FRACKING'S TOXIC LOOPHOLE

Thanks to the "Halliburton Loophole," Hydraulic Fracturing Companies Are Injecting Chemicals More Toxic than Diesel

ENVIRONMENTAL INTEGRITY PROJECT

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THE ENVIRONMENTAL INTEGRITY PROJECT

The Environmental Integrity Project (EIP) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for effective enforcement of environmental laws. EIP has three goals: 1) to provide objective analyses of how the failure to enforce or implement environmental laws increases pollution and affects public health; 2) to hold federal and state agencies, as well as individual corporations, accountable for failing to enforce or comply with environmental laws; and 3) to help local communities obtain the protection of environmental laws. Visit our website at http://www.environmentalintegrity.org.

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Executive Summary

The U.S. Environmental Protection Agency requires drilling companies to obtain Safe Drinking Water Act permits before they are allowed to inject diesel products into the ground to hydrofracture ("frack") for oil and gas. These permits act as safeguards for public health because they require drillers to take steps to reduce the risk that benzene and related pollutants found in diesel will contaminate groundwater.[1] The compounds found in diesel, called BTEX for Benzene, Toluene, Ethylbenzene, and Xylene, are highly toxic and subject to federal health-based standards for drinking water to reduce the risk of cancer and other diseases.[2] An August 2014 report by the Environmental Integrity Project, "Fracking Beyond the Law," documented the illegal use of diesel in fracking and described how this practice poses a risk to drinking water supplies.

In 2005, Congress created a loophole in the Safe Drinking Water Act that prohibits fracking with diesel without a permit because of diesel's toxicity – but allows fracking with much more toxic fluids. This double standard illustrates what happens when politicians manipulate environmental laws to benefit polluters, instead of allowing EPA to make public health decisions based on the best science.

This follow-up report describes an even greater potential public health threat from a loophole in the law. Because of a gap in the Safe Drinking Water Act, companies are allowed to inject other petroleum products (beyond diesel) without a permit, and many of these non-diesel drilling fluids contain even higher concentrations of the same toxins found in diesel. This report is based on a review of drilling company disclosures made to an industry-sponsored database of chemicals used in hydraulic fracturing, called "FracFocus," as well as industry Material Data Safety Sheets. Exactly how often companies use these other highly toxic petroleum products in fracking is unclear, in part because not all firms disclose to FracFocus, and some of those that do withhold chemical ingredients as "proprietary" information. But the Environmental Integrity Project's research suggests the use of fluids containing one or more BTEX toxins is fairly common. At least six fracking fluid additives on the market today contain more benzene (a carcinogen) than diesel fuel (see table C on page 4). And at least 21 fluids sold by Halliburton and other companies contain much higher concentrations of ethylbenzene (a probable carcinogen), xylene or toluene (which can cause neurological problems and other health effects) than diesel (see table F on page 6). Even the limited data available on FracFocus shows at least 153 wells in 11 states were fracked with fluids containing ethylbenzene between January 2011 and September 2014 (see attachment 1).

In some cases, the amount of toxic (but non-diesel) fracking fluids being injected into the ground is large. For example, in September 2014, a Texas-based oil and gas company called BlackBrush O&G, LLC, reported injecting a mix of crude oil, butane, and other fluids containing up to 48,000 gallons of benzene into a well in Dimmit County, Texas.

Between May 2013 and February 2014, another oil and gas firm, Discovery Operating Services, reported injecting solvents containing nearly 1,000 gallons of benzene into eleven wells in Midland and Upton Counties in Texas.[3]

While fracking fluids are injected into shale formations deep underground, even a small leak into a drinking water aquifer nearer the surface can be catastrophic. Federal standards for public water supplies limit benzene exposure to no more than 5 parts per billion, meaning that a quarter teaspoon of this toxin would be enough to make a swimming pool unsafe to drink.[4]

The 2005 Energy Policy Act preserved the Environmental Protection Agency's (EPA) authority to regulate diesel-based fracking fluids because of the toxicity of BTEX compounds and the concentrations found in diesel.[5] But the so-called "Halliburton loophole" in the same law *prohibits* EPA from applying the same groundwater protection standards for other fracking products that contain even higher percentages of the same toxins.[6] This double standard illustrates what happens when Congress manipulates environmental statutes for the benefit of polluters, instead of allowing EPA to make public health decisions based on the best available science.

