

Health worries pervade North Texas fracking zone



Taylor Ishee with mother Anita Ishee at the Baylor T. Boone Pickens Cancer Hospital in Dallas in October as he recovered from an infection. His cancer is in remission, but its ripple effects continue to haunt him. Jamie Smith Hopkins/Center for Public Integrity

By Jamie Smith Hopkins, The Center for Public Integrity

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<http://www.publicintegrity.org/2014/12/11/16396/health-worries-pervade-north-texas-fracking-zone>

<http://insideclimatenews.org/news/20141211/health-worries-pervade-north-texas-fracking-zone>

DALLAS—Propped up on a hospital bed, Taylor Ishee listened as his mother shared a conviction that choked her up. His rare cancer had a cause, she believes, and it wasn't genetics.

Others in Texas have drawn the same conclusions about their confounding illnesses. Jana DeGrand, who suffered a heart attack and needed both her gallbladder and her appendix removed. Rebecca Williams, fighting off unexplained rashes, sharp headaches and repeated bouts of pneumonia. Maile Bush, who needed surgery for a sinus infection four rounds of antibiotics couldn't heal. Annette Wilkes, whose own severe sinus infections were followed by two autoimmune diseases.

They all lived for years atop the gas-rich [Barnett Shale in North Texas](#), birthplace of [modern hydraulic fracturing](#). And they all believe exposure to natural gas development triggered their health problems.

“I’ve been trying to sell my house,” said Williams, a registered nurse, “because I’ve got to get out of here or I’m going to die.”

Texas regulators and politicians have shrugged off such complaints for years. The leap from suspected environmental exposure to definitive proof of harm is a difficult one, and they insist they’ve found no cause for concern. Officials in other states have said the same thing as hydraulic fracturing — known as fracking — moved beyond Texas and opened up lucrative oil and gas deposits across the country.

But scientific research — coming out now after years of sparse information — [suggests that proximity could pose risks](#).

Measurements taken near sites that residents identified as problematic in five states [found spikes in air toxics such as benzene](#), which can cause leukemia. A [Colorado study](#) found more babies born with congenital heart defects in gas-well-intensive areas than in places without wells. [Yale University researchers surveying Pennsylvania residents](#) — without mentioning gas — determined that those living close to wells were significantly more likely to report having skin and upper-respiratory problems than those farther away. This year a 16-university group [recommended substantially more research](#) given the potential problems.

Dr. Anne C. Epstein, an internal medicine specialist who sits on the Lubbock, Texas, Board of Health, reviewed the research herself and saw it as a call to action.

“I think the level of evidence that we currently have is enough to invoke the precautionary principal and take precautions to protect the public who live close to oil and gas development against the potential health effects of toxic exposure,” said Epstein, whose city sits at the edge of another Texas shale play, the Permian Basin. “I think it’s enough right now.”

The Barnett boom kicked off about 15 years ago, the early wave of a new phenomenon: Millions of Americans, rather than a relative handful in remote places, living amid the work of getting oil and gas out of the ground. Fracking — pumping water, sand and chemicals into the ground to shake loose gas and oil — kick-started the shale boom that brought drilling into urban and suburban places.

Sick in the Barnett Shale

By Eleanor Bell December 11, 2014

Registered nurse Rebecca Williams talks about the health issues she has witnessed in those living alongside gas wells and compressor stations in Azle, Texas.



That makes the Barnett region a laboratory of sorts, the longest-running experiment about what it means for people when fracked wells and their associated equipment move into neighborhoods on a large scale. The sorts of complaints first raised here are being echoed in the newer [Eagle Ford Shale play](#) in South Texas, where drilling has soared the past several years. The Center for Public Integrity and InsideClimate News have been reporting on air pollution in the Eagle Ford for more than a year and a half.

The Barnett Shale snakes under 25 counties, a region that includes Dallas, Fort Worth and dozens of suburban and exurban communities. More than 16,000 wells produce gas here, along with several hundred yielding oil.

Wells are tucked near homes, schools, parks, businesses and hospitals, sometimes less than 200 feet away. With them have come compressor stations, glycol dehydrators, storage tanks and other follow-on equipment — more than 6,000 sources of toxic emissions and thousands of others considered less significant. This infrastructure could run for decades even as the drilling boom fades.

Taylor Ishee lived within a mile and a half of 37 active gas wells before his Burkitt leukemia diagnosis at age 19, a Center analysis of state data showed. Half were drilled in the two years before he became ill. Wells were also sunk near his high school in [Argyle](#), in Denton County, while he was a student there. Then compressor stations, which move gas through pipelines, popped up on residential streets in the area.

Ishee's best friend, Justin Eaklor, was diagnosed with leukemia in May. Eaklor, 21, lives in another Barnett community with wells, including four just under two-thirds of a mile from his house.

For those who believe they've been harmed, proximity is troubling. For Texas as a whole, it's a bonanza.

Key findings:

The Barnett Shale, birthplace of modern fracking, lies beneath 5,000 square miles in North Texas and has 16,000 gas-producing wells.

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The Barnett is the longest-running experiment about what happens when fracking operations move next door to people.

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The Barnett region is more than twice the size of Delaware, and its 26 air monitoring stations leave most of it uncovered.

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Oil and gas emissions vary greatly, making it difficult to assess impacts on health — one Texan uses the phrase "trying to chase air."

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The state collected \$5.8 billion in natural gas and oil production taxes last fiscal year, triple the amount in 2003, early in the Barnett boom. That's after accounting for inflation. The technological advances that made the Barnett economical have spread to other plays in Texas, boosting not only taxes but also royalties for production on state land.

Politicians in Texas — many of whom receive campaign contributions from the oil and gas industry or have other financial ties — tend to focus on the [economic implications of the boom](#), which are much simpler to quantify than health. More mineral owners getting payments. More jobs. Cheaper energy.

Asked about health concerns, [Texas Gov. Rick Perry's](#) office did not respond. Neither did a spokeswoman for the governor-elect, state [Attorney General Greg Abbott](#).

