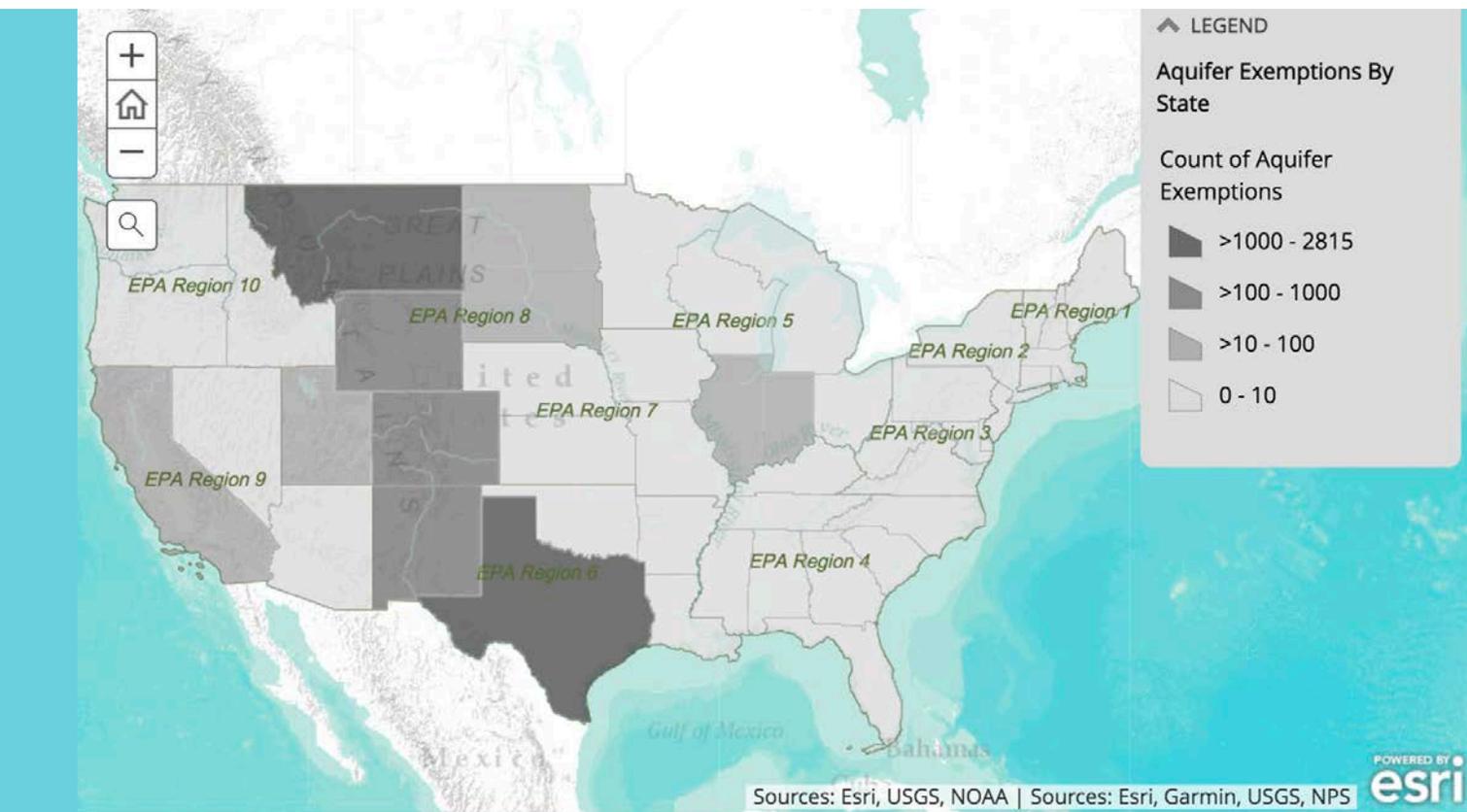


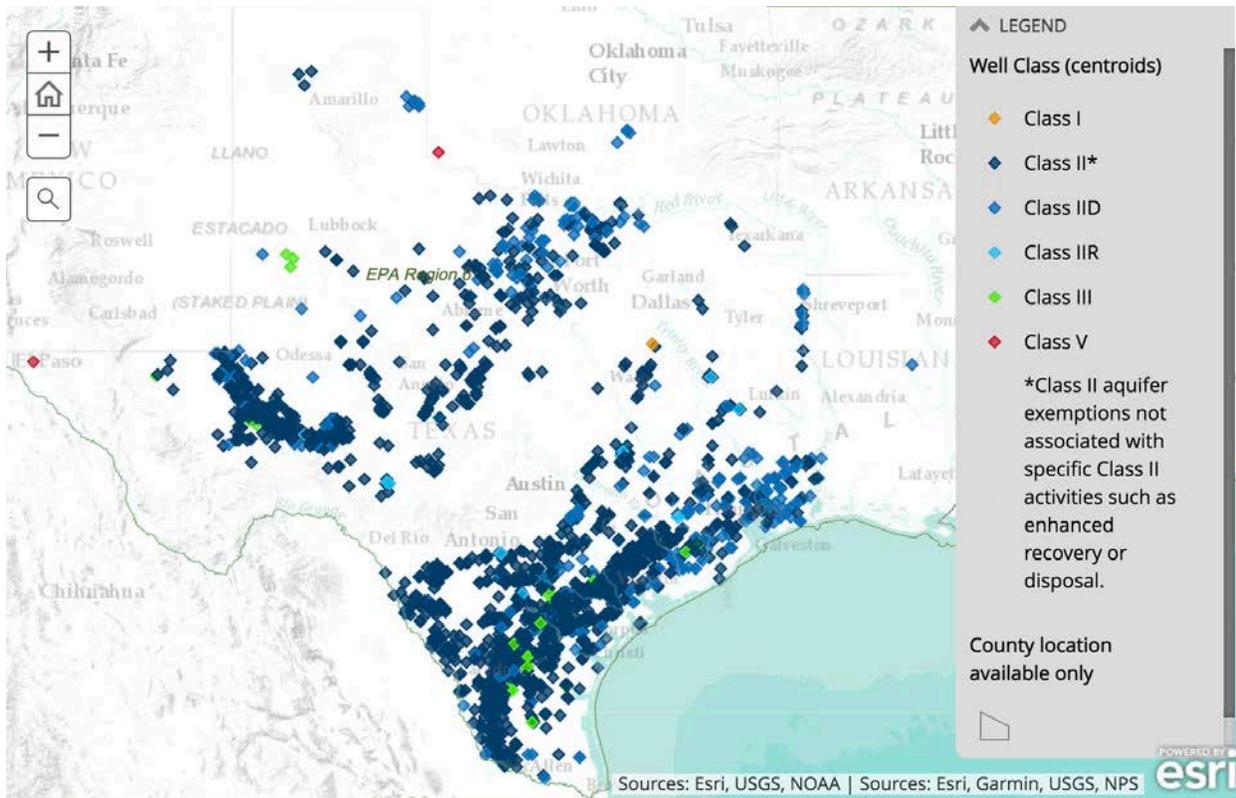
In Texas, underground injection wells are regulated by the RRC. A 2016 investigation by Clean Water Action concluded that the RRC had not upheld its obligations under the Safe Drinking Water Act.<sup>58</sup> RRC did not know exactly where oil and gas operators have been injecting wastewater into aquifers that could potentially serve as sources of drinking water.<sup>59</sup> In 2017, a report submitted by the RRC to the EPA identified 54 instances in which the RRC allowed oil and gas wastewater to be injected into underground sources of drinking water without the required approval by EPA.<sup>60</sup>

Whether aquifers are exempted or not, all injection wells pose a risk of groundwater contamination. In West Virginia, the United States Geological Survey (USGS) discovered contaminants from an unconventional oil and gas waste injection well in nearby streams and sediments.<sup>61</sup> Furthermore, in a 2014 report on the federal UIC program, the U.S. Government Accountability Office (GAO) concluded that the safeguards many states currently have in place to protect groundwater “do not address emerging underground injection risks, such as seismic activity and overly high pressure in geologic formations leading to surface outbreaks of fluids.”<sup>62</sup>

**The RRC has allowed oil and gas wastewater to be injected into underground sources of drinking water without the required approval of the EPA.**

Groundwater aquifers exempt by U.S. EPA for injection of oil and gas liquids. Texas has 2,815 exemptions, more than any other state. Source: U.S. EPA Aquifer Exemptions Map.<sup>57</sup>





Map of groundwater aquifers exempt from protective law to allow for injection of toxic oil and gas waste fluids. Source: U.S. EPA Aquifer Exemptions Map.<sup>68</sup>

