Volunteer Monitoring for Shale Gas Extraction Impacts

Mid-Atlantic Volunteer Monitoring Conference

West Virginia 2013

Jinnie Monismith

Katie Tomsho

Kelly McIntyre

Alliance for Aquatic Resource Monitoring ALLARM est. 1986

Dickinson

ALLARM Background

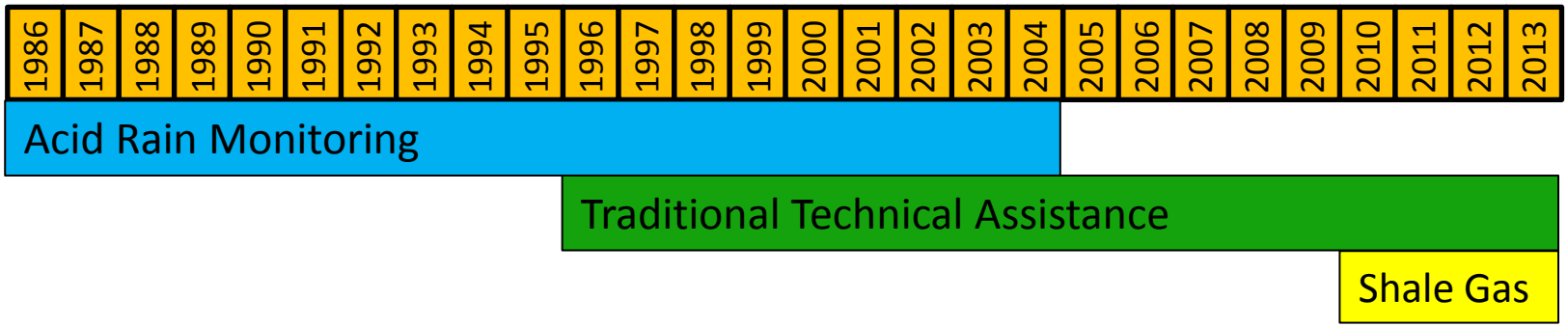
Empower communities with scientific tools to monitor, protect, and restore PA streams.

Educate. Engage. Empower.

Who is ALLARM?

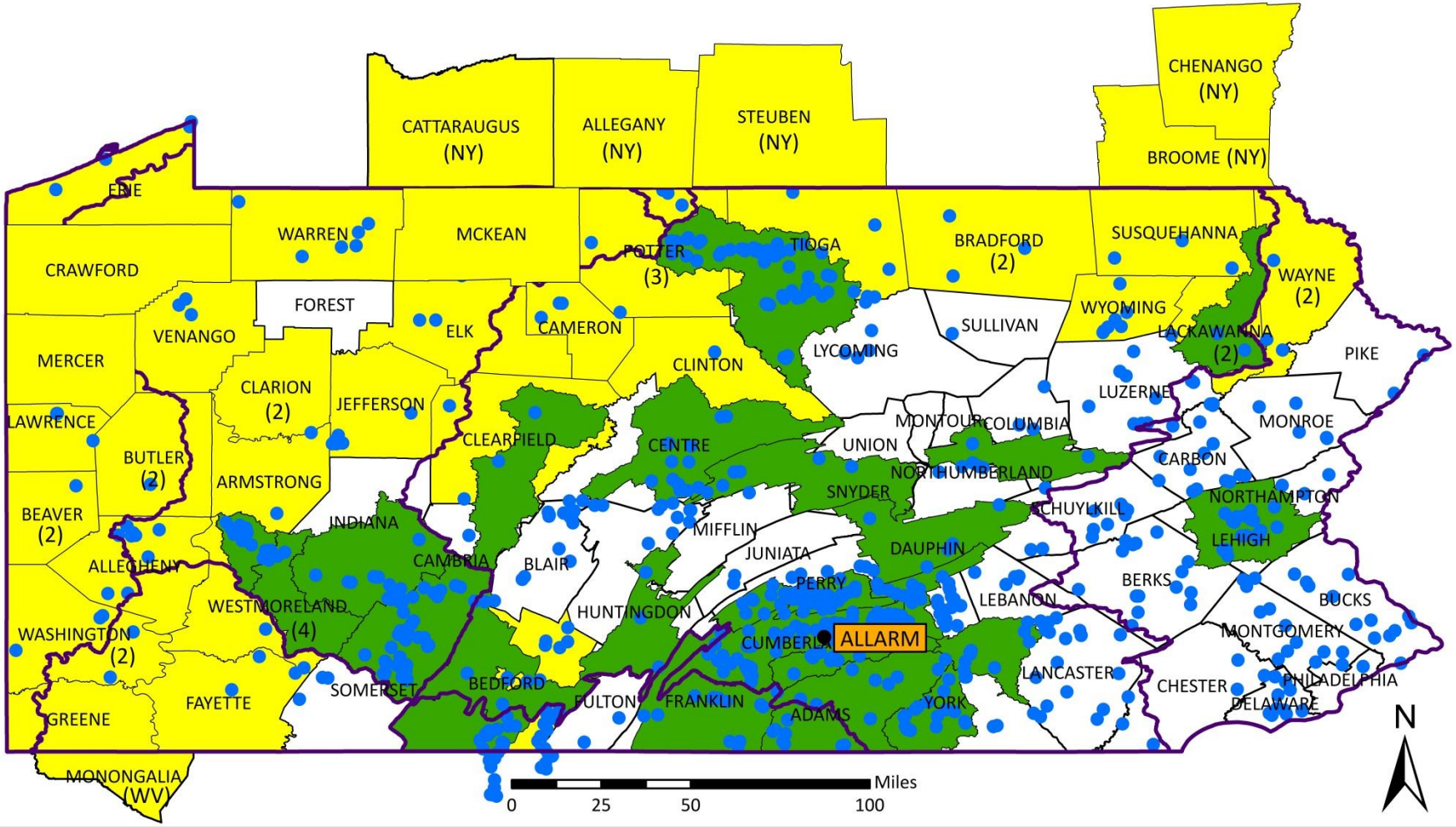
- Director: Julie Vastine
- Assistant Directors: Jinnie Monismith & Katie Tomsho
- Science Advisor/Founder: Candie Wilderman
- Dickinson College Students

ALLARM History



Monitoring Program	Region	Volunteers	Outreach
Acid Rain	Statewide	Individuals	Minimal
Traditional TA	Southcentral PA	Groups	Intensive
Shale Gas	Marcellus & Utica	Groups & Individuals	Regular

