United States Environmental Protection Agency

Technical Roundtables on EPA's Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

FLOWBACK AND PRODUCED WATER

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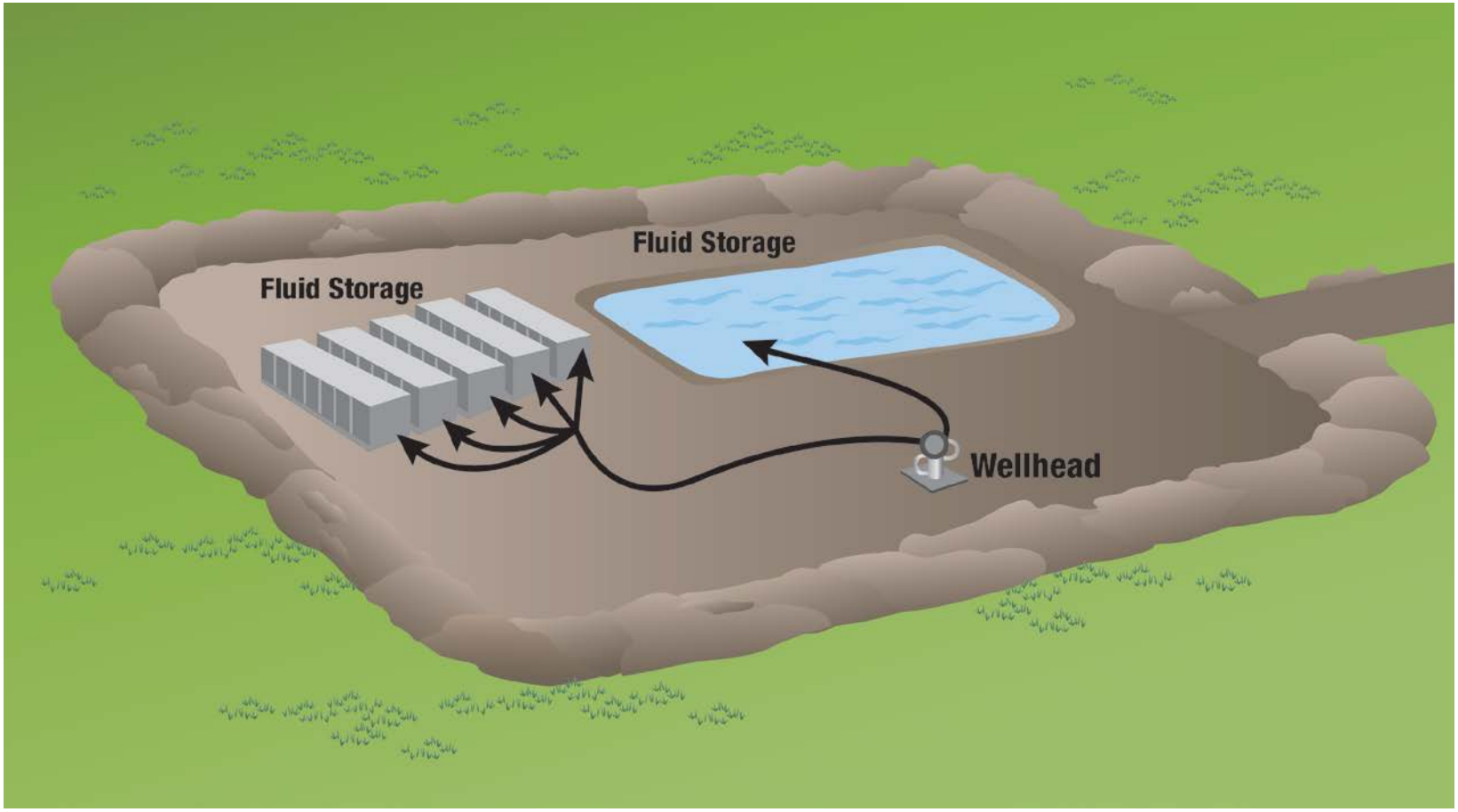
Flowback and Produced Water



What are the possible impacts of surface spills on or near well pads of flowback and produced water?

