Platt, Steve

From: graceann bergin <gbergin007@gmail.com>
Sent: Wednesday, September 11, 2013 3:11 PM
To: Platt, Steve
Subject: Fwd: FW: Highland Ext. -Zelman #1 Injection Well Brady Township Clearfield County, PA

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.>

Mr. Stephen Platt, EPA Region 111
Ground Water & Enforcement Branch
Office of Drinking Water & source (3WP2)
1650 Arch Street Philadelphia, PA 19103

re:PAS2D020BCLE
Brady Township Clearfield County, PA

Dear Mr. Platt,

I am writing you and members of the EPA again asking that you deny Wind Fall a permit to build, install and operate a Toxic Waste Well Class 2 Injection in Brady Township Clearfield County, PA.

I remind you and EPA members of the 21 earthquakes that happened in Ohio between March 17, 2011 & December 31, 2011. 19 earthquakes happened in the eastern part of the state, 13 earthquakes in Youngstown. The highest quake registering @4.0 on Dec.31,2011 occurred in Youngstown. A quake of that magnitude can be felt, rattling and breaking dishes, shattering windows, shaking buildings and cracking walls and foundations. The waste injection well was the contributing

factor in causing these quakes. A moratorium was put in place on waste injection wells and the quake activity has slowed to a stop.

That is one example of a waste injection well contributing to seismic activity, but there are other incidences across the United States including ones in Arkansas, Oklahoma, Texas, Colorado and West Virginia.

State officials in Arkansas and Ohio have shut down operations of waste injection wells because of seismic activity. In Texas near Dallas-Fort Worth airport a gas company shut down it's well activity because it was linked to causing quakes. Prague, Oklahoma has had several earthquakes, the largest happen November 6,2011 @5.7 on the Richter scale. It too was linked to a waste injection well and caused much damage to area homes and infrastructure.

Why would the EPA want to endanger the people of Brady Township and the people of the city of Du Bois and area, with a waste injection well on Zelman's property. All waste injection wells have the potential of causing earthquakes. The seismic activity has the potential of contaminating the water ways including streams, springs, private wells, the municipality well in Brady, and the city of Du Bois Reservoir's in Union township. Homes and businesses in the surrounding could be weakened and destroyed, windows broken, foundations cracked, pipe lines for water, gas and sewer lines damaged, roads destroyed,and so on and so.

It would be foolish to grant a permit to Wind Fall, to much is at stake. Please protect the people who live here.

Sincerely concern citizen .

Grace Bergin
216 E. Scribner Ave.
Du Bois, PA 15801-2250

gbergin007@gmail.com

Platt, Steve

From: Windstream Mail <fairway08@windstream.net>
Sent: Wednesday, September 11, 2013 4:39 PM
To: Platt, Steve
Subject: Highland Street injection well permit PAS2D020BCLE

September 10, 2013

EPA Region III
Ground Water & Enforcement Branch (3WP22)
Office of Drinking Water & Source Water Protection
1650 Arch Street
Philadelphia, PA 19103

Dear EPA:

RE: PAS2D020BCLE - Brady Township, Clearfield County, PA

This letter is to provide comment on the EPA Public Comment period for seismicity concerns for the Brady Township Underground Injection Control Permit PAS2D020BCLE. The EPA received extensive comments during 2012 that requested this permit be denied and seismicity was one of the listed concerns since area water sources could be contaminated.

1) Studies specific to injection wells need to be done before this proposed injection well is located in a residential area that is near so many private wells, multiple municipal water sources and our local municipal water reservoir.

2) Stating that seismic events are extremely rare in Clearfield County is an incorrect assumption that needs further study. Studies need to be specific to our area before it is assumed that "seismic events are extremely rare."

3) Monitoring pressure is insufficient to protect residents from an injection well failure since damage to water sources will have happened before shutdown procedures could be taken.

4) Man induced seismic concerns have already affected homes when a natural gas line blew up a home in the past. Blasting for coal in our township has cracked foundations of homes in the past and coal mining continues to operate in Brady township.

5) Prior public hearing testimony presented demonstrated residents' concerns of fault lines present in the review area that deeply concern residents of the chances being taken to cause seismic activities. The fault lines that exist cause concern and fluids traveling along the fault to flow towards abandoned deep gas wells and abandoned coal mines through old casings or a syncline is just a way to cause trouble in the future for residents.

6) The changes in underground pressures have the potential to affect the faults and cause seismicity concerns. Fluids may lubricate the faults causing seismic activity and possible earthquakes.

7) One study shed enough doubt on injection wells and seismic activities to stop this permit (Science Magazine on July 12, 2013 citied William Ellsworth from the Earthquake Science Center, U. S. Geological Survey, Menlo Park, California. Article is here

). Other studies and recent happenings in four states cause grave concerns that back up denying this permit.

8) Residents aren't willing to accept the risk of it "might not happen" when they have already seen mistakes happen first hand in our area at another injection well that is located in Bell Township, Clearfield County. **Exco operated the irvin injection well at a pressure exceeding its permitted maximum injection pressure for a**

three month period in 2010. Exco violated the terms of its uic permit by failing to immediately cease injection of brine into the irvin a-19 brine disposal well ("irvin well") upon discovering that the well had failed mechanical integrity.

9) There have been several studies done by reputable people associated with reputable labs and government agencies who all warn of pending and past seismic damage from injection well activity. I'm sure you have access to these reports just as we do. One of the latest talks about earthquakes that can/will happen 10 yrs in the future from these wells. (NBC Science) Do we listen to these experts and heed their warnings or continue towards an unknow fate. I don't think this is what the residents of the Village of Highland Street EXT envisioned when they/we built here.....

This permit for a proposed disposal injection well in Brady Township should be denied due to the increased risk of earthquakes due to known faults within the Area of Review.

Sincerely,

Mrs. Joanne Baird

1273 Highland Street EXT

DuBois, Pa. 15801

Platt, Steve

From: Windstream Mail <fairway08@windstream.net>
Sent: Wednesday, September 11, 2013 4:37 PM
To: Platt, Steve
Subject: Highland Street injection well permit PAS2D020BCLE

September 10, 2013

EPA Region III
Ground Water & Enforcement Branch (3WP22)
Office of Drinking Water & Source Water Protection
1650 Arch Street
Philadelphia, PA 19103

Dear EPA:

RE: PAS2D020BCLE - Brady Township, Clearfield County, PA

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This permit for a proposed disposal injection well in Brady Township should be denied due to the increased risk of earthquakes due to known faults within the Area of Review.

Sincerely,

Randall R. Baird Sr.

1273 Highland St EXT

DuBois, Pa. 15801

Platt, Steve

From: Duane Marshall <mrdewy@yahoo.com>
Sent: Wednesday, September 11, 2013 10:33 PM
To: Platt, Steve
Cc: Platt, Steve
Subject: Re: EPA Comments .

September 11, 2013

EPA Region III
Ground Water & Enforcement Branch (3WP22)
Office of Drinking Water & Source Water Protection
1650 Arch Street

Philadelphia, PA 19103

Dear EPA:

RE: PAS2D020BCLE - Brady Township, Clearfield County, PA

This is an additional comment on seismic concerns. In recent conversation with someone who worked in the coal mining industry we have learned that when blasting the effects of the explosion travel along the rock and the fault line which potentially is a man made seismic concern. Any coal mining blasts would enhance negative effects an injection well might have on the locally defined faults and potentially contaminate USDWs. At least four coal companies have the rights to mine coal in Brady Township. Faults have already been identified in the area. Combining an injection well, faults and blasting for coal mining is three ingredients we don't want to see mixed for an explosive problem waiting to happen.

Sincerely,

Duane & Darlene Marshall

From: Duane Marshall <mrdewy@yahoo.com>;
To: platt.steve@epa.gov <platt.steve@epa.gov>;
Cc: Steve Platt (EPA) <Platt.Steve@epamail.epa.gov>;
Subject: EPA Comments
Sent: Tue, Sep 10, 2013 6:48:56 PM

September 9, 2013

EPA Region III
Ground Water & Enforcement Branch (3WP22)
Office of Drinking Water & Source Water Protection
1650 Arch Street
Philadelphia, PA 19103

Dear EPA:

RE: PAS2D020BCLE - Brady Township, Clearfield County, PA

The original copies of our public comments have been mailed and should be delivered before September 11, 2013. Attached to this email, you will find copies of all the documents sent already.

We found a recent news article since mailing our public comments and wanted to share it with the EPA. It is attached for your records and we will mail an original copy to your office. The news article is from September 4, 2013 about Timpson, Texas and seismic concerns related to injection wells. After reading this news article our local residents question if our local water tower has been built to withstand earthquakes and what about buildings and homes. This is just one more article that provides a sound basis to deny this permit. Becoming the next Timpson, Texas is not something that Brady Township residents want to experience especially since many homeowners don't have earthquake insurance.

Sincerely,

Duane & Darlene Marshall

Duane & Darlene Marshall
1070 Highland Street Extension
DuBois, PA 15801
mrdewy@yahoo.com

Platt, Steve

From: Rick & Marianne Atkinson <marianne5@windstream.net>
Sent: Wednesday, September 11, 2013 6:51 AM
To: Platt, Steve
Subject: Comment by Richard Atkinson Windfall Zelman DIW
Attachments: Map of Basement Faults in PA DCNR.pdf; Comment by Richard Atkinson Windfall Zelman DIW.DOCX

The attached pdf map and link below are the sources of the maps.

http://www.searchanddiscovery.com/documents/2009/50203smith/index.htm

Windfall/Zelman #1 DIW ~ Permit # PAS2D020BCLE

There was human activity which induced seismic events that occurred at the Northstar 1 Class 2 injection well in the Youngstown, OH area.

Before January 2011, Youngstown, Ohio, which is located on the Marcellus Shale, had never experienced an earthquake, at least not since researchers began observations in 1776. However, in December 2010, the Northstar 1 injection well came online to pump wastewater from fracking projects in Pennsylvania into storage deep underground. In the year that followed, seismometers in and around Youngstown recorded 109 earthquakes, the strongest registering a magnitude-3.9 earthquake on Dec. 31, 2011. The well was shut down after that quake.

With only one seismometer deployed in the Youngstown area, state geologists lacked the necessary data on the earthquakes' depth and exact location to draw a direct correlation between the seismic events and the deep injection well.

Once sufficient monitoring equipment was in place, the focal depths of events were found to be about 4,000 ft (1,220 m) laterally and 2,500 ft (760 m) vertically from the wellbore terminus.

There is only one seismometer in the vicinity of the proposed Windfall/Zelman #1 DIW. This seismometer is located at the Penn State-DuBois Campus. It is part of the Penn State Seismic Network.

The reforms listed below will make Ohio's Class II deep injection wells among the most carefully monitored and stringently regulated disposal wells in the nation. Ohio will seek the following reforms to its Class II deep injection well program:

- Requires a review of existing geologic data for known faulted areas within the state and avoid the locating of new Class II disposal wells within these areas;
- Requires a complete suite of geophysical logs (including, at a minimum, gamma ray, compensated density-neutron, and resistivity logs) to be run on newly drilled Class II disposal wells. A copy of the completed log, with analytical interpretation will be submitted to ODNR;
- Evaluates the potential for conducting seismic surveys;
- Requires operators to plug back with cement, prior to injection, any well drilled in Precambrian basement rock for testing purposes.
- Requires the submission, at time of permit application, of any information available concerning the existence of known geological faults within a specified distance of the proposed well location, and submission of a plan for monitoring any seismic activity that may occur;
- Requires a measurement or calculation of original downhole reservoir pressure prior to initial injection;\
- Requires the installation of a continuous pressure monitoring system, with results being electronically available to ODNR for review;
- Requires the installation of an automatic shut-off system set to operate if the fluid injection pressure exceeds a maximum pressure to be set by ODNR;
- Requires the installation of an electronic data recording system for purposes of tracking all fluids brought by a brine transporter for injection;

Richard L. Atkinson ~ 221 Deer Lane, DuBois, PA 15801 marianne5@windstream.net

To bolster its earthquake monitoring capabilities, ODNR will purchase four additional portable seismometers. These sophisticated monitoring devices will augment existing seismometers where necessary, and provide state geologists with quick access to detailed data on seismic activity. In addition, ODNR is in the process of identifying an "outside" expert with experience in seismicity, induced seismicity, and Class II injection wells to conduct an independent review of the currently available technical information, as well as information to be supplied by the injection well owners in the vicinity of the Northstar 1 well. This independent analysis will provide a scientific third party evaluation and analysis of all technical information to ensure thoroughness of the process.

The Region 3 EPA should copy the ODNR and institute the same reforms for their Class 2 Disposal Injection Well program.

The following, "PRECAMBRIAN BASEMENT MAP OF THE APPLACHIAN BASIN AND PIEDMONT PROVINCE IN PENNSYLVANIA" shows seismic faults in the general area of the proposed Zelman #1 DIW, which is in the northwestern part of Clearfield County.

Seismic faults are seismically active geologic faults. This is a category of all geologic faults which may be seismically active and cause earthquakes or be long inactive.