ALLARM Monitoring Assistance



Alliance for Aquatic Resource Monitoring
Environmental Studies Department
Dickinson College
P.O. Box 1773
Carlisle, PA 17013-2896

www.dickinson.edu/ALLARM
ALLARM@dickinson.edu
717.245.1565

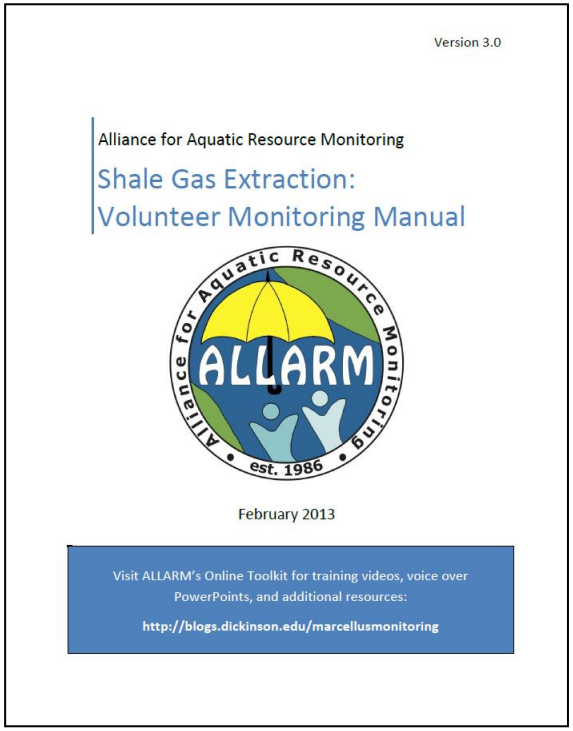
May 2013

- Acid Rain Sites
- Traditional Technical Assistance
- Shale Gas
- 6 Major PA Watersheds

Data Sources: ALLARM, NYS Office of Cyber Security, PA DOT, PSU, USGS, WVDEP

Shale Gas Volunteer Monitoring

Monitoring Type	Frequency	Location	Protocol	Examples
Discrete Monitoring	Sporadic (any time)	Any	General things to do looks for	Citizen surveillance
Baseline Monitoring	Continuous (weekly, monthly, etc.)	Same (chosen site)	Prescribed (step-by-step)	• ALLARM volunteers • Agencies • Data loggers



Version 3.0

Alliance for Aquatic Resource Monitoring

Shale Gas Extraction:
Volunteer Monitoring Manual

February 2013

Visit ALLARM's Online Toolkit for training videos, voice over PowerPoints, and additional resources:

http://blogs.dickinson.edu/marcellusmonitoring

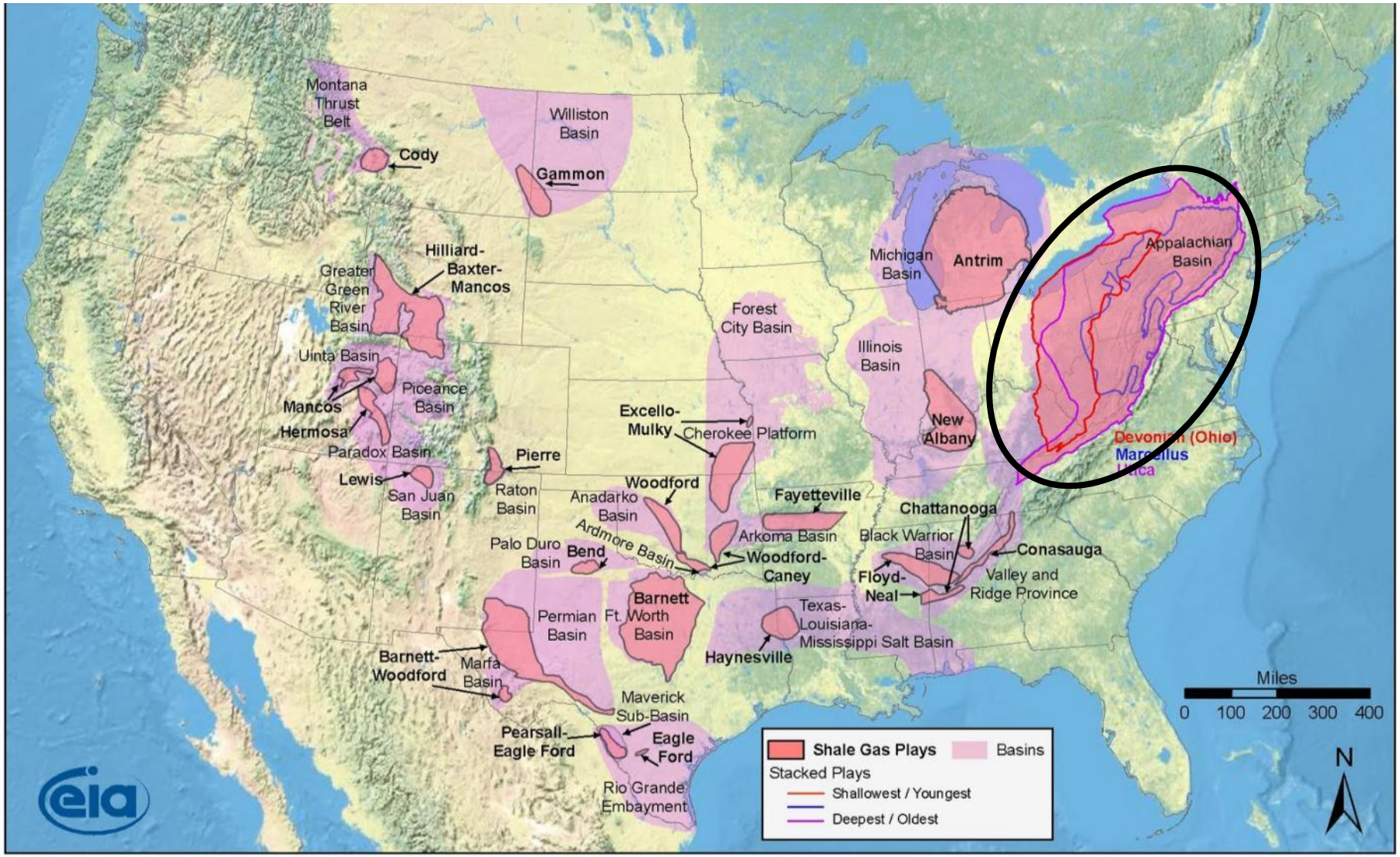
- Feasible
- Affordable
- Scientifically robust

