



Marcellus Shale Gas Extraction; Public Health Impacts and Visualizations of Environmental Threats



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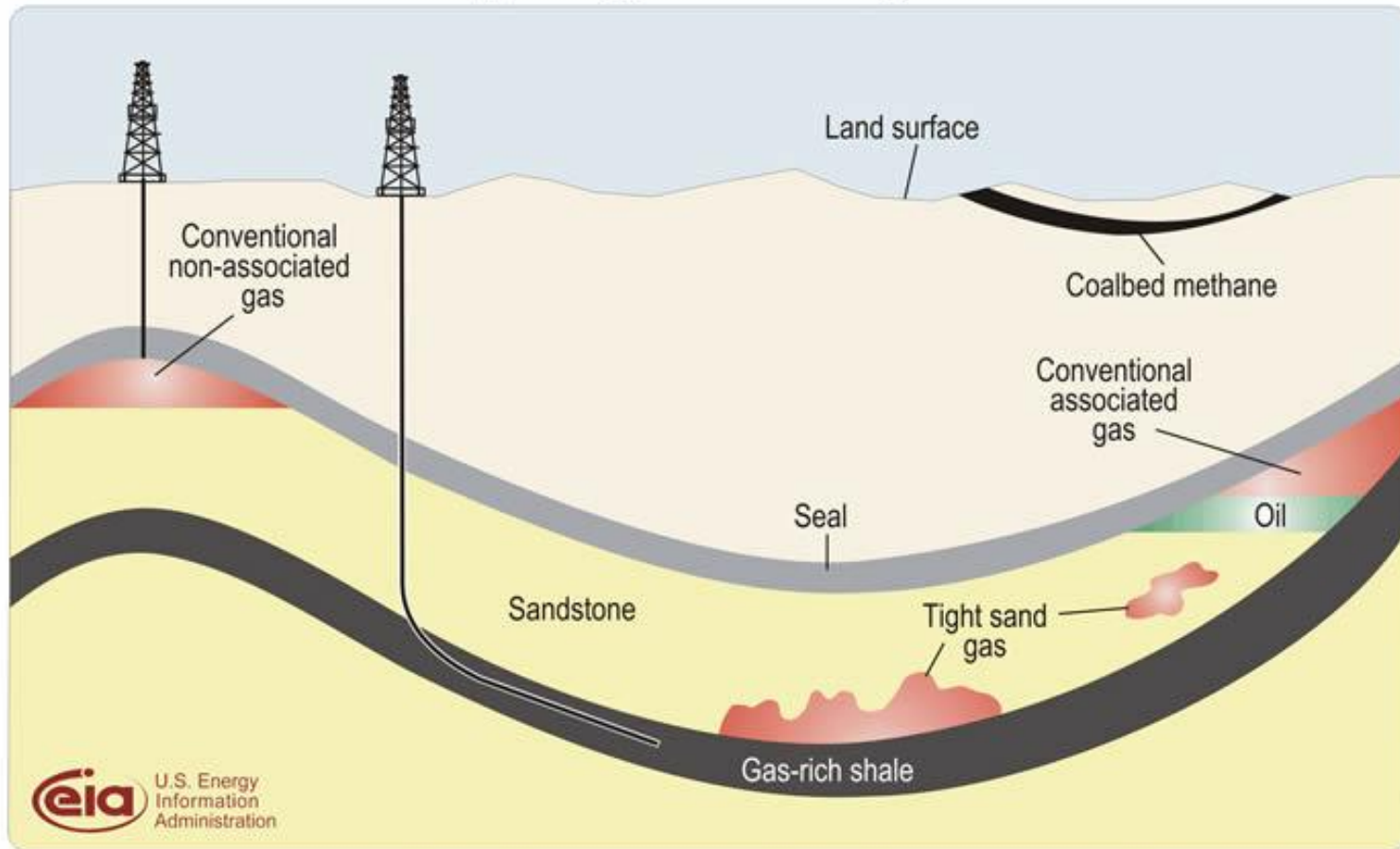
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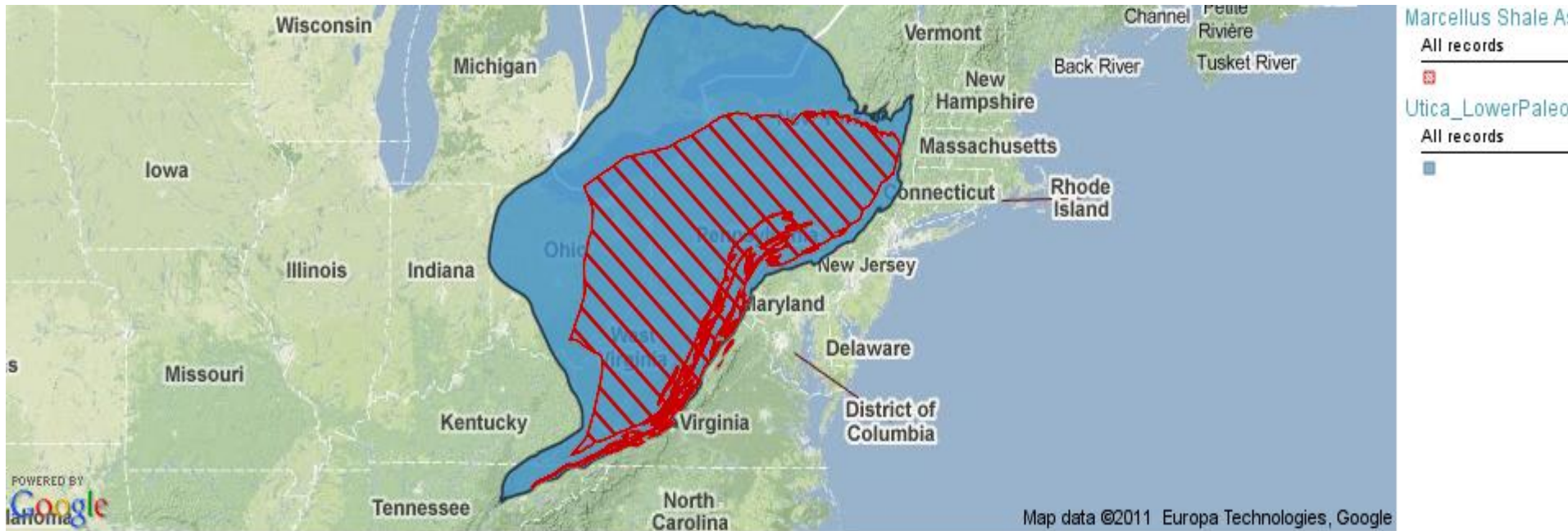
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Conventional and Non-conventional Natural Gas Extraction Methodologies