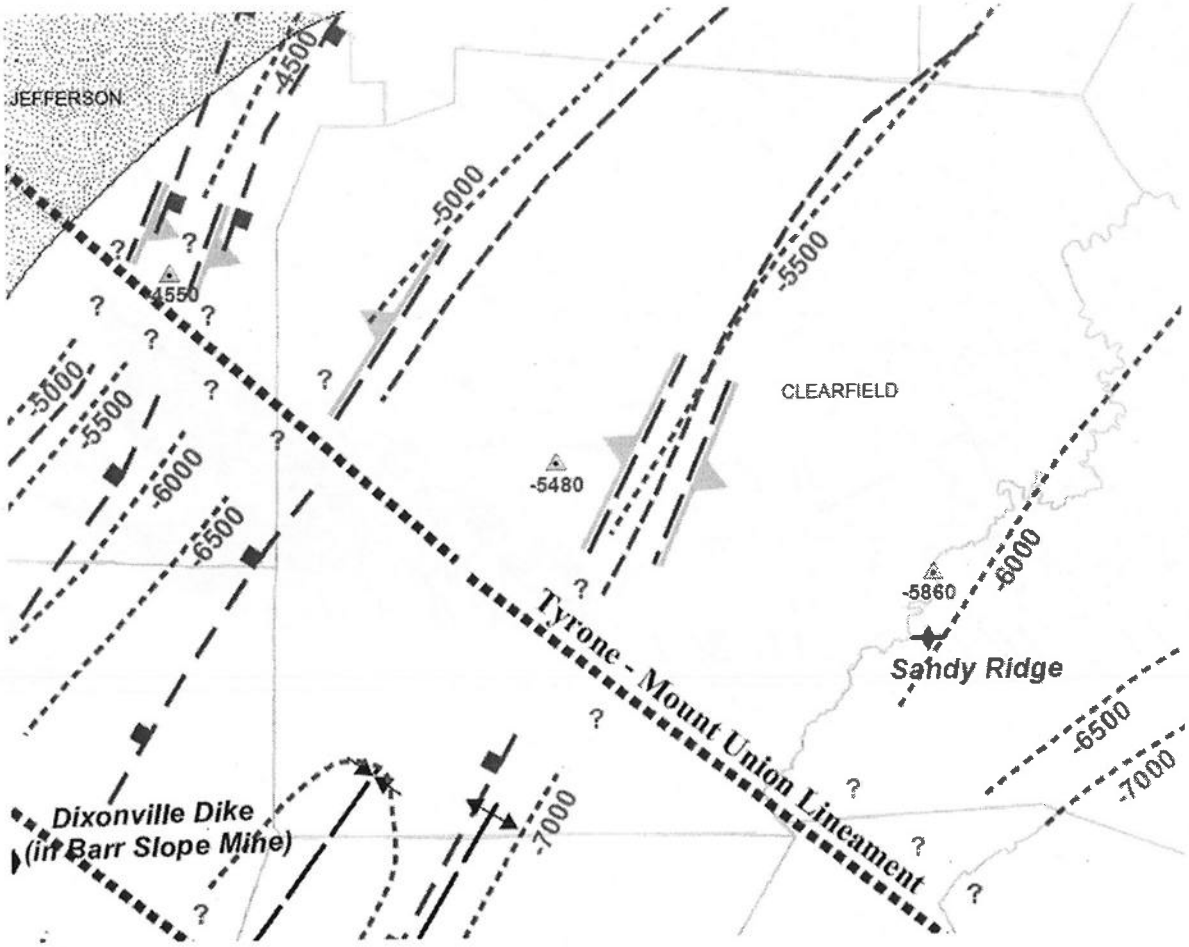
Richard L. Atkinson ~ 221 Deer Lane, DuBois, PA 15801 marianne5@windstream.net

PRECAMBRIAN BASEMENT MAP OF THE APPLACHIAN BASIN AND PIEDMONT PROVINCE IN PENNSYLVANIA

SYMBOLS LEGEND

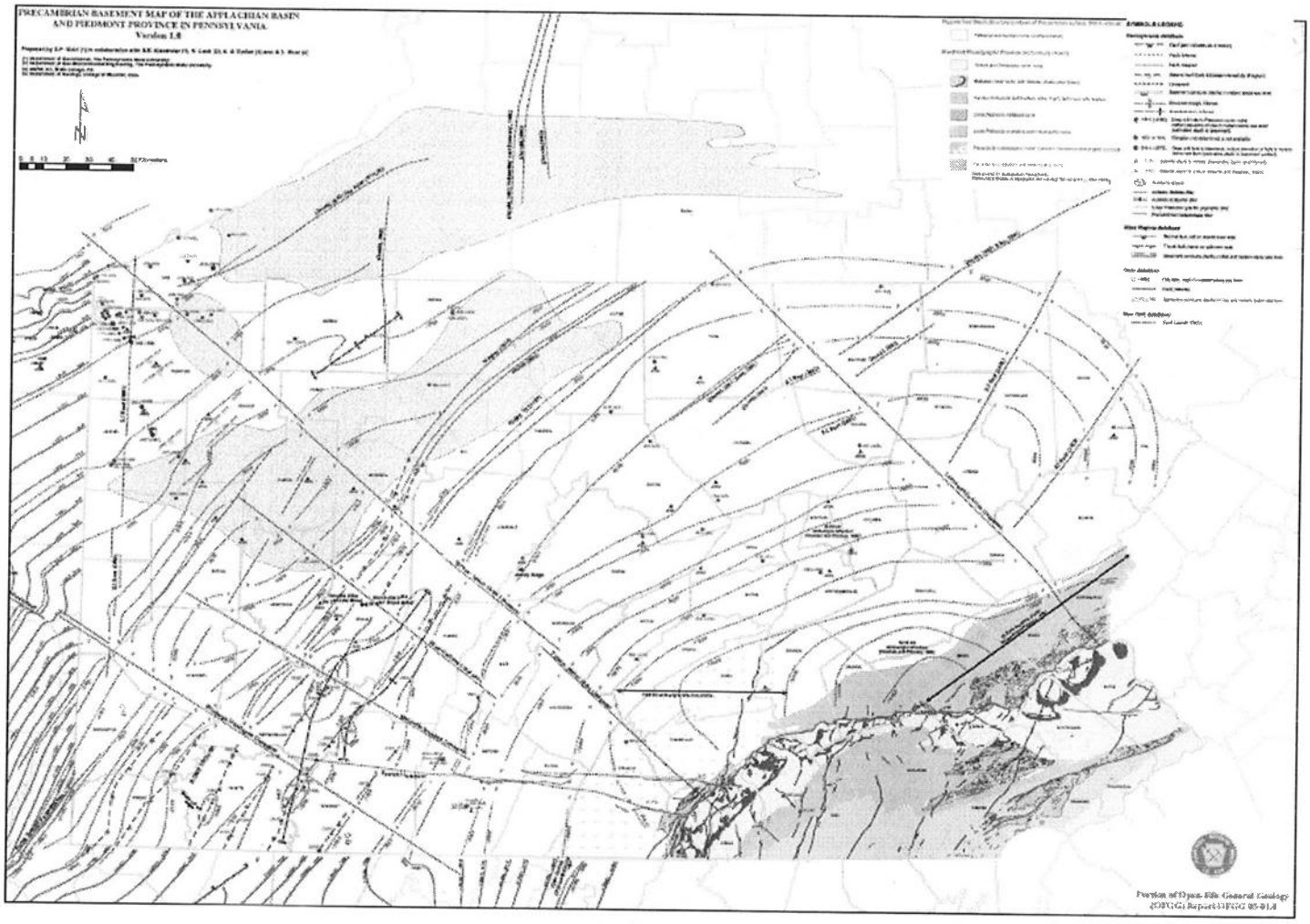
Pennsylvania database

- Fault (tab indicates dip direction)
- Fault, inferred
- Fault, mapped
- Seismic fault (barb indicates inferred dip direction)

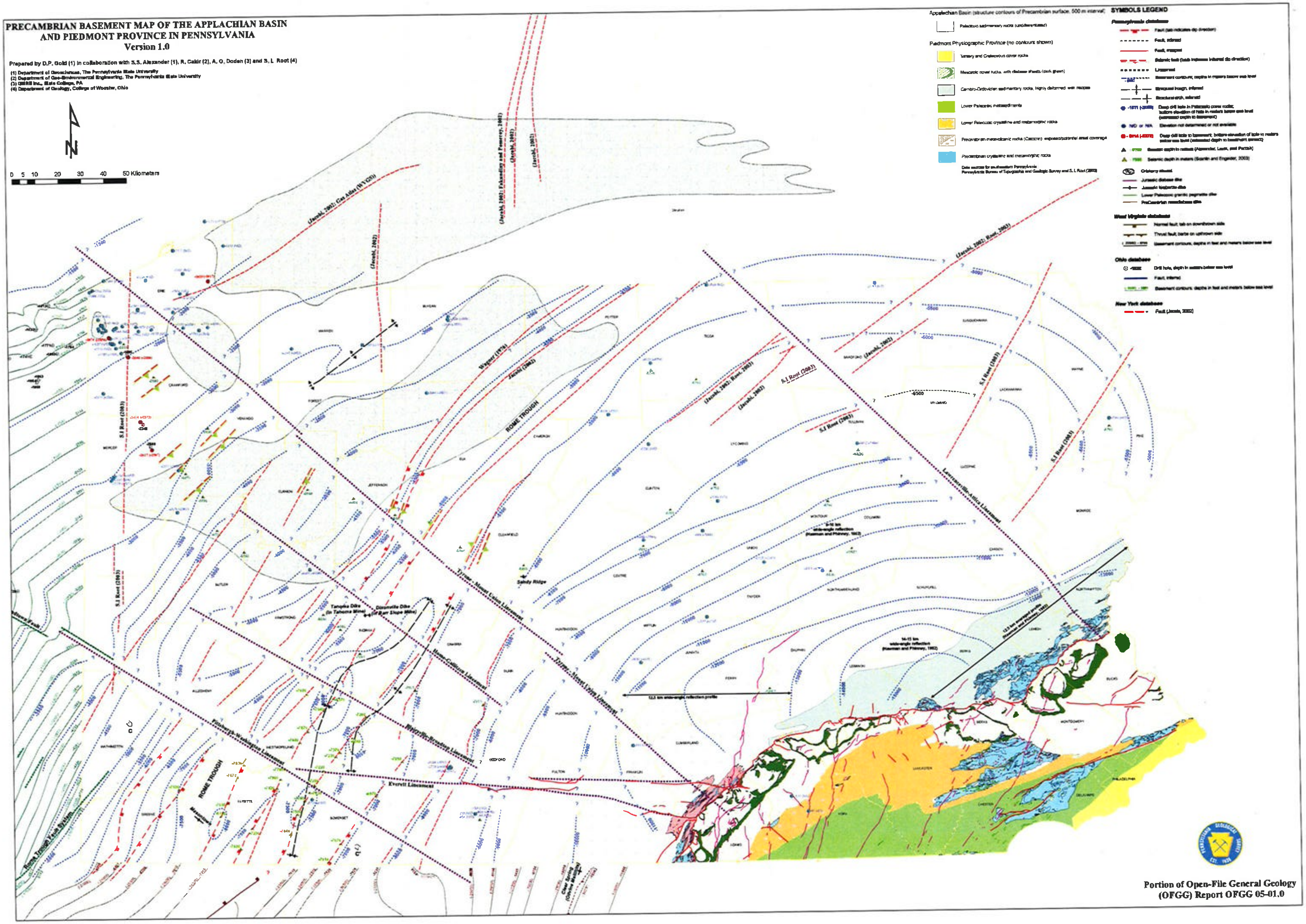


Richard L. Atkinson ~ 221 Deer Lane, DuBois, PA 15801 marianne5@windstream.net

PRECAMBRIAN BASEMENT MAP OF THE APPLACHIAN BASIN AND PIEDMONT PROVINCE IN PENNSYLVANIA



Richard L. Atkinson ~ 221 Deer Lane, DuBois, PA 15801 marianne5@windstream.net


PRECAMBRIAN BASEMENT MAP OF THE APPLACHIAN BASIN
AND PIEDMONT PROVINCE IN PENNSYLVANIA
Version 1.0
Prepared by D.P. Gold (1) in collaboration with S.S. Alexander (1), R. Cakir (2), A. O. Doden (3) and S. L Root (4)
(1) Department of Geosciences, The Pennsylvania State University
(2) Department of Geo-Environmental Engineering, The Pennsylvania State University
(3) GMRE Inc., State College, PA
(4) Department of Geology, College of Wooster, Ohio
0 5 10 20 30 40 50 Kilometers
Appalachian Basin (structure contours of Precambrian surface, 500 m interval)
Paleozoic sedimentary rocks (undifferentiated)
Piedmont Physiographic Province (no contours shown)
Tertiary and Cretaceous cover rocks
Mesozoic cover rocks, with diabase sheets (dark green)
Cambro-Ordovician sedimentary rocks, highly deformed with nappes
Lower Paleozoic metasediments
Lower Paleozoic crystalline and metamorphic rocks
Precambrian metavolcanic rocks (Catoctin) exposed/potential areal coverage
Precambrian crystalline and metamorphic rocks
SYMBOLS LEGEND
ROME TROUGH
Sandy Ridge
Everett Lineament
Portion of Open-File General Geology
(OFGG) Report OFGG 05-01.0

Windfall/Zelman #1 DIW ~ Permit # PAS2D020BCLE

From the Supplement to the Statement of Basis:

> The Huntersville Chert/Oriskany formation, the intended injection zone, has been a prolific producer of natural gas in this area since the late 1950s/early 1960s. The removal of both natural gas and brine from this formation has lowered the formation's pore pressure and has created available pore space (storage capacity) making this reservoir a good candidate for the disposal of fluids. Sites such as depleted oil and gas reservoirs can make excellent disposal zones, because

There is not much available pore space in the intended injection zone due to gas production. A relatively small amount of brine has been removed compared to the 30,000 bbls per month that could be permitted to be injected. The natural gas that has been produced was in solution under high pressure in the existing brine fluids. When a gas well was drilled and the underground pressure was released, the gas came out of solution, but the total volume of fluid decreased insignificantly. Therefore, there is very little newly available pore space due to gas production for the injected fluids to go into. The waste water would have to make room for itself by displacing native fluids.