## Seismic Activity from Waste Injection

Increases in earthquakes across Texas have been linked to oil and gas waste disposal. A community in the Barnett shale area was reported to have experienced at least 27 earthquakes in the three months from November 2013 to January 2014.<sup>63</sup> A paper published in 2017 found that the rate of earthquakes in Texas with a greater than 3.0 magnitude had increased between 2008 and 2016 from two to twelve per year—a 600 percent increase. The greatest increase was in areas with unconventional oil and gas development and the total number of earthquakes in the Barnett shale area alone was more than 200 in this nine-year period, with at least 32 of them having a magnitude greater than 3.0. They concluded that this dramatic increase was not natural, but rather caused by injection of oil and gas wastewater for disposal.<sup>64</sup>

In 2018, researchers confirmed these findings after investigating induced seismicity caused by underground injection in unconventional oil formations in five states, including the Permian Basin and Eagle Ford shale regions of Texas. The scientists concluded that 20 percent of underground injection wells in the Eagle Ford shale are potentially associated with earthquakes.<sup>65</sup> Also in 2018, it was reported that earthquakes measuring at least 2.5 in the Permian Basin have tripled to more than sixty a year.<sup>66</sup>



## Conclusion

Texas plans to expand oil and methane gas production well into the future despite the escalating harms it causes the people, water, air, and land of Texas as well as the global climate. Preventing industrial harm requires us to deal with long standing power dynamics that allow environmental injustice to persist. The harms faced by frontline communities can be mitigated by shifting power to those who bear the brunt of pollution. Meanwhile, Texas can create immediate improvements in public and environmental health by reducing oil and gas waste pollution in the following ways:

## Recommendations

- Because of lax rules and enforcement, the oil and gas industry and regulatory agencies continue to perpetuate the environmental and human harms associated with waste disposal in Texas. **State agencies should stop permitting oil and gas operations that send waste to facilities that harm human health and the environment, and waste facilities should not be permitted until protections and oversight are in place to prevent harm.**
- Oil and gas operations are inherently toxic, and no one should be forced to assume the risks of toxic exposure without their consent. **Therefore, regulators in Texas should require Free Prior Informed Consent<sup>67</sup> that gives communities and residents decision-making authority in the permitting decisions that affect them.**
- Oil and gas waste can contain hazardous materials. **Therefore, the Texas legislature should remove the exemption for the oil and gas industry from hazardous waste regulations.**
- Current disposal methods for oil and gas waste do not account for the cumulative impact of radioactive materials. **Therefore, Texas should stop releasing radioactive materials in oil and gas waste into the environment by prohibiting on-site pit burial and discharges to land or water.**
- Oil and gas companies are exempt from disclosing the chemicals they use in their operations, which end up in their waste. When waste spills and leaks, or is treated for discharge into the environment, full knowledge of its contents is necessary to ensure it's properly handled. **Therefore, Texas should require full disclosure of the types and concentrations of chemical additives used in all oil and gas operations.**
- Given the lack of chemical disclosure, new analytical methods, new rules, and strict oversight, current wastewater treatment methods cannot guarantee the safety of oil and gas wastewater for discharge into waterways or to irrigate land. **Therefore, Texas should prohibit the dispersal of wastewater into the environment.**