Schematic geology of natural gas resources



Fractracker.org Visualization of Marcellus and Utica Shale Extent



The Marcellus and Utica Shale Gas Plays

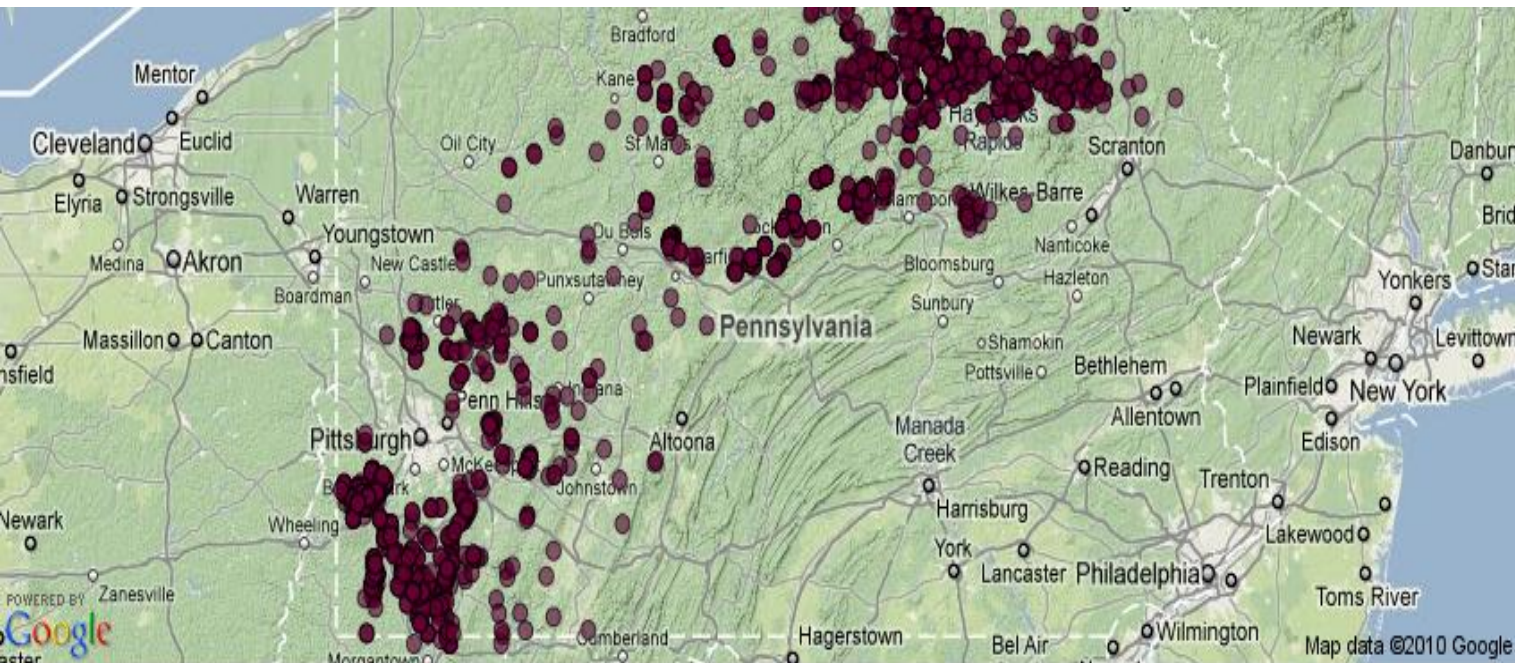
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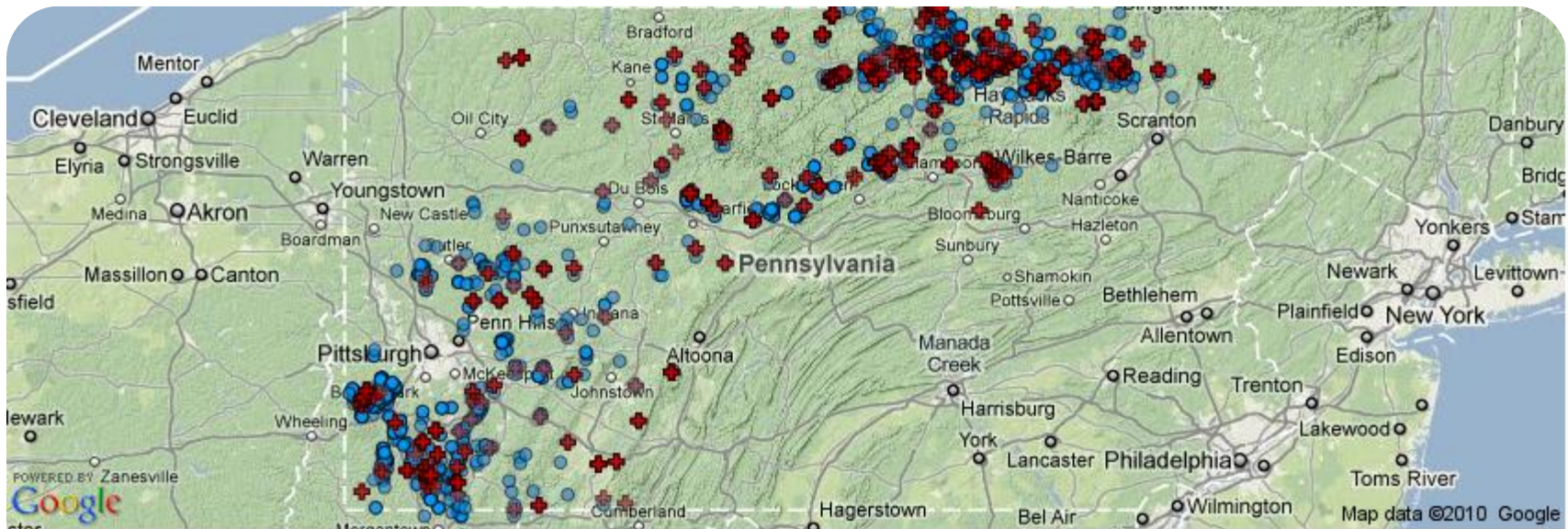
Marcellus Wells Drilled in Pennsylvania 2007 – September, 7 2010