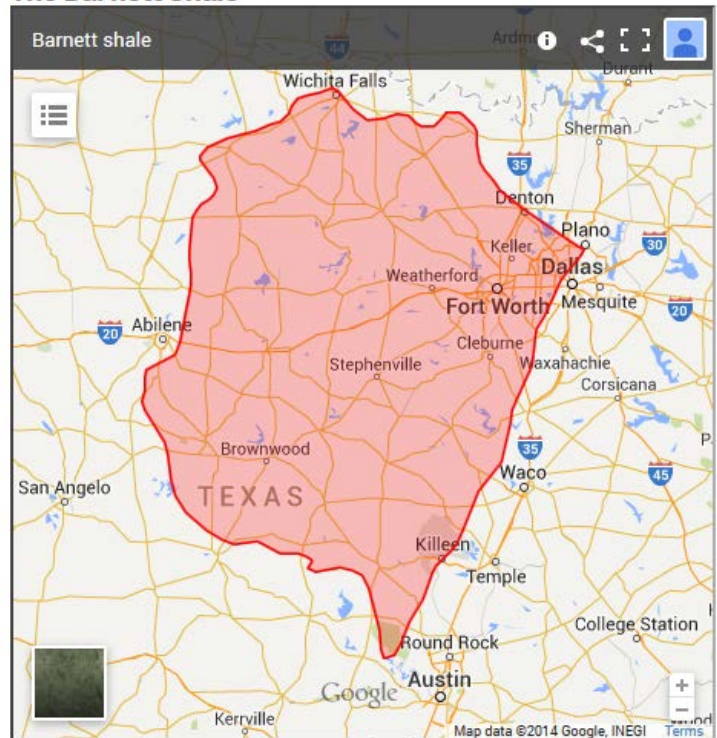
'No cause for alarm'

It's easy for Texas politicians to emphasize the positives, because the state's environmental protection agency gives Barnett air a thumbs-up.

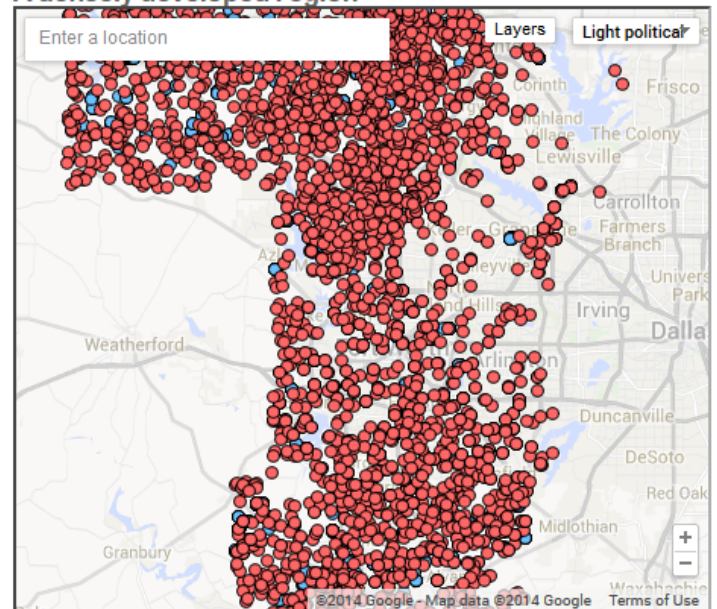
Air-toxics data from 26 fixed stations around the region flow to the [Texas Commission on Environmental Quality](#), known as the TCEQ. These monitors sample air either around the clock or once every six days, a network the agency said is unmatched in any other state.

TCEQ spokesman Terry Clawson said by email that the agency can't determine the cause of residents'

The Barnett Shale



A densely developed region



Four counties atop the Barnett Shale – Denton, Johnson, Tarrant and Wise – have the most natural-gas production in the region. Shown here are the gas and oil wells in those counties, along with the infrastructure that followed, such as compressor stations that move gas through pipelines.

- Red: Oil and gas wells
- Blue: Gas or oil infrastructure considered by the state to be "point sources," or more significant sources of air pollutants

Source: Railroad Commission of Texas and the Texas Commission on Environmental Quality

health problems when complaints arise, but “it is highly unlikely that chemicals are being emitted at levels high enough to cause adverse health effects such as cancer, kidney damage, or liver damage.”



Gas wells and related infrastructure, including storage tanks, can be sited close to homes in a variety of places in the Barnett Shale region. A tank is pictured here on a residential street in the town of Dish. Jamie Smith Hopkins/Center for Public Integrity

“Since 2008, the TCEQ has heavily monitored the oil and gas activities in the Barnett Shale,” he said.

“Monitoring millions of measurements each year, the TCEQ has found no cause for alarm.”

But air-emissions experts and other scientists say the state doesn’t have enough information to make broad judgments about safety. Emission levels can be widely variable, they say, and the vast majority of the region goes un-sampled.

The Barnett spreads across 5,000 square miles, an area more than twice the size of Delaware. The 26 air-monitoring stations there can’t quantify typical conditions near 16,000 wells and more than 6,000 compressor engines, tanks and other equipment, let alone determine where the highest emissions are.

Even right beside many of the state’s monitors, it’s difficult to get the full story on air quality. Samples are taken every six days at 11 of the stations.

“We don’t really have the experience to be able to say, ‘Oh, there’s nothing to worry about,’” said [Eduardo “Jay” Olaguer](#), program director for air quality science at the Houston Advanced Research Center, a nonprofit research group.

Given the measurement challenges, “traditional methods are really inadequate for the task at hand,” he said.

Olaguer uses a newer, mobile measurement method that can chase pollution plumes. What he’s finding suggests that emission “events” — significant releases of air pollutants — are larger and more frequent than expected.

Critics, meanwhile, contend that the TCEQ’s policies are too lenient to ensure public health or force improvements when residents complain.