Flowback and Produced Water Research Projects

Secondary Research Questions	Applicable Research Projects
1. What is currently known about the frequency, severity, and causes of spills of flowback and produced water?	Literature Review Spills Database Analysis Service Company Analysis Well File Review
2. What is the composition of hydraulic fracturing wastewaters, and what factors might influence this composition?	Literature Review Service Company Analysis Well File Review Analytical Method Development
3. What are the chemical, physical, and toxicological properties of hydraulic fracturing wastewater constituents?	Toxicity Assessment
4. If spills occur, how might hydraulic fracturing wastewaters contaminate drinking water resources?	Literature Review Case Studies (Bradford County, PA; Washington County, PA; Wise County, TX)

Analysis of Existing Data

United States Environmental Protection Agency

Data Sources

Literature Review
Existing papers and reports, focusing on peer-reviewed literature

Service Company Analysis
Information about hydraulic fracturing operations provided by nine service companies

Well File Review
Well-specific records provided by nine oil and gas operators

Anticipated Data

- Spills of hydraulic fracturing flowback and produced water
- Chemicals reported in hydraulic fracturing wastewater along with their environmental fate and transport

- Spills of hydraulic fracturing flowback and produced water
- Chemicals from water analyses

- Spill data from 333 well files
- Chemicals from water analysis tests

Analysis of Existing Data

RESEARCH PROGRESS:

- Literature review is underway.
- Data has been collected from service companies and oil and gas operators.
- Data has been compiled from company submittals.
- Data review and analysis is underway.

NEXT STEPS:

- Perform additional analyses on all datasets.
- Determine how best to summarize confidential business information.

Surface Spills Data Analysis: How Does It Apply to the Study?

Hydraulic Fracturing Water Cycle Stage As Defined in Study:	Applicable Research Questions:
Chemical Mixing	What is currently known about the frequency, severity, and causes of spills of hydraulic fracturing fluids and additives?
Flowback and Produced Water	What is currently known about the frequency, severity, and causes of spills of flowback and produced water?

Spills Database Analysis

OBJECTIVE:

To assess the frequency, severity, and causes of spills associated with hydraulic fracturing.

APPROACH:

- Search databases developed by the National Response Center (NRC) and selected states (CO, NM, PA, TX, WY) for spill data from hydraulic fracturing operations.
  - ❑ Data source
  - ❑ Location
  - ❑ Chemical/product spilled
  - ❑ Estimated/reported volume of spill
  - ❑ Cause of spill
  - ❑ Reported impact to nearby water resources
  - ❑ Proximity of the spill to the well or well pad

Topics Excluded from Spills Assessment

- Transportation-related spills (although tanker trucks may act as mobile portable storage containers for chemicals and products used on hydraulic fracturing drilling sites)
- Drilling mud spills
- Air releases
- Injection well disposal spills
- Erosion and sediment control issues
- Spill drills and exercise events (in National Response Center data)
- Well construction and permitting violations

Surface Spills Data Analysis

Hydraulic Fracturing Spill Data Sources	
Federal	**Source**
National Response Center	National Response Center – Freedom of Information (FOIA) Data
State*	
Pennsylvania	PA Department of Environmental Protection – Compliance Reporting Database
Colorado	Colorado Oil and Gas Conservation Commission – Spill/Release Database
New Mexico	New Mexico Energy, Minerals and Natural Resources Department – Spills and Pit Data
Wyoming	Wyoming Department of Environmental Quality – Water Quality Enforcement Actions
Texas	No public databases containing hydraulic fracturing spills were identified

*States were selected based on their large volumes of hydraulically fractured wells

National Response Center Data Fields

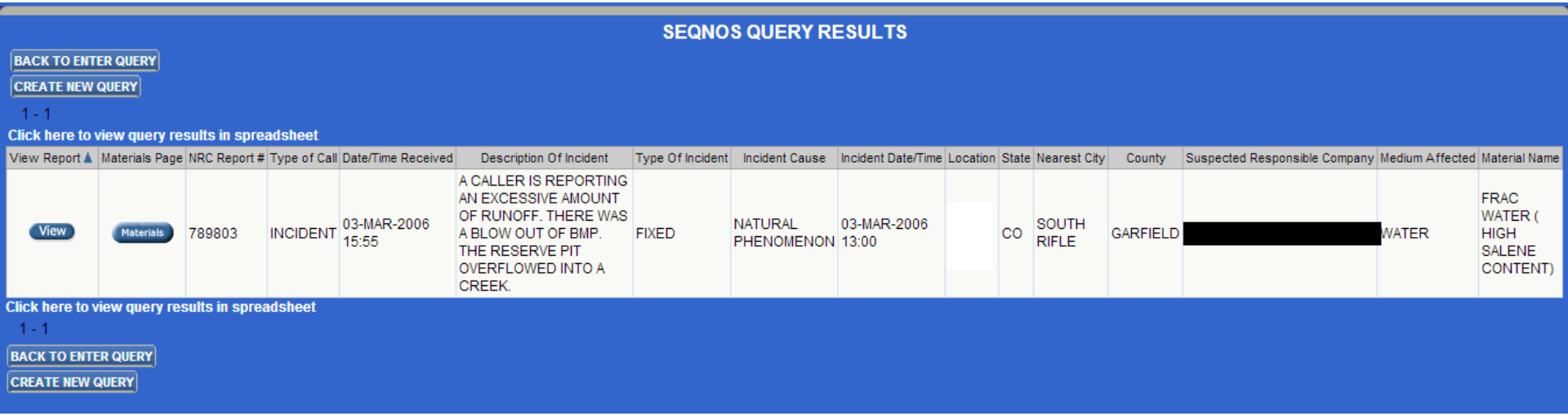
Fixed Data Fields*	Open Data Fields**
Type of Call	National Response Center Report Number
Incident Date Range	Nearest City
State	Company
County	Material Name
Incident Type	
Incident Cause	
Medium Affected	