Marcellus Shale Drilled Wells in PA 20...

All records

Marcellus Wells Drilled and PA DEP Violations



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Wells Drilled and Associated Violations in PA

Created by
Samantha Malone
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Permitted PA Facilities Accepting Wastewater from Oil and Gas Operations



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PA Facilities Approved to Receive Oil and Gas Wastewater

Created by Samantha Malone on Aug 14, 2010

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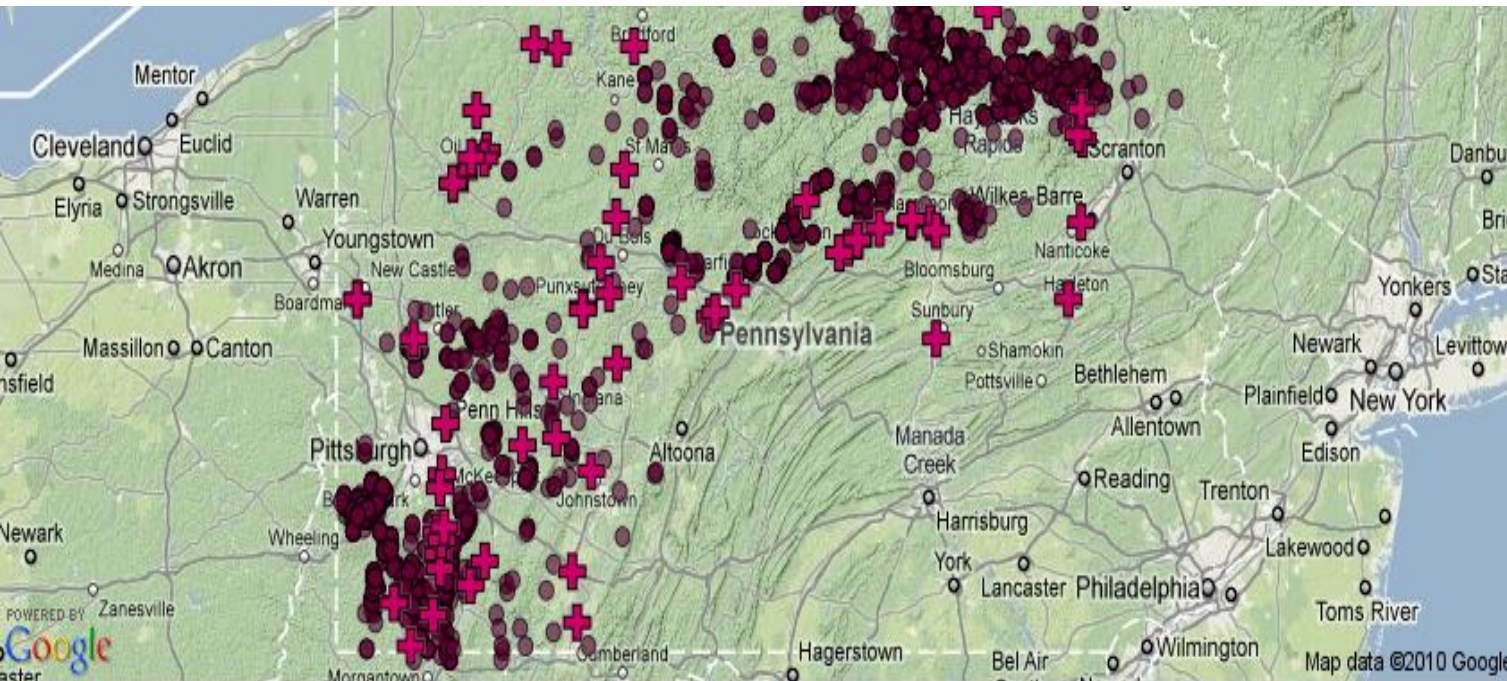
