

Hydraulic Fracturing: Where It's At and Where It's Going

HALLIBURTON

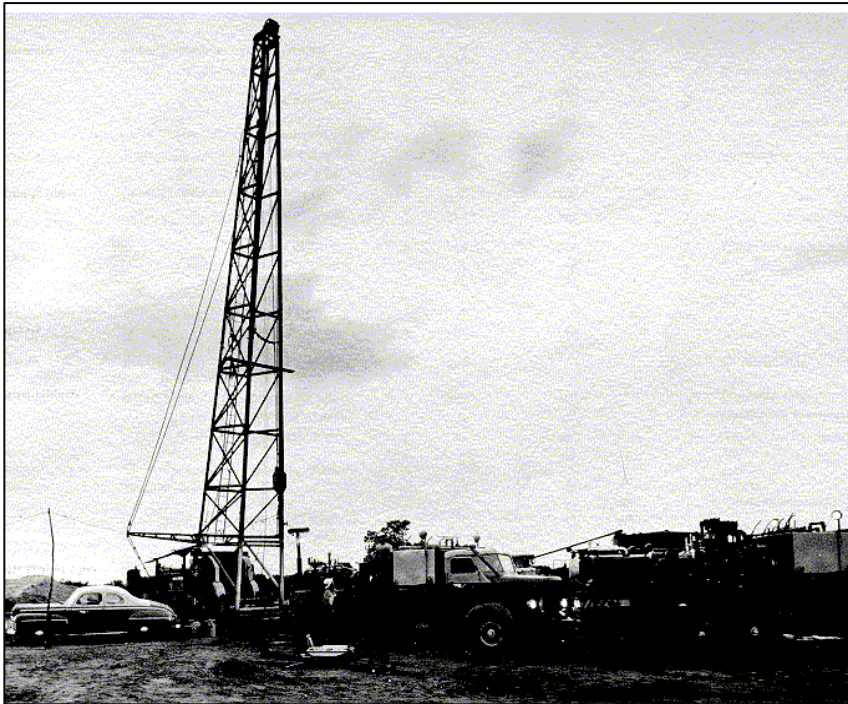
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Assistant General Counsel

Environmental Law Practice Group

Halliburton Energy Services

Background



- Hydraulic fracturing (HF) has been used for over 60 years to enhance oil and gas production
- HF techniques have been continually refined to maintain production levels from reservoirs that are increasingly difficult to access
- HF is critical to domestic oil and gas production

Hydraulic Fracturing: An Overview

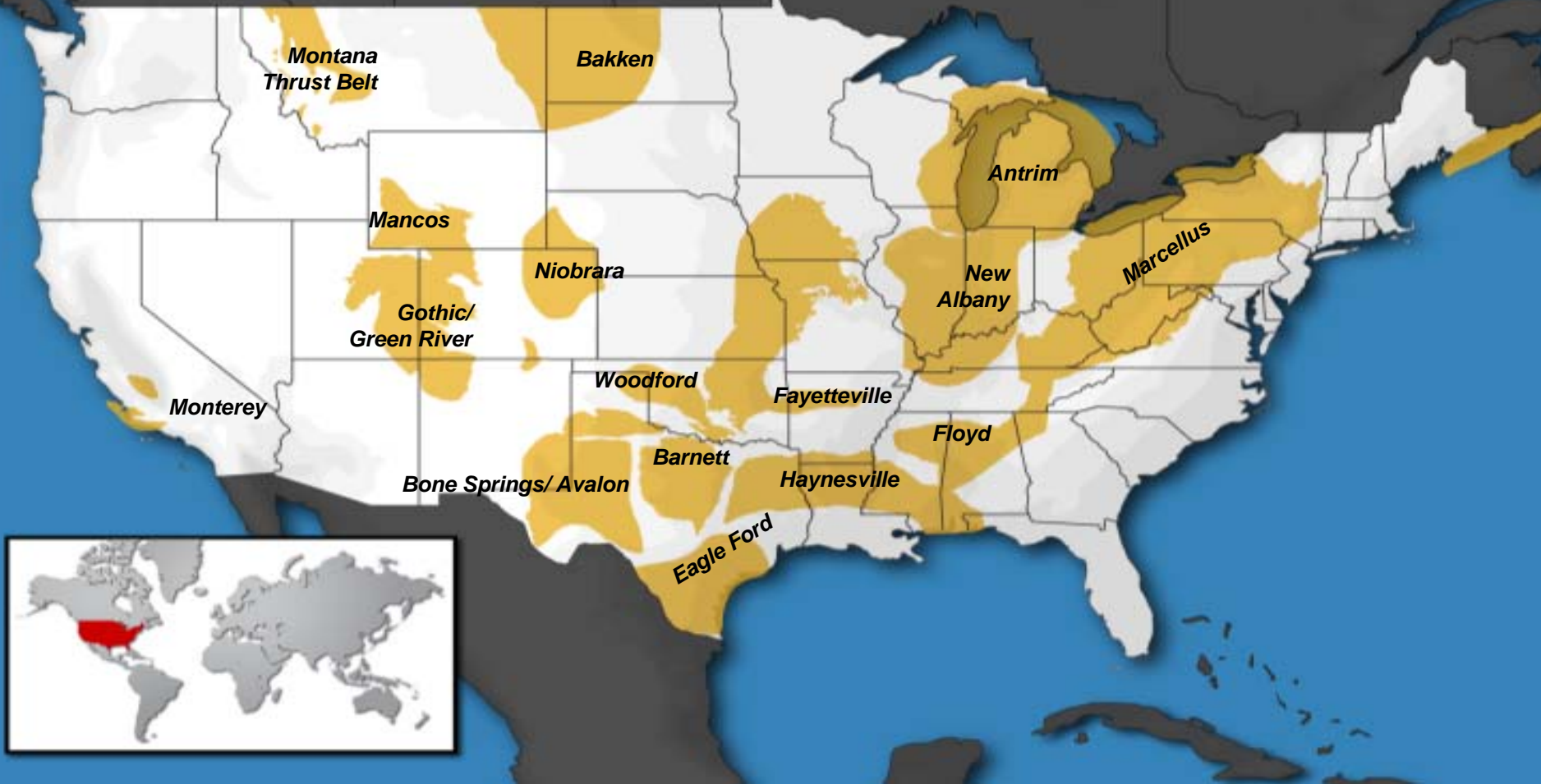


- **Hydraulic Fracturing:**
 - The use of fluids to create a pathway to the wellbore
 - The placement of small granular solids into the pathway to ensure that it remains open after the hydraulic pressure is removed
- **Objective:**
 - Increase the rate at which the well is capable of producing oil or gas
 - Increase the economically recoverable reserves for a well

Why HF Is Important

"Shale Gas: A Game Changer With Global Implications"

Medlock, PhD., Baker Institute for Public Policy, Rice University (2009)



Key Principles

HF Is A Safe Technology With Respect To Drinking Water

- HF has been used for over 60 years with no confirmed instances of contamination
 - Numerous state regulators in the U.S. and USEPA have repeatedly affirmed that they are not aware of any instances of HF resulting in contamination of drinking water aquifers

"There have been no documented cases of drinking water contamination that have resulted from hydraulic fracturing operating to stimulate oil and gas well in the State of Alabama."