# Endnotes

- 1 U.S. Energy Information Administration, "Crude Oil Production," available at: [https://www.eia.gov/dnav/pet/pet\\_crd\\_crpdn\\_adc\\_mbb1\\_m.htm](https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbb1_m.htm)
- 2 Railroad Commission of Texas, Summary of Drilling, Completion and Plugging Reports Processed For 2019, available at: <https://stage.rrc.texas.gov/media/55754/annual-2019-drilling-permits-completions.pdf>
- 3 Texas Almanac, History of Oil Discoveries in Texas, available at: <https://texasalmanac.com/topics/business/history-oil-discoveries-texas>
- 4 U.S. Energy Information Administration, "Crude Oil Production," available at: [https://www.eia.gov/dnav/pet/pet\\_crd\\_crpdn\\_adc\\_mbb1\\_m.htm](https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbb1_m.htm)
- 5 Railroad Commission of Texas, Summary of Drilling, Completion and Plugging Reports Processed For 2019, available at: <https://stage.rrc.state.tx.us/media/55754/annual-2019-drilling-permits-completions.pdf>
- 6 Railroad Commission of Texas, Wells Monitored by the Railroad Commission, As of September 30, 2020, available at: <https://www.rrc.state.tx.us/media/5buftq4u/wells-monitored-february-2021.pdf>
- 7 U.S. Energy Information Administration, Drilling Productivity Report, February 16, 2021: <https://www.eia.gov/petroleum/drilling/>
- 8 Railroad Commission of Texas, Oil and Gas Division, "Notice to oil and gas operators: Temporary Suspension of Maximum Daily Injection Rate Permit Conditions." February 18th, 2021.
- 9 Forthcoming, Oil Change International, June 2021, [www.priceofoil.org](http://www.priceofoil.org).
- 10 53 Federal Register §25448.
- 11 US EPA, Regulatory Determination for Oil and Gas and Geothermal Exploration, Development, and Production Wastes. 53 FR 25447, 1988. US EPA, Regulatory Determination for Oil and Gas and Geothermal Exploration, Development, and Production Wastes. 53 FR 25447, 1988. "The Agency found that organic pollutants at levels of potential concern (levels that exceed 100 times EPA's health-based standards) included the hydrocarbons benzene and phenanthrene. Inorganic constituents at levels of potential concern included lead, arsenic, barium, antimony, fluoride, and uranium. [p. 9]"
- 12 TCEQ Regulatory Guidance, Waste Permits Division: "Disposal of Special Wastes Associated with the Development of Oil, Gas, and Geothermal Resources," September 2006. Accessed online March 9, 2021: [https://www.tceq.texas.gov/assets/public/comm\\_exec/pubs/rg/rg-003.pdf](https://www.tceq.texas.gov/assets/public/comm_exec/pubs/rg/rg-003.pdf)
- 13 Railroad Commission of Texas (RRC) Table 2, Land Application Permit for Produced Water or Gas Plant Effluent Water: Analysis Required for Permit Application. Accessed online March 4, 2021: [https://www.rrc.state.tx.us/media/bc2loals/table2-landapply\\_analyses.pdf](https://www.rrc.state.tx.us/media/bc2loals/table2-landapply_analyses.pdf)
- 14 Justin Nobel, "America's Radioactive Secret." *Rolling Stone*, January 21, 2020. Available at <https://www.rollingstone.com/politics/politics-features/oil-gas-fracking-radioactive-investigation-937389/>
- 15 "An Analysis for the Impact of the Regulation of 'Radio-nuclides' as a Hazardous Air Pollutant on the Petroleum Industry," Prepared for the Committee for Environmental Biology and Community Health, Department of Medicine and Biology, American Petroleum Institute, October 19, 1982.
- 16 Railroad Commission of Texas (RRC) Table 2, Land Application Permit for Produced Water or Gas Plant Effluent Water: Analysis Required for Permit Application. Accessed online March 4, 2021: [https://www.rrc.state.tx.us/media/bc2loals/table2-landapply\\_analyses.pdf](https://www.rrc.state.tx.us/media/bc2loals/table2-landapply_analyses.pdf)
- 17 Railroad Commission of Texas, "NORM (Naturally Occurring Radioactive Material)" website, accessed March 4, 2021: <https://www.rrc.texas.gov/oil-and-gas/applications-and-permits/environmental-permit-types/norm-waste/>
- 18 Justin Nobel, "Where Does All The Radioactive Waste Go?" *DeSmog*, April 22, 2021.
- 19 Ibid.
- 20 Railroad Commission of Texas Online Inspection Lookup (RRC OIL), accessed April 22, 2021.
- 21 Jim Malewitz, "Eagle Ford Town's Residents Disgusted by Waste Site's Approval," *The Texas Tribune*, May 3, 2016.
- 22 Wilma Subra is also on the Board of Directors at Earthworks.
- 23 Julie Dermansky, "Nordheim: A Texas Town Facing A Toxic Future," *DeSmog Blog*, January 30, 2014.
- 24 Jim Malewitz, "Eagle Ford Town's Residents Disgusted by Waste Site's Approval," *The Texas Tribune*, May 3, 2016.
- 25 Robin Bradshaw, "TCEQ investigates Blackhorn Environmental Services in Orange Grove," *Alice Echo-News Journal*, December 1, 2020.
- 26 Oil and gas waste is exempt from hazardous waste law at the federal and state level, even though it can contain hazardous materials. See section of this report on Hazardous Waste.
- 27 Matt Stevens, "Residents near waste disposal facility fight permit renewal, company says it follows rules," *Caller Times*, February, 18, 2021.
- 28 Ibid.
- 29 Notice of Violation letter to Blackhorn Environmental from Railroad Commission of Texas Oil and Gas Division, April 7, 2021
- 30 Matt Stevens, "6 Investigates: Blackhorn Environmental receives permit renewal from Railroad Commission," KRIS 6 NEWS Corpus Christi, April 13, 2021.
- 31 Jeremy Thomas, "San Augustine Co. residents voice concerns over proposed oil and gas waste disposal site," KTRC Channel 9, MSN.com, December 23, 2020.
- 32 United Nations Food and Agricultural Organization of the United Nations, Free Prior and Informed Consent: An indigenous peoples' right and a good practice for local communities – Manual for Project Practitioners, 2016. Available online: <http://www.fao.org/3/i6190e/i6190e.pdf>