Since 2009, the year after Barnett drilling permits peaked, people in the four counties with the most gas development have filed more than 1,370 air complaints related to the industry with the TCEQ. It’s a laundry list of woes. Vertigo. Unbearable headaches. Chest pain. Hives. Vomiting. Seizures. Dead pets.

“Complainant stated that most of us in this area believe that someone will have to die from benzene exposure before the government does anything,” a TCEQ employee wrote in one summary.

In only 2 percent of those complaints did the TCEQ issue violation notices, according to a Center analysis of data from 2009 through September of this year. Ninety-four percent were closed without violations. The rest were either referred to other agencies or were pending.

A complaint doesn't necessarily mean there's any violation to find, TCEQ's Clawson said.

"These types of occurrences are rare and demonstrate that many of the operations within this state are compliant with state and federal regulations and pose no negative impact to human health and the environment," he said by email.

TCEQ detractors see it differently — as a lack of appropriate enforcement from an agency whose mission is to protect public health and natural resources “consistent with sustainable economic development.” Two residents of the Barnett were so fed up that they started a nonprofit called [ShaleTest](#) to take independent samples of air and water.

“The average person in Texas would not know if TCEQ just simply dissolved and went away,” said co-founder Calvin Tillman, who stepped down as mayor of the tiny Barnett town of Dish in 2011 so he could move his family off the shale. “They’re there to protect the oil and gas industry, not to protect the people being harmed by the oil and gas industry.”

We have decided to close our file'

When the TCEQ does issue violation notices, the consequences sometimes amount to nothing.

Sandy DenBraber, a nurse so chemically sensitive she spends almost all her time in her home or yard in [Arlington](#), Texas, prevailed upon the TCEQ in 2010 to find the operator of nearby gas wells in violation based on her medical records.

Because she doesn't get the everyday exposure to contaminants that most Americans do, TCEQ investigators were struck by the presence of chemicals such as ethylbenzene, xylene and hexane in her blood. They detected the same chemicals in the air near the gas pad, though not at levels the agency deems concerning to health.

“We don't really have the experience to be able to say, 'Oh, there's nothing to worry about.'”

- Eduardo “Jay” Olague, program director for air quality science at the Houston Advanced Research Center



Sandy DenBraber holds a picture showing the rig just beyond her street in Arlington, east of Fort Worth. Her health worsened during three years of drilling there, and tests showed chemicals in her blood that were also detected in the air near the drilling site. Jamie Smith Hopkins/Center for Public Integrity

DenBraber's doctor, the TCEQ report notes, detailed her health problems during three years of drilling: "exacerbation of asthma, frequent migraines, increased fatigue, elevated white blood cell count, nausea, decreased appetite, aching joints, flu-like symptoms, low temperature, sleep disturbance, elevated blood pressure, nasal congestion, coughing, airway spasms, and shortness of breath."

"They don't develop these numbers to benefit people in Texas that live around these facilities. They develop these numbers to benefit the entities that want to build."

- Jim Tarr, chemical engineer who worked for TCEQ's predecessor

DenBraber, who compared the odor outside her house to that of an oil refinery, waited for action. After almost a year, the TCEQ sent her a letter informing her that none would come.

"After thoroughly reviewing all available sources of information including the investigator's report, medical records, affidavits and monitoring data, we have decided to close our file on this matter and will not be pursuing formal enforcement action," the letter said, not specifying why.

[Jim Tarr](#), a chemical engineer who worked in enforcement for the TCEQ's predecessor agency in the 1970s, said Barnett complaints over the last five years have been so numerous that it would be difficult for TCEQ staff to fully investigate them all.

But Tarr, who evaluates toxic chemical exposure for residents across the country, said the bigger problem is that the agency puts industry above public health.

His exhibit A: In 2007 the TCEQ raised the amount of benzene it considers an acceptable level of exposure for permitting purposes, doubling it to 54 parts per billion for brief periods and increasing it 40 percent for longer durations, to 1.4 parts per billion. For air-monitoring purposes, the agency's brief-exposure guideline is even higher, at 180 parts per billion.

The World Health Organization's [guidelines](#) say "no safe level of exposure can be recommended." As far back as the 1940s, research separately produced for the American Petroleum Institute and Shell — later introduced in court proceedings — also concluded that no amount of benzene was safe.

The confidential Shell report in 1943 said "prolonged exposure to low concentrations may be most dangerous."

Tarr sees the raised benzene guideline as just one example of problems with the yardstick the TCEQ uses to conclude that the air in the Barnett is fine.

"They don't develop these numbers to benefit people in Texas that live around these facilities," he said. "They develop these numbers to benefit the entities that want to build."

The TCEQ's Clawson said the method the agency uses to set exposure guidelines went through two rounds of peer review and "multiple rounds of public comments." For benzene, Clawson said, the agency calculated numbers aimed at the mid-range of what the

U.S. Environmental Protection Agency considers an acceptable level of risk for cancer. (The TCEQ's long-term exposure guideline [barely falls within the mid-range](#).)

"Other states and countries use our values," Clawson said by email. "We are continually improving our processes."

Even after the TCEQ increased its benzene guidelines, it found the carcinogen at levels that exceeded them. During a [Barnett monitoring project](#) in 2009, agency employees discovered benzene above that yardstick in nearly a third of the 64 sites where they arrived to test for it.

Most of the problem samples exceeded the guideline for exposure over an extended time. Tests at two of the sites came back so high they were above the 180-parts-per-billion level deemed safe for brief exposure — including a 15,000 parts-per-billion measurement at a well pad. Thirty-four other chemicals there exceeded TCEQ's short-term guidelines, too.

That prompted repairs at the two sites with the highest levels, bringing benzene down to a fraction of a part per billion there, the TCEQ said.

Clawson said the focus should be only on those two sites because the agency does not consider it scientifically appropriate to compare brief air measurements to long-term exposure guidelines. The agency's toxicology division made that comparison in its report at the time because of a "concern about long-term cumulative exposure levels," but Clawson said the stationary monitors installed afterward allay those concerns.

He wrote in an email that "we can confidently say that emissions from natural gas operations in the area haven't significantly affected ambient levels of air toxics like benzene."