The analysis that follows is based on the limited amount of data available through FracFocus, as well as from Material Safety Data Sheets for drilling fluids that are offered for sale to well operators.[7] FracFocus is a privately-run, non-mandatory fracking chemical reporting program created by industry, but not all companies participate. Many of the companies that do report to FracFocus claim that fracking fluid recipes are proprietary information that cannot be disclosed. Yet Material Safety Data Sheets make clear that benzene, ethylbenzene, toluene, and xylene are significant components of fracking fluids, even if the failure to report or trade secret claims make it impossible to quantify the full extent of their use.

Benzene and Ethylbenzene in Fracking Fluids

Benzene

Diesel fuels contain a maximum of 0.1 percent benzene, according to EPA, or one part per thousand.[8] Benzene is known to increase cancer risk, and the Safe Drinking Water Act Maximum Contaminant Level (MCL) is designed to limit exposure to no more than five parts per billion. However, thanks to the Halliburton loophole, the Safe Drinking Act regulates diesel-based fluids but no other petroleum products with much higher benzene concentrations.

Between September 9 and 14, 2014, Blackbrush Oil & Gas, LLC, injected about 1,170,000 gallons of base fluid containing up to 4.1 percent benzene – or about 48,000 gallons --into a well in Dimmit County, Texas. That is as much benzene as contained in 48 *million* gallons of diesel fluid with a maximum concentration of 0.1 percent benzene.

TABLE A: BENZENE AND OTHER INGREDIENTS IN BASEFLUID INJECTED INTO DIMMIT COUNTY WELL IN SEPTEMBER, 2014

Ingredient	CAS No.	Maximum Concentration of Ingredient in Additive (%)	Maximum concentration of Ingredient in Fracking Fluid (%)	Maximum Volume of Ingredient Injected (gal)[1]
Crude Oil	Mixture	100.0	45.5	532,561
Natural Gasoline	8006-61-9	30.0	13.6	159,183
n-Hexane	110-54-3	10.0	4.5	52,670
Benzene	71-43-2	9.0	4.1	48,989
Napthalene	91-20-3	1.0	.45	5,267
Ethyl Benzene	100-41-4	1.0	.45	5,267
Sulfur	7704-34-9	0.5	.22	2,575

[1] Injection occurred between 9/9/14 and 9/14/14 API No. 42-127-35771. Source: Fracfocus.org
[2] Blackbrush reported injecting a total of about 1,170,465 gallons of base fluid, comprised of sweet crude and butane.

The FracFocus database shows that Blackbrush had already injected up to 14,000 gallons of benzene in another Dimmit County fracking well in August, based on its reported volume of 1.17 million gallons of drilling fluid with a maximum benzene concentration of up to 1.34 percent. Texas Midstream Transport, LLC, was identified as the supplier in both cases.

Also according to FracFocus, Discovery Operating, Inc., injected Xylene Still Bottoms containing up to 947 gallons of benzene into 11 wells in Midland and Upton counties in Texas between May 2, 2013, and February 28, 2014 (Table B). The FracFocus reports identify Halliburton Services as the supplier of the Xylene Still Bottom that Discovery used.

TABLE B: WELL INJECTION OF XYLENE STILL BOTTOMS (10% BENZENE) BY DISCOVERY OPERATING INC. AND HALLIBURTON SERVICES

Date	Well Name/Number	API #	County, State	Xylene Still Bottoms (gallons)	Benzene (gallons)
5/2/2013	J8 8	42-329-38598	Midland, TX	4,558	455.8
6/22/2013	Amos #3	43-329-38582	Midland, TX	410	41
6/28/2103	CT 35 #3	42-461-38678	Upton, TX	404	40.4
9/12/2013	JW 9 11	42-329-38818	Midland, TX	624	62.4
9/25/2013	Greenwood 3	42-389-33839	Reeves, TX	490	49
10/7/2013	JW 7 10	42-329-38830	Midland, TX	390	39
11/18/2013	Windham 42B	42-329-38835	Midland, TX	941	94.1
12/9/2013	Windham 38 10	42-329-38869	Midland, TX	469	46.9
1/13/2014	Windham 40 10	42-329-38893	Midland, TX	394	39.4
1/28/2014	Holzgraf 34 #10	42-461-38962	Upton, TX	401	40.1
2/28/2014	CT 39 9	42-461-39000	Upton, TX	395	39.5
Total				**9,476**	**947.6**