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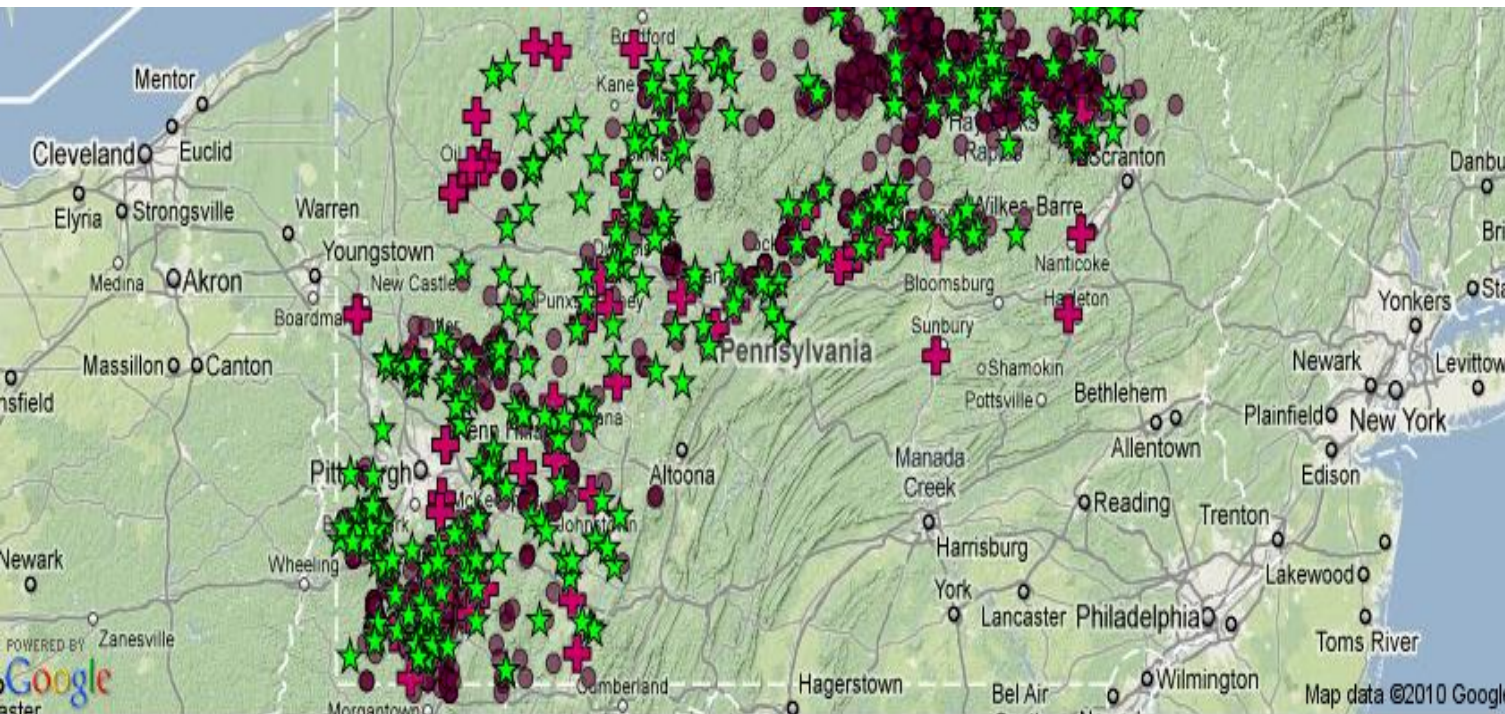
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Marcellus Wells and Wastewater Treatment Facilities in Pennsylvania



Wastewater Treatment Facilities Acc...
All records
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Marcellus Shale Drilled Wells in PA 20...
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Water Withdrawals, Wastewater Treatment Facilities and Marcellus Wells



Water Withdrawals by the Gas and Oil ...

All records



Wastewater Treatment Facilities Acce...

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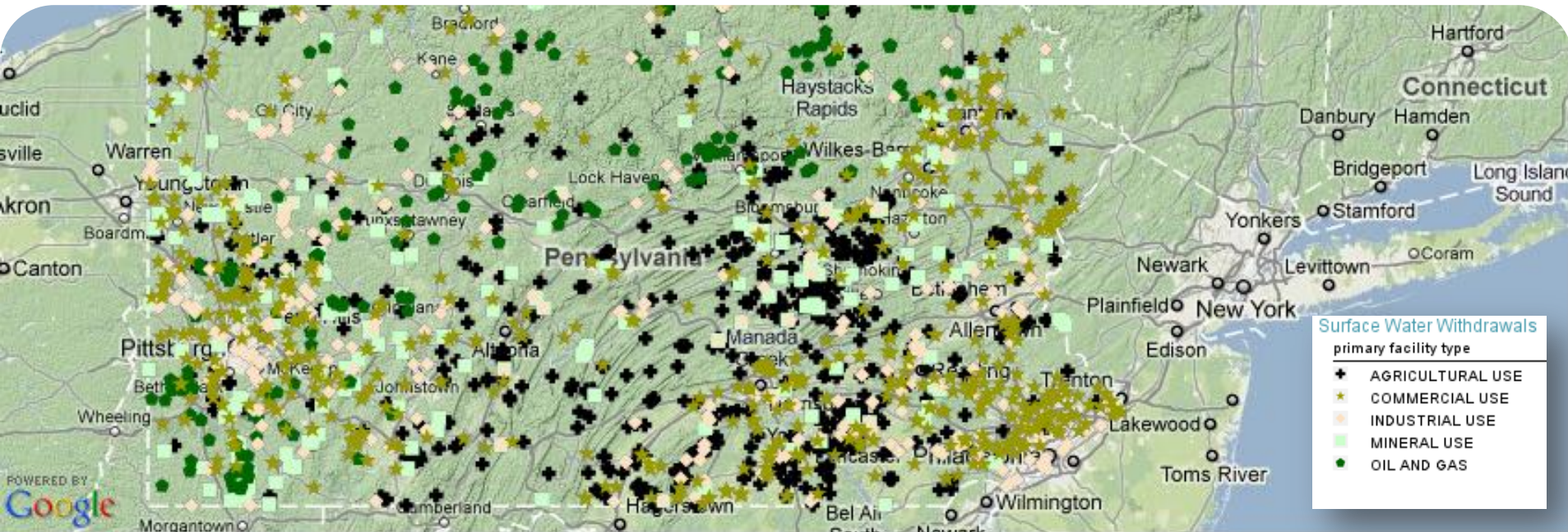