- 33 TCEQ Fact Sheet “Who Regulates Oil and Gas Activities in Texas?” Accessed online Feb. 4, 2021: [https://www.tceq.texas.gov/assets/public/assistance/sblga/oil-gas/state-wide\\_oilgas\\_prog\\_info.pdf](https://www.tceq.texas.gov/assets/public/assistance/sblga/oil-gas/state-wide_oilgas_prog_info.pdf)
- 34 Texas Commission on Environmental Quality, “TCEQ Now Accepting Permit Applications for Wastewater Discharge from Oil and Gas Facilities,” January 20, 2021.
- 35 Mella McEwen, “State senator calls for conversation about produced water,” *Midland-Reporter Telegram*, February 19, 2020.
- 36 Erin Douglas, “Lawmakers to weigh whether wastewater from oil fields could replenish the state’s aquifers.” *Green Source DFW*, January 21, 2021.
- 37 Ibid.
- 38 Texas Railroad Commission Online H10 Filing System Database, accessed March 4, 2021: <http://webapps.rrc.state.tx.us/H10/h10PublicMain.do>
- 39 U.S. Environmental Protection Agency, “Summary of Input on Oil and Gas Extraction Wastewater Management Practices Under the Clean Water Act,” May 2020.
- 40 Ibid, pg. 15.
- 41 RRC, Commercial Recycling & Surface Disposal Facilities, available at: <https://www.rrc.state.tx.us/oil-and-gas/applications-and-permits/environmental-permit-types/commercial-surface-waste-facilities/commercial-recycling-disposal-permits-list/>
- 42 RRC, Waste Separation Facilities, available at: <https://stage.rrc.state.tx.us/oil-gas/applications-and-permits/environmental-permit-types-information/waste-separation-facilities>
- 43 RRC, Recycling, available at: <https://stage.rrc.state.tx.us/oil-gas/applications-and-permits/environmental-permit-types-information/recycling/>
- 44 RRC, Reclamation Plants, available at: <https://stage.rrc.state.tx.us/oil-gas/applications-and-permits/environmental-permit-types-information/reclamation-plants>
- 45 Railroad Commission of Texas, Commercial Recycling & Surface Disposal Facilities, available at: <https://stage.rrc.texas.gov/oil-gas/applications-and-permits/environmental-permit-types-information/commercial-surface-waste-facilities/commercial-recyclingdisposal-permits-list/>
- 46 16 TAC 3.8(d)(3); See also TRRC, Summary of Statewide Rule 8, available at: <https://stage.rrc.state.tx.us/oil-gas/applications-and-permits/environmental-permit-types-information/swr8-summary/#a-c>
- 47 RRC, Pits, available at: <https://stage.rrc.state.tx.us/oil-gas/applications-and-permits/environmental-permit-types-information/pits/>
- 48 RRC. May 5, 2020. Notice to Operators — Temporary Exceptions to Certain Administrative Rules. [http://rrc.state.tx.us/media/lcblubg5/notice-to-operators\\_05-05-2020.pdf](http://rrc.state.tx.us/media/lcblubg5/notice-to-operators_05-05-2020.pdf)
- 49 Kevin Crowley & Sergio Chapa, “Texas Railroad Commission barred from waiving environmental rules,” *Bloomberg*, December 11, 2020.
- 50 TRRC, Discharges, available at: <https://stage.rrc.state.tx.us/oil-gas/applications-and-permits/environmental-permit-types-information/discharges/>
- 51 US EPA, Western and Central Gulf of Mexico Offshore Oil & Gas NPDES Program, available at: <https://www.epa.gov/npdes-permits/western-and-central-gulf-mexico-offshore-oil-gas-npdes-program>
- 52 US EPA, The NPDES General Permit for New and Existing Sources and New Discharges in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000), September 19, 2017, available at: [https://www.epa.gov/sites/production/files/2017-09/documents/2017\\_final\\_gp\\_for\\_fr\\_091817.pdf](https://www.epa.gov/sites/production/files/2017-09/documents/2017_final_gp_for_fr_091817.pdf)
- 53 US EPA, General Permit for Discharges from the Oil and Gas Extraction Point Source to the Territorial Seas of Texas (Permit No. TXG260000), February 15, 2012.