Purpose of Monitoring

1. Detect & prevent contamination
2. Document stream quality – long term impacts
3. Community education

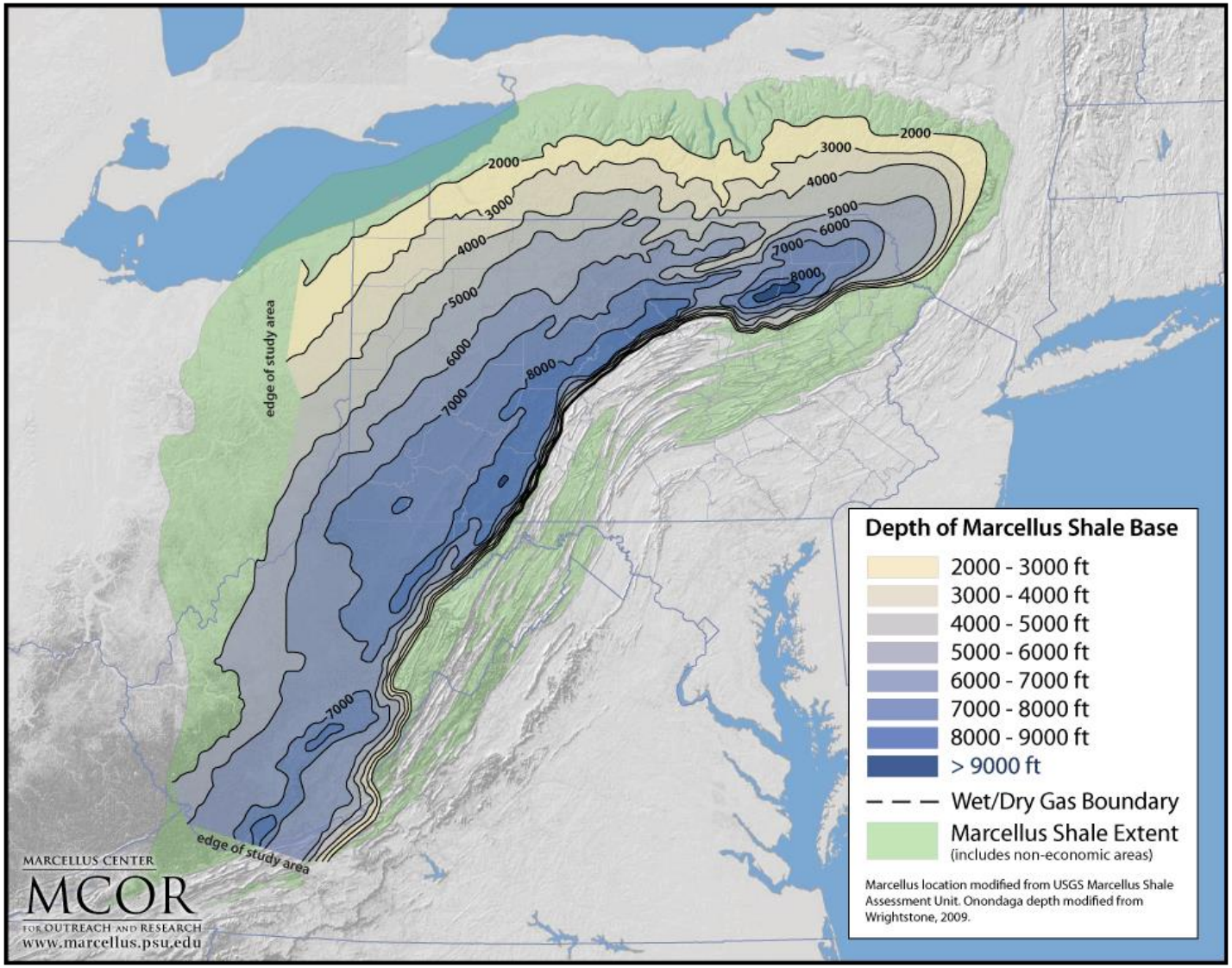
The data collected using this monitoring protocol are not intended to be used for legal purposes.

Shale Gas Plays

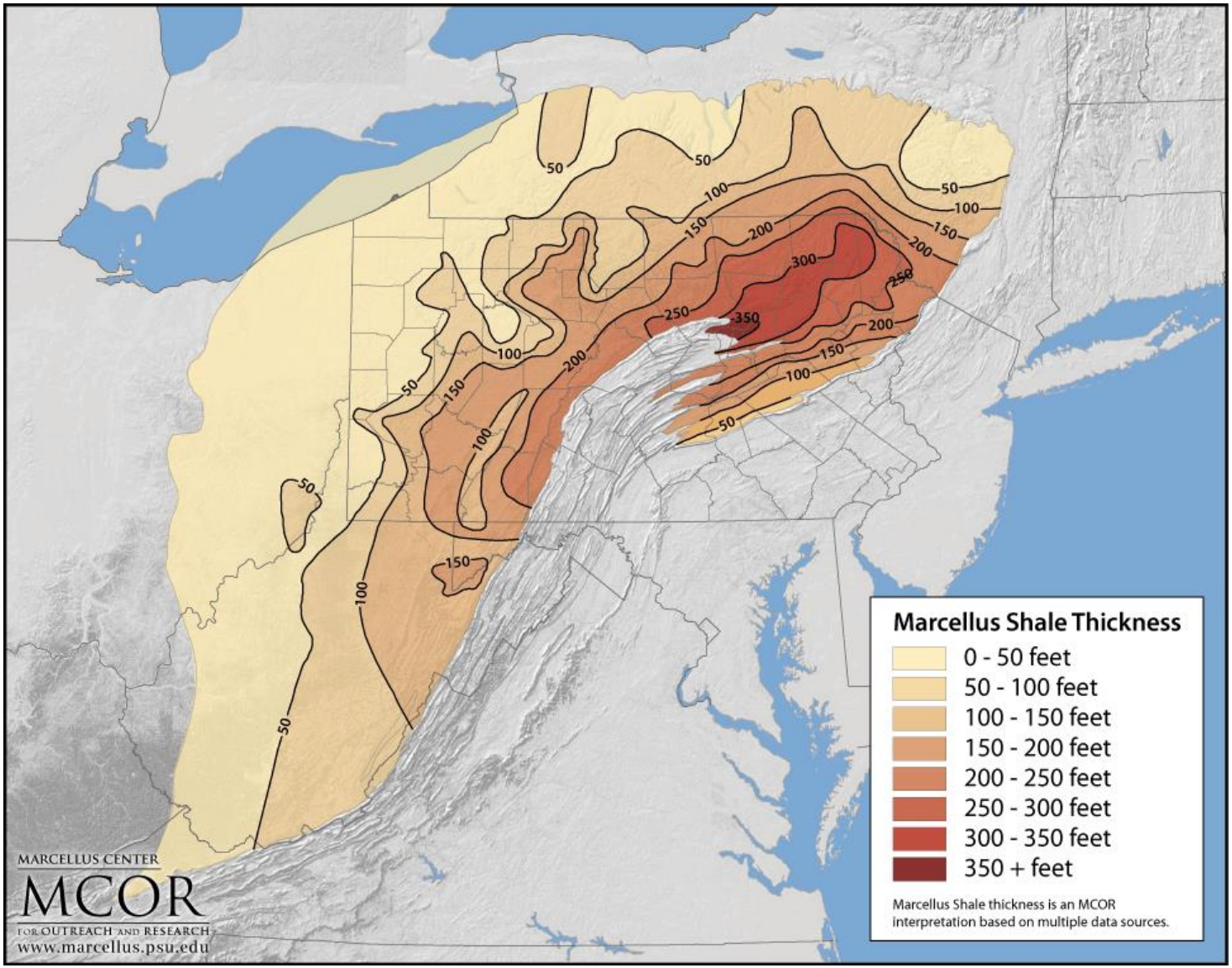


Source: Energy Information Administration based on data from various published studies
Updated: May 28, 2009

