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**National Geographic**

## **A Dream Dashed by the Rush on Gas**



The Hallowich family, Stephanie, Chris, and their children, Alie and Nate, on the land they say they hoped would be their "perfect ten acres." In the background is a gas tank, just a small part of the industry infrastructure that now surrounds them.

Photograph by Scott Goldsmith, National Geographic

Marianne Lavelle,

[National Geographic News](#)

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### **SPECIAL REPORT: THE GREAT SHALE GAS RUSH**

Exploring the promise and challenge of a new energy supply.

Chris and Stephanie Hallowich say they tried to choose carefully when they were seeking out their dream home in southwestern Pennsylvania. Thinking of their two young children, the high school history teacher and his wife, an accountant, rejected one property when they learned it

had once been the site of a strip mine for coal. They settled instead on 10 acres of long-fallow farmland for \$20,000, and began to build.

The Hallowiches' yellow, two-story home in Mount Pleasant Township, about 30 miles southwest of Pittsburgh in Washington County, was completed in November 2007. Nestled on a wooded hill far from the main roadway, it has a swing set and a garden on rolling land where the children could run.

But even as they were building, the bucolic view was being replaced by an industrial panorama. Four natural gas wells, a gas processing plant, a compressor station, buried pipelines, a three-acre plastic-lined holding pond, and a gravel road with heavy truck traffic surround them. Instead of the sound of bird calls and the scent of new-mown grass, the Hallowiches listen to the wheeze of tractor-trailer brakes and and breathe diesel fumes—and worse.

“It’s ruined our lives. That’s what it comes down to,” says Chris. “It’s ruined our plans that we had for the kids. It’s ruined what we thought was our perfect ten acres.”

### **Life in the Midst of a Boom**

Thanks mainly to deals struck by the previous owner of their property—the extent of which they say they did not understand at the time of their purchase—the Hallowiches now live on a hillside hub of the Marcellus shale boom.

(See Photos: "[A Changed Environment](#)")

Even though they receive some recompense—a monthly royalty check of a few hundred dollars—they say it doesn’t compensate for the money they’ve been spending to have fresh water delivered and stored at their home. They found pollutants in their well water, and although the extent and source are much in dispute, they refuse to drink, cook, or bathe with it. They say they fear that they and their children, now 6 and 9, face health risks from both polluted drinking water and air. And beyond that, they worry that the rural way of life here is being obliterated by an industry that, to them, seems to operate with little oversight or control.

It’s hard to dispute that the Hallowich land sits on one of the most active plots in the 95,000-square-mile (246,000-square-kilometer) Marcellus shale, the rock formation extending from West Virginia to New York that the energy industry is tapping, with a combination of technological innovations, to produce huge quantities of natural gas. And it is true that the Hallowiches cope with noisy permanent installations like the compressor station and gas processing plant that have disrupted their lives. But gas producers say the site should be seen as an anomaly, not as a sign of what’s to come.

### **Short-Term Disruptions?**

“From a nuisance perspective, I will tell you they have a legitimate concern,” says Matt Pitzarella, spokesman for Range Resources, the company that drilled the well that produces gas beneath the Hallowich site. His gas company and others say the bulk of their operations—the well sites themselves—are short-term disruptions and that the land is restored, as the state of Pennsylvania requires, within nine months after drilling is complete.

The water impoundments serve many wells and can be around longer—the one behind the Hallowich house has been there since July 2007—but gas producers also say these man-made, plastic-lined lakes are temporary. The land will be restored when the water holding area is no longer needed. “It is an industrial process and we're honest, open, and transparent about that,” says Pitzarella. In most cases, he says, “There are lights, some noises, some road dust, but within a year it's all gone and everything is put back together.”

In particular, Range and other companies cite numerous steps they take, such as construction of steel and concrete well casings, to protect groundwater. Still, the Hallowich case is one of a number of bitterly contested water disputes that have erupted since the industry began to spread out across Pennsylvania, one of the few states [without any private well regulation](#). There is no definitive proof where the pollution in the Hallowich well water came from.