An analogy would be opening a can of beer. When the pressure in the beer can is released, the carbon dioxide dissolved in the beer is released. The beer will go flat, but its volume in the can is virtually the same, even though a significant amount of carbon dioxide gas has escaped.

Therefore, there is little or no available pore space for the injection of waste fluids into the proposed Windfall DIW, since the pore space is already filled with brine. Brine pressure on faults will be increased because of the injected waste water. The pore pressure in the injection zone is going to increase because the waste water has to make room for itself by pushing away the existing fluids. Since liquids have a very low compressibility, any nearby faults will be hydraulically linked to the injection well pressure. Thereby, fluid pressure on the faults will increase, possibly inducing earthquakes.

Marianne Atkinson ~ 221 Deer Lane, DuBois, PA 15801 marianne5@windstream.net

Windfall/Zelman #1 DIW ~ Permit # PAS2D020BCLE

There was human activity which induced seismic events that occurred at the Northstar 1 Class 2 injection well in the Youngstown, OH area.

Before January 2011, Youngstown, Ohio, which is located on the Marcellus Shale, had never experienced an earthquake, at least not since researchers began observations in 1776. However, in December 2010, the Northstar 1 injection well came online to pump wastewater from fracking projects in Pennsylvania into storage deep underground. In the year that followed, seismometers in and around Youngstown recorded 109 earthquakes, the strongest registering a magnitude-3.9 earthquake on Dec. 31, 2011. The well was shut down after the quake.

The map below shows basement faults in the vicinity of the proposed Windfall/Zelman #1 DIW. If the UIC permit is issued, the same fate could happen in Brady Township as happened near Youngstown, Ohio. The UIC permit should be denied.

Structural contour map of basement with major faults, modified from Schumaker, 1996

The proposed Windfall/Zelman #1 injection well is the black dot below the black arrow.

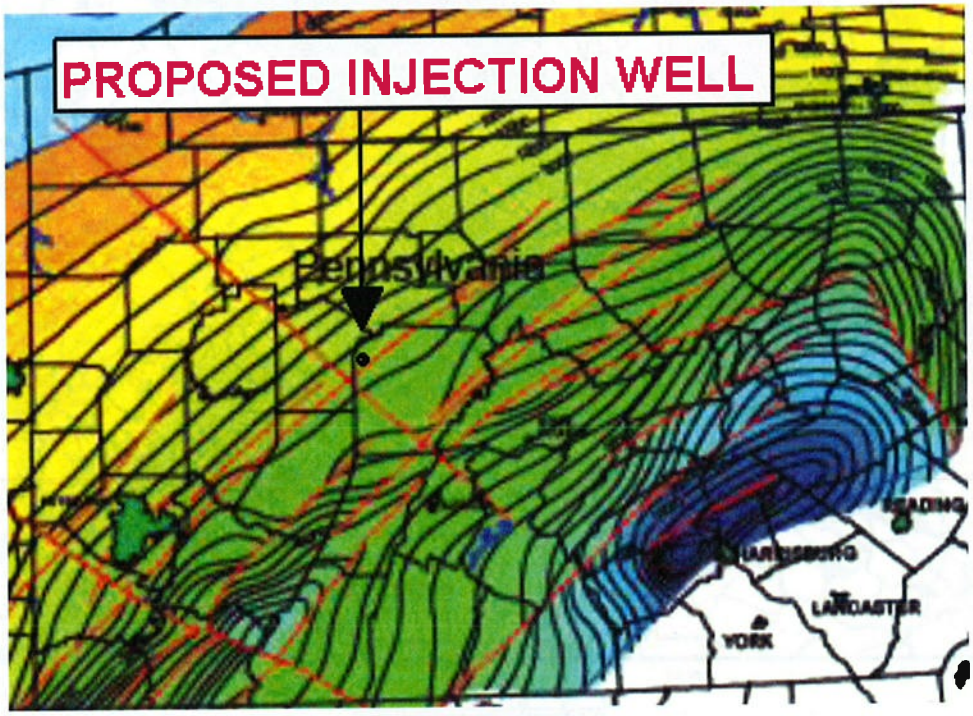


Figure 1. Structural contour map of basement with major faults, modified from Schumaker, 1996

Marianne Atkinson ~ 221 Deer Lane, DuBois, PA 15801 marianne5@windstream.net

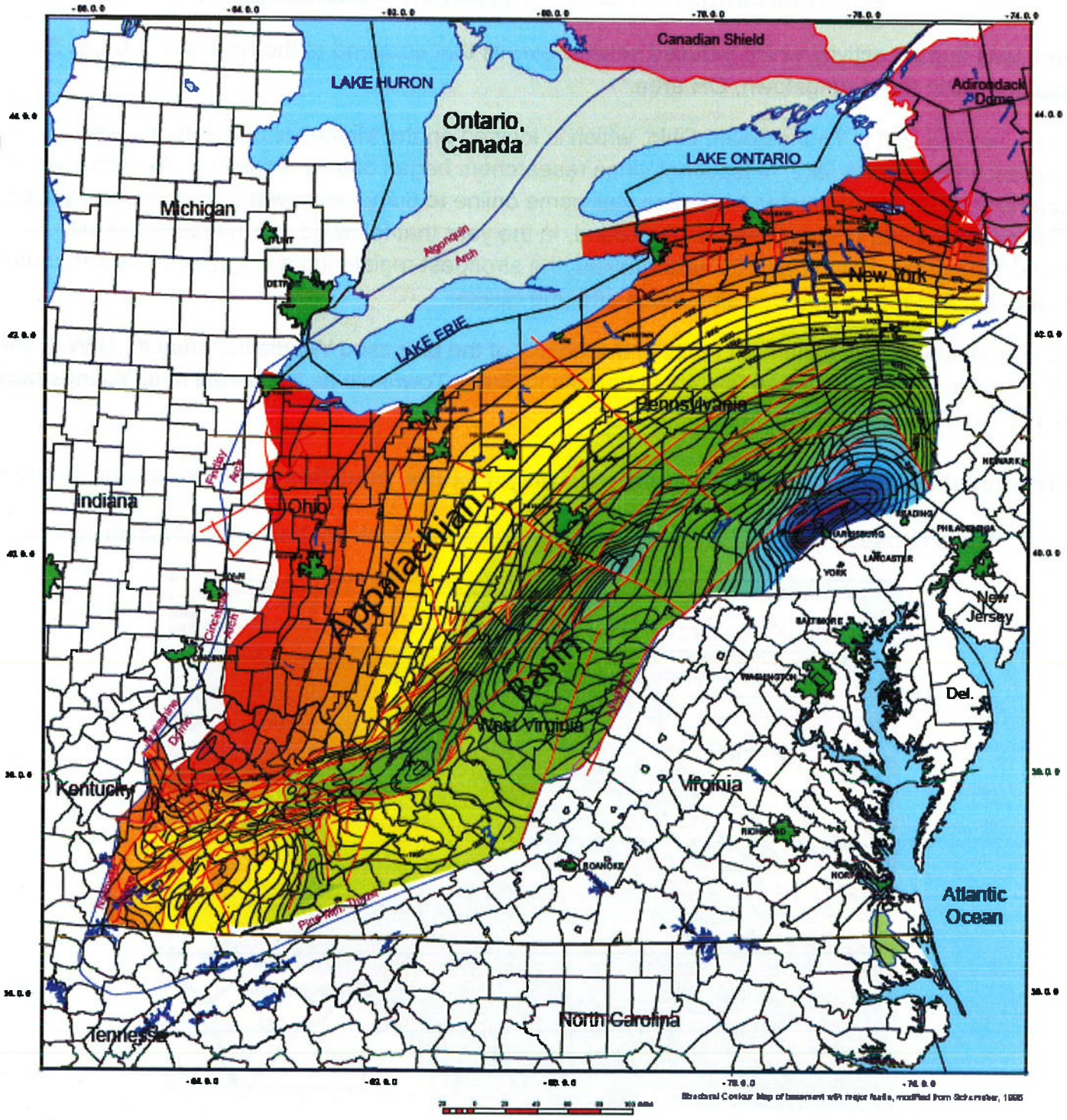


Figure 1. Structural contour map of basement with major faults, modified from Schumaker, 1996

Marianne Atkinson ~ 221 Deer Lane, DuBois, PA 15801 marianne5@windstream.net

Platt, Steve

From: Duane Marshall <mrdewy@yahoo.com>
Sent: Tuesday, September 10, 2013 2:49 PM
To: Platt, Steve
Cc: Platt, Steve
Subject: EPA Comments
Attachments: Confirmed.docx; Darlene EPA letter 9-8-13.docx; Dewy EPA 9-8-13.docx; Ethel_Marshall_9_8_2013.jpg; Insight.docx; Robert_Marshall_9_8_2013.jpg; Tremors in Timpson.docx; Vivian_Marshall_9_8_2013.jpg

September 9, 2013

EPA Region III
Ground Water & Enforcement Branch (3WP22)
Office of Drinking Water & Source Water Protection
1650 Arch Street
Philadelphia, PA 19103

Dear EPA:

RE: PAS2D020BCLE - Brady Township, Clearfield County, PA

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Sincerely,

Duane & Darlene Marshall

Duane & Darlene Marshall
1070 Highland Street Extension
DuBois, PA 15801
mrdewy@yahoo.com

Confirmed: Fracking practices to blame for Ohio earthquakes
Charles Q. Choi LiveScience
Sep. 4, 2013 at 3:54 PM ET

USGS
This map shows the intensity of shaking in the area of a magnitude-3.9 earthquake that struck near Youngstown, Ohio, on Dec. 31, 2011. Research has linked this earthquake to the underground injection of wastewater from fracking. Wastewater from the controversial practice of fracking appears to be linked to all the earthquakes in a town in Ohio that had no known past quakes, research now reveals.

The practice of hydraulic fracturing, or fracking, involves injecting water, sand and other materials under high pressures into a well to fracture rock. This opens up fissures that help oil and natural gas flow out more freely. This process generates wastewater that is often pumped underground as well, in order to get rid of it.

A furious debate has erupted over the safety of the practice. Advocates claim fracking is a safe, economical source of clean energy, while critics argue that it can taint drinking water supplies, among other problems.

One of the most profitable areas for fracking lies over the geological formation known as the Marcellus Shale, which reaches deep underground from Ohio and West Virginia northeast into Pennsylvania and southern New York. The Marcellus Shale is rich in natural gas; geologists estimate it may contain up to 489 trillion cubic feet (13.8 trillion cubic meters) of natural gas, more than 440 times the amount New York State uses annually. Many of the rural communities living over the formation face economic challenges and want to attract money from the energy industry.

Youngstown quakes
Before January 2011, Youngstown, Ohio, which is located on the Marcellus Shale, had never experienced an earthquake, at least not since researchers began observations in 1776. However, in December 2010, the Northstar 1 injection well came online to pump wastewater from fracking projects in Pennsylvania into storage deep underground. In the year that followed, seismometers in and around Youngstown recorded 109 earthquakes, the strongest registering a magnitude-3.9 earthquake on Dec. 31, 2011. The well was shut down after the quake.

Scientists have known for decades that fracking and wastewater injection can trigger earthquakes. For instance, it appears linked with Oklahoma's strongest recorded quake in 2011, as well as a rash of more than 180 minor tremors in Texas between Oct. 30, 2008, and May 31, 2009.

The new investigation of the Youngstown earthquakes, detailed in the July issue of the journal Geophysical Research Letters, reveals that their onset, end and even temporary dips in activity were apparently all tied to activity at the Northstar 1 well.

For instance, the first earthquake recorded in Youngstown occurred 13 days after pumping began, and the tremors ceased shortly after the Ohio Department of Natural Resources shut down the well in December 2011. In addition, dips in earthquake activity lined up with Memorial Day, the Fourth of July, Labor Day, Thanksgiving and other times when injection at the well was temporarily stopped.

"Earthquakes were triggered by fluid injection shortly after the injection initiated — less than two weeks," researcher Won-Young Kim, a seismologist at Columbia University's Lamont-Doherty Earth Observatory in Palisades, N.Y., told LiveScience. "Previously, we knew (of) unusual earthquakes around Youngstown, Ohio, only on March 17, around 80 days after injection began. If we had better seismographic station coverage, or if we were more careful, we could have caught those early events."

Ancient fault

The earthquakes were apparently centered in an ancient fault near the Northstar 1 well, and Kim suggested pressure from wastewater injection caused this fault to rupture. The quakes crept from east to west down the length of the fault — away from the well — throughout the year, a sign that they were caused by a traveling front of pressure generated by the injected fluid.

The researchers did note that of the 177 wastewater disposal wells of this size active in Ohio during 2011, only the Northstar 1 well was linked with this kind of seismic activity, suggesting this ability to cause earthquakes was rare. Kim personally felt injecting wastewater deep underground "is a fairly good method of massive fluid waste disposal."

Kim stressed these earthquakes are not directly related to fracking of rock for natural gas. "They are due to injection of waste fluid from fracking," he noted. In the future, "we need to find better ways to image hidden subsurface faults and fractures, which is costly at the moment," Kim said. "If there are hidden subsurface faults near the injection wells, then sooner or later they can trigger earthquakes." In the future, operators of such wells may look for earthquakes for about six months after the beginning of operations, Kim said. "However, there are cases when triggered earthquakes occurred nearly 10 years after the injection," he noted.