Source: FracFocus.org

Table C identifies six drilling fluids or additives that, according to Material Safety Data Sheets available online, contain maximum benzene concentrations ranging from 1 percent to 5 percent, or 10 to 50 times the highest concentrations found in diesel fuels. These products go by trade names of POC 150 Frac Fluid, Frac Oil, Lean Oil, Ultra-Stim C732, and Unisol, as well as the Xylene Still Bottoms from Halliburton mentioned earlier. The Environmental Integrity Project was unable to find these products on FracFocus, perhaps because so many reports are labeled "proprietary." The list excludes petroleum solvents and naphthas that comprise 60 percent or more of many fracking fluids and which may contain up to 50 times more benzene that diesel fuels.

TABLE C: BENZENE IN FRACKING FLUIDS OR PETROLEUM HYDROCARBON INGREDIENTS OF FRACKING FLUIDS

Product	Purpose	Maximum Benzene Content (%)
Diesel	Multiple Uses	0.1
Lean Oil	Hydrocarbon Fracturing and Well Service Fluid	5
Ultra-Stim C732 Frac Oil	Dewaxing and Fracture Stimulation	<5.0
POC 150 Frac Fluid	Dewaxing and Fracture Stimulation	1.0
Frac Oil	Well Stimulation	1.0
UniSol	Multiple Uses	5.0
Xylene Bottoms	Solvent	1.0
Sweet Crude Oil	Base Fluid	9.0

Source: Material Safety Data Sheets and Frac Focus.org. Also available upon request from Environmental Integrity Project.

Petroleum solvents, distillates, or aromatic naphthas can make up 60 percent or more of the volume of some drilling fluids. These are usually identified by Chemical Abstract Service (CAS) classification codes meant to group chemicals or hydrocarbons based on their common characteristics (e.g., their volatility or boiling point). Some of the feedstocks that are identified as drilling fluid ingredients can have from 6.5 to 50 times more benzene than the diesel oils regulated under the Safe Drinking Water Act. The examples in Table D are based on Material Safety Data Sheets.

TABLE D: PETROLEUM FEEDSTOCKS WITH MORE BENZENE THAN DIESEL FUEL

Product	CAS No.	Purpose	Maximum Benzene Content (%)
Heavy Aromatic Distillate	64742-47-8	Well Fracture/Stimulation	5.0
Aromatic Petroleum Naphtha	68603-08-7	Ingredient in Surfactant	2.0
Heavy Reformate	64741-68-0	Gasoline component	1.0
Heavy Straight Run Naphtha	64741-41-9	Fuel	1.0
#2 Diesel Dyed	68814-87-9 64742-46-7 64741-59-9	Fuel	0.65

Note that Table D includes #2 dyed diesel with a maximum benzene concentration of 0.65 percent, much higher than the 0.1 percent that EPA assumed as the upper limit for at least some diesel fuels in its 2004 report to Congress. Despite its greater benzene content, #2 dyed diesel products can be injected into oil and gas wells without Safe Drinking Water Act

permits because under EPA's guidance, permit requirements apply only to a subset of diesel products with different CAS numbers.

The actual benzene content of these petroleum-based feedstocks can vary widely, and be significantly lower than the concentrations displayed in Table D. But neither FracFocus nor Material Safety Data Sheet rules require suppliers or well operators to determine or disclose the benzene or BTEX content of any of the petroleum solvents, naphthas, or distillates that are identified as the principal component of many drilling fluids. The problem is that the Halliburton Loophole allows unlimited injection of these non-diesel oils regardless of their benzene content without requiring disclosure that would allow a full assessment of the potential risk.