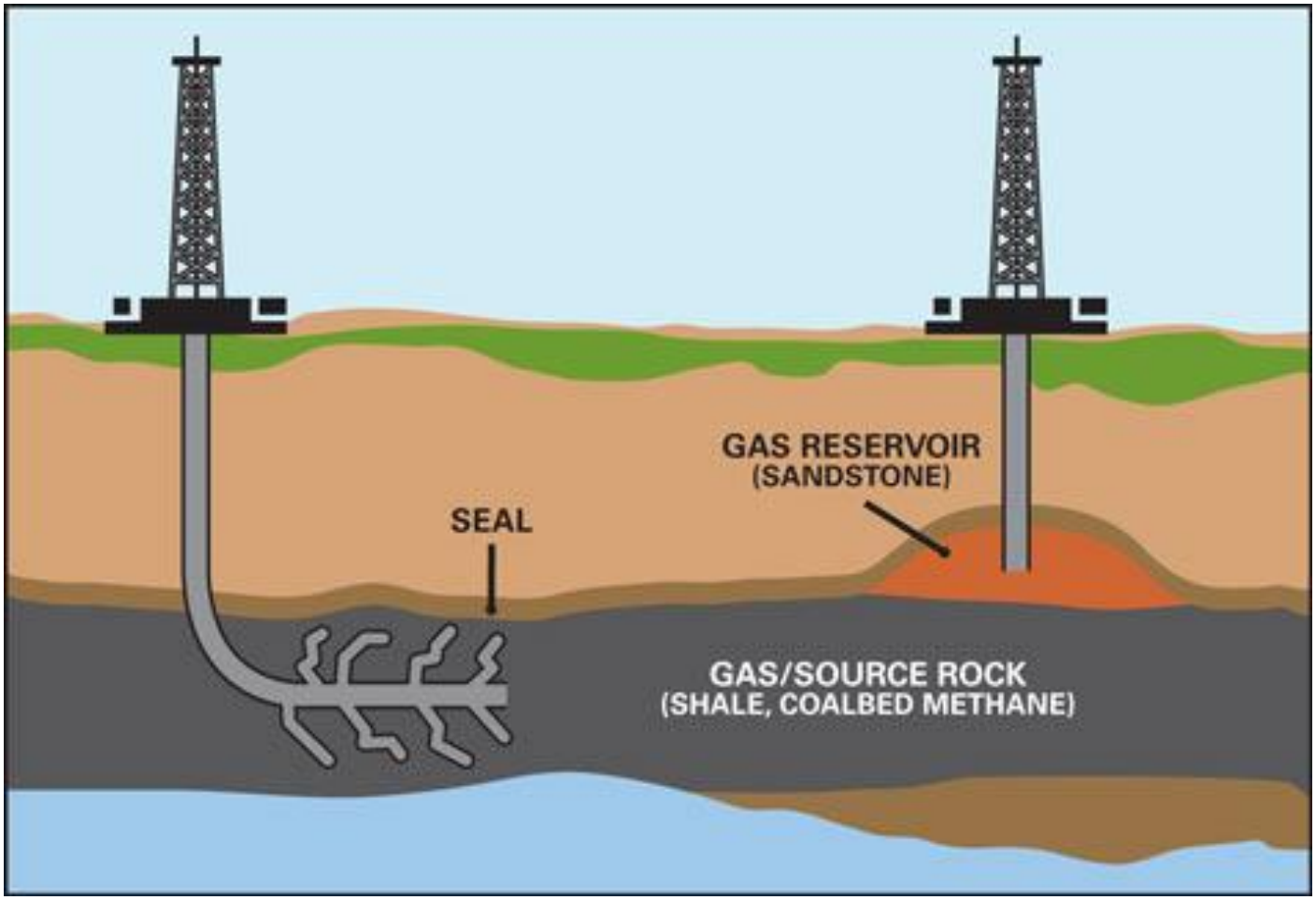
Depth to Marcellus Shale



Thickness of Marcellus Shale



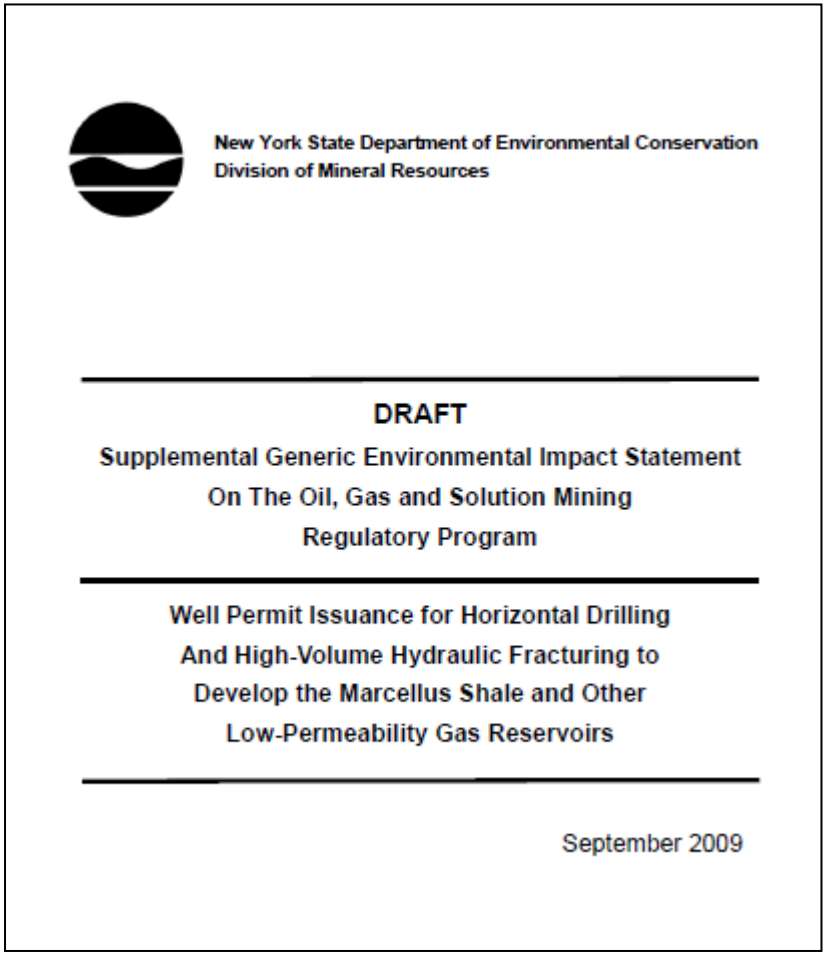
Conventional vs. Unconventional



http://seekingalpha.com/article/131641-unconventional-natural-gas-just-a-frac-away

Drilling Wastewater

- Frack water
  - 160+ known hazardous materials
- Flowback water
  - Inject water into ground or caverns/mines
  - Treat at authorized treatment facilities



New York State Department of Environmental Conservation
Division of Mineral Resources

DRAFT

Supplemental Generic Environmental Impact Statement
On The Oil, Gas and Solution Mining
Regulatory Program

Well Permit Issuance for Horizontal Drilling
And High-Volume Hydraulic Fracturing to
Develop the Marcellus Shale and Other
Low-Permeability Gas Reservoirs

September 2009

Flowback Water

Flowback water: water that returns to surface it consists of frack water plus chemicals released from underground rock formations.