REGULATORY STATEMENTS ON HYDRAULIC FRACTURING SUBMITTED BY THE STATES JUNE 2009

The following statements were issued by state regulators for the record related to hydraulic fracturing in their states. Statements have been compiled for this document.

ALABAMA:

Nick Tew, Ph.D., P.G.
Alabama State Geologist & Oil and Gas Supervisor
President, Association of American State Geologists

There have been no documented cases of drinking water contamination that have resulted from hydraulic fracturing operations to stimulate oil and gas wells in the State of Alabama.

The U.S. Environmental Protection Agency (EPA) approved the State Oil and Gas Board of Alabama's (Board) Class II Underground Injection Control (UIC) Program in August 1982, pursuant to Section 142 of the Safe Drinking Water Act (SDWA). This approval was made after EPA determined that the Board's program accomplished the objectives of the SDWA, that is, the protection of underground sources of drinking water. Obtaining primacy for the Class II UIC Program, however, was not the beginning of the Board's ground-water protection programs. The Board has been continuously and actively implementing programs, which include the regulation and approval of hydraulic fracturing operations, since the Board was established in 1945, pursuant to its mission and legislative mandates.

The State of Alabama, acting through the Board, has a vested interest in protecting its drinking water sources and has adequate rules and regulations, as well as statutory mandates, to protect these sources from all oil and gas operations, including hydraulic fracturing. The fact that there has been no documented case of contamination from these operations, including hydraulic fracturing, is strong evidence of effective regulation of the industry by the Board. In our view, additional federal regulations will not provide any greater level of protection for our drinking water sources than is currently being provided.

ALASKA:

Cathy Foerster
Alaska Oil and Gas Conservation Commission

There have been no verified cases of harm to ground water in the State of Alaska as a result of hydraulic fracturing.

There are regulations already exist in Alaska to protect fresh water sources. Current well construction is regulated in Alaska (as required by Alaska Oil and Gas Conservation Commission statutes).

Studies Show No Plausible Risk From Subsurface Migration

EPA 816-R-04-003

Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs

FINAL

June 2004

United States Environmental Protection Agency
Office of Water
Office of Ground Water and Drinking Water
Drinking Water Protection Division
Prevention Branch
1200 Pennsylvania Avenue, NW (4606M)
Washington, DC 20460

"Based on the information collected and reviewed, EPA has determined that the injection of hydraulic fracturing fluids into CBM wells poses little or no threat to USDWs."

The migration of hydraulic fracturing fluids from the Marcellus Shale to an overlying groundwater aquifer is "an implausible contamination pathway."

Human Health Risk Evaluation For Hydraulic Fracturing Fluid Additives Marcellus Shale Formation, New York

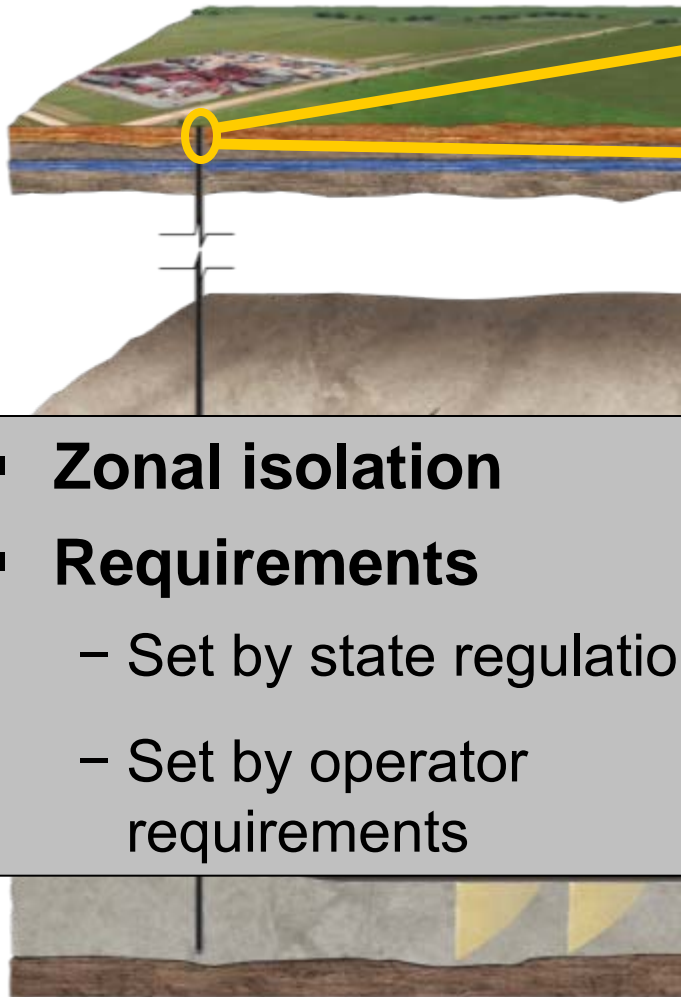
Prepared for
Halliburton Energy Services, Inc.
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December 31, 2009

