The Marcellus Shale Factor

Presented by:
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Center for Environmental Quality

Non-profit/equal opportunity employer, is operated and managed within the Department of Environmental Engineering and Earth Sciences at Wilkes University

Outreach Programs
- Environmental and Professional Education and Training
- Applied Research- Product Development
- Community and Business Outreach Programs
Website: http://www.wilkes.edu/water
B.F. Environmental Consultants Inc.

- Professional Consulting Services in the areas of water quality, soils, stormwater, geology, aquifer analysis, and land-development.
- Water Treatment Process/ Product Development
- [http://www.bfenvironmental.com](http://www.bfenvironmental.com)
- [http://www.water-research.net](http://www.water-research.net)

Target Audience

- Professionals providing baseline testing services or chain-of-custody to the public.
- Professionals providing consulting services to the Gas Companies
- Community Advocates and Scientists
- Municipal and Local Officials
- Water Supplies and State Regulators

Goals

- Private Well Water Quality for the Region
- Existing Problems in Region
- Brief Introduction to Marcellus Shale and Importance of Proper Well Construction
- Review of Hydraulic Fracturing
- The Citizen Groundwater Database
- Well Monitoring and Purging
- Chain-of-Custody
- Baseline Testing – What Parameters?
- Educating the Community
The Safe Drinking Water Act (SDWA), passed in 1974 and amended in 1986 and 1996, gives the Environmental Protection Agency (EPA) the authority to set drinking water standards. These standards are divided into two broad categories: Primary Standards (NPDWR) and Secondary Standards (NSDWR).

Primary Standards (NPDWR)
National Primary Drinking Water Regulations
Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in water. They take the form of Maximum Contaminant Levels or Treatment Techniques.

There are over 100 chemical and biological primary drinking water standards, which include trace metals, disinfection agents, disinfection by-products, radiological, microbiological agents, and organic chemicals.

Examples: Arsenic, Lead, MTBE, total coliform, Giardia, Trihalomethanes, Asbestos, Copper, Benzene, Trichloroethylene, etc.

Secondary Standards
National Secondary Drinking Water Regulations
These standards were established more for cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water.

The secondary standards include: aluminum, chloride, color, corrosivity, fluoride, foaming agents, iron, manganese, odor, pH, silver, sulfate, total dissolved solids, and zinc.
Private Wells Not Regulated

- Private Wells Are Not Regulated under Safe Drinking Water Act
  - EPA – NO
  - PADEP – NO
  - County – Very Few Counties in PA
  - Townships – some have basic ordinance on placement, some have comprehensive requirements

Private Wells/ Water Systems in Pennsylvania

![Image of private wells]

What?

<table>
<thead>
<tr>
<th>County</th>
<th># of homes served by private water systems</th>
<th>% of homes served by private water systems per year</th>
<th>% of all homes served by public water</th>
<th>% of all homes served by private water system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bradford</td>
<td>13,442</td>
<td>20,287</td>
<td>144</td>
<td>37</td>
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<tr>
<td>Carbon</td>
<td>6,594</td>
<td>17,876</td>
<td>564</td>
<td>55</td>
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<td>Lackawanna</td>
<td>9,952</td>
<td>15,538</td>
<td>279</td>
<td>86</td>
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<td>Luzerne</td>
<td>21,122</td>
<td>24,309</td>
<td>274</td>
<td>68</td>
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<tr>
<td>Pike</td>
<td>9,441</td>
<td>16,875</td>
<td>268</td>
<td>55</td>
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<tr>
<td>Sullivan</td>
<td>2,477</td>
<td>7,307</td>
<td>256</td>
<td>87</td>
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<tr>
<td>Susquehanna</td>
<td>9,424</td>
<td>23,000</td>
<td>279</td>
<td>75</td>
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<tr>
<td>Tioga</td>
<td>11,316</td>
<td>24,500</td>
<td>173</td>
<td>68</td>
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<tr>
<td>Wayne</td>
<td>9,913</td>
<td>19,097</td>
<td>918</td>
<td>33</td>
</tr>
<tr>
<td>Wyoming</td>
<td>7,236</td>
<td>10,078</td>
<td>142</td>
<td>27</td>
</tr>
<tr>
<td>Region</td>
<td>118,398</td>
<td>242,020</td>
<td>862</td>
<td>57</td>
</tr>
</tbody>
</table>
Private Wells the Facts