Another benzene finding prompted an internal investigation.

The agency told the Fort Worth City Council in 2010 that a mobile monitoring effort showed no benzene in the air. Not explained was the fact that the measurement techniques weren't sensitive enough to make that determination.

A TCEQ follow-up with more sensitive equipment found benzene above the agency's guidelines for longer-term exposure at four locations, but no one hastened to alert city officials. David Manis, a quality-assurance manager at the TCEQ, was so upset that he filed an internal fraud complaint, according to documents released in a public information request from state Sen. Wendy Davis, D-Fort Worth.

An [investigation](#) by the agency's chief auditor's office concluded that the original information, "while technically accurate, could be considered to be misleading."

Reached at home last month, Manis referred questions to the TCEQ.

The TCEQ's Clawson said by email that there had been a miscommunication about the data, but he defended its use because the measurements were brief.

"Samples collected over short time frames are not appropriate for comparison to long-term [exposure guidelines]," Clawson wrote.

A challenging task

Determining a safe level of exposure, as it happens, is extraordinarily tough — fraught with bizarre twists worthy of science fiction.

Take the endocrine system. It controls important functions such as growth, reproduction and energy levels, and it can be affected by very low levels of chemicals, including ones used in fracking, said Carol Kwiatkowski, executive director of the nonprofit [Endocrine Disruption Exchange](#).

Kwiatkowski said her group doesn't trust that government safe-level standards for endocrine-disrupting chemicals are actually safe. These substances are tricky. Years of research shows that at least some can damage health at high and low doses — but not in the doses in between.

That's a problem given that government researchers have typically stopped testing once they hit the dose where they observed no effects. In 2012 the director of the National Institute of Environmental Health Sciences [called for more low-dose testing](#) to fill the void.

Then there's the difficulty posed by so-called chemical soups.

Air sampling near natural gas sites typically detects multiple substances. A grab bag of nasties showed up in TCEQ tests taken around sites not far from Taylor Ishee's home in Argyle, for instance.

The carcinogen [benzene](#). Another carcinogen linked to leukemia called [1,3-butadiene](#). [Toluene](#), which can cause dizziness and headaches. [Xylenes](#), associated with those problems plus respiratory and cardiovascular effects. And a long list of additional chemicals, the cancer and other health impacts of which are in some cases unclear or unknown.

The effect of those chemicals when people are exposed to them together in low doses — frequently — is anyone's guess. Scientists typically study chemicals one by one, not in mixtures. But researchers have found that a blend of toxics can be more dangerous than the individual substances alone.

In a study published last year, prostate cells exposed to supposedly safe levels of arsenic and estrogen for six months turned cancerous. Co-author [Kamaleshwar Singh](#), an assistant



Gas wells were drilled and fracked in two locations beside this neighborhood in Denton in North Texas, including the one being flared behind these homes. City voters went on to ban fracking in Denton last month. Courtesy of Maile Bush

professor at Texas Tech University's Department of Environmental Toxicology, sees broad implications for chemical standards.

His research wasn't focused on chemicals common in natural gas work. But given the wide variety associated with such sites, it doesn't strike him as unreasonable to be concerned about those mixtures.

"You should worry," he said. "In my view."

An unexpected diagnosis

Taylor Ishee started college and his first real job in late August 2011, and by the end of that first week, he knew something was wrong. He felt so terrible he had to call in sick that Friday, as much as it embarrassed him to do it.

He dragged himself to a clinic for tests. The results went to his family doctor, who sent him straight to the emergency room.

His white blood counts were elevated. His platelet levels were in the basement. His entire family was in shock when they learned why.

"The worst thing I've ever had to do in my whole life was to tell Taylor that he had cancer," said his father, Joe Ishee.

Until that August, Taylor's family had no concerns about his health. He played basketball in high school, landing a spot on the Argyle High School varsity team his junior and senior year.

But now he had Burkitt leukemia, a rare and aggressive form of a blood cancer his doctors told him is typically found in patients with compromised immune systems. As with many cancers, they couldn't tell Taylor what caused it, only that he didn't have the risk factors such as HIV.

He went through four rounds of chemo and had several weeks blessedly cancer-free. Then it roared back, this time as Burkitt lymphoma.

As the family battled through it all, they thought of Taylor's cancer as simple bad luck. Then in May, Taylor's best friend, Justin Eaklor, was diagnosed with acute lymphoblastic leukemia.

"It was just shocking," said Taylor's sister, Nicole, 25. "I thought, 'This has got to mean something.'"

Eaklor, Taylor's high-school basketball teammate, lives in another Barnett community. So Nicole went digging into natural gas development, a common link between Eaklor's suburban [Highland Village](#) and the semi-rural Argyle, where her brother lived with their father and stepmother from 2009 to 2013.

She had thought of natural gas extraction as safe, when she'd thought of it at all. Now she found reports of carcinogens being used in the extraction process and coming up out of the

ground, naturally occurring, with the gas. She read with alarm about benzene, which can damage the immune system and trigger leukemia.

The family knew drilling was common in their region but didn't realize how many sites Taylor had lived near until the Center did its analysis.

Taylor's mother, Anita Ishee, gave a deep sigh when she heard the number, 37 in all. "No wonder we are where we are," she said.

As she sat with her son at the Baylor T. Boone Pickens Cancer Hospital in Dallas in October, she put into words what had weighed on her for months.

"Some people can bring cancer on of their own actions," she said. "But to think that he's been like this because of something completely out of his control that could have been prevented, if it was regulated in the right way—"

She had to pause to compose herself. "It's hard to accept," she said.

The family also has had to accept that they might never have the information they need to conclusively prove their suspicions or rule them out. It's not just that research on cancer risks from living near gas development is sparse. It's also the lack of specifics about what Taylor was exposed to — if anything — before he got sick.

Argyle has no stationary air monitors. The clues to air quality from when he lived there are scant, primarily brief samples taken by TCEQ investigators after other residents complained about bad odors and health problems.