### **A Question of Oversight**

Oversight of these disputes, along with other regulation of the shale gas industry here, is the responsibility of the Pennsylvania Department of Environmental Protection (DEP), which has more than doubled its staff to handle the job. DEP has conducted more than 3,400 inspections of more than 1,400 well sites so far this year. It requires reams of paperwork for every drill, water site, and waste discharge, and it mandates site restoration and regrading of any hills that are flattened for well pads.

With more than 2,100 Marcellus wells drilled in Pennsylvania since 2007, DEP has found more than 500 violations of state environmental regulations and more than 1,000 administrative violations, such as failure to keep drilling logs on site. Although DEP does not have an exact figure for fines paid by the Marcellus industry, the agency says its operations were the target of the majority of \$1.8 million in oil and gas industry fines it has levied so far this year. DEP also temporarily curtailed operations of two of the nearly 70 natural gas companies working in the Marcellus. Even industry supporters, who cheer the arrival of a cleaner fuel source to replace coal and oil, say there have been too many accidents and too much mistrust sown by industry secrecy and resistance to further oversight.

“This gas industry has a great product, but how they drill it and how they produce it is going to go a long way to deciding whether the American people embrace it or actually reject it,” says Pennsylvania DEP Secretary John Hanger, the state’s chief industry regulator.

### **Safe Process, but Risky Execution?**

Both Hanger’s office and the gas industry maintain that if the process is done properly, there is no threat to drinking water when chemically treated water and sand are blasted underground to fracture shale to produce gas.

(Related: [“Forcing Gas Out of Rock With Water”](#))

The hydraulic fracturing (fracking) fluid, about 4 million gallons (15 million liters) per well, is released into the shale layer at a depth of 4,000 to 8,500 feet (1,220 to 2,590 meters). (Related interactive: [“Breaking Fuel From the Rock”](#)) That means that there is about a mile or more of rock between the shale and underground water sources used for drinking water. About [1 million Pennsylvania households](#), nearly 20 percent of residences in the state, draw their water from

private wells that are relatively shallow. Wells in the western half of the state, for instance, would likely be drilled to depths of less than 150 feet (46 meters), according to the Pennsylvania Geological Survey.

The potential for contamination of drinking water aquifers is a major concern in the Keystone State, which has more people served by well water than any state but Michigan, according to a 2009 [analysis](#) year prepared for the state legislature. The chief bulwark against water pollution is a separating wall—a casing made of tons of steel and cement—built in each gas well not only to protect the environment, but also to ensure the valuable gas doesn't escape.

Hanger says there hasn't been a single confirmed case of frack fluid migrating from the shale layer deep underground to the shallow drinking water supplies in Pennsylvania. However, about 20 to 50 percent of the drilling liquid flows back to the surface, most of it right after the well is completed. And that's when proven trouble can occur.

### **“It's Not Water of Any Kind”**

This “produced water,” which includes the frack chemicals, is a super-salty brine, prone to bacterial growth, and potentially contaminated with heavy metals. “It smells like turpentine,” says Conrad Dan Volz, director of the [Center for Healthy Environments and Communities](#) at the University of Pittsburgh's Graduate School of Public Health, who has been researching the environmental impact. “It's not water of any kind.”

State regulations say the frack fluid has to be collected and disposed of as an industrial waste, or it can be treated and reused to drill more wells, a practice pioneered in Pennsylvania within the past year. (Related: “[Forcing Gas Out of Rock With Water](#)”) Hanger says the water reuse is in no small measure a result of the DEP's tough stance on wastewater handling.

