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Sunday Times review of DEP drilling records reveals water damage, murky testing methods

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First of two parts

State environmental regulators determined that oil and gas development damaged the water supplies for at least 161 Pennsylvania homes, farms, churches and businesses between 2008 and the fall of 2012, according to a cache of nearly 1,000 letters and enforcement orders written by Department of Environmental Protection officials and obtained by The Sunday Times.

The determination letters are sent to water supply owners who ask state inspectors to investigate whether oil and gas drilling activities have polluted or diminished the flow of water to their wells.

View interactive map:

Gas Drilling Complaints Map

Inspectors declared the vast majority of complaints - 77 percent of 969 records - unfounded, lacking enough evidence to tie them definitively to drilling or caused by a different source than oil and gas exploration, like legacy pollution, natural conditions or mining.

One in six investigations across the roughly five-year period - 17 percent of the records - found that oil and gas activity disrupted water supplies either temporarily or seriously enough to require companies to replace the spoiled source.

The letters confirming contamination or water loss from drilling and the orders that require companies to fix the damage provide what is likely the best official count of the industry's impact on individual water supplies in Pennsylvania because the state does not track the disruptions.

The Sunday Times requested the records in late 2011, and received access to them late last year after a state appeals court ruled that the DEP had to release the documents regardless of whether it was hard for the agency to find them in its files.

While the records compiled by the newspaper offer a more complete tally of the number of affected properties than was previously available, the count is not exhaustive:

- DEP tracks oil and gas-related disruptions to water supplies based on broad incidents, each of which might affect one or many water supplies, making comparisons between the totals difficult. A case of gas migrating into Dimock Twp. drinking water, for example, is considered one incident by DEP even though the state determined it affected 18 water wells used by 19 families. DEP spokesman Kevin Sunday said the agency compiles "some information" on the number of affected water wells and springs, but DEP's

statistics on impacted water supplies differ from the numbers documented in the letters and orders released to The Sunday Times. Between 2010 and 2012, DEP counted 103 impacted water supplies - six more than were documented for those years in the records released to the newspaper.

- DEP repeatedly argued in court filings during the open records case that it does not count how many determination letters it issues, track where they are kept in its files or maintain its records in a way that would allow a comprehensive search for the letters, so there is no way to assess the completeness of the released documents.

- Before a 2011 regulatory update, solutions worked out privately between homeowners and drillers were not required to be reported to the department. The Sunday Times requested the notices of potential water contamination that now have to be passed on to DEP by drilling companies that receive them from residents, but the request was denied by DEP and the state's Office of Open Records because the documents are considered part of protected investigations.

- The conclusions described in the determination letters are seldom absolute because substances read as signals of drilling-related contamination are also routine signs of other man-made or natural influences.

For regulators, tracking broad cases is more useful from a technical standpoint than counting impacted water wells, Mr. Sunday said in an email.

"The number of water supplies impacted is not always reflective of the scope of the problem," he said.

Using its definition of incidents, DEP counted 83 cases of drilling-related impacts on water supplies between 2008 and 2012, roughly the same period covered by the records released to The Sunday Times. The state has confirmed water supply impacts in 128 broad cases since 1987, he said.

The state's case-based tally suggests the rate of drilling-related contamination incidents increased with the start of the Marcellus boom: Drilling damaged water supplies at a rate of more than 16 cases per year during the past five years, according to the state's accounting. For the 20 years prior to 2008, the incidence rate was fewer than three cases per year.

Mr. Sunday said the increase can be attributed to a shift from drilling in western areas of the Commonwealth with a long history of oil and gas extraction to central and eastern regions where the shallow geology is complex, gas-rich and less studied. Those factors mean "that there will be an adjustment period during which operators refine casing and cementing practices in order to most effectively establish and maintain the highest standards of well integrity," he said.

The most recent trends - DEP counted five contamination cases that impacted roughly 19 water supplies in 2012 compared to 18 cases that impacted 27 water supplies in 2011 - suggest that the improvements are working, he said.

Transparency questioned

The department's water testing and reporting protocols have come under scrutiny in recent months as environmental activists and homeowners whose drilling-related complaints were dismissed have come to doubt the determinations' accuracy and value.

DEP recently changed its policy for issuing water contamination notices to require administrators in Harrisburg to approve them before they are sent out from the regional field offices that conduct the investigations. The state's laboratory technical director, deposed when a resident appealed the DEP's conclusion that drilling activities had not polluted his water supply, acknowledged that DEP reviews and reports back to homeowners only those contaminants it considers indicative of drilling-related contamination, not all of the contaminants that might surface in its water tests - a common practice for tailoring laboratory analysis but one that spurred critics to question the thoroughness and transparency of DEP's investigations.

In January, state Auditor General Eugene A. DePasquale announced his office is conducting a performance audit of the DEP's water testing program to "determine the adequacy and effectiveness of DEP's monitoring of water quality as potentially impacted by shale gas development activities" between 2009 and 2012.

Debate over the safety of oil and gas extraction - especially the combined tools of horizontal drilling and hydraulic fracturing used in pursuit of fuel from unconventional sources like the Marcellus Shale - is often characterized as an argument between activists who exaggerate claims of damage and industry public relations teams who minimize them.

But the determination letters released by the state reveal a widespread suspicion among water supply owners - farmers and summer residents, school board members and mini-mart operators, churches and a Wyoming County municipal water authority - that when their water seems soured, gas drilling operations might be to blame.

According to the state's records, they are sometimes right and for a myriad of reasons.