Between the time Taylor moved in and his diagnosis, the agency tested the air on 21 occasions within about a mile and a half of his home, according to online TCEQ records. The 30-minute samples offer insight into conditions in certain parts of the area for a total of less than a dozen hours during those two years.

Frequently when investigators arrived, whatever the residents had smelled was gone — at least, the investigators couldn't smell it.

Only three of the samples near wells were taken at times when the closest one could have been in the midst of drilling, fracking or the "flowback" that follows, when air-emission spikes are likely.

And none of the tests were on the Ishees' property. What wafted their way, and in what range of concentrations, is unknown.

The tests detected low levels of individual chemicals, generally measured in less than one part per billion. But each sample contained anywhere from a dozen to more than three dozen substances. Benzene and xylenes without fail. Toluene almost as frequently. 1,3-butadiene once. And other chemicals the Endocrine Disruption Exchange identified as affecting the immune system, including 1,2,4-trimethylbenzene, n-decane, n-nonane and n-octane.

The air samples were tested for a range of volatile organic compounds, but not every possible harmful substance. Formaldehyde and acetaldehyde, the former a carcinogen and

the latter a probable one, are among the chemicals not on the list. They've been detected near wells and compressor stations in other locations.

Eaklor thinks it's "just so crazy" that both he and his best friend developed cancer — and that he keeps finding more people from the area who are their age and in the same situation.

"That's why I'm thinking it has to be something chemical," he said.

Joe Ishee, a self-described conservative, believes the U.S. should tap its resources to be less dependent on foreign sources. He can see the impact that work has on the Texas economy. But he doesn't think enough effort had been put into determining whether people and wells should coexist.

He sees potential parallels in history, people exposed to dangerous substances that were thought at the time to be safe. Both his parents died from cancer after working with asbestos.

"I would just like to see a nonbiased review of the process," Joe Ishee said.

Last year Taylor, his father and stepmother moved to [Denton](#), a city whose residents [voted November 4 to ban fracking locally](#). He's been in remission for two-and-a-half years.

But the battle is far from over. The stem-cell transplant that saved his life prompted graft-versus-host disease, the new cells turning on him and attacking his body. He's been in and out of the hospital with complications ranging from infection to coma. His skin has thickened painfully, his face is periodically swollen from steroids and his teeth were undermined by radiation — he's lost five and required a dozen root canals.

Taylor, 22, wants to restart the life he had to pause three years ago. He dreams of going back to college to become a physician assistant and help people fight off cancer.

While he lay in his hospital bed in October, though, his own struggle was top of mind.

"I wouldn't wish it on my worst enemy," he said.

The industry's view

Gas-extraction companies in Texas aren't generally eager to talk about health concerns. None of the five largest operators in the Barnett region agreed to be interviewed. One referred questions to the [Barnett Shale Energy Education Council](#), but that industry trade group did not respond to repeated calls.

Still, the council's statements on its website make its position clear.

"While some activists would lead the public to believe that shale gas development, particularly through hydraulic fracturing, is a threat to public health, numerous scientific studies prove otherwise," the [council said](#).

One industry executive willing to talk directly is Chris Faulkner, CEO of Dallas-based [Breitling Energy](#) and a passionate defender of fracking.

“With proper setbacks, proper monitoring ... I see absolutely no problem with fracking,” he said. “Managed properly, the process is safe.”

Some companies don’t do a good job coexisting with residents in populated areas, in his view, but he contends that health concerns have been fueled by environmentalists with an ax to grind. He summed up the arguments he’s heard as “everyone’s going to get cancer,” whether through contaminated air or water.

“I just don’t believe it,” said Faulkner, who lives atop the Barnett near two wells. “If that was the case, I wouldn’t drink tap water every day and I wouldn’t live where I live.”

He’s similarly skeptical of complaints about asthma and other non-cancer health woes that nearby residents have blamed on natural gas. In the case of Denton, the city that just banned fracking, Faulkner argues that air pollution from cars “far outweighs” what comes from the approximately 270 gas wells there.

Where’s the evidence, he asked, that gas development is to blame for anybody’s bad health?

Regarding the studies that suggest links — to respiratory problems, for instance, or birth defects — he said, “Look, I’m not a scientist, nor do I pretend to be.” He said the state and federal government would step in if there were a problem. Surely if there were any proof of health effects, he said, the Obama administration “would be all over us.”

“Obama does not like oil and gas,” Faulkner said.

But states are the industry’s primary regulators. After several decades of congressional action, the EPA has less control over oil and gas development than other industrial activities.

The agency says those limits include exemptions to parts or all of several major federal environmental laws, including the Clean Water Act, the Superfund law and the hazardous-waste Resource Conservation and Recovery Act.

The EPA’s efforts to control air pollution in Texas have been met with pushback — not only from the industry but also from the state. Texas is [suing the EPA](#) over ozone regulations in the Barnett region. And the TCEQ saw little to like in the EPA’s first effort to reduce nationwide emissions from oil and gas wells after appeals for help from residents, including ones from Texas.

“EPA has seriously underestimated the impact of these rules on industry,” the [TCEQ said in comments](#) for standards that were instituted in 2012 and are being phased in. “From a regulatory perspective these rules will significantly increase the permitting and enforcement workload for TCEQ.”

Chasing air

The reason it’s so tricky to quantify oil and gas emissions, let alone potential health impacts, is that they vary. A great deal, in fact.

[Rob Jackson](#), an environmental scientist at Stanford University, said he’s seen many well pads with low emissions but some “leak a lot.” Even near a single site, two families could have very different experiences if one is typically upwind and the other downwind, he said.

“I’m not trying to generate a crisis,” Jackson said. “But I think air quality for people living near any industrial operation is a potential issue, and ... air quality and human health issues are likely to be very important for a minority of people living near oil and gas operations. We just don’t have a good idea of who they are.”

When Texans suspect they fall in that group, they can contact the TCEQ and have an investigator come out to do brief testing. Bob Parr, whose family called the agency frequently in 2010 and 2011, has a term for that: “trying to chase air” — hours or days after the problem started, at which point the wind, the emissions or both might have changed.