- Are they Regulated?
  - Not really – no state-wide construction standard
  - Not Classified as a Regulated Source
- Are they Permitted?
  - May be the Licensed Well Driller Submitted a Log
  - Maybe a permit issued at the local level
- Are they Tested?
  - Not required - Data not stored
- Do we know where they are located?
  - Maybe +/- a few hundred feet.
  - PaGWIS

PaGWIS (Windows Explorer or Arc GIS Format/ Access Files)

- PA Groundwater Information System
- Data by County, Latitude/ Longitude
- Database containing
  - Wells
  - Springs
  - Some Groundwater Quality
- Problems some wells have no coordinates and the actual locations are wrong and some duplication
  - http://www.doem.state.pa.us/ topics/gee/groundwater/PaGWIS /help.aspx
  - Download or Buy a CD for $ 5.00

Most Townships Only Requirement

- Well is 100 feet from septic disposal area
- Well is 50 feet from septic tank
- Well is 10 feet from property

- That is ALL Folks!
- No Water Testing
- No Construction Requirements
1. Concerns about groundwater quality
2. Concerns related to surfacewater quality.
3. They have never tested the water

Citizens Believe Their Water is PURE H2O

Our Groundwater is Pure?
Information We Know Without Compiling the Baseline Water Quality Data

Before Marcellus Shale Development
What was the Quality of Private Well Water?
A USGS survey found that 70% of private wells were contaminated. This contamination could result in acute or chronic health concerns (1996).

Testing Conducted by Wilkes University throughout the United States indicates that 30 to over 50% may be contaminated – Mostly by Total Coliform Bacteria (1999 – 2010).

PSU – Master Well Owner Network suggests that 33 to 50% of Private Well Owners in PA may have some Form of contamination.
Based on the geology of the NEPA and my 20 years experience, the common water quality problems are as follows:

- Corrosive Water
- Low pH
- Soft Water (low hardness) to Moderate Hardness
- Iron and Manganese Discolored Water – Reddish to Brown Tints
- Total Coliform Bacteria
- Sulfur Odors and Methane- Biogenic Gas (Tends to be < 10 mg/L)

Contamination by VOCs, SOCs, Glycols, Saline Water, and Radionuclides are NOT COMMON!

Most Contamination appears to be associated with Total Coliform Bacteria

- Insects, Larvae and Nests / Egg Masses
- Mouse Colonies
- Snakes
- Beehives
- Mud - when casing to close to ground

Therefore – In some cases - the Private Wells are Facilitating Groundwater Contamination.
How Contaminants Can Get In to the Aquifer (Surface)

Ungrouted Well Pit  Sanitary Well

How Contaminants Can Get In to the Aquifer (Subsurface)

Ungrouted Well Pit  Sanitary Well

Radon (In Air)- PA

Luzerne County and Many Other Counties are in the Red Zone—
Suggests indoor air radon levels greater than 4 pCi/L
Methane in Water

- Methane has been a hidden issue in NEPA.
- The gas is colorless, tasteless, and odorless and there are no known health effects.
- Potential concerns relate to flammability/explosiveness of gas.
- Background – appears to range from non-detect to over 20+ mg/L (highly variable) in Northeast Pennsylvania.

Methane (a little more)

- The Coal regions and northern portion of NEPA, and areas associated with the Mahantango / Marcellus Shale may have elevated levels of methane.
- No drinking water limit, but Office of Surface Mines recommends monitoring for concentrations from 10 to < 28 mg/L and immediate action for concentrations > 28 mg/L.
- Primary treatment options would include ventilation or aeration systems.

Methane Ventilation, process will also work for Radon and Hydrogen Sulfide
Problems with Iron, Manganese, and Sulfur – May be Bacterially Related

In Northeastern PA: “Nuisance Bacteria may be associated with an Odor, Iron, Manganese, or Sulfur problem. Up to 50% of the time.

Make sure to test for total coliform, standard plate count, and Nuisance Bacteria.

Nice Break

Marcellus Shale- What is it?

Dr. Sid Halsor
Holding a Core Sample from About 7800 feet
This is Causing all the Concern?

Outcrops Along the Southeastern Border of Pike County Along Route 209

Main Fracture Orientation
Looking Back 400 million Years

Marcellus Shale- Natural Gas Play
50 to 200 trillion cubic feet

Shale may be 150+ feet thick. The Grapevine is saying 200 to 300 feet

This is why the term – Fairway is being used to describe the play.