But in at least 130 cases documented since 2008 by the DEP, drilling wastewater has spilled into creeks and tributaries due to holding pond overflows, pump failures, and other errors. There have been at least two small fish kills. One occurred in October 2009, soon after Range started its program to reuse frack fluid: about 10,500 gallons (40,000 liters/250 barrels) leaked from a [broken pipeline joint](#) and killed about 170 creek chubs, blacknose dace, and other small fish, along with some salamanders and frogs in Brush Run, 30 miles southwest of Pittsburgh. Range says the fish killed collectively weighed about a pound. The company suspects vandalism, because bolts had been removed from the pipe connection. But no perpetrators have been tracked down, and the company was fined \$140,000 for polluting a high-quality waterway. (Range since has switched to using unbolted high-density polyethylene pipeline to transfer its drilling fluid, Pitzarella says.)

In another [case](#), involving East Resources\* in north-central Pennsylvania, the state quarantined cattle exposed to wastewater that leaked from a containment pond and killed grass over 1,200 square feet on a farm. State agriculture officials said they acted to prevent contaminated beef from entering the food chain, since the water contained the heavy metal strontium, a substance especially toxic to children and one that lingers long in an animal's system.

In a case that echoed the BP oil spill, although the results certainly weren't as severe, an EOG Resources well blew out on June 3, with natural gas and frack fluid spewing for 16 hours from the gas well on hunting club land inside the Moshannon State Forest in central Pennsylvania.

(Related: [“Parks, Forests Eyed for the Fuel Beneath”](#)) There should have been at least two pressure barriers or blowout preventers in the underground piping to prevent contaminated fluid from flowing to the surface, but only one barrier was in place, and it was damaged, the DEP’s investigation showed. EOG was hit with the harshest punishment to date by Pennsylvania’s shale regulators—a fine of \$353,000 and temporary suspension from drilling.

## **The Dimock Case**

But perhaps the most notorious Pennsylvania contamination case was in the northeastern part of the state, in rural Dimock Township, where natural gas was found in early 2009 to have contaminated the drinking water wells of 14 homes. Investigators were able to do a kind of “fingerprinting” to determine the source, and concluded the gas did not come from the Marcellus shale. But the state DEP contends that faulty well casing set into the ground by Cabot Oil & Gas as it drilled into the deep Marcellus allowed gas to migrate from more shallow geological formations into the groundwater. Dimock’s woes were recounted in the award-winning documentary film *Gasland*, forever linking the image of flammable drinking water to the Marcellus shale (even though the man who memorably set fire to his tap water in the film was in Colorado).

Now the dispute in Dimock has escalated, with the state DEP announcing in September that it would seek to recover from Cabot the \$11.8 million cost of building a line to hook the affected homes to a public water system, bypassing the natural gas pollution in their aquifer. Cabot, which originally signed consent orders with the state DEP agreeing to plug three of its wells, to pay at least \$240,000 in fines and to provide water treatment systems for the affected homes, began to publicly and aggressively fight the state. Cabot contends that the natural gas was naturally occurring in the area’s water, and on a [“Clearing the Air”](#) web site the company has posted affidavits of four longtime residents saying the area’s water was always known to be flammable.

The truth of the Dimock situation appears destined to be hashed out in the court system; in addition to the state DEP’s legal action, Cabot documents also say there is a pending suit by residents.

But the issue of faulty well construction is a concern for the regulators that goes beyond Dimock. In addition to the Cabot case, the DEP has cited companies nearly 50 times since 2008 for faulty well casing that posed a risk to groundwater. And in September, the DEP requested that one of the largest gas producers, Chesapeake Energy, [inspect 171 well casings](#) in northeastern Pennsylvania because natural gas had been found in six private water wells. Also, the state is in the final stages of approving more stringent well cementing and casing requirements for all drillers that Hanger says will be “as strong as any in the country.”

## **“They Need to See Every Spill . . . as Unacceptable”**

To oversee the oil and gas industry, the Pennsylvania DEP has enlarged its staff from 88 people to nearly 200, paid for by a significant hike in the cost of drilling permits that increased fee revenue from \$700,000 per year to more than \$10 million. But Hanger says that the gas industry has to do its part. “What we’ve been absolutely focused on is trying to build a culture of safety, by enforcing real rules,” he says. “Because at the end of the day, these companies are the only

folks who are there pretty much all the time. We will never have an inspector at every well site every minute of every day.