More than half of the records of contaminated water supplies confirmed by the state involved gas, loosened by drilling, seeping into drinking water aquifers. Faulty natural gas wells channeled methane into the water supplies for 90 properties, the letters show. Three of those cases were tied to old wells, one of which caused an explosion at a home after gas entered through a floor drain and accumulated in a basement.

Drilling-related road construction contaminated water at two homes, while construction for a large water-storage pond called an impoundment contaminated another. Pipeline construction twice polluted water supplies with sediment. Stray cement or rock waste displaced by drilling, called cuttings, contaminated seven water supplies.

The state has never implicated the underground gas extraction process known as hydraulic fracturing, or fracking, in a contamination incident, but inspectors noted that brine contamination suggesting "an

infiltration of frac water into the shallow ground water," damaged six fresh-water springs used for drinking water in northwestern Pennsylvania.

Some of the problems were short-lived: the DEP letters describe 20 of the confirmed contamination incidents as temporary.

Regulations needed

The incidents documented in the letters reinforce why the state and industry have focused on strengthening standards for above-ground activities so materials don't infiltrate the surface and well construction to ensure the cemented casings that protect groundwater are sound, Marcellus Shale Coalition CEO Kathryn Klaber said.

The natural gas industry has worked on several fronts to investigate and respond to contamination complaints, including providing drinking water to homeowners while their concerns are investigated, she said. The organization and university partners are also compiling a database of pre-drilling groundwater quality to help researchers assess background water quality and insulate operators from misplaced blame.

The letters obtained by The Sunday Times describe an array of problems that exist in Pennsylvania water supplies unrelated to oil and gas exploration, like high metal, salt and methane content and bacteria from surface water or nesting creatures invading poorly built water wells.

A 2011 Penn State study found that about 40 percent of water wells it tested prior to gas well drilling failed at least one federal drinking water standard, usually for coliform bacteria, turbidity or manganese. Pennsylvania is one of only a few states in the nation that does not have private water well construction standards.

"It really is time for Pennsylvania to put in place some standards for private water wells," Ms. Klaber said.

Regulations could help address pre-existing water quality problems and make sure water wells are stable enough to handle any nearby industrial activity, including oil and gas operations, she said. "When you've got vibration and activity proximate to an unlined water well you're going to get infiltration of dirt and other materials. That turbidity, usually temporary, is going to affect that water."

Presumed responsible

Indicators of drilling-related contamination might equally point to past pollution or natural systems changing with weather or seasons, so the contaminants DEP cites as evidence of a drilling impact in one letter can be cited as evidence of background water conditions in another.

Manganese, iron and a measure of the salts and minerals dissolved in the water known as total dissolved solids (TDS) are among the elevated parameters most frequently noted by DEP inspectors in water wells they determined were not influenced by drilling, but in at least 30 cases where the DEP

determined that oil and gas drilling had contaminated water supplies, increases in manganese, iron or TDS were described as a primary or sole indicator of a problem.

Letters sent to nine McKean County homeowners during an involved investigation of drilling-related contamination captured the difficulty of drawing conclusions based on substances that can indicate both normal conditions and harm: "An elevated level of these compounds is not uncommon in this region and can occur naturally," the investigator in the case wrote, "but it is also recognized that they can become elevated as a result of drilling oil and gas wells."

DEP does not rely only on water test results to determine whether a water supply was affected by drilling, Mr. Sunday said. "We employ a very complex analysis in these investigations." Inspectors "consider things like local water well and gas well integrity, a geochemical evaluation of the water supply, and the local rock formations and how water flows through them," he said.

In many cases, the failure that led to contamination is left as opaque as turbid water.

DEP blamed a Marcellus Shale driller in Susquehanna County for water contamination in 2010 after the salt, barium, strontium and gas concentrations in the Rush Twp. home's water supply spiked after the company drilled and fracked a well 600 feet away.

The post-drilling barium levels reached 47 milligrams per liter - more than 23 times the safe level of the toxic metal in drinking water - while the TDS, chloride and sodium levels peaked at more than 10,800, 5,800 and 3,800 milligrams per liter, respectively - more than 20 times the guidance levels set for aesthetic reasons like taste and appearance.

The determination letter and the subsequent order requiring the driller, Stone Energy, to replace the water well do not describe the mechanism for the pollution. Instead, Mr. Sunday said, the company was presumed responsible for the contamination based on the timing of the impact and the distance from the gas well and the company did not rebut the state's finding.

Stone Energy believed its drilling activity was not to blame for the pollution, but agreed to drill the homeowner a new water well and repay him for out-of-pocket living expenses without admitting to causing the problem, according to the enforcement order.

High TDS, chlorides, sodium, barium and strontium - all potential signatures of contamination from Marcellus development wastewaters - "also occur in brackish or saline groundwater which have been documented at relatively shallow depths in this part of the state," Mr. Sunday said. Although the concentrations of those elements surged to levels between 46 and 142 times the pre-drill concentration measured on the property, the post-drilling samples were taken from a different, deeper water well and so could have been affected by the shallow brine.

Critics of natural gas drilling say the ambiguity left by DEP investigations means the state needs more robust tools and a stronger will to pursue clues about contamination to its source.

Anthony Ingraffea, Ph.D., an engineering professor at Cornell University and a vocal critic of the oil and gas industry he once worked for, said that when DEP says it cannot find a connection between water well contamination and nearby gas activity it does not mean there is no link.

"If DEP sent me a letter that said, 'We can find no connection,' my natural question as a scientist would be, 'How did you look?'" he said.

He was concerned by DEP's practice of counting cases without counting individually impacted water supplies, which he said "makes their statistics look better."

"It doesn't help answer the question, which is how many individual families' private drinking water wells have been contaminated by oil and gas activities," he said. "No one knows the answer. Who should know the answer? DEP."

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