- Quantity: 10-25% of frack water flows back
- Quality:
  - Brine (salty water) including high concentrations of chlorides, sulfates: very high TDS
  - Metals, e.g. barium iron, manganese, arsenic, strontium, lead, cadmium, chromium, aluminum
  - Naturally occurring radioactive materials such as uranium, radium, and radon
  - Bacteria
  - Methane
- Pathway to environment: spills, incomplete treatment, well casing leaks, migration through bedrock, illegal dumping

Flowback Water Concentrations

TDS: 70,000 mg/L

TDS: 211,000 mg/L

TDS: 132,000 mg/L

TDS: 217,000 mg/L

Source: Amy Bergdale, USEPA

Aspects of Monitoring

- Determining Site Location
- Baseline & Continuous Monitoring
  - Chemical
  - Stage
  - Visual
- QA/QC
- Data Management

Where Do I Monitor?

Step 1:

Find where drilling permits have been issued (lat/long)

- eNOTICE/eFacts/eMap PA
- DEP reports

Step 2:

Find issued drilling permit locations on map

- Google Maps
- Topographic map

Step 3:

Choose monitoring site based on important features

- Well locations
- Stream access

Parameters

1. Chemical Monitoring:

Conductivity & TDS
Barium & Strontium

2. Stage Monitoring:

Relationship to conductivity

3. Visual Assessment:

Land disturbances
Spills & discharges
Gas migration & leakages
Pipelines

http://www.rocketcourier.com/pictures/rivergas.jpg

Chemical Monitoring

Conductivity & Total Dissolved Solids

- Flowback water contains high concentrations of salts and minerals
- Bulk parameter that can indicate a pollution event

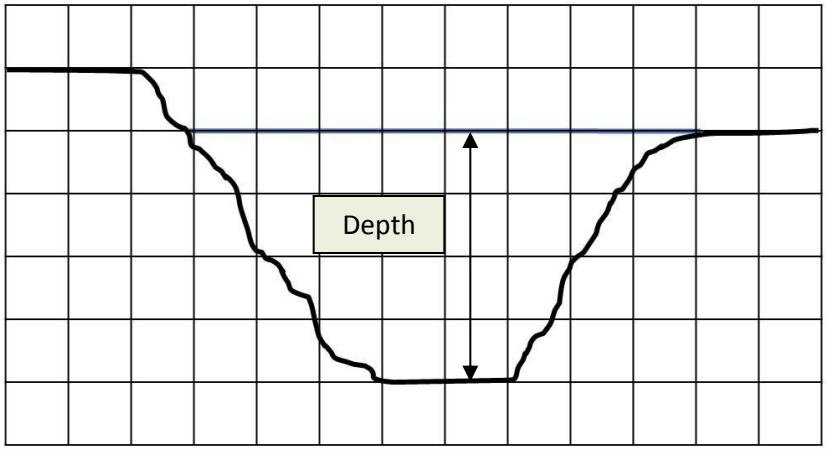
Barium & Strontium

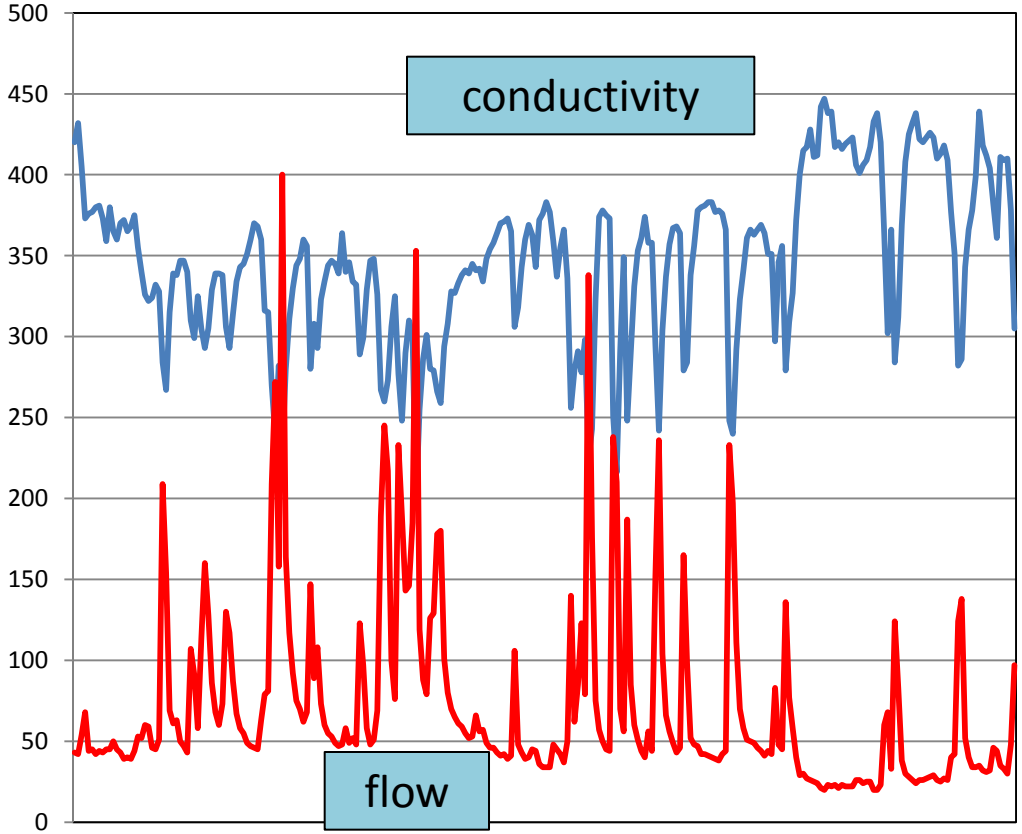
- Naturally occurring metals found deep underground
- Indicate contamination event from Marcellus Shale activities (signature chemicals)

Certified lab analysis

Water Quantity Monitoring: Stage

Stage – understand relationship between amount of water in stream and conductivity





Pollution Event

- A conductivity level 3x or higher than it should be at a comparable flow

Date	Stage	Conductivity
2.6.12	1.7	119.3
2.15.12	1.7	132.3
3.7.12	1.9	119.7
3.13.12	1.7	430

Quality Assurance/Quality Control

Standard QA/QC Practices:

- Training requirements
- Care/calibration of equipment
- Replicates
- Documentation of procedures
- Split sample analysis

Visual Assessment

- Earth Disturbances
- Spills and Discharges
- Gas Migration/Leakages
- Pipelines

Marcellus Shale Well Sites in Dimock, PA; 2010

Earth Disturbances:
Drill Pad, Storage Pond, & Staging Areas

Photo: Independent Oil and Gas Association, "Drilling & Developing the Marcellus Shale", 2008; http://www.lyco.org/LinkClick.aspx?fileticket=vojKFateF1U%3D&tabid=527&mid=1007