“So these companies are creating what I describe as the bed in which they will lie with the public,” Hanger says. “They need to see every spill and every leak as unacceptable. They need to see every blowout as unacceptable, every gas migration case as completely unacceptable.”

### **Public and Private Battles**

Although the industry maintains that the majority of wells have been drilled safely, and that companies have paid for the damage they’ve done in isolated cases, the industry is clearly on the defensive. No drilling is currently permitted in Pennsylvania’s easternmost counties. That’s by decision of the Delaware River Basin Commission (DRBC), a federal-multistate compact agency that governs water use in the environmentally sensitive watershed on Pennsylvania’s border with New Jersey and New York, which provides water to 17 million people. The DRBC decided on June 14 to halt all natural gas drilling [in its region](#) while it writes new environmental rules. In New York, where the Marcellus underlies the Catskill Mountains region that provides New York City with its drinking water—in one of the largest unfiltered water systems in the world—gas drilling has been on [hold](#), in effect, since 2008.

On September 9, the U.S. Environmental Protection Agency asked [nine natural gas service companies](#) to submit information on the chemicals they use in hydraulic fracturing—indicating the agency will use its legal authority to compel disclosure of the information if the companies do not comply. EPA is in the midst of a [study of the safety](#) of fracking, for which it held packed meetings in Pennsylvania and New York. Leading energy industry analysts believe that in whatever energy bill Congress passes next, there will be both a new federal requirement on frack chemical disclosure and an amendment to assure that fracking is regulated by the federal Safe Drinking Water Act (SDWA). (In its 2005 energy bill, Congress included an exemption from SDWA oversight for the water put into the ground for hydraulic fracturing—a provision that has come to be known as the “Halliburton loophole” after the oil and gas industry service company that is active in the shale industry.)

In addition to increasing official scrutiny, the Marcellus gas industry is embroiled in private battles like the one with the Hallowich family. Ironically, because of a lease signed by the previous owner of their property before they purchased it, the Hallowiches get a royalty check from Range Resources every month, typically between \$300 and \$400, for natural gas produced from under their land. That previous owner would have been due those royalties, and actually tried to back out of the sales agreement with the Hallowiches before closing in 2006. But they took her to court and forced the sale. The Hallowiches said they did not understand the lease was for gas drilling; they say they were told at closing that the lease was for work on a pipeline at the other end of the farm.

### **Tracking the Source of the Pollution**

Now, the Hallowiches are suing Range and others; they say all the royalty money they earn goes to fighting pollution woes. But how much pollution they face, and where it comes from, are subjects steeped in acrimony; successive rounds of water testing by different parties have only made the matter murkier.

Since June 2009, the Hallowiches say, they have spent more than \$5,000 to have water for drinking, cooking, and bathing delivered and stored in a 1,500-gallon (5,700-liter) rented tank in their garage, filled every three weeks, and pumped through the house. State DEP testing conducted in May 2009 showed that their well water had levels of the mineral manganese, a potential neurotoxin, more than three times higher than the state water quality standard. The state DEP said in an August 2009 letter to the Hallowiches that the manganese was a common problem in southwestern Pennsylvania, and could be naturally occurring.

But the Hallowiches had follow-up tests done by two private labs. One of these detected acrylonitrile, a chemical used to make a wide variety of plastics; it can affect the central nervous system, according to the U.S. Agency for Toxic Substances and Disease Registry. The same lab's testing showed trace levels of other toxic chemicals.

The state DEP said in its August 2009 letter to the Hallowiches that the only contaminant in the water that consistently exceeded state standards for drinking water was manganese. The DEP noted that the testing by the other private lab hired by the Hallowiches did not detect any acrylonitrile, and the DEP suggested that the compound could have come from the plastic decorative rock the Hallowiches used over their well.