Marcellus Shale Drilled Wells in PA 20...

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Permitted PA Surface Water Withdrawals



Surface Water Withdrawals Permitted by the PA DEP

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Public Health Problems Associated with Intense Marcellus Shale Gas Production

1. Community and behavioral health impacts.
2. Excessive groundwater and surface water usage, lowering freshwater aquifers and surface water sources. (Each fracked well uses about 5 million gallons of water)
3. Exposure to fracking chemicals from leaks, spills, accidents, off gassing from frac-water pits.
4. Groundwater contamination from flowback and produced water that contain toxic metals/elements, organic compounds (BTEX), and elevated levels of radionuclides from the shale formation itself.
5. Inadequate treatment and inappropriate disposal of brine water into surface water, which adds toxic anions and cations and increases TDS levels in drinking water supplies.
6. Inhalation exposure from volatile organic compounds in frac water, and air contaminants from diesel usage (trucks), compressor stations and gas drying and production facilities.
7. Methane gas in air and water and explosion potential from casement failures, which can be made worse with time.



Shale Gas Extraction—An Experiment in Progress-Without Adequate Scientific Review

Radon Activities in Homes over the Marcellus Shale Formation-

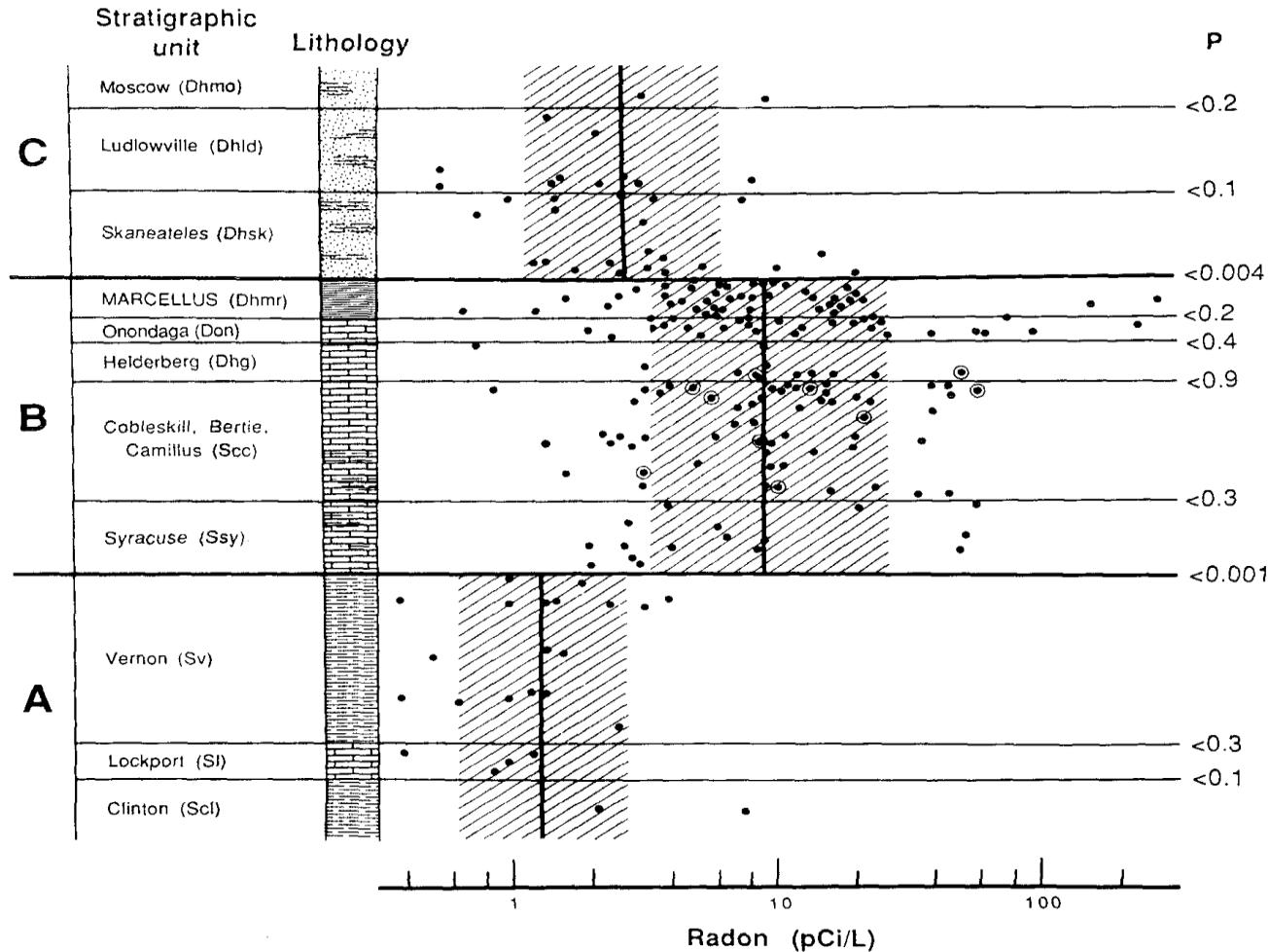


Figure 3. Radon activities plotted against stratigraphic position. Vertical lines indicate geometric means; diagonal rule pattern = area within 1 standard deviation of mean. A, B, C correspond to regions in Figure 1. Circled data points are homes north of Rock Cut, now inaccessible to ground water that has passed through Marcellus Shale. P is probability (based on Student's t test) that data from adjacent formations might represent single population. Parenthetical symbols designate units differentiated on Geologic Map of New York (Fisher et al., 1971).

Major Facilities Accepting Wastewater in the Monongahela Drainage and Volume Permitted

Thousand Gallons per Day tgd

McKeesport - Monongahela (POTW)	115
Clariton Municipal Authority - Peters Creek (POTW)	60
Mon Valley Brine (Monongahela River)	200
Authority of Borough of Charleroi - Monongahela (POTW)	30
(2 permits), Municipal Authority of Belle Vernon - Monongahela (POTW)	10
	5
Borough of California - Monongahela (POTW)	10
Brownsville Municipal Authority - Dunlap Creek (POTW)	9
Franklin Township Sewer Authority - South Fork Tenmile Creek (POTW)	50
Waynesburg Borough - South Fork Tenmile Creek (POTW)	8
Shallenberger-Ronco - Monongahela	
NPDES permit effective on 10/1/2008,	500
WQM permit issued on 9/12/2009, consent order & agreement issued on 9/12/2009, EHB appeal of consent order filed on October 13, 2009.	
Litigation ongoing.	
Shallenberger-Rankin Run NPDES permit effective on 11/1/2008.	125
Shallenberger Connellsville – Youghiogeny	1000
Somerset Regional Water Resources (East Branch Coxes Creek)	
RO and Evaporators proposed. NPDES permit granted on: 12/17/2009, amendment to the NPDES permit is pending	?

612 - 2112 tgd

Concentrations of Selected Important Contaminants from Marcellus Shale Flowback Water*

Total Dissolved Solids	161,636 mg/L
Barium	2,950 mg/L
Strontium	3,280 mg/L
Chloride	95,400 mg/L

Conversions to pounds of contaminant per day into Monongahela drainage;

- 612,000 gallons FB water * 3.79 L/gallon* 161,636 mg/L dissolved solids* 2.2×10^{-6} pounds/mg=
824,825 pounds of dissolved solids
- 612,000 gallons FB water * 3.79 L/gallon* 2,950mg/L Barium* 2.2×10^{-6} pounds/mg=
15,053 pounds of barium
- 612,000 gallons FB water * 3.79 L/gallon* 3,280mg/L Strontium* 2.2×10^{-6} pounds/mg=
16,737 pounds of strontium
- 612,000 gallons FB water * 3.79 L/gallon* 95,400 mg/L chloride* 2.2×10^{-6} pounds/mg=
486,812 pounds of chloride

* From Bluch, MF et al, 2009, Marcellus Shale Post-Frac Flowback Water-Where is all the Salt Coming From, SPE 125740