Spills & Discharges

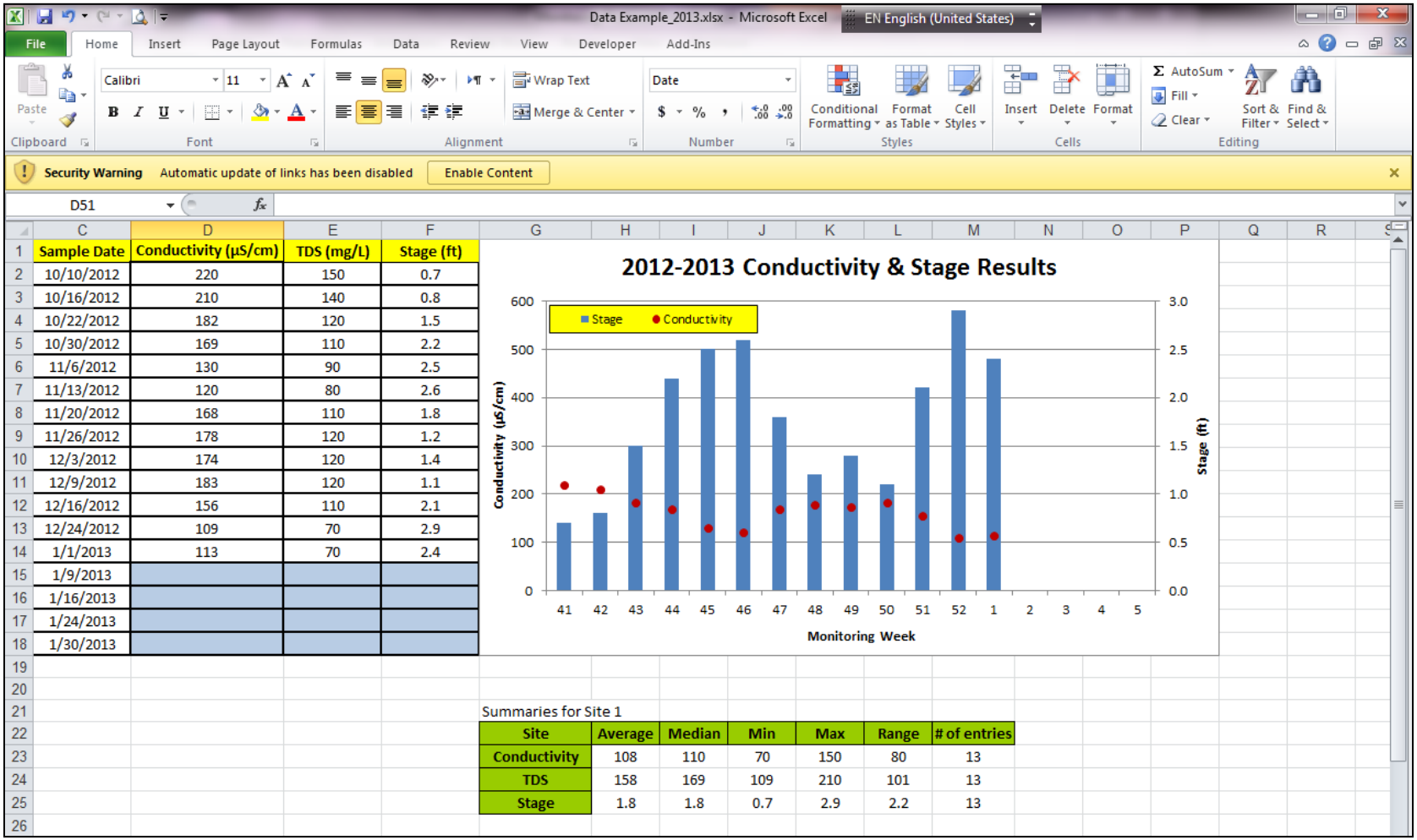
Gas Migration or Leakages

Pipeline Erosion & Sedimentation

Monitoring Overview

Assessment	Parameters	Method	Frequency
Chemical	Conductivity & TDS	Meter	Weekly
	Barium & strontium	Certified lab	2x/year & confirm pollution event
Water Quantity	Stage	Staff gage	Weekly
Physical	Earth disturbances	Visual assessment	Weekly
	Spills & discharges		
	Gas migration & leakages		
	Pipelines		

Data Management



Sample Date	Conductivity (µS/cm)	TDS (mg/L)	Stage (ft)
10/10/2012	220	150	0.7
10/16/2012	210	140	0.8
10/22/2012	182	120	1.5
10/30/2012	169	110	2.2
11/6/2012	130	90	2.5
11/13/2012	120	80	2.6
11/20/2012	168	110	1.8
11/26/2012	178	120	1.2
12/3/2012	174	120	1.4
12/9/2012	183	120	1.1
12/16/2012	156	110	2.1
12/24/2012	109	70	2.9
1/1/2013	113	70	2.4
1/9/2013			
1/16/2013			
1/24/2013			
1/30/2013			

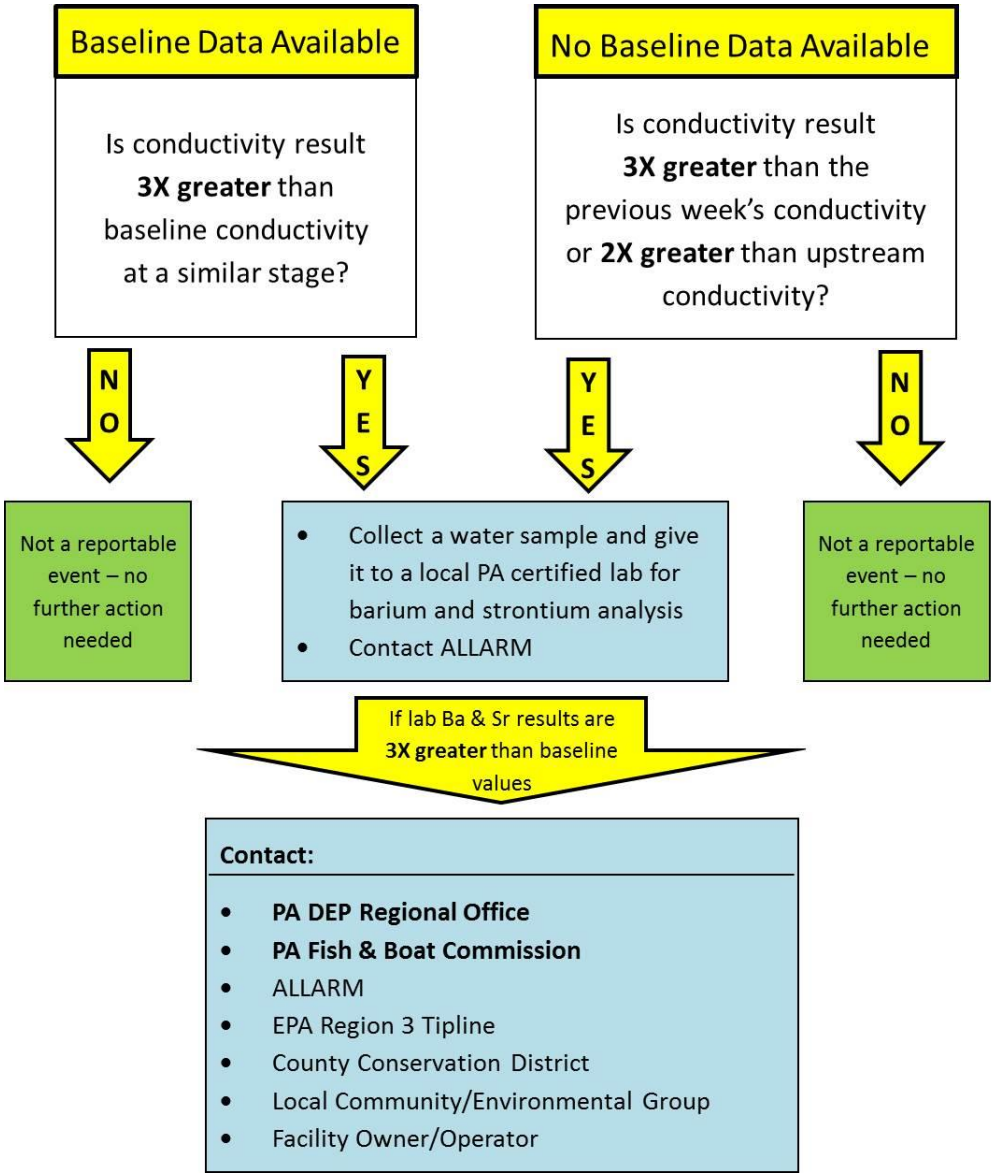
Site	Average	Median	Min	Max	Range	# of entries
Conductivity	108	110	70	150	80	13
TDS	158	169	109	210	101	13
Stage	1.8	1.8	0.7	2.9	2.2	13