Duane Marshall
1070 Highland Street Extension
DuBois, PA 15801

September 9, 2013

EPA Regions III
Ground Water & Enforcement Branch (3WP22)
Office of Drinking Water & Source Water Protection
1650 Arch Street
Philadelphia, PA 19103

Dear EPA:

RE: PAS2D020BCLE - Brady Township, Clearfield County, PA

This letter is in response to the opportunity for public comments on the seismic issue with the disposal injection well. This permit should be denied due to the proximity of a known fault. The Guy-Greenbrier fault in Arkansas was an unknown fault until it was affected by an injection well. They now require new wells to be 1 to 5 miles from known faults. Steve Horton from the University of Memphis Center for Earthquake Research and Information wrote in a study published in "Seismological Research Letters" in the March/April issue "Given the strong spatial and temporal correlation between the two wells and seismic activity on the fault it would be an extraordinary coincidence if the recent earthquakes were not triggered by the fluid injection. For these reasons, I conclude that fluid injection triggered the recent seismicity."

I don't believe we should take this risk with the information we already know concerning faults and injection well locations.

Thank you for hearing my concerns on this matter.

Sincerely,

Duane Marshall

Insight: Arkansas lawsuits test fracking wastewater link to quakes
By Mica Rosenberg
GREENBRIER, Arkansas | Tue Aug 27, 2013 1:42am EDT

GREENBRIER, Arkansas (Reuters) - Tony Davis, a 54-year-old construction worker in central Arkansas, said he welcomed the boom in natural gas drilling that brought jobs and new businesses to his hometown starting about a decade ago. But that was before the earth shook.
In 2010 and 2011, the quiet farming town of Greenbrier, Arkansas, was rattled by a swarm of more than 1,000 minor earthquakes. The biggest, with a magnitude of 4.7, had its epicenter less than 1,500 feet from Davis's front porch. "This should not be happening in Greenbrier," Davis recalls thinking. He said the shaking damaged the support beams under an addition to his home.
Then came another surprise: University of Memphis and Arkansas Geological Survey scientists said the quakes were likely triggered by the disposal of wastewater from hydraulic fracturing - commonly known as fracking - into deep, underground wells. That finding prompted regulators from the Arkansas Oil and Gas Commission to order several wells in the area shut down, and the earthquakes soon subsided.

It also prompted Davis and more than a dozen of his neighbors to file five lawsuits in federal court against Chesapeake Operating Inc, as the owner in 2010 of two injection wells near Davis' home, and BHP Billiton, which purchased Chesapeake's shale gas assets in 2011.
Another company, Clarita Operating LLC, owned a third well that was shut down, but the company went bankrupt and was dropped from the litigation in 2011. Chesapeake and BHP both declined to comment, citing policies not to discuss ongoing litigation. In court documents they denied they were responsible for the quakes and for any damage the quakes may have caused.
The litigation marks the first legal effort to link earthquakes to wastewater injection wells, according to a search of the Westlaw database and interviews with legal experts, and the first attempt to win compensation from drilling companies for quake damage.

If any of the earthquake cases make it to a jury and the plaintiffs prevail, the outcome could spark additional litigation, since wastewater injection wells are used not only in fracking, but in other kinds of oil and gas drilling and geothermal energy production. "The scientific community is really focusing on this issue so I imagine we will see more cases because of that," said Barclay Nicholson, a Houston lawyer who represents major oil and gas companies and is not involved in the Arkansas cases. "That's one of the new battlegrounds."

LITIGATION WAVE
The first of the suits, filed in U.S. District Court in Eastern Arkansas, is scheduled to go to trial before Judge J. Leon Holmes next March, though the parties have been engaged in settlement talks, according to the court docket. The Arkansas Independent Producers & Royalty Owners, an oil and gas industry group, acknowledges that scientists found a possible connection between the disposal wells and the spate of minor quakes in and around Greenbrier. But J. Kelly Robbins, the group's executive vice president, said the companies had no way of knowing of any such link before wastewater injection began, and he said the operators shut the wells down when questions were raised.

"The appropriate state agencies stepped up, collected data, did what they were supposed to do and made a decision," Robbins said in an interview. "Industry abided by that and those wells were closed." Robbins also said that while Arkansas is a traditional oil and gas producing state, fracking

in the Fayetteville shale had brought billions of dollars of investment and boosted the state's natural gas production ninefold in seven years.

The earthquake cases are part of a wave of litigation that has followed the rapid expansion in natural gas production across the United States using fracking, a drilling process that deploys a highly pressurized mix of water and chemicals to break apart shale rock to release oil and gas.
Since 2009, some 40 civil suits related to fracking have been filed in eight states, claiming harm ranging from groundwater contamination to air pollution to excessive noise. So far none of the lawsuits has made it to trial and about half have been dismissed or settled, with company lawyers mainly arguing that a link between fracking and contaminated groundwater or other environmental problems has not been proven, according to a Reuters analysis of legal filings.
The U.S. Environmental Protection Agency is expected to issue a major report on fracking and drinking water next year that could have an impact on these cases, lawyers closely following the litigation say.

FINDING FAULT
The Arkansas litigation does not target fracking itself, but rather the disposal of the leftover toxic, briny water known as "flowback." Millions of gallons of wastewater are typically trucked from the fracking site to the well site, where they are injected thousands of feet underground into porous rock layers, often for weeks or months at a time. Seismologists say fracking can cause tiny "micro earthquakes" that are rarely felt on the surface. The process of disposing of the wastewater, though, can trigger slightly larger quakes when water is pumped near an already stressed fault, even one that hasn't moved in millions of years, according to the U.S. Geological Survey.

Only a handful of the 30,000 injection wells across the country have been suspected of causing earthquakes, the U.S. Geological Survey has said. That rare event likely happened in central Arkansas, said Scott Ausbrooks, a geologist at the Arkansas Geological Survey in Little Rock who lives in Greenbrier and said he received calls from panicked neighbors when the quakes were rattling the town more than a dozen times a day.

Ausbrooks said he became interested in studying wastewater injection in the area because it had previously experienced some earthquakes, including a notable swarm in the 1980s. He worked with Steve Horton from the University of Memphis Center for Earthquake Research and Information to set up seismic monitors around eight disposal wells. They found that 98 percent of the 2010-11 swarm of small quakes occurred within 3.7 miles of two of the wells. "Given the strong spatial and temporal correlation between the two wells and seismic activity on the fault," Horton wrote in a study published in "Seismological Research Letters" in the March/April 2012 issue, "it would be an extraordinary coincidence if the recent earthquakes were not triggered by the fluid injection. For these reasons, I conclude that fluid injection triggered the recent seismicity."

It was only after the wastewater injection wells went online that scientists discovered a previously unknown fault, now called the Guy-Greenbrier fault, Ausbrooks and Horton said.
The Arkansas Oil and Gas Commission declared a permanent moratorium on new injection wells in almost 1,200 square miles (3,100 sq km) around the newly discovered fault. The commission now requires new wells to be between 1 mile and 5 miles from known faults, and it more closely monitors the amount and pressure of injected wastewater.

The EPA currently has no regulations relating to earthquakes and disposal wells - known as Class II wells - but the agency began working on a report addressing the issue in the wake of a spike in

quakes in the central and eastern United States. In a November 2012 draft report, the EPA said it was studying "injection-induced seismicity" in central Arkansas; north Texas; Braxton County, West Virginia; and Youngstown, Ohio.

In Texas, operators in 2009 voluntarily plugged two disposal sites after regulators started investigating whether the wells touched off several quakes around the Dallas Forth-Fort Worth International Airport. Virginia's Department of Environmental Protection in 2010 reduced the rate of wastewater injection allowed after a series of small tremors. And in Ohio, officials shut down five injection wells in Youngstown following a 4.0 earthquake on New Year's Eve 2011 in an area that had never experienced seismic activity before, the EPA report said.

The EPA said the draft, obtained by the specialized news service EnergyWire through a Freedom of Information Act request, was a "technical report" as opposed to a policy blueprint and "is still under development."

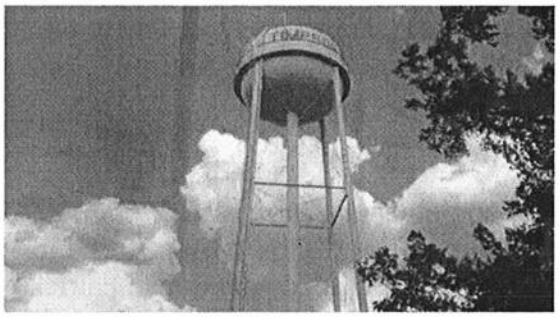
SEEKING PLAINTIFFS

While the federal regulatory process plays out, the relationship between injection wells and earthquakes could first be thrashed out in court. Defense lawyers say proving negligence could be a difficult hurdle. "You have to prove that the conduct was unreasonable," said Thomas Daily, an Arkansas lawyer who represents energy firms and is not involved in the earthquake cases. "You are not liable for a bolt out of the blue." The plaintiffs' attorneys, from the Little Rock firm Emerson Poynter, claim the companies should have known the risks of drilling in a historically seismic area. "The scientific proof is absolutely there," said plaintiffs' lawyer Scott Poynter.

Emerson Poynter lawyers said they currently represent 35 homeowners, about half of whom have yet to file lawsuits but plan to do so in state court. Along U.S. highway Route 65, which cuts through Greenbrier, the firm sprung for a billboard that features an illustration of a cracked brick wall next to the caption, "Earthquake damage?" written in a shaky looking font. The firm's phone number is at the top. No matter how many people sign on, state regulators said the lawsuits will not deter oil and gas drilling.

"It's something that happened, we addressed it and developed some rules to keep it from happening again and everyone has moved on," said Lawrence Bengal, director of the Arkansas Oil and Gas Commission. "Whether the past will result in some award of money to someone I really don't know. But I don't know what more could have been done." (Reporting by Mica Rosenberg; Additional reporting by Elizabeth Dilts; Editing by Eric Effron and Tim Dobbyn)

Tremors in Timpson: Residents of Timpson, Texas, discuss a series of earthquakes which have shaken the city since 2011.



Written by Adam Duvernay

A recently closed saltwater injection well outside Timpson, Texas. Such wells, which inject a waste brine created during natural gas production, have been linked to earthquakes like the one that shook Timpson on Sept. 2. / Adam Duvernay/The Tim

TIMPSON, TEXAS — A little tremble didn't shake the folks at a Labor Day cookout on Lake Timpson in East Texas. "I was cooking fish," Timpson, Texas, resident Kevin Bradford said. "One of our local police officers had stopped by on his break. He was eating shrimp when the quake started. He never stopped eating. He just swayed a little bit. We all knew what it was. We didn't get too excited."

The 45-second experience was no minor thing — three miles below the surface of the earth, tectonic pressure released in the form of a magnitude-4.1 earthquake followed almost two hours later by a second rated at 4.3.

Timpson residents are getting used to the earth moving beneath their feet, but the phenomenon is only about two years old. The first quakes started in 2011, usually around a magnitude of 2, but they've returned every few months since and have been as powerful as a 4.8 tremor in May 2012 and a 4.1 in January.

Timpson, which sits in the middle of the North American tectonic plate, should be geologically stable. The last significant shaking in East Texas before 2011 was a magnitude-3 quake 20 miles north 30 years prior, U.S. Geological Survey geophysicist Robert Williams said.
The science surrounding the sudden and continued outburst of tremors there makes no certainties as to the cause, but geologists are pointing to a correlation that makes sense to many of Timpson's residents.

"We never had these before they started punching all them holes in the ground," lifelong resident James Box, 64, said.Timpson and the surrounding area are home to more than 20 commercial saltwater injection wells, sites used to dispose of a brine waste product created during the extraction of natural gas. The wells inject the wastewater thousands of feet into the earth, and their presence has been linked to unusual earthquakes across the country.

"Putting fluids in the ground near faults has caused earthquakes in the past, no doubt about it," Williams said. "There are relics of former tectonic upheavals everywhere. We don't know where all the faults are, and we don't know which are susceptible to being reactivated."

There are 59 commercial saltwater disposal well sites in Louisiana, 16 of which are approved for construction and will need further approval to begin operation once completed, according to the Louisiana Department of Conservation. There are four active wells in Caddo and three in Bossier. In DeSoto Parish, Stallion Oilfield Services has been granted approval to construct a saltwater injection well. It's the second in the parish.

The police jury adopted a resolution opposing the construction of the well June 10 and sent it to Baton Rouge on June 12. But that resolution arrived after public comment closed May 30 and couldn't be factored into the permitting process, Department of Conservation spokesman Patrick Courreges said. Juror Ernel Jones said he planned to bring the issue to the jury after the publication of an Aug. 9 article in The Times concerning that well. He never did, however, conceding there wasn't enough support to fight the state. He said he's given up trying to stop Stallion from operating that well but may try to block others in the future.

"When you're raising hell to deaf ears, what's the point? In Texas and Louisiana, it's hard to get anything against the oil companies. They're oil states," Jones said. "The earthquakes are my biggest concern here in DeSoto. They're not going to stop at building one or two of those wells. They're going to keep coming. We're going to be Timpson all over again. People need to stop looking at just the money and see what might happen to the parish."

The USGS is actively studying the relation of saltwater injection wells and the appearance of earthquakes in historically stable geologic zones, Williams said. There are thousands of such well sites across the country, but only a handful of oddly placed earthquake zones in proximity. Areas like Prague, Okla. — which registered three earthquakes above magnitude-5 between Nov. 5 and 8, 2011 — have little history of geologic tremors, but have recently become hotbeds for injection sites. Arkansas, Ohio and Colorado have reported similar events.