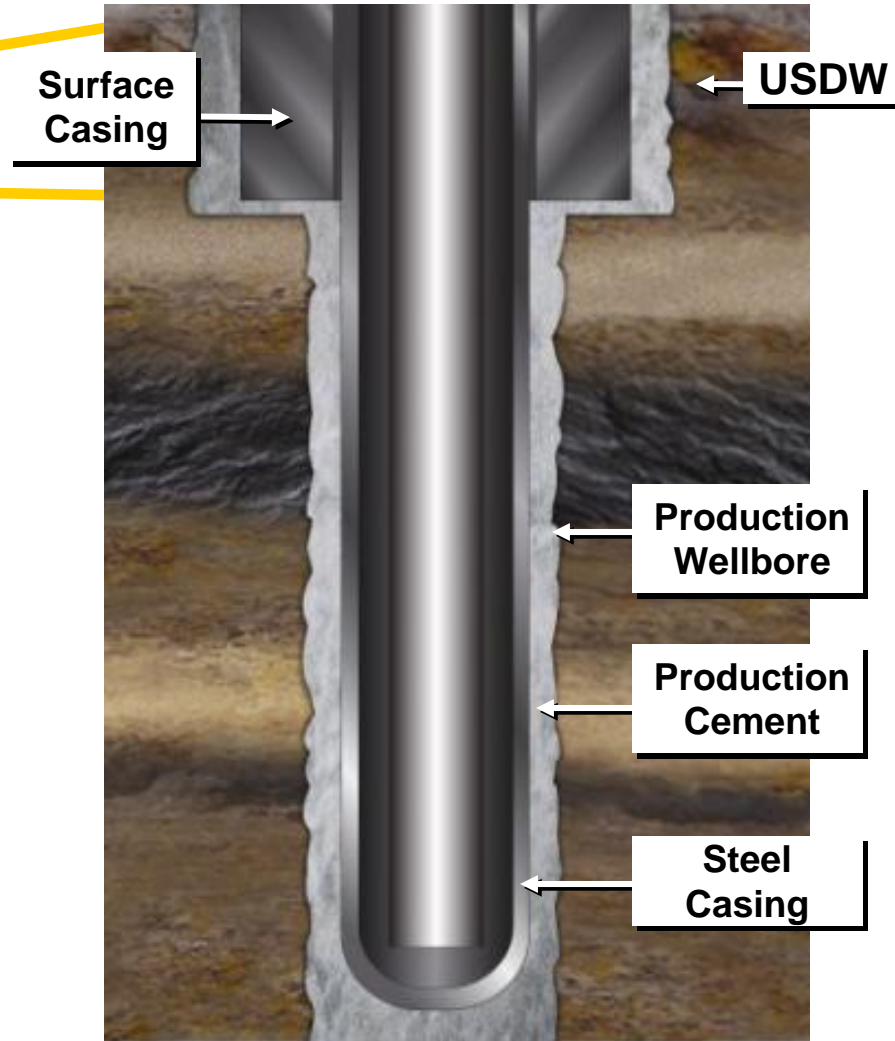


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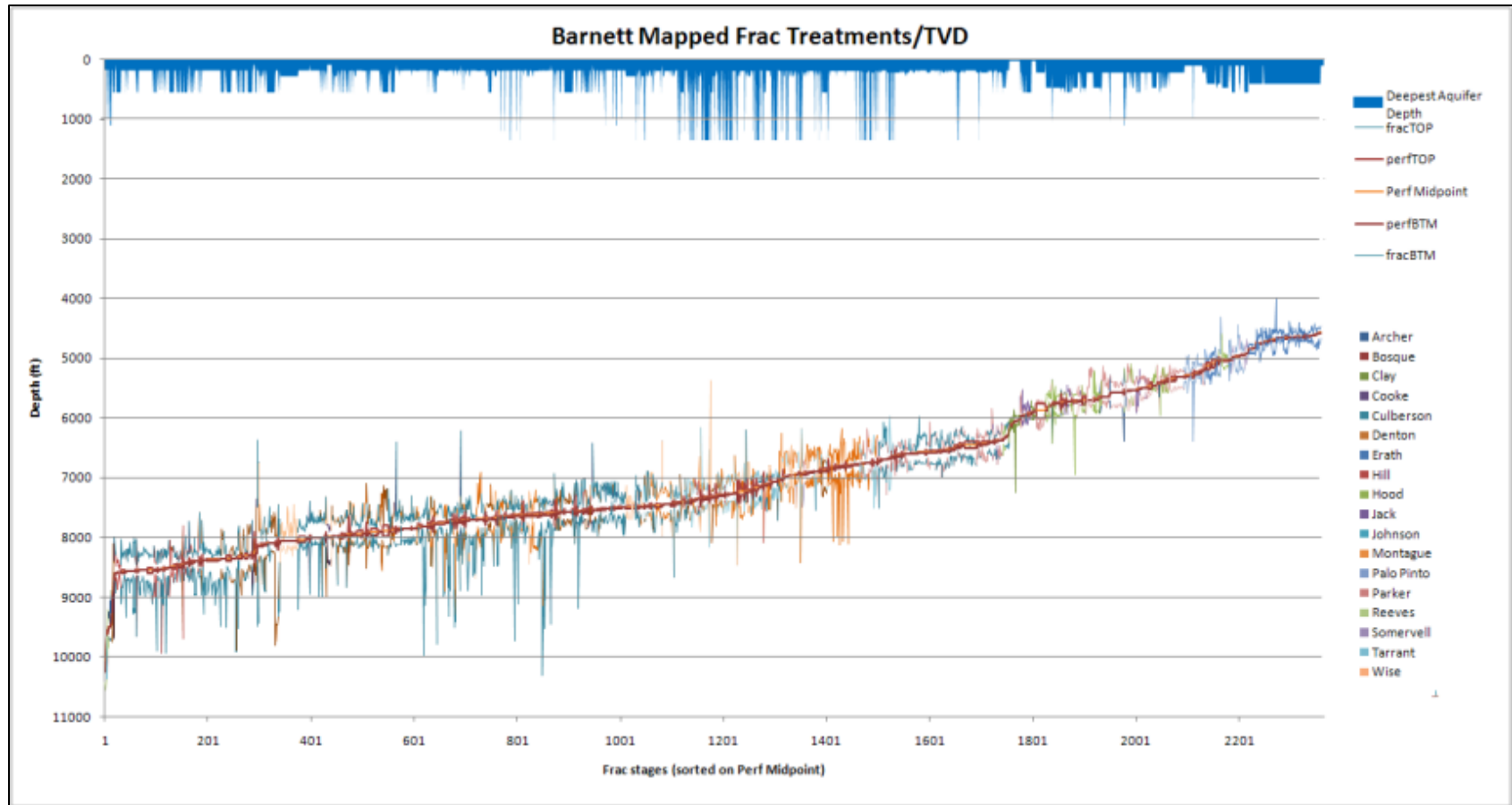
Well Construction Techniques: Casing And Cementing



- **Zonal isolation**
- **Requirements**
 - Set by state regulations
 - Set by operator requirements