ALLARM created easy to use templates for volunteers to store their chemical, stage, and visual assessment data.

Data Use: Decision Trees

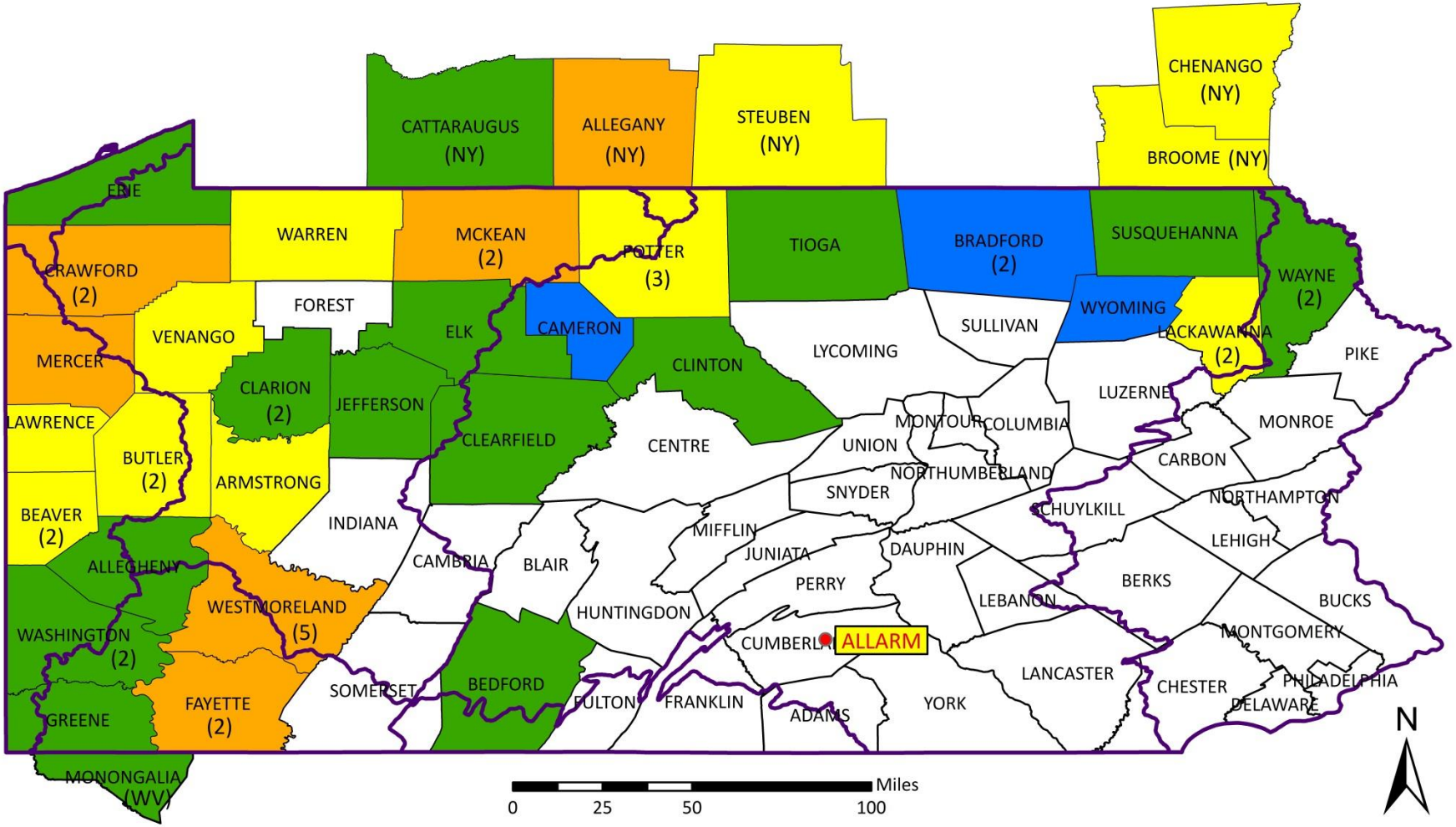
Report monitoring results when values exceed criteria found in decision trees:

- Chemical monitoring
- Visual Assessment
- Pipelines



Online Monitoring Toolkit

ALLARM Shale Gas Workshops



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Data Sources: ALLARM, NYS Office of Cyber Security, PA DOT, PSU, USGS, WVDEP

August 2013

2013 Workshops
2012 Workshops
2011 Workshops
2010 Workshops
6 Major PA Watersheds
51 workshops total

Tailoring the ALLARM Protocol

Well Location Information

Establish where wells are located and where they *will* be located.

Laboratory Testing

Find an entity who is willing to perform QA/QC checks (conductivity & TDS) and barium & strontium analysis (signature chemicals).