*Fixed list data fields are search terms that a user may choose from a list appearing in a dropdown menu.
**Open data fields are search terms entered by the user

Examples: National Response Center Freedom of Information Database

Material Name
Flowback or Flow Back
Fracking or Fracturing or FRAC
Hydraulic and Well or Drill
Hydraulic and Natural and Gas
Produced water
Most frequently reported hydraulic fracturing chemicals reported in FracFocus

Report Example: National Response Center Spill Incident Report



SEQNOS QUERY RESULTS

BACK TO ENTER QUERY

CREATE NEW QUERY

1 - 1

Click here to view query results in spreadsheet

View Report	Materials Page	NRC Report #	Type of Call	Date/Time Received	Description Of Incident	Type Of Incident	Incident Cause	Incident Date/Time	Location	State	Nearest City	County	Suspected Responsible Company	Medium Affected	Material Name
View	Materials	789803	INCIDENT	03-MAR-2006 15:55	A CALLER IS REPORTING AN EXCESSIVE AMOUNT OF RUNOFF. THERE WAS A BLOW OUT OF BMP. THE RESERVE PIT OVERFLOWED INTO A CREEK.	FIXED	NATURAL PHENOMENON	03-MAR-2006 13:00		CO	SOUTH RIFLE	GARFIELD	[redacted]	WATER	FRAC WATER (HIGH SALENE CONTENT)

Click here to view query results in spreadsheet

1 - 1

BACK TO ENTER QUERY

CREATE NEW QUERY

New Mexico Oil Conservation Division Spills Database Preset (Fixed List) Search Keywords for Spills Data Fields

(The related keywords in **bold** have been searched)

Spill Materials		Spill Cause	Spill Source	
All	**Gelled Brine (Frac Fluid)**	Blowout	**All**	**Pipeline (Any)**
Acid	Hydrogen Sulfate	Corrosion	Coupling	**Production Tank**
Brine water	Crude Oil	Equipment Failure	Gas Compression Station	Pump
B.S. & W (basic sediment & water)	Motor Oil	Fire	Dump Line	Separator
Chemical (specify)	**Natural Gas (Methane)**	Freeze	Motor	Transport
Condensate	**Natural Gas Liquids**	Human Error	**Flowline - Injection**	**Unknown**
Diesel	Lube Oil	Lightning	Flowline - Production	**Valve**
Drilling Mud/ Fluid	Other (Specify)	Other	**Frac Tank**	**Well**
Glycol	**Produced Water**	Normal Operations	Fitting	Water Tank
Gasoline	**Unknown**	Vandalism	**Injection Header**	
		Vehicular Accident	Other (Specify)	

Report Example: New Mexico Spill Data

Spill Search (1 records returned)

Incident Number	Facility Name / Well Name	Facility Type	API	Operator	Incident Type	Incident Referrer
nSEB0809931025	[redacted]			[redacted]	Release Other	Industry Rep

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Incident Date	Notification Date	Waterway Affected	Involves UIC	Final Report	Emergency	Material Spilled	Volume Spilled	Volume Recovered	Volume Lost	Unit Of Volume	Spill Cause	Spill Source
3/7/2008		No	No	No	No	Gelled Brine (Frac Fluid)	5	1	4	BBL	Equipment Failure	Frac Tank

ULSTR	OCD Letter	Lat/Long	Ground Water Depth	Ground Water Impact
B-14-12S-26E	B	33.2831264419902 / -104.307754272831	0	No

Report Example: Pennsylvania Department of the Environmental Protection Compliance Reporting Database

INSPECTION ID	INSPECTION CLIENT NAME	INSPECTION DATE	INSPECTION TYPE	PERMIT #	UNCONVENTIONAL	INSPECTION CATEGORY	REGION	COUNTY
2064711	[redacted]	04/27/2012	Routine/Complete Inspection		Yes	Primary Facility	EP DOGO NCDO Dstr Off	Lycoming

MUNICIPALITY	INSPECTION RESULT DESCRIPTION	INSPECTION COMMENT
Gamble Twp	Violation(s) Noted	Uncontrolled washoff from containment without a berm.