Scientists recognize the relation, but earthquakes on the continent's interior are not well understood, Williams said. It isn't unheard of for "swarms" of interior-continent quakes to appear and last for a few months to four years, he said. "It's a lot of speculation. We're still learning why particular interior spots become active. It's well studied but poorly understood," Williams said. "There are a lot of factors to understand better. We have a ways to go."
The Texas Railroad Commission, the state's authoritative body on oil and gas, is following the study of injection well and earthquake correlation, spokeswoman Ramona Nye said. In an email, she said commission staff have "not identified a significant correlation between faulting and injection practices."

"As epicenters are reported, RRC staff evaluates the area to see if there are any Underground Injection Control wells nearby. For some reported epicenters, there have been no UIC wells nearby. If there is a UIC well nearby, RRC staff conduct physical inspections of the area, as well as a review of UIC well permit restrictions to ensure compliance with Commission Statewide Rules," she said. "Following this recent seismic event, commission staff on Tuesday inspected

two nearby commercial disposal wells and found no violations of commission rules, and the wells were found to be operating within their permit conditions."

In Timpson

Laura Carroll keep breakables off the walls these days — her home on Timpson Lake has been shaken one too many times. "I don't have a picture left with glass in it in my house," Carroll said. "There was a lot of talk about the earthquakes in the beginning. A lot of people were wondering. I guess we're used to it now." Monday's quake only knocked a few items off shelves and dropped several decorative metal stars to the ground, she said. A quake earlier this year damaged their chimney, dropping bricks onto the roof, which splintered three rafters. Her husband, Paul, made the repairs himself. Earthquake insurance was never a necessity.

There was no major damage inside city limits Monday, said Larry Burns of the Timpson Public Works Department. The cost of the earthquakes in property damage, he said, has been minimal so far. "But it seems to be a matter of time before a big one hits," Burns said. After a quake, Burns and his small crew go street by street checking for damage. Since 2011, there have been minor gas leaks associated with ruptured pipes and a few busted sewer and water mains. Residential chimneys sustained some damage, and gravestones at a nearby cemetery have toppled, he said.

The city council has discussed, but not adopted, new building standards to protect against earthquakes, Burns said. Adding new construction standards would mean a great cost to locals who want to remodel or build. One of the big concerns, he said, is the city's water tower. Although it was designed to survive high winds — something Williams said is beneficial to earthquake protection — Burns said anything over a magnitude-5 quake could cause serious structural damage. "The water tower wasn't built to earthquake standards. There was no need for it," Burns said. "It was built in 1996, and so far it hasn't moved."

Ricky Askins said he was inside his home for every quake since they began two years ago, but he was standing in his fields Monday when the earth started moving. "The cows started bawling. The dogs started howling," Askins said. "It took me a second to realize what it was. As soon as I realized it was an earthquake, it scared me then." Askins said he believes the quakes are related to the millions of gallons of brine which have been injected into Shelby County, but not everyone in town agrees.

"Some people say it's the fracking, but I don't think the changes they're making are enough to cause earthquakes," said Paul Spinuzzi, who lives just outside Timpson. "The only thing I can think of it's just another time for geological change in this area. It's happening all over the United States."

Darlene Marshall
1070 Highland Street Extension
DuBois, PA 15801

September 8, 2013

EPA Regions III
Ground Water & Enforcement Branch (3WP22)
Office of Drinking Water & Source Water Protection
1650 Arch Street
Philadelphia, PA 19103

Dear EPA:

RE: PAS2D020BCLE - Brady Township, Clearfield County, PA

This is a letter with public comments on the seismic issues dealing with the Brady Township Underground Injection Control Permit PAS2D020BCLE. Previously comments were submitted by me in December 2012 with a request the permit be denied based on numerous reasons.

Public hearing testimony produced additional proof that the permit should be denied due to faults, deep old gas well locations, local coal mines, syncline, and residential area. Another public hearing should be held for this public comment period. We request a public hearing be held due to the prior hearing beginning over an hour later than commenters expected. We know some left and didn't get a chance to make comments due to the lateness of the comments given.

Testimony proved our coal mines go all over below our area and city. The coal mines have water that flows into the Sandy Lick Creek next to our mall, which was stated by a Sandy Township Supervisor. Just one leak of the disposed waste into mines below our homes could create an explosion due to the methane trapped below ground. An explosion would create seismic activity as a result of the injection well activities.

We presented information on abandoned, old, deep, gas wells that causes potential to contaminate USDWs (Underground Sources of Drinking Water). Especially as an engineer presented at the public hearing that the faults would flow waste directly to two old, deep, gas wells. Old casings would allow waste to migrate up into USDWs. These faults would be affected by the pressure of waste injected underground and it was stated these faults could contain (confine) the waste disposed. The confining layer above the injection zone as defined in the permit application was noted by this engineer at the public hearing as inaccurate and much thinner than stated. Many factors had been researched by residents and stated as concerns including the local faults.

USDWs in the area also were demonstrated to be interconnected through various water sources and flow studies. At a Brady Township water authority meeting we learned of a local water tunnel that flows to our city reservoir, which was cause for concern. Local residents presented that old, deep, gas wells in the area affect their water sources when any work is done on these wells. Residents are extremely concerned about USDWs getting contaminated from the old, deep, gas wells and from seismic activities due to faults being lubricated by fluid or fluid flowing along the faults.

Darlene Marshall
1070 Highland Street Extension
DuBois, PA 15801

A supervisor from Brady Township presented information about the underground resources potentially being currently full of brine. This is due to the knowledge of the amount of brine that has been removed previously for the old, deep, gas wells. Residents realize how often the brine had to be removed from the deep gas well located on the Atkinson property. Waste, brine and gas below ground under our homes will all work to create pressure on the fault lines in the review area. This will cause things underground to change without anyone knowing the particulars, so we request this permit be denied on the potential of the fault lines being lubricated by waste or pressure causing the faults to shift. We know historically from experience seismic activity has occurred from waste disposal as I stated in my prior public comments.

The location of this proposed disposal injection well is near residents with private water wells, the Brady Township water supplies and the City of DuBois water supplies. These factors combined with a fault in the review area make this site a risky chance on issuing a permit for disposal of waste. If any USDWs or coal mines become contaminated due to waste it will not be enough to state "we told you to deny the permit" since properties will be ruined and lives would be placed in danger.

Studies have found concerns that disposal injection wells have been tied to seismic activity and the US Geological Survey states more research must be done. Combining all these factors: an already fractured area due to old, deep, gas wells; faults; syncline; the potential of disposal fluids leaking into USDWs or flowing along the identified fault near coal mines; new pressures on this fault potentially causing sympathetic reactions to earthquakes; seismic activity migrating disposed fluids into local coal mines and USDWs with grave affects to our area; local Marcellus Drilling activities planned for area; and different changes in pressures and activities have the potential to contaminate USDWs especially due to seismic activities created by waste disposal.

This area has felt the ground move due to earthquakes and man-made seismic activities: once due to a natural gas home explosion that rocked our area; at least once recently due to an earthquake from another state; and local coal mining in the area. At least four coal companies are operating in our area, which has affected foundations of residents homes including one of our own family members. Any of these type of seismic factors would compromise the integrity of the well casing and allow USDWs or coal mines to be contaminated. Man-made seismic events are happening in Clearfield County so this permit should be denied since further study should have been done. Local specific studies should be done for an area before it is assumed that "seismic events are extremely rare." Our local area has already experienced seismicity concerns.

Risk should be taken into consideration and given to this being an unacceptable risk to even allow a permit to be considered. This permit should be denied based on all the facts already presented that question the seismic issues and given that our precious water resources shouldn't be jeopardized or threatened. Just knowing we lack sufficient specific studies on injection wells located in residential areas with proximity to reservoirs, private wells and multiple municipal water wells. The statement has been proven invalid that seismic events are extremely rare in Clearfield County.

Darlene Marshall
1070 Highland Street Extension
DuBois, PA 15801

Residents refuse to believe monitoring pressure protects against failure after seeing the results of the Irvin well overpressurized for three months. USDW damage must be proven by the residents and this is unfair when residents are unaware that anything is happening or even made aware quickly enough. If they can overpressurize for three months without anyone knowing at the EPA or locally what does that state about protection for our residents if we allowed this disposal well to be permitted near our USDWs. Residents have stated they'd live in fear of drinking the water daily if an injection well is installed.

Monitoring pressure is insufficient to protect residents from an injection well failure since damage to a water source will have happened before shutdown procedures would be taken. This permit should be denied because of what happened at the Irvin injection well, since our area risk is higher.

The USGS has stated injection well studies need to be done. So this permit should be denied based on this information alone. Since this proposed injection well is located in a residential area that is near so many private wells, multiple municipal water sources and our local reservoir.

The permit should be denied based on the prior public hearing testimony presented since local residents demonstrated fault lines present in the review area caused concern of potential for seismic activities. The fault lines cause concern that fluids traveling along the fault will flow towards abandoned, old, deep, gas wells and abandoned coal mines through old gas well casings. A syncline is also located in the area.

The permit should be denied due to the changes in underground pressures potential affecting the faults and causing seismicity concerns. Fluids may lubricate the faults causing activity.

We request this permit be denied because the EPA, Windfall or residents are all unable to predict the future beneath us (underground). Taking a chance is an unsafe risk with USDWs, coal mines, properties and water sources.

This permit should be denied due to a study previously submitted in December that provided information on injection wells and seismic activities that had occured. One article in Science Magazine on July 12, 2013 citied William Ellsworth from the Earthquake Science Center, U. S. Geological Survey, Menlo Park, California. Other studies and recent happenings in four states cause grave concerns that reinforce denying this permit. Enclosed is two articles that concern residents especially knowing Arkansas residents already experienced earthquakes and have decided to file suits against injection well operators. Ohio has experienced earthquakes in an area that never had prior seismic activities recorded before an injection well operated.

Residents appreciate the EPA reviewing all the information presented and explaining the EPA process. The residents are counting on the EPA denying this permit and setting an example that residents research shows substantial risk to USDWs through seismic issues sufficient to deny this permit. Residents shouldn't need to provide this evidence since the original maps for the permit showed a fault through the area. All the articles on file for this public comment period are insufficient evidence with all

the actual happenings having taken place since residents started researching this issue two years ago. Let us not repeat history like Colorado, Oklahoma, Texas, Ohio or Arkansas has experienced just deny the permit.

Two articles are attached to this testimony to demonstrate seismic concerns and backup the residents request to deny this permit. The main points are stated here in my letter and highlighted in the attached article.

An article by Charles Choi in Live Science titled "Confirmed: fracking practices blamed for Ohio earthquakes" tells us that Ohio experienced quakes from injection wells. It states, "Before January 2011, Youngstown, Ohio, which is located on the Marcellus Shale, had never experienced an earthquake, at least not since researchers began observations in 1776. However, in December 2010, the Northstar 1 injection well came online to pump wastewater from fracking projects in Pennsylvania into storage deep underground. In the year that followed, seismometers in and around Youngstown recorded 109 earthquakes, the strongest registering a magnitude-3.9 earthquake on Dec. 31, 2011. The well was shut down after the quake."

The Choi article also tells us it has been long know that injection of waste can trigger earthquakes and it stated, "Scientists have known for decades that fracking and wastewater injection can trigger earthquakes. For instance, it appears linked with Oklahoma's strongest recorded quake in 2011, as well as a rash of more than 180 minor tremors in Texas between Oct. 30, 2008, and May 31, 2009."

The "Confirmed" article also tells us that injection well activity activated earthquakes based on injection and states, "The new investigation of the Youngstown earthquakes, detailed in the July issue of the journal Geophysical Research Letters, reveals that their onset, end and even temporary dips in activity were apparently all tied to activity at the Northstar 1 well. For instance, the first earthquake recorded in Youngstown occurred 13 days after pumping began, and the tremors ceased shortly after the Ohio Department of Natural Resources shut down the well in December 2011. In addition, dips in earthquake activity lined up with Memorial Day, the Fourth of July, Labor Day, Thanksgiving and other times when injection at the well was temporarily stopped."

Choi tells us earthquakes started immediately after injection well operations began. "Earthquakes were triggered by fluid injection shortly after the injection initiated — less than two weeks," researcher Won-Young Kim, a seismologist at Columbia University's Lamont-Doherty Earth Observatory in Palisades, N.Y., told LiveScience. "Previously, we knew (of) unusual earthquakes around Youngstown, Ohio, only on March 17, around 80 days after injection began. If we had better seismographic station coverage, or if we were more careful, we could have caught those early events."

The "Confirmed" article states that, "Ancient fault - The earthquakes were apparently centered in an ancient fault near the Northstar 1 well, and Kim suggested pressure from wastewater injection caused this fault to rupture. The quakes crept from east to west down the length of the fault — away from the well — throughout the year, a sign that they were caused by a traveling front of pressure generated by the injected fluid."

Darlene Marshall
1070 Highland Street Extension
DuBois, PA 15801

The Choi article findings state, "In the future, we need to find better ways to image hidden subsurface faults and fractures, which is costly at the moment, Kim said. If there are hidden subsurface faults near the injection wells, then sooner or later they can trigger earthquakes. In the future, operators of such wells may look for earthquakes for about six months after the beginning of operations, Kim said. However, there are cases when triggered earthquakes occurred nearly 10 years after the injection, he noted."