It took two days on average for investigators to respond to air complaints related to oil and gas the last two fiscal years in the Barnett, Clawson said, though the agency prioritizes health complaints when those come in.

In some of the cases in which investigators found violations, they did so by arriving on the weekend or in the middle of the night — times when problems often seem to crop up, residents say.

Parr’s wife, Lisa, said she prevailed on the TCEQ to send an employee one particularly bad

Sunday evening in 2010. The Parrs raise cattle in [Wise County](#), a more rural part of the Barnett, and they’re ringed by wells. Investigators showed up in time to get a whiff of the fumes sickening the Parrs — 30 seconds in the plume of toxic compounds was enough for one of the men to feel dizzy and develop a sore throat.

The [report](#) described “very strong, offensive odors.” The air test came back with chemicals over the TCEQ’s guidelines. Contractors were just finishing up work called a nitrogen lift on one of the wells, and Lisa Parr doubts an investigation the next day would have done much good.

After another bad evening a few months earlier, she said, the TCEQ found nothing of concern in the air. That time, the investigator arrived the following morning.

David R. Brown, a public health toxicologist working for the nonprofit [Southwest Pennsylvania Environmental Health Project](#), said his group’s measurements show emissions from wells and compressor stations typically have big fluctuations. Any monitoring that isn’t continuous can miss the irregular spikes reaching nearby residents, he said.



Bob Parr and his stepdaughter, Emma Duvall, with their horses on their property in Wise County, Texas. Parr, his wife Lisa and her daughter are surrounded by gas wells and won a lawsuit against one of the operators after airborne chemicals sickened them. Jamie Smith Hopkins/ Center for Public Integrity

“The exposures are very high exposures for short periods of time,” said Brown, an official at the federal Agency for Toxic Substances and Disease Registry in the 1990s. “And so a person can get a tremendous dose in an afternoon.”

One problem after another

Annette Wilkes was sitting in her backyard in [Flower Mound](#) in 2004 when she got her first clue that a natural gas well had been drilled in the North Texas community, less than half a mile from her property.

“We saw them flaring,” said Wilkes, now 43. “We wondered what it was.”

She had to stop taking her children to the elementary school playground beside the field with the gas-well pad because her eyes would swell up in what seemed like severe hay fever. But she didn’t spend much time thinking about the new neighbor. She had other matters on her mind.

Her sinus issues rapidly worsened, eventually prompting two surgeries to try to get the infections under control. Around the same time, she lost much of her hair. Alopecia areata, her specialist said — an autoimmune disease.

“He put me in the allergy category,” she said, meaning she was reacting to something — what, no one knew. “He could not believe I’d never had alopecia before because it was such an extreme case.”

In 2006 her then 3-year-old son was diagnosed with a type of periodic fever syndrome that doesn’t have a known cause. His temperature would spike as high as 104 degrees for several days straight every few weeks, requiring frequent doses of medicine to keep the fever from turning dangerous.

Then Wilkes was diagnosed with Hashimoto’s disease, a thyroid-attacking autoimmune disorder. It was so advanced that she needed surgery to remove her thyroid.

Early on in this parade of bad news, Wilkes — who had previously been healthy — went searching for external explanations. Mold in the house, maybe? Her husband was having “bizarre skin reactions,” after all. But a mold test found nothing.

Others in her immediate neighborhood fell ill, too.

A next-door neighbor died of leukemia. Within a block, one woman developed a brain tumor and another was suffering from what turned out to be multiple myeloma.

Lorrie Squibb, diagnosed in 2010 with that blood cancer, said the first words out of her doctor’s mouth were, “What have you been exposed to?”

“I was 40 years old,” said Squibb, a stay-at-home mother who had just moved from Flower Mound to Michigan. “I was the second-youngest my oncologist has ever seen with multiple myeloma.”

Like Wilkes, Squibb is convinced gas development made her sick. As children in the neighborhood developed cancer, others had the same thought.

In 2010 and 2011, the [Texas Department of State Health Services](#) responded to the concerns by tallying several types of cancer in the two ZIP codes that cover most of Flower Mound to see whether the cases were higher than expected.

The state calculated its figures using a 99-percent confidence interval. That meant the number of cancer cases had to be so elevated that there was only one chance in 100 that happenstance alone was responsible.

Using this standard, staffers concluded that only breast cancer was higher than expected, and they thought population growth could explain that.

This spring an [article in an environmental law journal](#) said that if the state had used a 95-percent calculation, more typical in such cases, it would have found clusters of blood cancers among boys — lymphoid leukemia in one ZIP code and non-Hodgkin lymphoma in the other.

The attorney who wrote the article, University of Texas at Austin researcher Rachael Rawlins, also suggested that studying a smaller area than broad ZIP codes might have better addressed people's fears about specific neighborhood exposures.

The state health agency responded with [another analysis](#) — this time using a 95-percent calculation with more recent cancer data, but still focused on the two ZIP codes that bisected the town. Christine Mann, a spokeswoman for the state health department, said it wasn't possible to analyze the cases in neighborhoods because the numbers would be too small to produce statistically valid results.

Again, only breast cancer was higher than expected. Again, the agency suggested that problems other than environmental exposure could explain it.

“Relative to other risk factors, the chance of a person developing cancer as a result of exposure to an environmental contaminant is small,” the July report said. It cited an estimate, drawn from 1981 research, that exposure to environmental contaminants is to blame for only 2 percent of cancer deaths.

But that figure is far from universally accepted. A [presidential advisory panel](#) declared in 2010 that “the true burden of environmentally induced cancer has been grossly underestimated.”

When asked about that, Mann said the point of the Flower Mound study wasn't to evaluate “environmental or other risk factors,” simply to look at the number of cancer cases there.