Source: Cabot – Marcellus Shale Thickness Map
2.3 to 6.3 mmcf/day

$ 12,400/day
$ 3000/day (25%)

3.4 mmcf/day

$ 23,900/day
$ 5900/day (25%)

Marcellus Shale Development

- Drilling
- Casing
- Cement
- What are the weaknesses?
- What are the contaminants of concern?
- Where to monitor?

Marcellus Shale Drilling Site

Pads can be 5+ acres – but one pad may support drilling multiple horizontal wells.
Even after new regulations, there may be a zone from 1500 to 2000 feet thick not cemented.

Getting to The Natural Gas

Freshwater Well

Top hole fluids – typically the water from the freshwater aquifer. This water from the first 600 to 1200 feet.

Bottom hole fluids – brine or connate water.

Stimulation Fluids – fluid used to improve recovery (frac process)- includes biocides and other chemicals.

Production Fluids – water produced along the natural gas release – similar to bottom hole fluid.
Active Marcellus Production Site – Frac Fluid Chemistry

Typically Frac Water is comprised of clean water with a low probably for scale formation, but treated effluents and other sources being evaluated.

The components include:

- Friction Reducer – anionic polymer high molecular weight (hold frac sand and other particles)
- Wetting Agent- nonionic surfactant - reduce surface tension and improve frac water flowback
- Biocides- control growth or regrowth of microorganisms.
- Scale Inhibitor – phosphate based chemicals to inhibit precipitate formation and scale formation.

Flowback Water Chemistry

Flowback water is generated from drilling and it is what gets produced from the first 5% of water returned after a well is started.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Env 1</th>
<th>Env 2</th>
<th>Env 3</th>
<th>Env 4</th>
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<tbody>
<tr>
<td>Chloride (mg/L)</td>
<td>1,129</td>
<td>1,400</td>
<td>775</td>
<td>490</td>
</tr>
<tr>
<td>Sodium (mg/L)</td>
<td>14,180</td>
<td>3,140</td>
<td>483</td>
<td>519</td>
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<tr>
<td>Iron (mg/L)</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
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<tr>
<td>Magnesium (mg/L)</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Calcium (mg/L)</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Total hardness (mg/L)</td>
<td>833</td>
<td>833</td>
<td>833</td>
<td>833</td>
</tr>
<tr>
<td>Dissolved solids (mg/L)</td>
<td>1,750</td>
<td>2,060</td>
<td>2,060</td>
<td>2,060</td>
</tr>
</tbody>
</table>

May contain elevated levels of trace metals, nitrogen, bromide, uranium, and hydrocarbons. Most of the dissolved solids includes chloride and sodium.

Source: http://www.prochemtech.com/
Produced water is wasted water that accompanies oil extraction and is high in salinity. Typically, separated on site and then hauled to treatment/disposal facility. May contain elevated levels of trace metals, nitrogen, bromide, uranium, and hydrocarbons. Most of the dissolved solids includes chloride and sodium.

Source: http://www.prochemtech.com/

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Concentration</th>
<th>PWS</th>
<th>Multiple Above PWS Standard</th>
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<tr>
<td>Aluminum</td>
<td>mg/L</td>
<td>0.2</td>
<td>0.2</td>
<td>5</td>
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<tr>
<td>Arsenic</td>
<td>mg/L</td>
<td>0.014</td>
<td>0.01</td>
<td>1.4</td>
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<tr>
<td>Barium</td>
<td>mg/L</td>
<td>0.7</td>
<td>0.7</td>
<td>36</td>
</tr>
<tr>
<td>Bromide</td>
<td>mg/L</td>
<td>0.09</td>
<td>0.08</td>
<td>17.6</td>
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<tr>
<td>Barium</td>
<td>mg/L</td>
<td>0.5</td>
<td>0.5</td>
<td>75</td>
</tr>
<tr>
<td>T. Dissolved Solids</td>
<td>mg/L</td>
<td>512.5</td>
<td>500</td>
<td>62</td>
</tr>
<tr>
<td>Magnesium</td>
<td>mg/L</td>
<td>0.17</td>
<td>0.15</td>
<td>10</td>
</tr>
<tr>
<td>Calcium must</td>
<td>mol/L</td>
<td>6.5 - 8.5</td>
<td>ok</td>
<td>5</td>
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<tr>
<td>Chloride</td>
<td>mg/L</td>
<td>278000</td>
<td>250</td>
<td>108</td>
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<tr>
<td>Gross Alkalinity</td>
<td>mol/L</td>
<td>222.3</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Gross Base</td>
<td>mg/L</td>
<td>78.5</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Radiocarbon 226</td>
<td>pCi/L</td>
<td>1.95</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Strontium</td>
<td>pCi/L</td>
<td>88.65</td>
<td>5</td>
<td>14</td>
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</table>