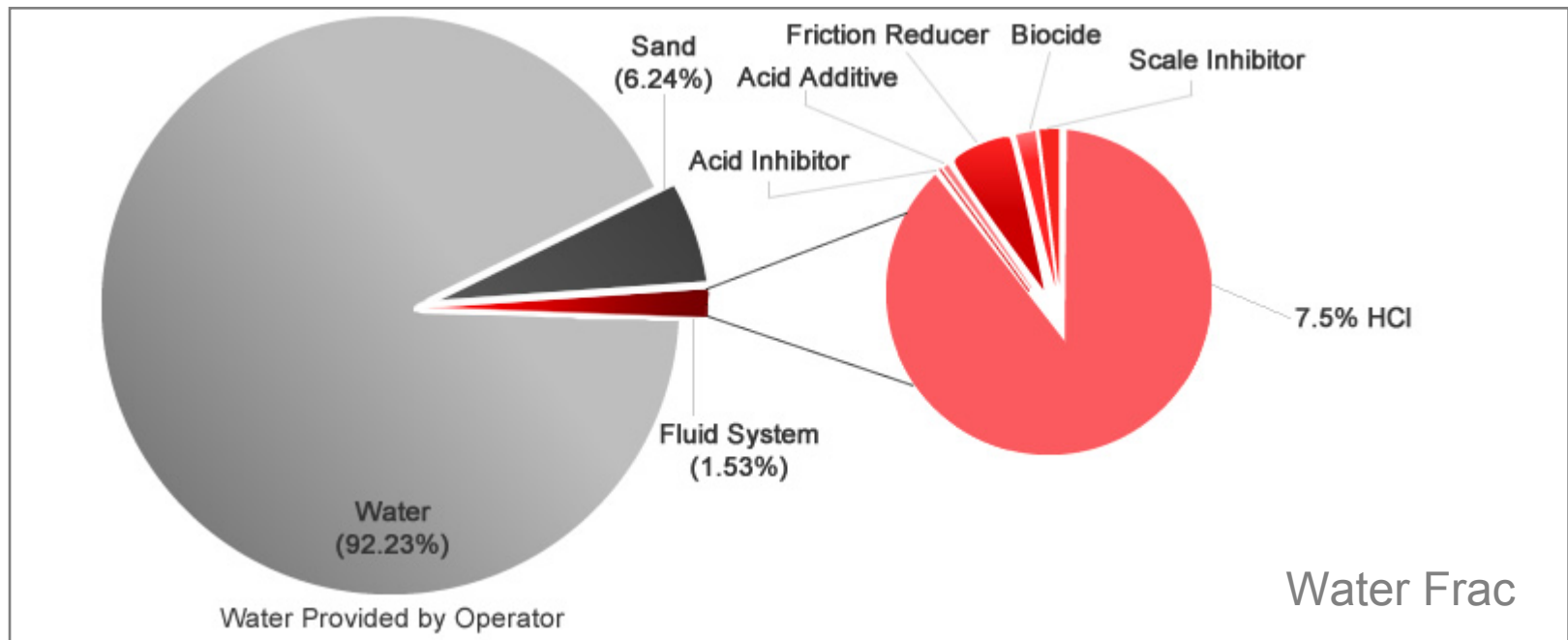


1000s Of Feet Separate Fractures From The Water Table



HF Fluids Contain Low Concentration Levels of Chemical Additives

- Concentrations of chemical additives are far below the levels necessary to pose a threat



Methane Contamination

- Methane is *naturally* present in up to 30 percent of all drinking water wells in the US
 - USGS: naturally occurring methane is present in over 75 percent of water wells in West Virginia
- Methane contamination linked to shale gas development has been associated with improper well construction not HF

"We found no evidence for contamination of drinking-water samples with deep saline brines or fracturing fluids"

Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing

Stephen G. Osborn¹, Avner Vengosh¹, Nathaniel R. Warner¹, and Robert B. Jackson^{1,2*}

¹Center on Global Change, Nicholas School of the Environment, ²Division of Earth and Ocean Sciences, Nicholas School of the Environment, and ³Biology Department, Duke University, Durham, NC 27708

Edited by William H. Schlesinger, Cary Institute of Ecosystem Studies, Millbrook, NY, and approved April 14, 2011 (received for review January 13, 2011)

Directional drilling and hydraulic-fracturing technologies are dramatically increasing natural-gas extraction. In aquifers overlying the Marcellus and Utica shale formations of northeastern Pennsylvania and upstate New York, we document systematic evidence for methane contamination of drinking water associated with shale-gas extraction. In active gas-extraction areas (one or more gas wells within 1 km), average and maximum methane concentrations in drinking-water wells increased with proximity to the nearest gas well and were 19.2 and 64 mg CH₄ L⁻¹ (n = 26), a potential explosion hazard; in contrast, dissolved methane samples in neighboring nonextraction sites (no gas wells within 1 km) within similar geologic formations and hydrogeologic regimes averaged only 1.1 mg L⁻¹ (P < 0.05; n = 34). Average $\delta^{13}\text{C-CH}_4$ values of dissolved methane in shallow groundwater were significantly less negative for active than for nonactive sites (-37 ± 7‰ and -54 ± 11‰, respectively; P < 0.0001). These $\delta^{13}\text{C-CH}_4$ data, coupled with the ratios of methane to higher-chain hydrocarbons, and $\delta^2\text{H-CH}_4$ values, are consistent with deeper thermogenic methane sources such as the Marcellus and Utica shales at the active sites and matched gas geochemistry from gas wells nearby. In contrast, lower-concentration samples from shallow groundwater at nonactive sites had isotopic signatures reflecting a more biogenic or mixed biogenic/thermogenic methane source. We found no evidence for contamination of drinking-water samples with deep saline brines or fracturing fluids. We conclude that greater stewardship, data, and possibly—regulation are needed to ensure the sustainable future of shale-gas extraction and to improve public confidence in its use.

groundwater | organic-rich shale | isotopes | formation waters | water chemistry

Increases in natural-gas extraction are being driven by rising energy demands, mandates for cleaner burning fuels, and the economics of energy use (1–5). Directional drilling and hydraulic-fracturing technologies are allowing expanded natural-gas extraction from organic-rich shales in the United States (6, 7) where (2, 3). Accompanying the boom in natural-gas extraction are public concerns about potential contamination from drilling activities (4, 8). However, these concerns are often based on

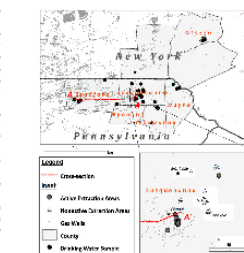


Fig. 1. Map of drilling operations and well-water sampling locations in Pennsylvania and New York. The star represents the location of Binghamton, New York. Inset A: Close-up in Susquehanna County, Pennsylvania, showing areas of active (closed circles) or nonactive (open triangles) extraction. A drinking-water well is classified as being in an active extraction area if a gas well is within 1 km (see Methods). Note that drilling has already spread to the area around Brookton, Pennsylvania, primarily a nonactive location at the time of our sampling (see inset). The stars in the inset represent the towns of Dimock, Brookton, and Montrose, Pennsylvania.

Concerns for impacts to groundwater resources are based on (i) fluid (water and gas) flow and discharge to shallow aquifers due to the high pressure of the injected fracturing fluids in the gas wells (10); (ii) the toxicity and radioactivity of produced water from a mixture of fracturing fluids and deep saline formation waters that may discharge to the environment (11); (iii) the potential explosion and asphyxiation hazard of natural gas; and (iv) the large number of private wells in rural areas that rely on shallow groundwater for household and agricultural use—up to million wells in Pennsylvania alone—that are typically unsealed and unlined (8, 9, 12). In this study, we analyzed groundwater from 68 private water wells from 36- to 150-m deep in

Contributions: S.G.O., A.V., and R.B.J. designed research; S.G.O. and R.B.J. performed research; A.V. contributed new reagents/analytic tools; S.G.O., A.V., N.R.W., R.B.J., and A.V. analyzed data; and S.G.O., A.V., N.R.W., and R.B.J. wrote the paper. The authors declare no conflict of interest.