The Hallowiches, who obtained a letter from the decorative rock company and material data safety sheets stating there was no acrylonitrile in the plastic fixture, are convinced that the chemicals migrated from the natural gas drilling operations. Because acrylonitrile is in so many plastics, they maintain that a probable source is one of the plastic liners—either in the fresh water impoundment or in one of the drilling waste pits buried on site. But Range, which has publicly disclosed its fracking chemicals since this summer, says acrylonitrile is not used in its processes or in its plastic liners.

As in Dimock Township, it appears it will be up to the courts to decide the truth. Complicating matters is the fact that the Hallowiches have no definitive proof on any of the pollution issues. Because they did not test their water for chemicals before drilling began, they have no baseline against which to compare any current readings. In fact, the Hallowiches did not test their water, except for the bacteria, until a year and a half after gas drilling ended. That omission is important, because by Pennsylvania law, an oil or gas company is presumed to be responsible for pollution if a well is drilled within 1,000 feet of a water supply (as is the Range Resources well next door to the Hallowiches) but only if it can be shown that the pollution occurred within six months of drilling.

Because of the liability potential, Range and most other companies routinely do a pre-drilling analysis of water wells within 1,000 feet of a planned oil or gas well. But the Hallowich site fell between the cracks in the law. The family didn't tap their underground water until three months after gas drilling began in July 2007. The Hallowiches said they were never notified or warned to have their water tested, as they believe they should have been. And Stephanie says she was not originally worried about the gas operations. "Just water and sand," she says, is all she understood to be used in the shale gas process.

But as the gas operations encroached, Stephanie contacted groups opposed to natural gas drilling elsewhere in the state, including activists who organized not far from trouble-ridden Dimock. They are the ones, Stephanie says, who urged that the couple do their own water testing for a range of chemicals they say they never would have considered if they had collected a sample

before the gas drilling began. After all that she has since learned, from the activists and her own exhaustive research, Stephanie is convinced that drilling is rife with hazards. “It’s just like a big chemistry experiment in the ground,” she says.

### **Worries, Too, About the Air**

The Hallowiches also have fears about the air, after suffering burning eyes, sore throats and other symptoms when gas was released several times during apparent equipment malfunctions. A windsock now tells the Hallowiches when air is blowing from the direction of the gas facilities, so they can keep the children indoors.

University of Pittsburgh environmental researcher Conrad Dan Volz, whose center, along with the University of Washington, Seattle, is researching the Hallowiches’ case as part of a larger study on the industry impact, believes the Marcellus air pollution risk is largely being overlooked. Air pollution is one of Volz’s areas of focus in a \$1.8 million, three-year project funded by the Heinz Endowments, which includes the launch of a web site called [FracTracker](#), to be used by citizens, community groups, government agencies, and public health officials. Information, he says, has been as dispersed as the industry. “If any new industry moved into an area and essentially wanted to build a factory, they would have to submit all these environmental plans,” he says. “This industry, because it’s more diffuse over such a large geographic area, has avoided getting that kind of scrutiny. The [federal] Clean Air Act is very much devised to regulate the largest industrial processors, not necessarily an industrial process spread through an entire region.”

Although the individual gas plants do have to obtain Clean Air Act permits, and their emissions are regulated, it is the cumulative impact of numerous facilities that has caused a problem for the Hallowiches.

### **The Dispute Goes to Court**

Pitzarella says that Range has offered to buy the Hallowich property, while leaving them the mineral rights, for around \$200,000. Pitzarella says the offer—which was made verbally, not in writing—was based on a real estate agent’s assessment of the fair market value of the property. But the Hallowiches, who have put their house on the market for close to \$500,000, say they never received either a verbal or written offer from Range, although the company invited them to talk. They say that Range asked what they wanted; they replied that they wanted the company to buy their house, reimburse them for water, pay their legal fees, and create an escrow account for medical monitoring for the family.