Flower Mound now has among the most restrictive gas-development rules in the Barnett, including a setback preventing drilling within 1,500 feet of homes. Wilkes, who moved her family out of Flower Mound in 2006 after deciding gas-extraction was the root of her problems, returned three years later to a neighborhood where she felt comfortable no drilling would occur.

Her health has improved. Her son's fevers stopped.

Like other residents, she sees no way to definitively prove why it all happened in the first place.

“That’s what drives me crazy,” Wilkes said.

Going to court

That definitive-proof problem hampers residents who want legal redress. Health impacts by their very nature are hard to prove, said Ilan Levin, a Texas-based attorney who is associate director of the [Environmental Integrity Project](#), a nonprofit research and advocacy group.

“So, of course very few people bring suits for injuries,” he wrote in an email. “Of those who do, the vast majority settle and sign gag orders.”

Those gag orders — called nondisclosure agreements — pose a problem for people researching health effects.

“We’ve had sites where we were monitoring 14 people and the industry came in and paid each one \$50,000 to get out of the study,” said Brown, with the Southwest Pennsylvania Environmental Health Project. “We can’t follow them anymore.”

A rare case that went forward without settling — and [succeeded](#) — was brought by the Parrs, the Wise County couple who live near the spot where the TCEQ investigator was sickened by fumes in 2010. A Dallas jury awarded them \$2.9 million in April, a verdict the company has appealed.

Aruba Petroleum said in a statement that the award “represents an attempt by the jury to compensate the plaintiffs for alleged toxic tort injuries that fail for lack of causation evidence required under the law.” The company owns wells near the Parrs, including the one the TCEQ found in violation, but is not the only operator in the vicinity.

“No evidence was presented that proved that plaintiffs’ alleged injuries resulted from Aruba’s operations,” the company said in its statement.

The Parrs, whose suit alleged the company had created a nuisance, came with documentation that most people who suspect health impacts can only wish they had.

At a doctor’s suggestion, Lisa Parr started a health diary of her mounting symptoms in the hopes of figuring out a cause. Soon after, the Parrs discovered that a family on their street was keeping another detailed log — of emission events from nearby wells. Those events matched up with times Lisa Parr felt particularly bad, including occasions when she ended up at the emergency room, she said.

The neighbors had also hired a scientist to test their air. Bob Parr, on hand to fix a fence when the consultant arrived with the results, listened in dawning comprehension as she explained the implications of the chemicals she’d found.

Health problems had already hit the entire family by that point, including Lisa’s daughter, then in elementary school. All three of them and some of their horses had nosebleeds. Cows were giving birth to calves that weren’t right — tiny, hairless and in some cases dead.

Bob Parr’s blood pressure rose. Daughter Emma Duvall was diagnosed with asthma. And Lisa Parr, a stay-at-home parent at the time, could barely function.

She had trouble speaking and walking. Rashes broke out over her body. Several times a week, she'd wake up and vomit something that looked like foam. In July 2010 an environmental health specialist tested her blood and found many of the chemicals the TCEQ had just detected in the air four days earlier.

The specialist urged them to move. The family squeezed into the small house that serves as Bob Parr's office.

After the TCEQ violation and the lawsuit, Aruba shut down the well the Parrs suspected was the worst offender. That helped, they said. They're back in their home.

But Lisa Parr, 46, worries about the long-term effects. And she doesn't know whether the shut-down well might someday be restarted.

"I have asked in depositions," she said. "They won't answer us."

New neighbors

The new neighborhood in Denton, a city of 123,000 north of Argyle and Flower Mound, looked perfect. Maile Bush and her husband just wanted to know the plan for the empty land nearby. Homes and a future park, the builder told them.

They bought in four years ago — missing, as many neighbors did, the paragraph buried in closing paperwork that warned how else the land could be used.

The rigs went up in August 2013. Drilling was about to commence 450 feet from Bush's house in one direction and 750 feet away in another.

Another family of four, the Ogletrees, calculated that they were just 182 feet from the closest site.

The work stretched to April, an industrial operation amid suburban brick homes and beautiful lawns. Heavy equipment arrived, along with too many vehicles to count — a single shale-gas well can demand hundreds of truck trips.

Bush tracked the noise with a monitor, getting readings on her property consistent with a kitchen blender on high. "Frac sand" — which releases fine particles that can cause the lung disease silicosis — sat in big piles and blew everywhere, she said. Now there's a compressor station in the neighborhood, too, its equipment sending out emissions that another North Texas resident picked up on an infrared camera.

Bush, who said she's not prone to sinus infections, had one this year so bad that four rounds of antibiotics didn't help. She had surgery in October and still isn't back to normal.

She's more worried about her son, though. Before the work started, his asthma was under control. Now, she said, he frequently needs two inhalers a day rather than one. He went from a no-nosebleed kid to a boy who develops them weekly.

"I understand that correlation is not causation, I understand that, but it's kind of suspicious," said Bush, 41, who keeps both her children indoors as much as possible now. "If there is a chance, a tiny chance — if there is a 1 percent chance — that fracking is

contributing to my child's problem, then there is a problem. And we need to stop and take a step back and figure out what the impacts are before we just go off willy-nilly making people sick."

The state [Railroad Commission](#), which despite its name regulates drilling, said it sets no minimum distance between gas wells and homes. The TCEQ-mandated minimum in the populated Barnett is 50 feet. Cities can establish setback rules if they wish.

Denton had passed a [1,200-foot setback](#) seven months before the rigs came to Bush's neighborhood. But operator EagleRidge Energy contended that it was grandfathered under older rules, and Denton officials said [their hands were tied](#). EagleRidge, which didn't respond to calls seeking comment for this story, moved ahead.

Residents who'd pushed for the bigger setback now consider it toothless because so much of the city had already been permitted for wells. They said they saw only one option left. They gathered signatures [to force a vote on a fracking ban](#).

Locals and the activists who helped them were outspent nearly 10 to 1 by the industry, but the ban passed by a wide margin last month — 59 percent to 41 percent.

That made Denton the first Texas city with such a ban. The lawsuits hit the next morning.