- 54 TRRC, Injection and Disposal Wells, available at: <https://stage.rrc.state.tx.us/about-us/resource-center/faqs/oil-gas-faqs/faq-injection-and-disposal-wells/>
- 55 TRRC, Electronic Document Management System, available at: <https://stage.rrc.texas.gov/about-us/resource-center/research/online-research-queries/about-edms/>
- 56 US EPA Aquifer Exemptions Map, Accessed March 3, 2021 online at <https://www.epa.gov/uic/aquifer-exemptions-map>
- 57 U.S. EPA Underground Injection Control (UIC) Aquifer Exemptions Map. Accessed online January 20, 2021: [https://www.epa.gov/uic/aquifer-exemptions-map#Inter\\_AEMap](https://www.epa.gov/uic/aquifer-exemptions-map#Inter_AEMap)
- 58 Clean Water Action, Texas Aquifer Exemptions, August 25, 2016, available at: <https://cleanwateraction.org/publications/texas-aquifer-exemptions>
- 59 Malewitz, Jim, “Texas Promised to Track Oilfield Waste in Aquifers. It Didn’t,” *The Texas Tribune*, August 24, 2016, available at: <https://www.texastribune.org/2016/08/24/texas-promised-34-years-ago-track-oilfield-waste-a/>
- 60 Clean Water Action, State of Texas Aquifer Exemption Project—Report by Texas Railroad Commission, March 19, 2018, available at: <https://cleanwateraction.org/publications/state-texas-aquifer-exemption-project-report-texas-railroad-commission>
- 61 Akob, D.M., et al., “Wastewater Disposal from Unconventional Oil and Gas Development Degrades Stream Quality at a West Virginia Injection Facility,” *Environmental Science Technology*, (2016), 50 (11), 5517-5525.
- 62 GAO. EPA Program to Protect Underground Sources from Injection of Fluids Associated with Oil and Gas Production Needs Improvement. 2014.
- 63 Druzin, Rye, “UT: Oil and gas water disposal linked to more earthquakes,” *Houston Chronicle*, November 13, 2018, available at: <https://www.chron.com/business/energy/article/UT-Oil-and-gas-water-disposal-linked-to-more-13383913.php>
- 64 Magnani, M. B., Blanpied, M. L., DeShon, H. R., and Hornbach, M. J., “Discriminating between natural versus induced seismicity from long-term deformation history of intraplate faults,” *Science Advances*, November 24, 2017, DOI: 10.1126/sciadv.1701593. See also: Guarino, Ben, “Oil and gas industry is causing Texas earthquakes, a ‘landmark’ study suggests,” *The Washington Post*, November 24, 2017, available at: [https://www.washingtonpost.com/news/science/wp/2017/11/24/fracking-and-other-human-activities-are-causing-texas-earthquakes-study-suggests/?utm\\_term=.9b5039e23da4](https://www.washingtonpost.com/news/science/wp/2017/11/24/fracking-and-other-human-activities-are-causing-texas-earthquakes-study-suggests/?utm_term=.9b5039e23da4)



- 65 *Science Daily*, "Where water goes after fracking is tied to earthquake risk," November 1, 2018, available at: <https://www.sciencedaily.com/releases/2018/11/181101133823.htm>
- 66 Collins, Ryan and David Wethe, "Earthquakes in heart of Texas Oil Country Spur Water Crackdown," Bloomberg, December 5, 2018, available at: <https://www.bloomberg.com/news/articles/2018-12-05/earthquakes-in-heart-of-texas-oil-country-spur-water-crackdown>
- 67 United Nations Food and Agricultural Organization of the United Nations, Free Prior and Informed Consent: An indigenous peoples' right and a good practice for local communities—Manual for Project Practitioners, 2016. Available online: <http://www.fao.org/3/i6190e/i6190e.pdf>
- 68 U.S. EPA Underground Injection Control (UIC) Aquifer Exemptions Map. Accessed online January 20, 2021: [https://www.epa.gov/uic/aquifer-exemptions-map#Inter\\_AEMap](https://www.epa.gov/uic/aquifer-exemptions-map#Inter_AEMap)