Reported Spills & Accidents Related to MSGE*

Date	Incident Details	Location	Material	Amount	Remediation/Notes
5/30/09	The impoundments draw significant amounts of water per day from nearby waterways. Such large volume diversions could impair the existing uses of the waterways.	Cogan House Township & Mifflin Township, Lycoming County, PA	Water withdrawal	n/a	DEP ordered Range Resources - Appalachia LLC & Chief Oil & Gas LLC to suspend a portion of their operations. The orders will remain in effect until the DEP has received & approved a water management plan from both companies, & each firm has obtained the necessary permits.
6/5/09	A leaking waste water pipe from a Range Resources Marcellus shale gas well drilled in polluted water, killing fish, salamanders, crayfish & aquatic insect life.	Cross Creek Lake, Washington County, PA	Returned frac fluid, waste water discharge	Unknown	DEP fined Range Resources as of January 2010.
9/1/09	A toxic algae bloom resulted in a massive fish kill (complete mussel kill). Favorable algae growth conditions were caused by high TDS levels, dry weather & water withdrawals for fracturing operations.	Along 43 miles of Dunkard Creek (Along WV & PA border)	Golden algae	Unknown	Lower chlorides & TDS levels. Consol Energy is now allowed to pumped out water from its Blackville No. 2 mine on specific conditions issued by the WV DEP.
9/24/09	Cabot Oil & Gas Corp. experienced 3 separate spills in less than 1 week, which polluted Stevens Creek & a nearby wetland.	Heitsman well in Dimock Township, PA	Water/fluid mixture	8,000 gallons	The DEP's order stopped all hydro fracking operations at each site throughout the county. Cabot has since submitted the necessary forms according to DEP specifications, & resumed operations.
10/10/09	A Range Resources temporary above-ground water transfer line connection failed. Minnows, crawfish & frogs died / were impaired.	Brush Run Creek, Hopewell Township, Pa	Partially recycled flowback & fresh water, Chlorides	250 barrels (10,500 gallons)	PA DEP officials inspected about 4/10 of a mile of Brush Run near the spill. Fines for this incident have not yet been published, but should be announced in Spring 2010.
2/1/10	Proper ownership information missing, flow-back fluids discharging into tributary	3 natural gas wells, Troy Township, Bradford County, PA	Flow-back fluids	Unknown	Fortuna Energy Inc. promptly placed a pump into the sediment basin to pump the fluids back into tanks & hired a consultant to conduct appropriate sampling. PA DEP has fined the company \$3,500 for the violations.
3/15/10 (Approx)	Fluid leak into the ground water caused by a hole in the pit liner	Dimock, Susquehanna County, PA	Black drilling liquid	Unknown	PA DEP issued a notice of violation to Cabot Oil & Gas
3/15/10	A substance used in the natural gas drilling process is discoloring & distorting the texture of spring water runoff.	Cummings Township, PA	Airfoam HD	Unknown	Representatives of PA General Energy, w/whom DEP members have been communicating, are investigating the problem.
3/17/10	Dumping of fluid onto a road from a tanker truck.	Bee Branch, AR	Fluid (unknown components)	5,000 gallons	Unknown
3/17/10	Cummings C-West gas well pad site, run by Williams Production: frac fluid spill while conducting flowback activities	Town of Flower Mound, TX	Flowback water w/frac fluid	80 barrels - or 3,000 gallons	Sampling & remediation of the spill will be conducted by the Texas Railroad Commission. The Texas Commission on Environmental Quality has been notified.
3/21/10	Range Resources: Broken pipe & flushing of water in field	Hickory, PA (Caldwell St.)	Water (unknown components)	Unknown	PA DEP investigating. Incident reported to researchers by witness.
3/26/10	Mud overflowed Anadarko Corp. well pad	Sproul State Forest, PA	Mud used as a cooling agent	8,000 - 12,000 gallons	A contractor has begun cleanup.
3/31/10	Atlas Energy gas well fire (natural gas storage tank or liner)	Hopewell Township, PA	Fire, smoke	n/a	Emergency personnel let the fire burn itself out. Investigation being conducted.