Violation Details

VIOLATION ID	VIOLATION DATE	VIOLATION CODE & DESCRIPTION	VIOLATION TYPE	VIOLATION COMMENT	RESOLVED DATE	RELATED ENFORCEMENTS
638374	04/27/2012	78.54 - Failure to properly control or dispose of industrial or residual waste to prevent pollution of the waters of the Commonwealth.	Environmental Health & Safety		05/07/2012	283371
638375	04/27/2012	402CSL - Failure to adopt pollution prevention measures required or prescribed by DEP by handling materials that create a danger of pollution.	Environmental Health & Safety		05/07/2012	283371
638376	04/27/2012	SWMA301 - Failure to properly store, transport, process or dispose of a residual waste.	Environmental Health & Safety		05/07/2012	283371

Enforcement Details

ENFORCEMENT ID	ENFORCEMENT CODE & DESCRIPTION	PENALTY FINAL STATUS CODE & DESCRIPTION	COMPLETED DATE	PENALTY AMOUNT	TOTAL AMOUNT COLLECTED	RELATED VIOLATIONS
283371	NOV - Notice of Violation		05/07/2012			638374
						638375
						638376

Report Example: The Colorado Oil and Gas Conservation Commission

You requested :	Spill/Release Information
Maximum records are limited to:	10

Search Results - 1 record(s) returned.								
Submit Date	Doc #	Facility ID	Operator #	Company Name	Ground Water	Surface Water	Berm Contained	Spill Area
3/23/2012	2223619	103-11796	96850	[redacted]	N	N	Y	5276

- The COGCC database is only searchable by API number, complainant, operator, facility/lease, location, remediation project number, and document number.
- EPA queried the database for all spill/release reports from January 1, 2006, to April 30, 2012. This search returned over 2,500 incident reports.

Spills Database Analysis: Progress

- Reviewed databases and developed lists of spills that may be related to hydraulic fracturing activities.
- Currently evaluating the lists of spills to determine relevance to this study and conducting QA/QC.
- Determined that TX database does not include chemical spills; therefore, there will be no further analysis of this database.
- Unable to determine whether incidents in the Wyoming Department of Environmental Quality's water quality enforcement action database were hydraulic fracturing-related violations; therefore, there will be no further analysis of this database for the study.

Spills Database Analysis: Next Steps

- Evaluate the list of incidents generated by searching the National Response Center, CO, NM, and PA databases to determine the relevance of each incident to hydraulic fracturing.
- Create a reference table of information gathered from all incidents determined to be related to hydraulic fracturing.
- Analyze reference table for trends in the causes, chemicals/products spilled, and volumes of hydraulic fracturing-related spills

Retrospective Case Studies

Purpose

To determine whether drinking water contamination has occurred at the case study locations and, if so, identify the cause of contamination.