Direct Submission article had a preeminent editor. It is available online through the PNAS open access option. For more information, contact the PNAS open access editor. For correspondence, please address: Robert B. Jackson, rbj@duke.edu. Article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1101080108/-DCSupplemental.

States Are Effectively Regulating HF

- **State regulation allows for regional characteristics to be considered in setting standards**
- **States have taken steps to address HF and related activities**
 - **Colorado** - 2008 rulemaking comprehensively updated and revised oil and gas regulations to address hydraulic fracturing
 - **Wyoming** - 2010 rulemaking addressed HF operations including disclosure requirements
 - **Pennsylvania** - Extensive rule revision and amendment in 2010 addressed wastewater handling and disposal, casing and cementing standards and HF disclosure
 - **Louisiana** - Revisions and amendments in 2009 and 2010 addressed water protection, wastewater disposal and recycling of flowback and produced water from shale gas development
 - **Arkansas** - 2010 rulemaking addressed casing and cementing standards, wastewater storage, handling and treatment and HF disclosure

The Disclosure Issue

- **Perceived danger prompts demands for chemical disclosure by NGOs**

- **Public Perception:**

- HF pollutes ground water with 100s of chemicals
- Industry is hiding information from the public



Buried Secrets

Gas Drilling's Environmental Threat

www.ProPublica.org

Secret Potion # 9- Fracking Fluid Still a Mystery

www.dcbureau.org

- **Environmental/citizen groups have called for complete public disclosure of the chemical formulas for products used in fracking fluids**

Public Disclosure Of Formulas Jeopardizes Proprietary Technology

- **Trade secret information is protected only as long as it is kept confidential**
- **Unprotected full disclosure means:**
 - Loss of trade secret protection
 - Loss of competitive advantage
 - Loss of R&D investment costs

Halliburton's Approach To Disclosure

It's no secret: Halliburton supports transparency with adequate protections for confidential business information

HALLIBURTON

Hydraulic Fracturing

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Fluids Disclosure

Fracturing 101

Glossary

In Focus: What's In The Fluids?



We are providing information about the additives that go into our fracturing solutions along with the chemical constituents that comprise the additives. Ultimately, we plan on providing data to more states.

- + Pennsylvania Water Frac Formulation
- + Pennsylvania Hybrid Frac Formulation
- + Northeast Foam Frac Formulation

+ Click the plus sign to explore disclosure

Halliburton pioneered fracturing technology in the mid-1940s, and has always supported and complied with state and federal requirements promoting disclosure of additives that typically comprise less than one-half of 1percent of our solutions.

Much of this information has been available to the public for quite a while – although it tends to be hard to find and even tougher to understand. This site aims to change

Halliburton Supports the GWPC/IOGCC State HF Chemical Registry

Hydraulic Fracturing Fluid Product Component Information Disclosure

Fracture Date:	12/1/2012
State:	Pennsylvania
County:	Susquehanna
API Number:	37-115-20299
Operator Name:	Test C Appalachia
Well Name and Number:	Test Well 1
Longitude:	-76.052537
Latitude:	41.719388
Long/Lat Projection:	NAD27
Production Type:	Gas
True Vertical Depth (TVD):	7,157
Total Water Volume* (gal):	4,764,606

- Supported at the highest levels of Halliburton management
- MSDS level disclosure

Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
Water		Carrier / Base Fluid			100.00%	87.19000%	
Sand (Proppant)		Proppant			100.00%	11.89718%	
Acid, Hydrochloric (1	PP CO	Acid Package	Hydrochloric Acid	007647-01-0	15.00%	0.11853%	
A999	PP CO	Acid Corrosion Inhibitor	Methanol	67-56-1	40.00%	0.00050%	
			Fatty Acid	Proprietary	30.00%	0.00037%	
			Prop-2-yn-ol	107-19-7	10.00%	0.00012%	
			Aliphatic alcohols, ethoxylated #1	Proprietary	30.00%	0.00037%	
L058	PP CO	Iron Control Agent	Sodium Erythorbate	6381-77-7	100.00%	0.00474%	
B999	PP CO	Friction Reducer	Distillates (petroleum), hydrotreated light	64742-47-8	30.00%	0.01275%	
			Aliphatic alcohol, glycol ether	Proprietary	5.00%	0.00213%	
B-88	SPEC CHEM	Anti Bacterial Agent	Glutaraldehyde	111-30-8	27.00%	0.00992%	
			n-Alkyl dimethyl benzyl ammonium chloride	68424-85-1	5.50%	0.00202%	
			Ethanol	64-17-5	4.00%	0.00147%	
			Didecyl dimethyl ammonium chloride	7173-51-5	8.00%	0.00294%	
TS-00	SPEC CHEM	Scale Inhibitor	Sodium polyacrylate	Proprietary	30.00%	0.00325%	

*Total Water Volume sources may include fresh water, produced water, and/or recycled water

** Information is based on the maximum potential for concentration and thus the total may be over 100%

All component information listed was obtained from the supplier's Material Safety Data Sheets (MSDS). As such, the Operator is not responsible for inaccurate and/or incomplete information. Any questions regarding the content of the MSDS should be directed to the supplier who provided it. The Occupational Safety and Health Administration's (OSHA) regulations govern the criteria for the disclosure of this information. Please note that Federal Law protects "proprietary", "trade secret", and "confidential business information" and the criteria for how this information is reported on an MSDS is subject to 29 CFR 1910.1200(i) and Appendix D.

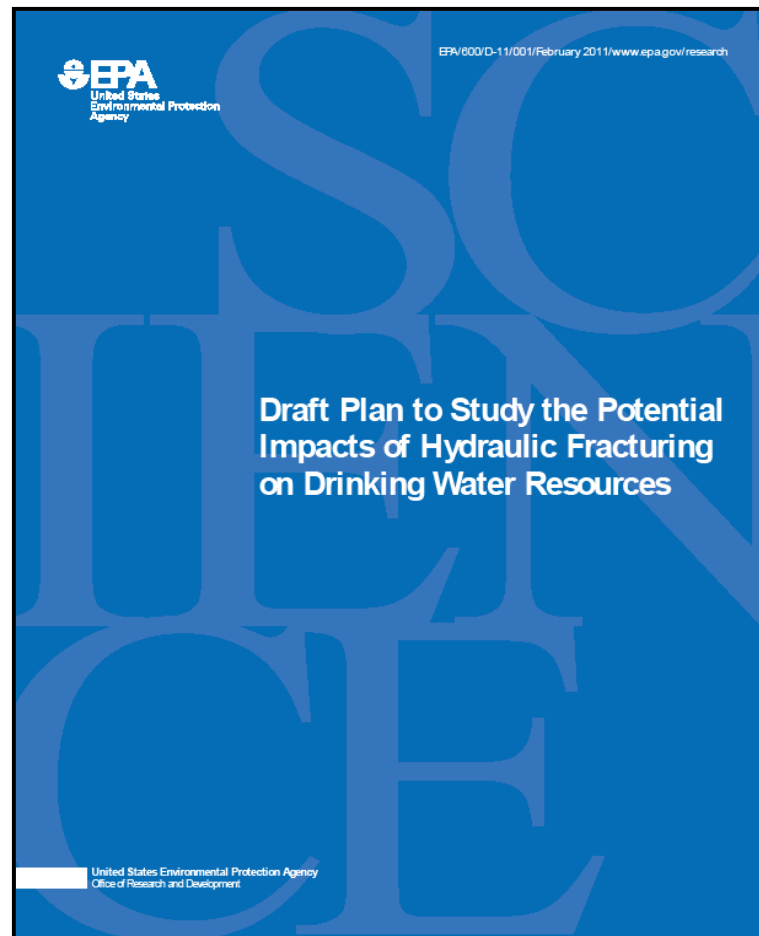
Where Are We Now?