Mica Rosenberg wrote on Tuesday, August 27, 2013 an article titled "Insight: Arkansas lawsuits test fracking wastewater link to quakes" that states our concerns. "Seismologists say fracking can cause tiny micro earthquakes that are rarely felt on the surface. The process of disposing of the wastewater, though, can trigger slightly larger quakes when water is pumped near an already stressed fault, even one that hasn't moved in millions of years, according to the U. S. Geological Survey."

The "Insight" article stated, "Steve Horton from the University of Memphis Center for Earthquake Research and Information worked to set up seismic monitors around eight disposal wells. They found that 98% of the 2010-11 swarm of small quakes occurred within 3.7 miles of two of the wells." It was concluded earthquakes were triggered by wastewater fluid injection and an unknown fault was identified, so they declared, "a permanent moratorium on new injection wells in almost 1,200 square miles around the fault."

Rosenberg stated, "In a November 2012 draft report, the EPA said it was studying injection-induced seismicity in central Arkansas; north Texas; Braxton County, West Virginia; and Youngstown, Ohio. In Texas, operators in 2009 voluntarily plugged two disposal sites after regulators started investigating whether the wells touched off several quakes around the Dallas Forth-Fort Worth International Airport. Virginia's Department of Environmental Protection in 2010 reduced the rate of wastewater injection allowed after a series of small tremors. And in Ohio, officials shut down five injection wells in Youngstown following a 4.0 earthquake on New Year's Eve 2011 in an area that had never experienced seismic activity before, the EPA report said."

We have a known fault in our area so this should be cause to deny this permit based on all this recent data. If seismologists have long known a problem exists with injection wells, residents shouldn't need to prove this permit should be denied. Thank you for your consideration of all this information.

Sincerely,

Darlene Marshall

EPA Region III
Ground Water + Enforcement Branch (3WP22)
1650 Arch St.
Philadelphia, PA 19103

1154 Highland St Ext
DuBois, PA 15801

September 8, 2013

RE: PAS2D020BCLE
Brady Township
Clearfield County, PA

DEAR EPA,

My specific concerns deal with water contamination of USDWs from seismic activities created by man from permitting disposal injection wells. As I stated on 12/7/12 we have "outstanding" water now + we are concerned this will not be the case if the EPA doesn't deny the Zelman #1 Injection Well permit. Coal mines are under our area, faults + we have deep gas wells that are old. A USGS study shows injection wells near faults have caused earthquakes. Won-Young Kim, a seismologist at Columbia University's Lamont-Doherty Earth Observatory found wastewater injection pressure caused a fault to rupture in Ohio, which was caused by a traveling front of pressure generated by injected fluid in an area that never had quakes before injection of waste happened. Don't repeat this mistake here + take any chance with our USDWs + homes.

Sincerely, Ethel Marshall Ethel Marshall

EPA Region III
Ground Water & Enforcement Branch (3WP22)
1650 Arch St.
Philadelphia, PA 19103

1154 Highland St Ext
DuBois, PA 15801

September 8, 2013

Brady Twp, Clearfield, PA
RE: PAS2D020BCLE

Dear EPA,

On December 7, 2012 I'd provided testimony on the Zelman #1 Injection Well proposed for Brady Township in Clearfield County, PA. My testimony states I've always had good drinking water and the hydrology report shows this permit would inject fluids below my home near faults where water flows from the proposed site towards my home. Additionally I stated concerns of earthquakes (seismic activity) and enclosed an article on the USGS asking you to deny the permit.

Now more disposal injection wells have caused quakes proven in Ohio, Arkansas, Oklahoma & Texas. Lawsuits are pending.

Sincerely, Robert Marshall Robert Marshall

Vivan Marshall
St. Michaels Terrace
111 West Long Avenue Apt. 5E
DuBois, PA 15801

September 8, 2013

Mr. Stephen Platt, EPA Region III
Ground Water & Enforcement Branch
Office of Drinking Water & Source Water Protection (3WP22)
1650 Arch Street
Philadelphia, PA 19103

RE: UIC Permit PAS2D020BCLE (Windfall/Zelman #1)

Dear Mr. Platt:

My concerns deal with contamination of USDWs by seismic activity through an injection well for waste disposal. As I told you in December having water on a daily basis that's safe is important to my family. Also, I stated more research should be done. The USGS also stated this after what happened in Ohio with an injection well causing earthquakes where none had never been before. I remember the last quake we had here & we don't need to repeat Ohio's mistakes here.

Sincerely, Vivian Marshall

Vivian Marshall

University of Pittsburgh

School of Law
Environmental Law Clinic

(Use this address for U.S. Mail)
P.O. Box 7226
Pittsburgh, PA 15213-0221

Sennott Square, Room 5207
210 South Bouquet Street
Pittsburgh, PA 15260
412-648-1300
Fax: 412-648-1992

September 11, 2013

Sent via electronic mail
Stephen Platt
Class II Team Leader
U.S. EPA - Region III (3WP22)
1650 Arch St.
Philadelphia, PA 19103
platt.steve@epa.gov

Re: Comments on Supplemental Statement of Basis for Underground Injection Control Permit PASD020BCLE

Dear Mr. Platt,

The University of Pittsburgh School of Law Environmental Law Clinic submits the following comments on behalf of its client, Ms. Marianne Atkinson. These comments are submitted in response to the re-opening of the comment period for UIC Permit PAS2D020BCLE and the accompanying changes to the Statement of Basis for the proposed permit. We have attached an expert report commissioned by the Clinic and Ms. Atkinson to this comment and hereby incorporate the full expert report of Mr. Phil Grant from Terra Dynamics, Inc., into this comment.[1]

The United States Environmental Protection Agency Region III ("EPA" or "Region III") noticed Permit PAS2D020BCLE for Windfall Oil and Gas, Inc., ("Applicant" or "Windfall") on November 7, 2012.[2] The Permit at issue will authorize Windfall to operate the Zelman #1 Class II-D injection well ("Zelman Well"), in Brady Township, Clearfield County, Pennsylvania. As these comments will demonstrate, the Applicant has not met its burden to demonstrate that its injection will not cause endangerment of underground sources of drinking water. The Draft Permit in its current form contains multiple deficiencies and should be denied or significantly revised. As the endangerment standard has not been meet, EPA does not have authority to issue the permit.

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[1] UIC Permit Technical Review, Windfall Oil & Gas #1 Zelman, Brady Township, Clearfield County, PA, prepared by Philip R. Grant, Senior Geologist, Terra Dynamics, Inc., Austin, TX, attached as Exhibit 1 (hereinafter Expert Report").
[2] Permit PAS2D020BCLE attached as Exhibit 2.

Legal Background

In determining whether to issue any Underground Injection Control (UIC) permit, Congress required that "the applicant for the permit to inject must satisfy the [permitting authority] that the underground injection will not endanger drinking water sources."[3] Congress established a minimum standard for endangerment of drinking water sources as the following:

> Underground injection endangers drinking water sources if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system's not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons.[4]

EPA has issued regulations that define the underground sources of drinking water (USDWs) that must be protected as "an aquifer or its portion…which contains a sufficient quantity of ground water to supply a public water system; and…contains fewer than 10,000 mg/l total dissolved solids."[5]

I. The Supplemental Statement of Basis does not allow for a meaningful opportunity for the public to comment on EPA's determination.

EPA defends its seismicity determination in the Supplemental Statement of Basis by identifying limits on the rate, volume, and maximum pressure of injected fluid. Yet, the public cannot adequately critique the EPA's determination of the risk to USDWs from the authorization of operation of the Zelman Well without additional information on EPA's (not the Applicant's) maximum injection pressure and area of review calculations. EPA's rules require that a statement of basis "…briefly describe the **derivation** of the conditions of the draft permit and the **reasons** for them…."[6] In the Statement of Basis, EPA lists the factors that it is required to consider in determining the area of review. Unfortunately, EPA never identifies the specific pressure increase calculations around the proposed wells over the lifetime of those wells. EPA does not identify the permeability value for the injection zone that *EPA*, not the Applicant, used to determine that a fixed area of review (¼ mile) was acceptable to EPA. The public cannot accurately critique EPA's decision on the area of review without an explanation of EPA's full calculation of the zone of endangering influence used to confirm the validity of the default ¼ mile area of review. Without the methodology and results used by EPA in their calculations, the public cannot adequately comment on the area of review determination.

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[3] 42 U.S.C. § 300h(b)(1)(B).
[4] *Id.* at § 300h(d)(2).
[5] 40 C.F.R. § 144.3 (definition of underground source of drinking water (a)(2)(ii)).
[6] 40 C.F.R. § 124.7 (emphasis added).

Similarly, EPA provides a limit for the maximum injection pressure without describing the reasons that EPA believes that the maximum allowable surface injection pressure is appropriate. EPA merely states that it used the values presented by the Applicant in making its determination (without providing the actual values aside from specific gravity and well depth). EPA also states that "[t]hese pressure limitations will meet the regulatory criteria...," but does not state its reasons for that belief.

EPA should revise the Statement of Basis and the Supplemental Statement of Basis to include the derivation of its reservoir modeling input values and any other calculations that helped the agency determine the proper area of review and the maximum injection pressure since the agency apparently relies on that information to form the basis of its opinion that the maximum injection pressure will ensure that USDWs will not be endangered by the proposed injection due to seismicity.

II. EPA's Supplemental Statement of Basis Fails to Meet the Endangerment Standard.

The Need for Data on Rock Properties and Net Fluid Balance to Determine the Potential for Fault Failure

EPA should require that the Applicant provide scientific data to allow the agency to properly determine the potential for a seismic event due to the proposed injection activity. EPA did not require the Applicant to provide information on any of the recommended site assessment criteria developed by the EPA Underground Injection Control National Technical Workgroup in November 2012.[7] EPA should also follow its own draft guidance in the area of well operations, monitoring and management.[8] In addition, EPA should require the Applicant to evaluate and provide data on regional rock stress components, which would allow the agency to estimate the potential for fault failure due to localized injection zone pressure increases,[9] and net fluid balance as recommended by the National Academy of Sciences.[10] This would allow the agency to make an educated determination about seismicity before permit issuance *and* EPA could provide the required information in the statement of basis for public evaluation and comment.

Calculations of critical shear stresses and rock failure envelopes can be determined through the use of rock properties data gathered from whole cores taken from the injection zone during well drilling.[11] EPA should request that cores be gathered and petrophysical analyses performed. After subjecting that information to public notice and comment, EPA may determine whether the endangerment standard has been met.

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[7] EPA Draft on Minimizing and Managing Potential Impacts of Induced-Seismicity from Class II Disposal Wells: A Practical Approach, *available at* http://www.eenews.net/assets/2013/07/19/document_ew_01.pdf (last checked September 6, 2013).

[8] *Id.* at 30-33.

[9] Expert Report at 3-4 (Geology).

[10] National Academy of Sciences study, p.1.

[11] Expert Report at 4 (Geology).

In the Supplemental Statement of Basis, EPA states that injected wastewater "should be confined within the fault block as long as injection pressure is maintained below a critical stress, such as fracture pressure."[12] However, EPA has not told the public what it believes that critical stress and fracture pressure to be. According to Mr. Grant, these inputs are available to the Applicant and to EPA from published regional rock data.[13] Yet, EPA has not provided the public with any information about the inputs that it has used to determine the proper maximum injection pressure.

In fact, EPA uses the National Academy of Sciences' recent publication "Induced Seismicity Potential in Energy Technologies" to highlight only part of the findings of that study: that "very few events have been documented over the past several decades relative to the large number of disposal wells in operation."[14] However, the first part of that same sentence states that "[i]njection for disposal of wastewater derived from energy technologies into the subsurface does pose some risk for induced seismicity...."[15] The study also states that "[t]he factor that appears to have the most direct consequence in regard to induced seismicity is the net fluid balance (total balance of fluid introduced into or removed from the subsurface)...."[16] However, EPA does not bother to require the Applicant to determine the net fluid balance at issue here to allow a proper determination and proper public review under the endangerment standard.

In the Supplemental Statement of Basis, EPA routinely cites to the rarity of injection-induced seismic events. However, the endangerment standard requires that EPA account for that rare event and evaluate the site-specific conditions to determine whether the "injection *may* result in the presence in underground water which supplies."[17] In other words, EPA's statistics on the number of documented cases compared to the number of operating injection wells in the country has absolutely no bearing on whether EPA should issue the permit. Instead, EPA only needs to determine if an injection-induced seismic event *may* result in contamination of a USDW. According to Congress, any risk of contamination is too much when deciding whether to issue a UIC permit.

Transmissivity of the Fault

As EPA guidance makes clear, one of the reasons for pre-injection review of structural geology is that "under certain circumstances, subsurface fluid injection can stimulate movement along some faults ... [and when] movement occurs, stored seismic energy is released as an

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[12] Supplemental Statement of Basis at 2.
[13] Expert Report at 4 (Geology).
[14] Induced Seismicity Potential in Energy Technologies, National Academy Press (2013) at 1.
[15] *Id.*
[16] *Id.*
[17] 42 U.S.C. § 300h(d)(2).

earthquake."[18] Another reason for pre-injection review of structural geology is that cracks and joints (i.e., faults) can "channel fluids rapidly away from an injection well in a single direction or where they provide flow paths through confining strata."[19]

There are several ways in which EPA or an applicant can determine structural geology: (1) examination of rock cores obtained during drilling, (2) well logging and testing, and (3) prior experience with similar wells.[20] However, EPA does not provide data related to any of these possible ways of determining the geology and seismic risk related to injection from the Zelman #1 Well in either the original Statement of Basis or the Supplemental Statement of Basis.