Retrospective Case Studies

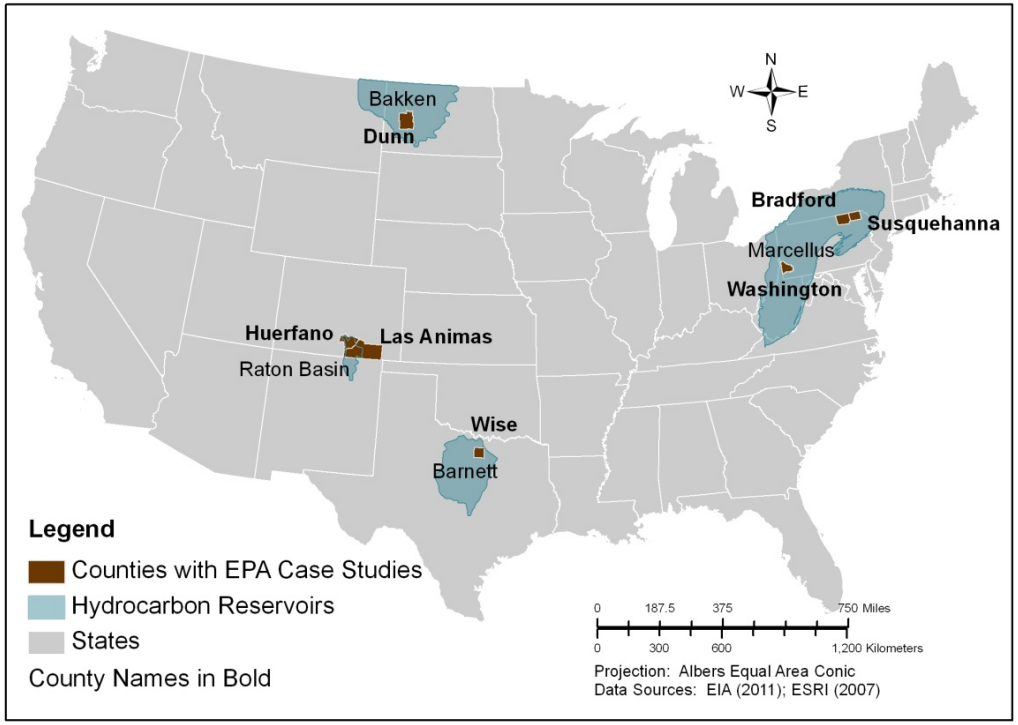
Approach

- Solicited potential case studies from stakeholders during public meetings and through the public comment process.
- Identified and narrowed case study candidates based on rigorous criteria.
- Prioritized case studies based on additional criteria.
- Selected five case studies to investigate reported drinking water impacts from shale gas development in the area.

Retrospective Case Studies

Approach (cont.)

- Case study locations
  - Bradford County, PA
  - Las Animas/Huerfano Counties, CO
  - Dunn County, ND
  - Washington County, PA
  - Wise County, TX



Retrospective Case Studies

General Analyte List

- Gasoline Range Organics and Diesel Range Organics
- Volatile and Semi-Volatile Organic Compounds
- Major and Trace Cations (Metals) and Anions
- Dissolved Organic and Inorganic Carbon
- Dissolved Gases (such as methane)
- Stable Isotopes
- Glycols and Alcohols
- Low Molecular Weight Acids
- General Water Quality Parameters (e.g., pH, temperature, specific conductance)

Retrospective Case Studies

Bradford County, PA

- Areas for research
  - Reported ground water and drinking water well contamination
  - Suspected surface water contamination from a spill of fracturing fluids
  - Reported methane contamination of multiple drinking water wells
- Sampling rounds: October/November 2011, April/May 2012
- Sampling locations: domestic wells, springs, stream, pond
- Analytical results for first two rounds will be released concurrently with the 2012 progress report
- Working with partners to determine focus and extent of future sampling events

Retrospective Case Studies

Dunn County (Killdeer), ND

- Areas for research
  - Production well failure during hydraulic fracturing
  - Suspected drinking water aquifer contamination
  - Possible soil contamination
- Sampling rounds: July 2011, October 2011, October 2012
- Sampling locations: monitoring wells, drilling supply wells, domestic wells, municipal well
- Analytical results for first two rounds will be released concurrently with the 2012 progress report
- Working with partners to determine focus and extent of future sampling events

Retrospective Case Studies

Las Animas/Huerfano Counties (Raton Basin), CO

- Areas for research
  - Potential drinking water well contamination (methane and other contaminants) in an area where hydraulic fracturing is occurring within an aquifer
- Sampling rounds: October 2011, May 2012, November 2012
- Sampling locations: domestic wells, production wells, monitoring wells, stream
- Analytical results for first two rounds will be released concurrently with the 2012 progress report
- Working with partners to determine focus and extent of future sampling events

Retrospective Case Studies

Washington County, PA

- Areas for research
  - Changes in water quality in drinking water, suspected contamination
  - Stray gas in wells
  - Leaky surface pits
- Sampling rounds: July 2011, March 2012
- Sampling locations: domestic wells, springs, stream
- Analytical results for first two rounds will be released concurrently with the 2012 progress report
- Working with partners to determine focus and extent of future sampling events

Retrospective Case Studies

Wise County, TX

- Areas for research
  - Spills and runoff leading to suspected drinking water well contamination
- Sampling rounds: September 2011, March 2012, September 2012 (limited sampling), December 2012 (anticipated)
- Sampling locations: domestic wells, industrial well, production well, ponds
- Analytical results for first two rounds will be released concurrently with the 2012 progress report
- Working with partners to determine focus and extent of future sampling events

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Questions?