One came from the [Texas Oil & Gas Association](#), which argued that the rule unconstitutionally treads on regulatory ground reserved for the state. The ban would effectively stop drilling in Denton because Barnett wells aren't economical without fracking, the trade group said.

The [other suit](#) targeting the ban was filed by a state agency, the Texas General Land Office.

"If it were allowed to be enforced it would hurt the schoolchildren of Texas, who earn hundreds of millions of dollars a year on oil and gas production on Permanent School Fund lands," Texas Land Commissioner Jerry Patterson said in a statement.

Some state legislators have suggested they'll seek a law to ban such bans. But Denton Councilman Kevin Roden has called on legislators to treat the vote as a different sort of wake-up call.



Maile Bush and her two children, Kaden (right) and Cassidy, stand behind their yard sign advocating for a ban on fracking in their city of Denton. Bush rarely lets them play in the yard these days because she's concerned about air pollution from the gas wells and compressor station near them. Jamie Smith Hopkins/Center for Public Integrity

He'd like cities to get a share of the production taxes now flowing to the state, and he wants locals to have more regulatory authority, such as the explicit ability to limit gas development to industrial areas. Otherwise, he said, legislators risk "turning the hearts of your citizens away from this industry."

Trying to get out, and already gone

Rebecca Williams' health began its U-turn from good to bad last year. Her husband's followed a few months later. Some of their problems are identical: migraines, respiratory problems, nosebleeds, vomiting, forgetfulness, rashes. One of their dogs gets rashes, too.

"I try not to go outside of my house, because when I do, I get sick," said Williams, 45, who lives northwest of Fort Worth just outside [Azle](#), near a compressor station and heavy gas-well development.

She's had pneumonia three times within the last year and a half, despite a vaccination against it, and twice her lips and fingers turned blue. The last time, suspecting the pneumonia was chemically induced, she thought to ask whether her white blood cell count indicated a viral or bacterial cause. Neither, her doctor said.

In addition to pneumonia, she's had one respiratory infection after another. Antibiotics don't seem to help. She's had to get a nebulizer, which turns medication into a mist to be inhaled.

Williams is a nurse who works for a health insurer, reviewing multiple cases a day, and said she's seeing certain diseases increase in gas-well-intensive areas. Leukemia, heart attacks among people in their 30s and 40s, respiratory illnesses, certain autoimmune disorders.

"Something's not right," she said.

She wants to sell her spacious house and get out, but it was on the market for more than six months this year with no offers. She plans to cut the price substantially and try again.

Jana DeGrand did move — after her gallbladder attached itself to her small intestine, after the appendix her surgeon described as "obliterated" was removed, after her heart attack at age 50. She moved from her town straight off the shale.

DeGrand lived in Argyle, about a mile from the Ishees. She was fine until late 2007, after several years of drilling.

"It kind of snowballed after that — lots of things that the doctors were scratching their heads [over], saying, 'We don't know why,'" said DeGrand, now 53.

Only two TCEQ air samples were taken near her during the years her health worsened, neither on her property. Both tests picked up chemicals with known cardiovascular and gastrointestinal effects, though in very low concentrations.

Like Taylor Ishee, DeGrand lived near numerous wells. For several months a sludge pit for a well pad that residents ultimately fought off sat 100 feet from her back fence, filled with an oily substance that smelled like diesel. And she was about two miles north of the Argyle Central Facility, a compressor station built in 2010 that people nearby repeatedly complained about.



After developing health problems, including rashes, that she attributes to nearby gas sites, Rebecca Williams wants to sell her house outside of Fort Worth. Eleanor Bell/Center for Public Integrity

Compressors push gas along pipelines to keep it flowing. Emissions ranging from methane to volatile organic compounds can come from multiple sources on site: the compressor engines, the dehydration units removing water from the gas, the tanks holding that waste.

The Argyle Central Facility, surrounded by homes, had all that equipment — four engines, a dehydrator and 19 tanks at the time it was built.

It falls into a regulatory category called “permit by rule.” If operators estimate their facility’s emissions will fall under a certain level — including no more than 25 tons per year of volatile organic compounds and some other types of air contaminants — they can simply get cracking. Registration is required in some cases but not all.

When the TCEQ did a one-time tally of Barnett compressors and equipment authorized under that rule and similar ones in 2009, they topped 8,600.

No other oil or gas site in Denton County received as many air complaints in the last five years as the Argyle Central Facility, according to the Center’s analysis. None of the 63 complaints prompted the TCEQ to issue a violation notice.

But the EPA did so in 2011 after inspecting the site. Investigators found five tank hatches releasing methane, which the EPA described as “an extremely hazardous substance.” (It’s a flammable and potent greenhouse gas, though the operator said the amount released was so minor that it posed no danger.)

Separately in 2011, the facility’s operators documented 510 “blowdowns,” the venting of gas and potentially dangerous chemicals. Forty-five percent of those events happened in the lead-up to the day that March that DeGrand collapsed in her garage, face numb, heart no longer functioning properly. Whether one had any connection to the other, DeGrand can’t know, but she’ll always wonder.

The operator at the time, a subsidiary of energy firm Williams Cos., estimated that the 2011 blowdowns emitted a total of 43,000 pounds of gas and 43 pounds of volatile organic compounds, known as VOCs. That’s well below permit-by-rule limits and didn’t constitute a violation, the TCEQ said. All told, the company emitted about 6.3 tons of VOCs that year, the agency said.

Tom Droege, a spokesman for Williams, which no longer owns the facility, attributed many of the complaints to the high level of activity on the site during construction. Of the blowdown emissions, he said, “residents would likely get more of an exposure from VOCs by living close to any of the local highways.”

Without clear information on what she was breathing, DeGrand can only say how she felt while she lived in Argyle. And what happened after she moved north of the Barnett in July.

“Time will tell how lasting and permanent the effects are, but I do know I’m better since I got out of there,” she said. “I know several people who’ve left. They all got better.”

Jim Morris of the Center for Public Integrity and Lisa Song and David Hasemyer of InsideClimate News contributed to this article.