*This list of spills & accidents potentially related to Marcellus Shale natural gas extraction is not comprehensive & is constantly being updated. If you would like to add to this list, please send CHEC an email (chec.pitt@gmail.com) with the details

Blowouts and Fires



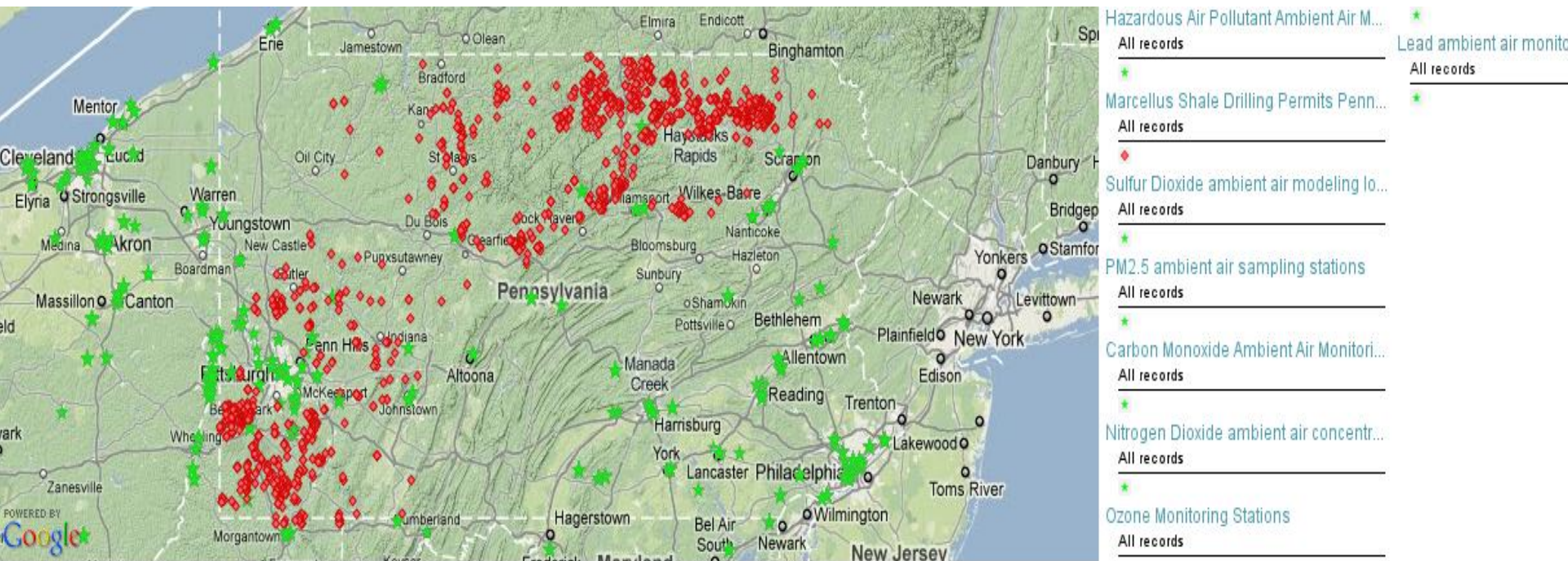
Fracking Pond Fire – Hopewell Township, PA – reported by Post Gazette April 1, 2010