EPA asserts in the Supplemental Statement of Basis that "there is no geologic evidence that [nearby] faults provide a mechanism for the transmission of formation fluids or that the other conditions necessary to cause seismic activity are present."[21] Unfortunately, EPA lacks geologic evidence because the Applicant failed to respond to the agency's Notice of Deficiency on the question of faulting in the injection zone and injection-induced earthquakes.[22] If the Applicant fails to provide required information, according to Congress' endangerment standard, EPA does not have the authority to issue the permit.[23]

While Applicant and EPA acknowledge the presence of a fault in the area of review, EPA does not look at the fault, even assuming that it is nontransmissive, as a mechanism to increase pressure in the reservoir.[24] EPA continues to have no direct evidence of the lateral and vertical sealing of the fault even though the Applicant has the ability to determine whether the fault is nontransmissive.[25] EPA uses the assertion of the nontransmissive nature of the fault as a reason that the injected wastewater will remain contained, but does not account for the increased pressure that will result due to a laterally-sealed fault within the injection zone. Thus, the Applicant has not met its burden to show that its proposed injection will not cause endangerment of USDWs.

EPA appears to claim in the Supplemental Statement of Basis that gas well production history in the area is evidence of the nontransmissive nature of the fault in the injection zone. However, EPA never shared the historical records that it relied upon in making this determination. While gas production data in the area was clearly used for surface-measured fracture breakdown pressure,[26] EPA has not described a link or a methodology that allows it to draw conclusions from that information and the nontransmissive nature of the fault in the

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[18] U.S. Environmental Protection Agency, Office of Drinking Water, *Final Injection Well Construction Practices & Technology* 11 (1982).
[19] *Final Injection Well Construction Practices* at 11.
[20] *Id.*
[21] Supplemental Statement of Basis at 2.
[22] Expert Report at 4.
[23] 42 U.S.C. §§ 300h(b)(1)(B), 300h(d)(2).
[24] Expert Report at 3-4.
[25] *Id.*
[26] *Id.* at 6.

injection zone. According to EPA's own rules, the administrative record is required to consist of "All documents cited in the statement of basis."[27] EPA did not provide such documents in the administrative record. Therefore, EPA should re-notice the draft permit and statement of basis with the gas well production documents cited in the statement of basis and re-open the comment period for a full 30 days.

As described in Mr. Grant's expert report, pressure increases occur in "laterally fault-defined reservoirs."[28] The type of basement faulting present at the site of the Youngstown, Ohio injection well that resulted in seismic activity there is the same type of faulting at issue here. According to Mr. Grant, EPA should use available regional rock stress data as inputs to determine the potential for fault failure due to the proposed injection activity.[29] EPA's draft permit allows the Applicant a maximum injection pressure that is equal to the fracture pressure of the rock.[30] Despite any operational testing required by EPA, Mr. Grant states that seismic activity could occur without warning due to the maximum injection pressure allowed by EPA.[31] Mr. Grant recommends that EPA require the Applicant fulfill its duty to prove that its injection activities will not cause endangerment of USDWs by providing whole core data from the Injection Zone during well drilling and petrophysical analyses.[32]

Maximum Injection Pressure Calculation and Operational Restrictions

EPA states that operating conditions, such as limits on the maximum injection pressure, constitute a mechanism to "minimize conduits for fluid to potentially contaminate" USDWs.[33] Yet, the proposed operating conditions and injection pressure limits (a sliding scale of injection pressures) are unworkable and inaccurate.[34]

Finally, EPA should set the maximum injection pressure with a margin of safety rather than at the equivalent of fracture pressure of the formation. Mr. Grant recommends a safety margin of "at least 100-200 psi" for the "maximum allowable bottom-hold (and surface) injection pressure."[35]

EPA contends that earthquakes are caused by the under-pressurization or over-pressurization of reservoirs within a geologic formation, that the Oriskany formation is currently under-pressurized due to decades of natural gas extraction and has not experienced any earthquakes to date, and that the proposed injection activities will not over-pressurize the

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[27] 40 C.F.R. § 124.9(b)(4).
[28] Expert Report at 3.
[29] *Id.* at 4.
[30] *Id.* at 3-4 (geology), 5-6 (formation testing program and stimulation program).
[31] *Id.* at 4.
[32] *Id.*
[33] Supplemental Statement of Basis at 2.
[34] Expert Report at 3-6 (Operating Data, Formation Testing Program, Stimulation Program, and Injection Procedures).
[35] *Id.* at 5.

Oriskany formation.[36] However, it is unhelpful to the decisionmaking process to suggest that the lack of earthquakes due to depressurization of the Oriskany gas reservoir is in and of itself proof of the lack of endangerment when there is no scientific evidence to suggest a correlation between that data.[37]

In addition, EPA should not simply consider the fracture gradient of the injection zone.[38] Instead, the agency should also incorporate fracture pressures of the adjacent overlying Onondaga Limestone.[39]

EPA makes general assertions without any support in the Supplemental Statement of Basis about the limits on rate and volume of injected wastewater reducing the potential for seismicity.[40] EPA fails to describe how the particular limits on the rate and volume of the fluid to be injected reduces the potential for seismicity. Mr. Grant reviewed the calculations provided by the Applicant and found serious oversights by EPA. Unfortunately, the Applicant's inputs and calculations of permeability, pressure increases over time, fracture gradient, reservoir surface pressure and maximum wellbore pressure are all drawn into question in Mr. Grant's review of the application, NODs and draft permit.[41]

For injection rate, the Applicant has used an incorrect formula that assumes a linear relationship between injection rate and pressure.[42] In addition, the characteristics of the wastewater to be disposed of appear to be unrepresentative of the fluid to be injected.[43] In addition, it is unclear that the Applicant used the correct permeability input because of repeated unit conversion problems.[44] And, again, EPA does not share the inputs that it used with the public. While EPA states that it "used instantaneous shut-in pressure from gas production wells located near the proposed Windfall well location as a basis to establish the maximum injection pressure for this permit,"[45] it does not share documentation of those pressures with the public.[46]

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[36] Supplemental Statement of Basis at 2.
[37] Expert Report at 3. Mr. Grant calls it "not particularly relevant."
[38] *Id.* at 6.
[39] *Id.*
[40] Supplemental Statement of Basis at 2-3.
[41] *See generally* Expert Report.
[42] Expert Report at 5 (Operating Data).
[43] *Id.*
[44] *Id.*
[45] Supplemental Statement of Basis at 3.
[46] Notably, at a public meeting held after issuance of UIC Permits PAS2D215BWAR and PAS2D216BWAR in the Bear Lake Properties, LLC, matter, Mr. Steve Platt stated that he was readily willing to send information such as calculations used in a modified Theis equation for determining the zone of endangerment. But later correspondence with Mr. Platt and EPA Assistant Regional Counsel Nina Rivera revealed that EPA was only willing to provide such information in response to a FOIA request rather than as part of the public notice and comment process. A video of the response by Mr. Platt is available at http://www.youtube.com/watch?v=u_Cie3q7cx4 (last checked September 10, 2013).

In the original Statement of Basis, EPA states that annual falloff testing will prevent seismic activity caused by the well. In the Supplemental Statement of Basis, EPA refers to an ultimate failsafe: a well design that automatically detects well integrity failures that causes the well to stop operating.[47] While it is somewhat heartening that the well would stop operating during a seismic event, EPA does not describe the risk of endangerment to USDWs in the area when the already-injected and stored wastewater is subjected to such conditions. In addition, it does not appear that EPA offered any changes to the permit to require such a design of the well. In fact, EPA's proposed tests, monitoring and injection procedures are "not operationally realistic" according to Mr. Grant.[48]

Far from instantaneous shut-in, the Applicant has proposed to observe injection pressure, rate and volumes only one time per week and recording those values only once per month.[49] EPA does not appear to offer any changes to the draft permit to facilitate a continuous monitoring and recording scheme for injection pressure, rate and volume in the Supplemental Statement of Basis. Merely requiring continuous monitoring of tubing and annulus pressures is far from sufficient when such a high level of risk is present from injection-induced seismicity in this region.[50] Even with continuous monitoring of the tubing and annulus pressures, EPA has not provided for minimum annulus and differential pressures to make its token monitoring program effective.[51] Mr. Grant identifies several other mechanical integrity issues with EPA's proposal.[52] Thus, there is little doubt that EPA's narrative description of the well design failsafe in the Supplemental Statement of Basis is an insufficient method to meet the endangerment standard.

III. Conclusion

EPA has not provided sufficient evidence to meet the endangerment standard. EPA should request a great deal of geologic information and calculations from the Applicant before the Safe Drinking Water Act would allow EPA to issue a permit. In addition, EPA must abide by its duty to include necessary information in its statement of basis to allow for meaningful public participation in the permitting process. After the Applicant provides sufficient information upon which EPA can craft a reasonably supported statement of basis for a draft permit, EPA should re-issue a draft permit and statement of basis for public review and comment for a 60-day period.

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[47] *Id.*
[48] Expert Report at 6.
[49] *Id.* at 7.
[50] *Id.* at 7-8.
[51] *Id.*
[52] *Id.* at 8.

Thank you for the opportunity to submit the above comments and for your consideration of them. Should you have any questions or concerns regarding any of the preceding, please do not hesitate to contact the University of Pittsburgh School of Law Environmental Law Clinic at (412) 648-1300.

Respectfully Submitted,

Emily A. Collins, Esq.
Supervising Attorney

Exhibit 1

UIC Permit Technical Review
Windfall Oil & Gas #1 Zellman
Brady Township, Clearfield County, PA

Subject:
Draft UIC Permit PAS2D020BCLE
Windfall Oil and Gas Inc.
Zellman #1 Class II-D Injection Well
Clearfield County, Pennsylvania

Prepared for:
University of Pittsburgh School of Law
Environmental Law Clinic

Prepared by:
Philip R. Grant
Senior Geologist
Terra Dynamics Inc
Austin, TX

Date:
April 26, 2013

A review of the publically available documents related to the Windfall Oil and Gas #1 Zellman Class II-D injection well permit application and draft permit (PAS2D020BCLE) was performed at the request of the Environmental Law Clinic of the University of Pittsburgh School of Law. The following technical review and comments are based on that available information. Additional documents may be in the possession of the applicant or the USEPA which are not currently available for review, and which may address some of the issues raised in the following review.

The following technical review is divided into subject areas addressing various Attachments of the permit application, the USEPA Notice of Deficiency (NOD) letter, the applicant's responses to that NOD, the USEPA's Statement of Basis for issuance of the permit, and the USEPA's Draft UIC permit.

AOR Calculation (Attachment A)

The applicant uses a default ¼ mile radius AOR, and does not demonstrate why a larger AOR is not necessary; based on pressure increase calculations around the proposed well over the lifetime of the well. Based on the low permeability value presented for the injection zone (0.0061 mD,

TERRA DYNAMICS INC

later revised to 6.1 mD), there is a significant possibility that the AOR will encompass an area larger than the minimum ¼ mile radius during the life of the well.

The USEPA in its NOD requested that a calculation of the zone of endangering influence (ZEI) be provided to confirm the validity of using a minimum ¼ mile radius AOR. The agency also noted that the applicant's initially provided permeability of 0.0061 mD was too low, yet failed to note that the calculation of that value was incorrect due to the utilization of incorrect unit conversions for permeability. The agency suggestion that a value of 10-100 mD permeability value is more realistic provided no backup data for such a range.

The applicant in its NOD response noted the error in the permeability calculation; a revised value is 6.1 mD was given. However, the lack of an understanding of permeability unit conversions and realistic ranges puts into question the validity of the entire group of reservoir input values presented in the application. The applicant in its NOD responses also noted a current surface reservoir pressure of 90 psi, based on offset wells' gas gathering line pressures. If this value is the correct surface pressure, then the calculations of permeability in Attachment H and maximum wellbore pressure (Attachment I) use an incorrect reservoir surface pressure of 15 psig. These calculations should be revised to provide corrected determinations of permeability and maximum wellbore pressure. These revised values will in turn require the calculation of the ZEI to be redone.

The USEPA in its Statement of Basis notes that the agency calculated a zone of endangering influence (ZEI) using inputs provided by the applicant, and confirmed that a ¼ mile radius AOR was sufficient. However, the agency does not provide the methodology or results of their calculations. None of the USEPA calculations have been provided for public comment or review, which brings into question the independent nature of their review. The USEPA calculations needs to be made available for public review, to confirm that their inputs, methodology, and calculations are appropriate and valid.

<u>USDW (Attachment D and E)</u>

The applicant noted that the depth to salt water is estimated to be at around 1,000 feet, but assumes salt water aquifers to have total dissolved solids (TDS) values of 3,000 mg/L or greater. Their assertion that a USDW is 3,000 mg/L or less TDS is incorrect, as a USDW is defined as an aquifer with a TDS of less than 10,000 mg/L. If the applicant will be protecting to the base of the lowermost USDW as noted in the USEPA Statement of Basis, then they are to place and cement surface casing back to surface from that depth. The initially proposed surface casing depth is to 1,200 feet, which *may* protect the lowermost USDW. However, an actual demonstration (through log analysis or other accepted techniques) of the depth to the lowermost USDW has not been presented. Adjacent oil/gas wells' open hole electric logs could be used to

determine TDS values of the formation brines at these shallow depths, thus verifying the depth to the base of the lowermost USDW, by employing standard oilfield calculations of water resistivity using the Archie Equation.