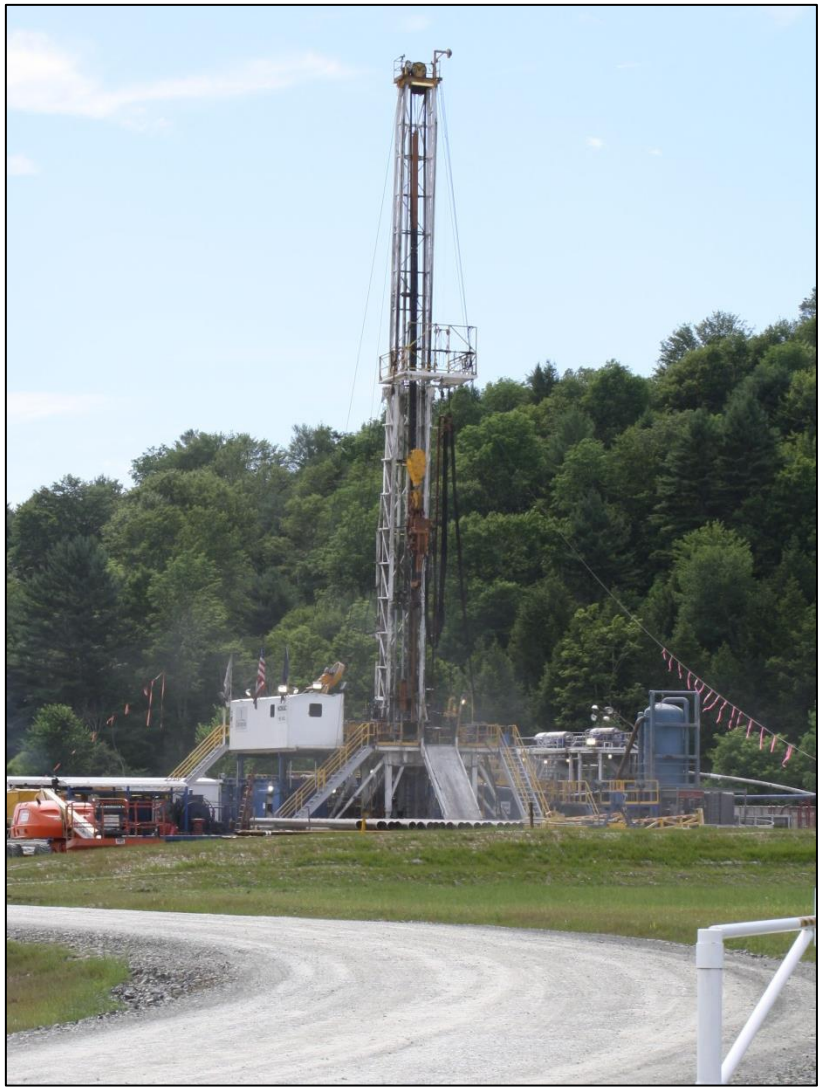
Agency Reporting

Determine which agency you to report violations (multiple) & understand how they will respond.

Well Location Information

- State agency
- Non-profit entity

Develop a protocol for monitors to find/track well locations and status.



Laboratory Testing

- State agencies
- State-certified labs
- Colleges/universities

Develop an agreement and create a protocol for monitors to follow.

SHALE GAS VOLUNTEER MONITORING PROGRAM
Quality Assurance/Quality Control Form

1. Fill out the label on your QA/QC bottle.
2. Enter the stream and face upstream. Fill your QA/QC bottle and pour the rinse water out downstream. Rinse your bottle and cap three times. Fill your QA/QC bottle completely with stream water and close it tightly with the cap.

ALLARM Shale Gas Volunteer Monitoring Program
Quality Assurance/Quality Control Bottle

Monitor Name	
Stream Name	
Collection Date	
Bottle #: 0021-01-1301	

3. Record your results in the boxes below.

Parameter	Units	Replicate #1	Replicate #2	Average Result
Conductivity	µS/cm			
Total Dissolved Solids	mg/L			
Stage	feet			

4. Fill out the information in the boxes below.

Monitor Information		Sample Information	
Monitor's Name		Stream Name	
Mailing Address		Latitude Coordinate	
		Longitude Coordinate	
Email Address		Collection Date	
County Monitored		Collection Time	
Affiliation (if applicable)		Equipment Used (i.e. LaMotte meter)	

5. Pack a small box with your QA/QC bottle and this QA/QC form. Secure the bottle so it cannot move around during shipment. Mail the box to ALLARM for QA/QC processing at:

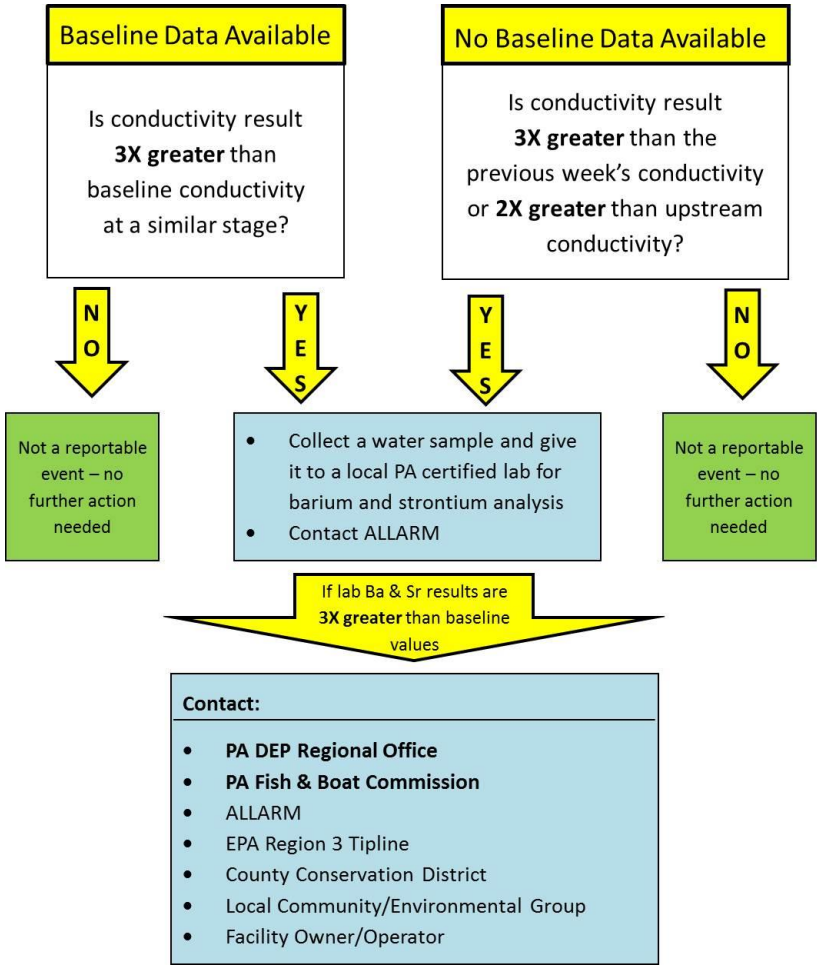
ALLARM
Dickinson College
5 N Orange Street
Carlisle, PA 17013

Alliance for Aquatic Resource Monitoring (ALLARM) June 2013

Agency Reporting

- Local, state & federal agencies
- Interested parties

Develop a decision tree and a contact list for monitors to use if they witness a violation.



ALLARM Contact Information

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