The two sides disagree on exactly when negotiations broke down, but the Hallowiches say they did not want to sign away their right to sue because their problems, they say, are bigger than polluted well water and go beyond their issues with Range. Stephanie Hallowich points out that their lives also have been disrupted by two big facilities built by other companies the year after they moved into their home: a gas compressor station 580 yards (530 meters) away, operated by MarkWest Energy Partners of Denver and a gas conditioning facility 340 yards (310 meters) away operated by a subsidiary of Tulsa, Oklahoma’s Williams Company. “Would you want to buy my house?” asks Stephanie. “Our house and property are worth nothing. Even if we found somebody who’d be willing to buy it, there’s probably not a bank that would finance it.”



So the Hallowiches have filed a notice of intent to sue Range, MarkWest, and Williams Company, as well as the Pennsylvania DEP, which they blame for failing to enforce the law. DEP spokesman John Repetz says that the agency's investigation into the Hallowich situation is continuing. But he said the agency could say little more about the case while it was in litigation. MarkWest and Williams also said they did not comment on matters in litigation.

Range's Pitzarella says that because Pennsylvania never has required homeowners to test their private drinking water wells, the potential is great for clashes between residents and the new gas industry. In regions where chemicals and minerals entered aquifers long ago from both farming and coal mining, Pitzarella says, the gas industry is being blamed unfairly for pollutants that were in the groundwater long before its arrival.

"Oftentimes, when we do our pre-drilling analysis, we'll find there are people that have bacteria, agricultural runoff, and sediment in their water supplies," he says. "We've had some landowners that have water wells drilled into old mine pools that they've been drinking out of for years. It's a problem in Pennsylvania."

### **'An Absolutely Unique Situation'**

As for the Hallowich property, Pitzarella says, the conflict escalated because it involved one of the first sites ever drilled in the Marcellus shale—three of the wells there were experimental. He says in both the siting of facilities and communication with residents, his company has worked harder since then to be a good neighbor.

"They are in an absolutely unique situation," he says. "Not only will you not see it in the future, you won't see it now, and you won't see it since then." He points to the more than 2,100 Marcellus wells drilled in Pennsylvania so far and the thousands of landowners across the state who have signed leases allowing gas companies to produce on or under their properties. "If this were the norm, there would be tens of thousands of people saying, 'It's happening everywhere. I can't get away from it.'"

Pitzarella says he can show many Range sites in southwestern Pennsylvania where there is little remaining sign of any drilling operation—just a low, green pipe and valve structure, commonly called a "Christmas tree," fenced off from surrounding land. There also are numerous happy landowners among the hundreds of Range leaseholders in Washington County.

### **Some Embrace the Industry**

Typical is Beverly Romanetti, whose family lives just over a mile from the Hallowich place. "We have not had a problem at all," she says about the gas well, which takes up three to five acres of their approximately 150-acre cattle farm. "They are very polite, and try to please," she says of the gas company.

"It definitely has changed our way of living in this county," Romanetti concedes. "We're used to no traffic, and now you have the big trucks." But, she says, "what they have given back to every inch of this county is amazing." Romanetti mentions the lease money that has allowed farmers to stay on their land and not sell or subdivide, the donations that the companies have made to local charities and the student agricultural group, 4-H, and the road repairs that Range has made to make up for the damage done by its trucks. "People should embrace them," she says.

(Related: [“A Drive for Jobs Through Energy”](#))

In July, Range, which was the first company to drill in the Marcellus, also became the first shale company to voluntarily [disclose the chemicals](#) it uses at each frack site, and as of late last year it has aimed to reuse 100 percent of its drilling wastewater. “This is far too important and too great of an opportunity to not get it right,” Pitzarella says. “I’ll be the first to tell you that we’re not perfect and we may make some mistakes—poor communication with a landowner, choosing a bad location for an access road, things like that. But if we make a mistake we own up to it and make it right.”

Evidence on the dispute with the Hallowiches is now being gathered in Washington County court. The Hallowiches are giving up their dream of ten acres and a home in the country for now. They are planning to rent a place in the Pittsburgh suburbs.

*\* Most of East Resources assets have since been acquired by Royal Dutch Shell, which is sponsor of the National Geographic initiative [The Great Energy Challenge](#). This report is produced as a part of that initiative, in which National Geographic maintains autonomy over content.*