FRAC Act

- **The Fracturing Responsibility and Awareness of Chemicals Act ("FRAC Act") was re-introduced in the U.S. House of Representatives (H.R. 1084) and the Senate (S.587)**
- **Similar to the FRAC Act bills introduced in the last Congress (H.R. 2766 and S.1215), but go even further in requiring disclosure:**
 - Requires federal regulation of HF under the Safe Drinking Water Act
 - Detailed requirements for both pre-frac and post-frac disclosure, which must include:
 - The list of specific chemicals intended for use, including the chemical constituents of mixtures;
 - CAS numbers for each constituent;
 - MSDS sheets where available; and
 - The anticipated volume of each chemical.
 - Disclosure of formulas to medical professionals

EPA HF Study

- **Draft Study Plan was recently issued by EPA and submitted to the SAB**
 - SAB held public hearings on the Draft Study Plan in March 2011
 - Draft Recommendations by SAB review panel submitted to full SAB for quality review in June 2011
- **EPA anticipates initial study results by late 2012 and final report in 2014**



Waxman Investigation

- **February 2010 - House Energy and Commerce Committee**
- **Information requests to eight service companies seeking data on chemicals used in HF and potential environmental and health impacts**
- **Waxman Memo: asserted violation of 2003 MOA**
 - 1/31/2011 Waxman letter to EPA regarding diesel use: alleges violations of SDWA



EPA Proposed Guidance on Permitting of HF Using Diesel Fuels

- **Proposed UIC permitting guidance based on application of existing Class II regulations to HF operations**
- **Public and stakeholder webinars held in May and June 2011**

Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels



U.S. Environmental Protection Agency
Office of Ground Water and Drinking Water

EPA Discussions with Stakeholders

Potential BLM Regulations

DOC HASTINGS OF WASHINGTON
RANKING REPUBLICAN MEMBER

U.S. House of Representatives
Committee on Natural Resources
Washington, DC 20515

December 1, 2010

The Honorable Ken Salazar
Secretary
Department of the Interior
1849 C Street, NW
Washington, DC 20240

Dear Mr. Secretary:

The comments made yesterday by yourself and Presidential Advisor Carol Browner at the Departmental forum on hydraulic fracturing are deeply concerning. The distinct implication is that the Administration has already decided to move forward with a plan to increase permitting requirements on federal land with a policy that would threaten thousands of jobs, deepen the federal deficit through reduced revenues, and harm natural gas development and our nation's energy security.

Before this dramatic proposed policy change advances further, it is requested that you respectfully allow Congress an opportunity to fully examine the issue, the impact to jobs and communities, and to consult relevant experts, including federal agencies, state regulators, federal leaseholders, operators and contractors.

Additionally, it is requested that before taking action to unilaterally implement this policy, Secretary, that you appear before the House Natural Resources Committee in the 112th Congress to provide testimony and answer questions from Committee members. It is important for the Department to carefully consult and consider guidance from the House Natural Resources Committee on policy that will impact technological innovation and competitiveness on federal lands. The concept of transparency for fracturing is already in place at the state level and through numerous federal statutes including OSHA requirements dealing with Material Safety Data Sheets (MSDS) for first responders as just one example.

The Department's consideration of requiring duplicative and burdensome disclosures – and beyond the significant efforts already taken at the state level – raises the very real possibility of further crippling of federal land communities and the jobs of tens of thousands of Americans that are dependent on the responsible development of those lands.

Following the November election, President Obama personally identified natural gas development as an area where he believes bipartisan cooperation is possible, and it is in this spirit that I ask you to consider these requests.

Sincerely,



Doc Hastings
Ranking Republican Member

<http://republicans.naturalresourcescommittee.house.gov>

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House of Representatives
COMMITTEE ON ENERGY AND COMMERCE
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WASHINGTON, DC 20515-R115

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December 3, 2010

The Honorable Ken Salazar
Secretary
Department of the Interior
1849 C Street, N.W.
Washington, D.C. 20240

Dear Secretary Salazar:

Pursuant to Rule X, Clause 1(f) of the Rules of the U.S. House of Representatives, the Committee on Energy and Commerce has responsibility for oversight of laws protecting public health, including water quality and waste management, as well as statutes and regulations dealing with the exploration, production, storage, supply, and reliability of energy. As Ranking Members of the Committee on Energy and Commerce, and Subcommittee on Energy and Environment, we write regarding a hydraulic fracturing forum held by the Department of the Interior (DOI) earlier this week. We seek additional information regarding the Administration's intentions, and any hydraulic fracturing-related policy or regulatory proposals that may be forthcoming from DOI.

Safe drilling practices are of critical importance. Because hydraulic fracturing is already a regulated practice, however, we believe it is essential that DOI focus on understanding the universe of existing federal and state regulations of hydraulic fracturing, water quality for underground sources of drinking water, emergency planning and reporting, and waste disposal requirements, and the expertise already being brought to bear on these activities before placing additional regulatory requirements on natural gas exploration and production. We fear a rush to regulate by DOI and the Administration will chill domestic oil and gas development and would negatively impact our efforts to increase energy security and to provide for a reliable and affordable energy supply. We have repeatedly heard testimony before our Committee that access to reliable and affordable energy is essential for our nation's economic growth and competitiveness.