Ethylbenzene

Ethylbenzene is classified as a probable carcinogen, and cancer risk is considered significant when concentrations exceed the Maximum Contaminant Level of 0.7 parts per million in drinking water. Diesel fuels may contain up to 1.0 percent ethylbenzene, a probable carcinogen, and less than 1 percent xylene or toluene.[9] FracFocus disclosures show that between May 1, 2013, and April 28, 2014, the Citation Oil and Gas Corporation of Texas injected solvents containing up to 4,538 gallons of ethylbenzene, equivalent to the amount found in nearly half a million gallons of diesel fuels in Oklahoma. For a list of wells that reported fracking with ethylbenzene on FracFocus, see Attachment 1.

Table E identifies counties where well operators have reported injecting at least 500 gallons of ethylbenzene into one or more wells within the past several years.

TABLE E: COUNTIES IN WHICH OPERATORS INJECTED OVER 500 GALLONS OF ETHYLBENZENE DURING FRACKING

County, State	No. Wells	Date Range	Ethylbenzene Injected (gal)[1]
Dimmit, TX	2	8/22/2014-9/9/2014	6,924.75
Carter, OK	39	4/3/2013 to 9/17/2014	4,382.1
Webb, TX	3	8/12/2011 to 9/15/2011	4,056.1
Kern, CA	5	3/23/2012 to 10/13/2012	1,318.9
Reagan, TX	2	6/27/2014-7/28/2014	928.6
Irion, TX	1	6/29/2014	794.1
Ionia, MI	1	6/2/2013	522.0
Total	**53**		**18,926.55**

[1] Volumes are based on total water volume because not all operators reported both water and non-water volume. These are conservative estimates. For a full list of wells, see Attachment 1.

At least 21 different fracking fluid additives contain ethylbenzene concentrations between 5 and 40 percent, based on Material Safety Data Sheets available online, with even higher concentrations of toluene and xylene (see Table F on next page). Many of these products do appear in FracFocus reports, or on state agency websites that post Material Safety Data Sheet information about the chemicals used in fracking wells within that state. But neither FracFocus nor government websites provide enough information to determine the total amount of ethylbenzene injected into fracking wells every year.

TABLE F: ETHYLBENZENE, TOLUENE, AND XYLENE IN FRACKING FLUIDS

Vendor	Product	Purpose	Ethyl-benzene (%)	Toluene (%)	Xylene (%)
Multiple	Diesel	Fracturing Fluid	1.0	.007 to 0.7	0 to 2
Universal Well Services	NDL-100	Fracturing Dispersant	30.0	60.0	60.0
Ondeo Nalco Energy Services	EC2312A	Demulsifier	30.0		5.0
Universal Well Services	Paranox	n/a	30.0	40.0	60.0
Universal Well Services	Parasol II	Paraffin Inhibitor	13.0	60.0	40.0
Universal Well Services	Parasurf	Paraffin Control	40.0	70.0	60.0
PSC	Para Clear D500	Paraffin Dispersant	10.0	60.0	60.0
PSC	Pro Sperse	Paraffin Control	40.0	70.0	60.0
PSC	Pro Loss	Fracturing Dispersant	30.0	60.0	60.0
Diversity Technologies Corp.	Emul-Break	Emulsion Preventer	10.0	5.0	60.0
Superior Well Services	Xylene	Paraffin & Scale Additives	30.0	0.9	90.0
Barsol	Xylene[1]	Solvent	30.0	1.0	60.0
Valley Solvents	Xylene[1]	Solvent	30.0	10.0	100.0
Weatherford	PC2 Xylene[1]		30.0		90.0
Smart Chemical Services	SCS P762[1]	Corrosion Inhibitor	25.0	5.0	10.0
Sanjel	StimSol[1]	Surfactant	13.0		70.0
Baker Hughes	Mil-break 943	Oxyalkylated Phenolic Resin	7.0	25.0	
Halliburton Services	Xylene	Solvent	20.0		83.0
Halliburton Services	Paragon	Solvent	30.0		100.0
Haliburton Services	N-Ver-Sperse O with Xylene	Dispersant	30.0		90.0
Halliburton Services	Barsol D100	Solvent	5.0		10.0
CalFrac Well Services	DWP 931[1]	Non-Emulsifier	5.0		13.0

[1] Source: FracFocus and Material Safety Sheets (online or available on request from EPA).