Lack of Emergency Response Training and Public Health Preparedness



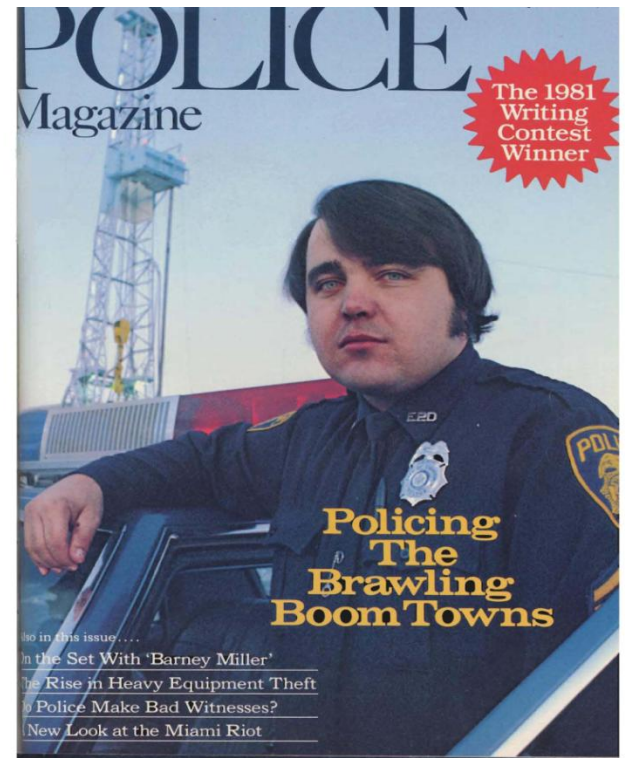
Fracking Pond Fire – Hopewell Township, PA – reported by Post Gazette April 1, 2010

Regulatory Structure Inadequate to Insure Public Health of Citizens –Air Monitoring Stations Not Located Near Major Gas Fields



Psycho-Social and Behavioral Health Effects

1. Disproportionate increases in mental health case loads, crime, divorce, suicide, and alcoholism in impacted community as compared to nearby non-impacted communities (Kohrs, E.V., 1974. *Social Consequences of Boom Growth in Wyoming*).
2. While Kohrs' work has been criticized as unscientific, later research has determined that in many boom communities such social problems did indeed occur at disproportionate rates when compared to non-booming communities. Social service case loads can skyrocket, in many cases at rates faster than even the population increase.
3. Most studies have found that impacts in these areas cannot be attributed exclusively to either old-timers or newcomers, and the reasons for these increases have not been concretely determined. The stresses of social change, uncertainty, isolation, inadequate housing and infrastructure, and substandard services are generically blamed.



Extracted from: **From-Energy Boomtowns & Natural Gas: Implications for Marcellus Shale Local Governments & Rural Communities**
NERCRD Rural Development Paper No. 43
January 2009, 63 pp. Jeffrey Jacquet , The Northeast Regional Center for Rural Development , The Pennsylvania State University

Impacts on Community Safety and Roads in Wetzel County, West Virginia (Courtesy of Wetzel County Action Group)

Below: Trucks parked along blind bend in road.



Above: Slip below drill site closes road to ambulance.



Above : Road Disintegration from Truck Traffic

Creation of Significant Challenges for Local Government

Jurisdictional unevenness: The energy development prompting population growth takes place in a political jurisdiction different from the one which bears the cost.

New Comers vs. Old Timers: Rapid growth frequently requires major new infrastructure expenditures to accommodate new residents and older residents may oppose subsidizing such expenditures under uniform taxation arrangements.

Insufficient control of land use: decisions about disposition of land as in federal coal or offshore leasing prevents the local government from using zoning or siting arrangements to ease adjustment.

Severity of growth: Sheer numbers of people entering to work, despite adequate housing, may be unassimilatable without significant declines in quality of public services and community life.

Creation of Significant Challenges for Local Government: Continued

Volatile production patterns: The boom-bust cycle associated with energy development presents the local government with an uneven future path of public service demand.

Monopoly of information: the industry or regulatory agency exercises tremendous power over the pace of development and the amount of information that is available to planners; sometimes, an incentive to misinform exists.

Risk. The uncertainty surrounding the future of many energy activities raises the risk premium, often so high that the financial sector is unwilling to lend funds to or buy bonds of local governments.

The Center for Healthy Environments and Communities (CHEC); Community Research and Outreach Activities Targeting Gas Extraction Activities and Impacts

Overall Strategy

1. Engage Key Community Informants to establish trusted links to community residents (Washington County, Fayette, and Bedford County)
2. Establish and Maintain A Steering Committee of Key Environmental Organizations in order to coordinate activities connected to gas drilling impacts such as development of citizen surveillance groups, education and state wide coordination and information sharing
3. Develop and maintain sophisticated web-based information commons in conjunction with Rhiza Labs
4. Establish and Facilitate Workshops to Empower Individual Community members to host community information meetings on Gas Drilling and its related impacts.
5. Provide technical assistance in the development of a pilot citizen surveillance project with Youghiogheny River Keeper.

Engage Key Community Informants to Establish Trusted Links to Community Residents

- Work with Key Informants to Document Experiences of poor health outcomes, environmental impacts and psycho-social issues related to gas drilling operations. (Washington County, Fayette, and Bedford County)
- Develop Superfund P42 pilot project uniting community outreach with innovative monitoring and remediation technology
- Maintain contact lists of community contacts for the purpose of providing ongoing and new information

Develop and Maintain Web-Based Information Commons

- Rhiza Labs in conjunction with Maya Design has developed a community access and very user friendly web based information commons which is able to manage and process data from many sources. This platform will be implemented through the CHEC for use by community groups and individuals throughout the state.
- Citizen Surveillance groups will upload photos, videos, journals, documents of their experiences of the impacts of gas drilling in their area
- Citizen groups will be apprised of a very simple training on the use of the web based information platform.