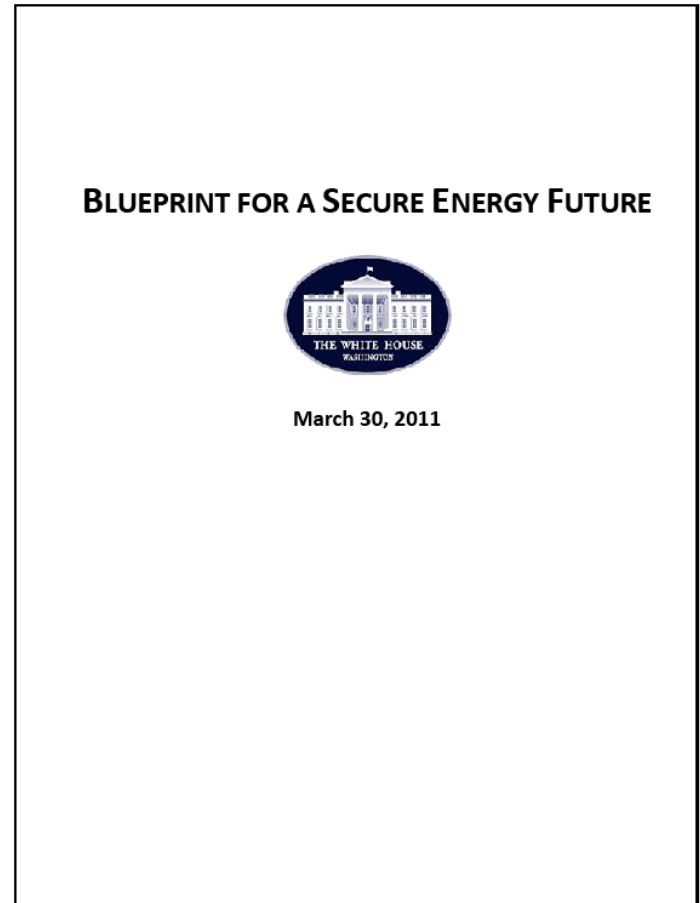
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT



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U.S. Department of Energy (DOE) Task Force on Hydraulic Fracturing (HF)

- **Presidential Directive in Obama's "Blueprint for a Secure Energy Future"**
- **Department of Energy Secretary Steven Chu announced members of the "Advisory Board Natural Gas Subcommittee to Examine Fracking Issues" in May 2011**



Charge for the DOE HF Task Force



The Secretary of Energy
Washington, D.C. 20585

May 5, 2011

MEMORANDUM FOR WILLIAM J. PERRY
CHAIRMAN
SECRETARY OF ENERGY ADVISORY BOARD

FROM: STEVEN CHU 

SUBJECT: Charge to Secretary of Energy Advisory Board Natural Gas
Subcommittee to Examine Fracking Issues

On March 30, 2011, President Obama announced a plan for U.S. energy security, in which he instructed me to work with other agencies, the natural gas industry, states, and environmental experts to improve the safety of shale gas development. The President also issued the Blueprint for a Secure Energy Future ("Energy Blueprint"), which included the following charge:

"Setting the Bar for Safety and Responsibility: To provide recommendations from a range of independent experts, the Secretary of Energy, in consultation with the EPA Administrator and Secretary of Interior, should task the Secretary of Energy Advisory Board (SEAB) with establishing a subcommittee to examine fracking issues. The subcommittee will be supported by DOE, EPA and DOI, and its membership will extend beyond SEAB members to include leaders from industry, the environmental community, and states. The subcommittee will work to identify, within 90 days, any immediate steps that can be taken to improve the safety and environmental performance of fracking and to develop, within six months, consensus recommended advice to the agencies on practices for shale extraction to ensure the protection of public health and the environment."
Energy Blueprint (page 13).

The President has charged us with a complex and urgent responsibility. I have asked SEAB and the Natural Gas Subcommittee, specifically, to begin work on this assignment immediately and to give it the highest priority.

This memorandum defines the task before the Subcommittee and the process to be used.

Membership:

In January of 2011, the SEAB created a Natural Gas Subcommittee to evaluate what role natural gas might play in the clean energy economy of the future. Members of the Subcommittee include John Deutch (chair), Susan Tierney, and Dan Yergin. Following consultation with the Environmental Protection Agency and the Department of the Interior, I have appointed the following additional members to the Subcommittee: Stephen Hodditch, Fred Krapp, Kathleen McGinty, and Mark Zoback.

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- Charge Memo to the subcommittee establishing scope and objectives of review
- Consultation with other agencies (EPA and Department of Interior)
- Public input and expert advice from industry and regulators
- Provide recommendations and identify best practices and other steps to enhance companies' safety and environmental performance of HF
 - 90 day report
 - 180 day report

State Developments

- **Texas**

- Recent legislation concerning HF disclosure to be followed by rulemaking

- **New York**

- Revised Draft SGEIS due "on or about" June 1, 2011, with minimum 30 day additional comment period
- *De facto* moratorium on drilling in the Marcellus remains in effect until Final SGEIS is issued (expected Fall 2011)

- **Recent legislative/regulatory developments in other states**

- California
- Indiana
- Montana
- Louisiana
- West Virginia

Regional Developments

- **Delaware River Basin Commission**
 - Proposed regulations for Marcellus Shale wells
 - Proposing to require lists of chemicals and amounts used



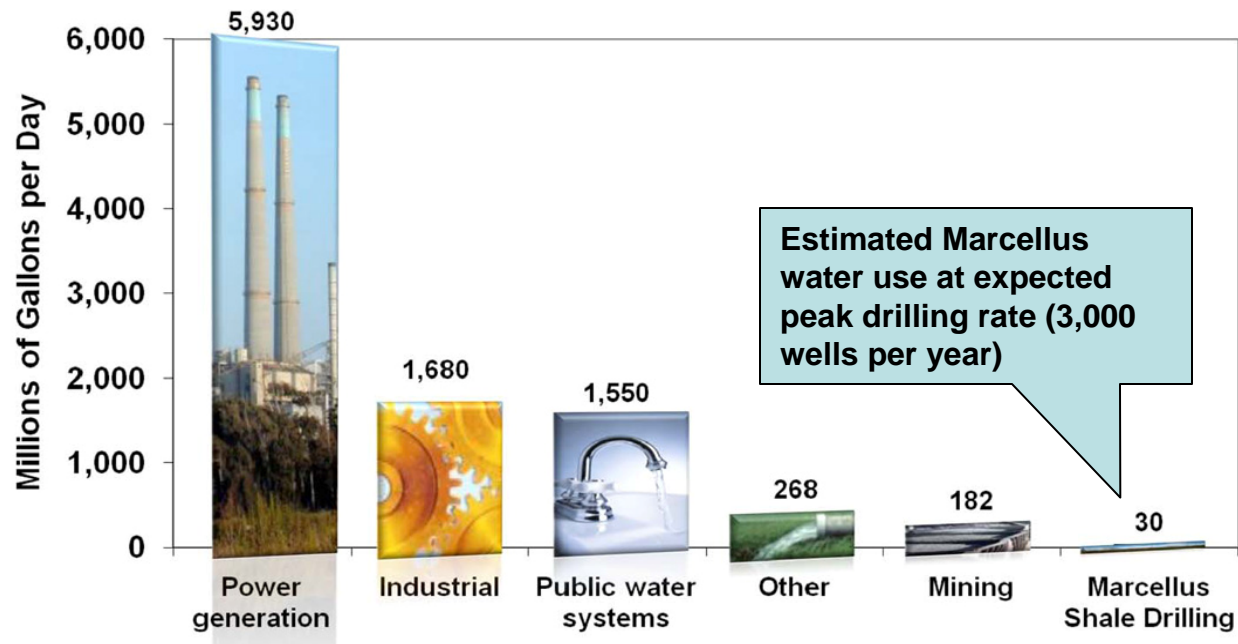
What Role Does Water Play?