Private Interests and the Public's Health

The Energy Policy Act requires Safe Drinking Water Act permits for the injection of diesel fuels into hydraulically-fractured wells because of diesel's high concentration of benzene and ethylbenzene, but the law eliminates those safeguards for fluids that contain much higher concentrations of the same contaminants. The limited information available through FracFocus, Material Safety Data Sheets, and state agency websites indicate that these carcinogens are pouring through the Halliburton loophole and into fracked oil and gas wells, although trade secret claims and data limitations make it impossible to determine the full impact.

Some companies have made efforts to reduce benzene and other BTEX compounds in petroleum products to help customers meet other regulatory needs (e.g., for low-emitting fuels), or to avoid the stigma associated with carcinogens. For example, Halliburton markets an "Ultra-Clean" line of fracturing gels that contain no benzene or other BTEX compounds, which the company acknowledges, "are discouraged in injected water." That did not, however, stop Halliburton from supplying Discovery Operating oil and gas company with Xylene Still Bottoms containing up to 947 gallons of benzene in 2013 and 2014. That transaction is a reminder that we cannot depend upon private economic interests to address public health concerns.

Conclusions and Recommendations

Congress should reverse its 2005 mistake and repeal the Halliburton Loophole by authorizing EPA to require Safe Drinking Water Act safeguards for the injection of any fracking fluids that contain significant quantities of benzene, ethylbenzene, and other toxic pollutants. Such action would not "ban" fracking or even the use of these toxic chemicals, but would establish sensible safeguards to keep them from leaking into drinking water supplies.

EPA should revisit its guidance and broaden the categories of diesel products that require Safe Drinking Water Act permits before they can be injected into oil and gas wells. It is absurd for the agency to limit these requirements based on a narrow subset of chemical abstract (CAS) identification numbers while exempting products with much higher benzene concentrations that are clearly labeled as diesel fuels.

State agencies have adopted FracFocus and posted Material Safety Data Sheets in a commendable effort to inform the public about chemicals used in fracking wells. As this report demonstrates, both data sources have too many gaps to be reliable sources of information. At a minimum, state agencies should require that suppliers and well operators disclose when

the benzene, ethylbenzene, toluene, and xylene in fracking fluids exceed the concentrations found in diesel fuels.

Meanwhile, the oil and gas industry can demonstrate its corporate responsibility by disclosing the BTEX content of the products they market or use. The next step should be eliminating or at least minimizing the use of fracking fluids that contain benzene and other toxins. Commercial websites indicate that fracking products certified as "BTEX free" are widely available. Companies that make the switch should avoid alternatives that are high in naphthalene or other toxic hydrocarbons that can also make groundwater unsafe to drink.

Without these reforms, we are perpetuating a loophole that allows the unpermitted and unregulated injection of unlimited quantities of carcinogens and other highly toxic pollutants into the ground. Once a drinking water aquifer is contaminated, it can take a generation or more before it can be restored.

Clean and safe groundwater is a public right. We cannot rely solely on private interests for its protection.

NOTES

[1] See, e.g., 42 U.S.C. 1421, and U.S. Environmental Protection Agency, "Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels: Underground Injection Control Program Guidance #84,(February 2014), at http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/epa816r14001.pdf.

[2] USEPA, "2012 Edition of the Drinking Water Standards and Health Advisories," pp. 1-7, (April 2012) at http://water.epa.gov/action/advisories/drinking/upload/dwstandards2012.pdf

[3] Source: FracFocus. The FracFocus disclosure data referenced in this report are available online through FracFocus.org or by request to the Environmental Integrity Project.

[4] *Supra, n. 2,* p. 1.

[5]USEPA, "Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs," (June 2004), at 4-4, available online at http://nepis.epa.gov/Adobe/PDF/P100A99N.PDF

[6] Energy Policy Act, 42 U.S.C. § 15801, *et seq.*

[7] *Supra,* n. 3, FracFocus. The Material Safety Data Sheets referenced in this report are available online or by request to the Environmental Integrity Project.

[8] *Supra* n. 5 at 4-4

[9] Based on Material Safety Data Sheets.

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