The applicant in its NOD response provides a revised depth to the lowermost USDW of 797 feet, based on a local driller's log indicating that fresh water is present at a depth of 750 feet. If freshwater is still present at 750 feet, it is unlikely that the transition to salt water (>10,000 mg/L TDS) occurs within a vertical distance of 50 feet. Again, the applicant appears to be confusing usable quality water aquifers (<3,000 mg/L) with USDWs (<10,000 mg/L). Moving the base of the lowermost USDW upward from 1,000 feet to 797 feet is not as protective or justified.

The USEPA in its Statement of Basis appears to accept the applicant's designation of the USDW at 800 feet depth. The agency agrees that surface casing can be set to 1,000 feet and be protective of the lowermost USDW, whereas setting to a depth of 1,200 feet was initially proposed by the applicant. The Agency appears to be proposing less restrictive surface casing requirements that the applicant initially proposed.

Geology (Attachment G)

The fault shown intersecting the injection zone on maps in the application, with an offset of 397 feet and located to south of the proposed well and within the AOR, is noted to be both laterally and vertically sealing by the applicant. Yet no discussion is presented providing direct evidence of that statement. If laterally sealing, the ZEI and resulting COI should be re-calculated employing a pressure model with a no-flow boundary, as nearby lateral sealing faults result in higher reservoir pressures over time due to restricted lateral reservoir extent. The USEPA-proposed reservoir fall-off testing during well completion will help to both define any nearby lateral boundaries and natural reservoir fracturing, as well as determine the reservoir permeability.

The USEPA NODs bring up the issue of the faulting present in the injection zone within the AOR, and request that the issue of fault movement (earthquakes) due to injection be addressed, due to the heightened sensitivity of this issue in the Northeast. The applicant does not address how the lateral sealing faults affect injection pressures over time in their NOD response, or the potential for localized earthquakes related to injection. Instead they note that the Oriskany Formation (Injection Zone) has lateral sealing faults and an overlying sealing confining zone. The presence of faulting is not in dispute, but the pressure increases that occur within these laterally fault-defined reservoirs have not been resolved. The issue of faults as related to injection-induced earthquakes is also not addressed in anything but a broad cursory manner. The presented example of gas storage fields not producing earthquakes is not particularly relevant; the pressures generated by continued injection results in reservoir pressures significantly higher

than those in gas storage fields where fluids are both injected and withdrawn and the reservoir pressures do not reach the levels present at commercial injection wells. The earthquake activity in neighboring Ohio and other parts of the country relates to injection wells that are used exclusively for wastewater disposal, not as ballast wells for gas storage fields. In the cases of these injection-induced earthquakes, basement faulting that extended upward into the Injection Zone (similar to those in the AOR) reached a pressure threshold great enough to allow critical shear stress failure on the fault planes. This scenario needs to be addressed in the application, as published regional rock stress components are available to input into estimations of fault failure due to localized Injection Zone pressure increases.

The USEPA does not further address the issue of laterally sealing faults and resulting pressure increases within the Injection Zone, even though the applicant in its NOD responses did not address the issue as requested. The Agency appears to contradict itself when it notes that the basement faults that are present within the AOR do not continue upward into the injection zone, but later states that based on gas production nearby, geologic faults exist within the Injection Zone which provide geologic traps for gas. In addition, the Agency rejects the possibility that earthquakes due to these basement faults could be induced by injection activities (a well-documented phenomenon) as well as by natural tectonic stresses.

The Agency in its Statement of Basis is requiring annual falloff testing as a method of assisting in the prevention of seismic (earthquake) activity related to the proposed injection well. While these tests provide a good indicator of reservoir pressure conditions, they do not in themselves assist in the warning or prevention of earthquake activity. The pressure test data can be used to track reservoir conditions, but the maximum injection pressure requested (discussed in the following section) is currently equal to the fracture pressure of the rock. Seismic activity could thus occur without any warning cues from the annual falloff test.

Calculations of critical shear stresses and rock failure envelopes can be determined through the use of rock properties data gathered from whole cores taken from the Injection Zone during well drilling. However, without site-specific petrophysical core lab analyses to determine tensile strengths, only a rough approximation of critical shear stresses can be made. It is suggested that the USEPA include in their permit requirements that such cores be gathered and such petrophysical analyses performed.

Operating Data (Attachment H)

The applicant provides information demonstrating a fracture gradient of 0.90 psi/ft, as evidenced from hydraulic fracturing performed in nearby wells completed in the Oriskany Formation. A USEPA letter confirms that value. The proposed maximum bottom-hole injection pressure of 6,575 psi is equal to this fracture gradient pressure of the rock at 7,306 feet depth. An additional

nearby well's fracture gradients is also presented showing a gradient of 0.9518 psi/ft, which appears to include tubing friction loss. After just presenting data showing a fracture gradient of 0.90 psi/ft for the Oriskany Formation, it does not seem appropriate to then justify a higher fracture gradient exceeding the maximum bottom-hole injection pressure of the previously demonstrated fracture gradient.

Again, the applicant continues to confuse units of permeability in this Attachment. A calculated permeability is noted as .0061 millidarcies (mD), or 6.1 darcies. The unit conversion is reversed, as 6.1 millidarcies is equivalent to 0.0061 darcies. The applicant appears to not be conversant regarding reservoir characteristics and terminology.

The proposed maximum allowable injection rate of 2,296 bbls/day is calculated using inputs from another well whose location and formation characteristics are unknown. In addition, the assumption that the relationship between injection rate and pressure is linear (as used in their formula) is also suspect. As such, utilizing this formula does not appear to be appropriate.

The samples of the types of fluids to be injected provides analyses of four types of fluids proposed for disposal at the facility. One of these analyses (RMS # 4/11/13) shows a total dissolved solids (TDS) value of 341,000 mg/L. This may not be a representative oilfield brine sample from the Oriskany Formation as stated, as the maximum TDS value for normally saturated NaCl brines is 311,300 mg/L (equal to a specific gravity (S.G.) value of 1.2). As this sample has an undefined specific gravity value and appears to contain high levels of strontium, the source of the sample is suspect. As oilfield brines in this region may contain strontium levels of up to 100-200 mg/L, a reported level of 25,300 mg/L (over 100 times the typical maximum concentration value) either is due to a lab error or the reported Oriskany brine contains significant contaminants from some other unknown source. Of note, the EPA recommended maximum contaminant level (MCL) for strontium in finished municipal drinking water is 4 ppm (approximately 4 mg/L). The USEPA does not address the issue of the excessively high specific gravity request by the applicant, and the possibility that a maximum value of 1.26 may allow for the injection of fluids other than the requested reservoir brines from oil and gas production.

Formation Testing Program (Attachment I)

The requested maximum allowable bottom-hole injection pressure of 6,575 psi, as noted previously. This pressure is equivalent to the fracture pressure of the formation, as calculated by the applicant themselves. There is no reason that the maximum injection pressure should so closely approach the fracture pressure. A safety margin of at least 100-200 psi should be incorporated into the determination of the maximum allowable bottom-hole (and surface) injection pressure. In addition, it is impossible to accurately measure the maximum bottom-hole pressure using the proposed surface gauges. A more appropriate methodology would be to

instead use a maximum surface injection pressure (applicant's proposed range is from 3,411 to 2,589 psi), calculated using only the maximum permitted specific gravity injectate and providing a safety margin of 100-200 psi. A sliding scale of injection pressures as proposed, based on varying injectate specific gravity values, is impractical and subject to significant calculation and lag time error. Of note, the adjacent # 327 well just outside of the AOR was intentionally fractured and had a surface measured fracture breakdown pressure of 2,400 psi in the Oriskany at the same depth as the proposed well's injection zone. This 2,400 psi fracture pressure value is 190 psi lower than the applicant's proposed low-end maximum injection pressure.

As discussed previously, the proposed maximum specific gravity of 1.26 is higher than a typical saturated NaCl brine (1.2 S.G.), which suggests that the proposed waste streams will consist at times of wastewaters from sources other than oilfield operations (see Attachment H discussion above). Also, the fracture gradient is noted in this Attachment as 0.95 psi/ft, whereas in other parts of the application a gradient of 0.9 psi/ft is documented and accepted from Oriskany Formation wells.

As no fracture gradients of the Confining Zone are presented, the argument that the Confining Zones provide confinement for regional gas storage is immaterial if the proposed injection well reaches subsurface pressures in the Oriskany Formation high enough to fracture the adjacent overlying onfining Onondago Limestone. Gas storage wells purposely hold injection pressures low enough so that no fracturing of their confining strata occurs, which would result in loss of valuable stored product.

Stimulation Program (Attachment J)

The applicant's proposed stimulation program is designed to fracture the Injection Zone, as sand is injected as a proppant into the stimulation-generated fractures. Thus the plan to limit the stimulation bottom-hole injection pressures to 6,480 psi so as to not exceed the proposed fracture pressure, to avoid fracturing the formation, is counter-intuitive. Based on the calculated permeability of 6.1 mD, it is very likely that this well will require such stimulation to be able to inject the quantities of fluid planned.

Injection Procedures (Attachment K)

The use of a variable maximum bottom-hole injection pressure, depending on the specific gravity of the injectate, cannot be accurately calculated in real time. The variables of tubing friction and injection rate in addition to specific gravity make any real-time calculation, where the injection pump's rate could be backed off so as to prevent exceeding the maximum bottom-hole pressure, not operationally realistic.

Construction Procedures (Attachment L)

The applicant's proposed cementing procedures to allow a wait of 12 hours before drilling out the casing shoe may not be appropriate. It is suggested that the drilling procedures be amended to increase the cement wait time to 24 hours for at least the shallow casing strings. Cementing of the long string casing back into the surface string casing at 1,200 feet, instead of only back to 5,000 feet depth, would be more protective of USDWs, and additionally isolate the long string casing from corrosion due to circulating brines present in shallower formations.

As noted earlier, the USEPA assumes the base of the lowermost USDW is at 800 feet depth, whereas there is no direct evidence for that depth presented in the application. In fact, the applicant states that the base of the lowest fresh water aquifer (3,000 mg/L or less) is estimated at a depth of 700-800 feet. If the intermediate 8 5/8-inch casing is placed at 850 feet instead of 1,200 feet, it would be less protective of usable quality waters (3,000 mg/L or less), and not protect the lowermost USDWs at all. It is suggested that the intermediate casing string should extend more than 50 feet below the 3,000 mg/L level, to at least 1,200 feet as originally proposed. The long string casing is proposed to be cemented up to 5,000 feet depth, so any lowermost USDWs present appears to not be protected below 800 (or 1,200) feet. It is suggested that the long string casing be cemented back up into the surface casing or to surface.

Preparedness and Contingency Plan (Attachment O)

The USEPA requested more information on site security. No additional information was provided by the applicant in its NOD responses. As site security is a major concern for most remote industrial facilities, the applicant's lack of additional detail is of concern. Vandalism or containment failure at remote injection well facilities when un-manned is a major concern to most commercial injection well operators, where surface spills would be potentially disastrous to surrounding land and water resources.

Monitoring Program (Attachment P)

The applicant's plan for observing injection pressure, rates, and volumes only one time per week, and recording these values only one time per month, is of insufficient frequency. Continuous monitoring and recording of these parameters is possible with the monitoring instrumentation proposed, and should be employed. Otherwise discursions from the permitted well parameter limits are unlikely to be identified unless occurring during the weekly observation event.

Although the tubing and annulus pressures are to be recorded continuously, the minimum annulus pressure and differential pressure from the tubing values are not demarcated. The USEPA does not define what is the minimum acceptable annulus pressure value to be continuously held is, or what differential pressure value between the annulus and tubing must be

maintained. Without these values being defined, no valid monitoring of mechanical integrity can be assumed. These values should be defined and written into the permit operating conditions.

The applicant proposed that a mechanical integrity test (MIT) demonstration occur at 5-year intervals. A two-year testing schedule was then recommended by the USEPA in their Statement of Basis. However, the proposed mechanical integrity testing (employing an annulus pressure test) does not provide any evaluation of whether fluid movement is occurring into USDWs via upward movement outside of the production casing. Testing of that potential conduit which can lead to mechanical integrity failure are available and commonly employed as part of scheduled MIT testing of injection wells. A differential temperature survey or radioactive tracer test (using a low level dose of I-131 with an 8 day half-life) should be considered as an addition to the two-year annulus pressure test MIT requirement.

Plug and Abandonment Plan (Attachment Q)

The applicant's proposed plug and abandon plan procedures do not match the accompanying plugging schematic. Differences in casing recovery lengths and cement plug depths are evident. In addition, the plugging plan to employ sand plugs across the fresh water zones is not as protective as using a cement plug over the entire length of these aquifers. The USEPA suggests gel spacers between the cement plugs, but mud plugs would likely be a better option, and a full cement plug from bottom to top would be most protective. It is suggested that, to be the most protective of the shallow aquifers, the borehole be filled from bottom to top with cement after the 4 ½-inch casing is shot off and partially retrieved.

The USEPA accepts the plugging methodology and cost. However, the plugging methodology is not adequately protective of USDWs, and the plugging costs are understated. The subcontractor and applicant cost estimates to plug the well are outdated, and appear to be significantly underestimated. As these costs directly relate to the financial assurance demonstration, these values need to be revised.

Standby Trust Agreement (Attachment R)

The standby trust agreement needs to be updated to reflect more realistic plugging and abandonment costs.

Technical Review Conclusions

The discussions and documentation included in the permit application, the USEPA NODs, the applicant's responses to the NODs, the USEPA Statement of Basis, and the USEPA draft permit do not adequately address the issues raised in this technical review. Until these issues are addressed in a satisfactory and complete manner, it would be prudent for the USEPA to

reconsider the issuance of the final UIC permit for the proposed Windfall Oil & Gas #1 Zellman Class II-D injection well.