Water Related Issues

- **Water use/sourcing requirements**
 - Restrictions on water withdrawals
 - Reporting water sources
- **Water Disposal Restrictions**
 - NYT articles:
 - problems with radionuclides in flowback discharged to POTWs
 - recycling no cure-all for flowback
 - Unavailability of well disposal in key jurisdictions
 - General prohibitions on direct discharge

Water Use Comparison

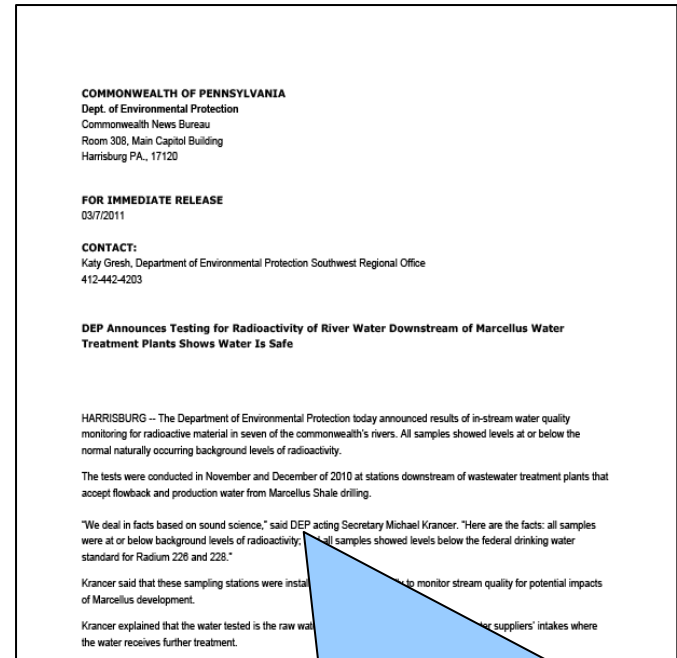
- The average unconventional well requires 3 - 5 million gallons of water for drilling and completion, including HF
- While this amount is small in comparison to other uses, Halliburton is working to minimize water usage (as discussed below)



Source: USGS, Pennsylvania Water Consumption

Flowback and Produced Water Issues in Pennsylvania

- **Elevated levels of Total Dissolved Solids (TDS)**
 - Study confirmed elevated levels of TDS - specifically bromide - downstream of 15 wastewater treatment plants in Pennsylvania
 - Industry group commits to reduce amount of waste water taken to surface discharge facilities
- **Dilution effect - Naturally Occurring Radioactive Materials (NORM)**

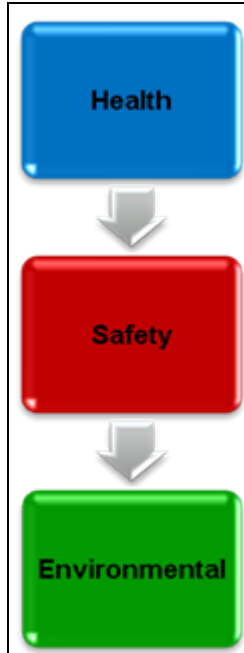
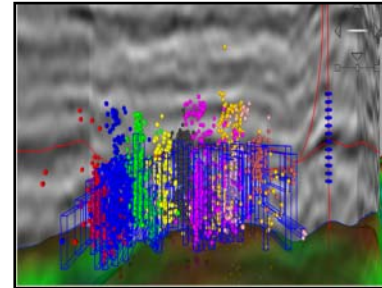
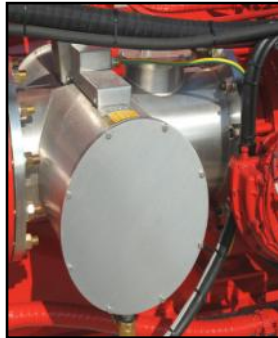


Pennsylvania Department of Environmental Protection (PADEP) tested seven streams and all were within or below background levels for NORM

Recycling and Environmental Solutions

- **Increased industry efforts to recycle flowback and produced water**
 - Marcellus Shale Coalition reports that on average 90 percent of flowback and produced water is recycled
 - Industry moving toward 100 percent recycling and zero discharge
 - Onsite/mobile treatment options and other recycling technologies are increasing
- **Industry research and development of environmental fluid solutions**

Halliburton's Environmental Technology: A CleanSuiteSM of Advancements



Home CleanSuiteSM Technologies Fluids Disclosure Fracturing 101 Glossary

Hydraulic Fracturing

An "overnight" triumph of science and engineering, 60-plus years in the making. Today, it's being used to redefine what's possible in accessing clean-burning energy resources deep underground. What will it help us do tomorrow? Click around to find out.

Hydraulic Fracturing 101

Sand, water and pressure: the basic components of building a great sandcastle. And the same ones being used today to spur a revolution in the way Americans access and utilize clean-burning energy resources: confined deep underground.

At the forefront of this revolution is a technology known as hydraulic fracturing, a well stimulation practice first pioneered by Halliburton in the 1940s...

In-Focus: What's in the Fluids?

Even though sand and water typically comprise more than 99.5 percent of the fluid system used in fracturing, getting that fluid to formations thousands of feet underground requires advanced chemistry and engineering to do things like:

- Fight the growth and buildup of bacteria in the fluid and the wellbore.

CleanSuiteSM Technologies

Halliburton invests considerable time, energy and resources in engineering solutions that set new standards for environmental safety – all while helping our customers do more by using less.

- CleanStimSM Formulation, a fracture fluid system comprised of materials sourced entirely from the food industry.



Halliburton and the Total Water Management Solutions (TWMS)

- **HESI Water Treatment Technologies**
 - CleanWave
 - CleanStream

CleanWaveSM Water Treatment System

A new water treatment service that goes where our customers go – and helps them recycle their water while it's there



CleanStream[®] Service

Controlling the growth of bacteria is key to promoting the flow of energy and preventing corrosion. Thanks to CleanStream[®] service, now it's a job that can be done by using UV-light instead of additives.



Where are We Going?

What to Expect on the Road Ahead

- **Federal level activity**
 - Focus on EPA study
 - Possible development of regulations by BLM governing federal leases
- **State level activity**
 - Expect continued efforts to revise existing state statutes and regulations to include new requirements for well casing/cementing, disposal of flowback and produced waters, and disclosure of chemicals used in HF fluids
 - Objective of states is to fill any potential regulatory gap the EPA study may identify and prevent the need for any federal regulation