Glycols may be as high as 130 mg/L. Most VOCs / SOCs < 1 mg/L. Radionuclides Varies ND – 5800 pCi/L.
Approximate Flowback Water - Wastewater Chemistry
Concentration - mg/L (Source: PSU and Marcellus Shale Coalition)

Concerns Related to Marcellus Shale

- In general, the concerns are related to the following:
  - Surface Spills and Releases Near Surface
  - Methane Gas Migration
  - Pushes and Slugs associated with Improper Cementing and not Properly Sealing the Existing Confining Layers
  - Improper Disposal of Brines
  - Freshwater Aquifer Contamination by brine water and drilling fluids/muds
  - Drilling fluids may contain environmental contaminations (metals and organics).

Younger Older Younger

Water Well

Anticline

1200 ft
600 ft

Fresh Water < 1000 mg/L

Brines > 10,000 mg/L

Target Formation
Goal of the Database

- Provide a Central Location to Store Baseline Pre-Drilling and/or Post-Drilling Water Quality Data for the Region
- Document Quality by Geological Formation
- Identify Existing Regional Issues or Concerns
- Provide an Un-Biased Community Resource
- Provide a Mechanism to Track Temporal, Spatial, and other Geospatial Variation in Water Quality.

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Citizen Database at Wilkes University - Guidelines for Submission

1. Third Party Samplers following chain-of-custody to certified laboratory.
2. Submit detailed reports from certified laboratory with a GPS position for the well.
3. The water sample must be collected ahead of any water treatment system.
4. other conditions – Learn More at the Wilkes University Website.

Learn More –
http://www.wilkes.edu/water

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Recent Baseline Testing in Luzerne County, PA
320 Private Wells

Study Area

Image Source: Luzernecounty.org

Tested Conducted by Certified Laboratories
Third Party Samplers
Not Wilkes University
What are Phthalates?

- Used as Plasticizers- is a substance which when added to a material, usually a plastic, makes it flexible and easier to handle.
- Bis(2ethylhexylphthalate) (DEHP) – DW Standard – 6 ppb – GI problems, possible endocrine disruptor and carcinogen.
- Recent Testing – Highest Value was 60 ppb.
- How did this get in the aquifer?

How? Not Sure – Here are Some Ideas

- Trace Level or near Detection Limit may be related to contamination during field sampling or laboratory testing, but this does not appear to account for levels at or above the drinking water standard.

Other Sources

- Private Wells Not Regulated and there are no plumbing codes.
- Sources – PVC plastic piping used in the home.
- Sources – Deep Pipe and Delivery Piping used in the well.

This is only a hypothesis.
Sometimes we also see it for Vinyl Chloride and Toluene
(What the electric Taps ?!!!)
The Marcellus Shale Factor - The Truth about Private Wells

- In 1996 – we knew 50% of Private Wells in PA were contaminated – But What Did We Do?
- The Marcellus Shale Factor or the Development of this resource is NOW bringing this problem to the surface.
- Baseline Testing is being conducted and more problems with groundwater quality are being identified.
- What do we do now? What is the Risk? What is the pathways to Contamination? Impact? How should Risk be Managed?
- What to Test For as Part of Baseline Testing?
- Some Private Wells may be the pathway to Contamination.

Baseline Testing

- Baseline Testing
  - Proper Well Purging, Field Monitoring, and Sampling
  - Documenting Existing Conditions and Well or Water Source Information
  - Chain-of-Custody Protocols
  - Using a Certified Lab / Using Certified Methods
  - Picking Water Quality Parameters

If you are working for a Gas Company – Work in Teams!

Well Purging / Field Monitoring

- Document the Source Information
  - Source Type, GPS Location, Yield, Pump Setting, Static Water Level, and Photograph.
  - Owners name and address – Give the Well Owner the Unique ID for the Well.
  - If possible calculate the wellbore volume and specific capacity.
  - Properly purge the well and monitor the purging process and Give each Sampling Site a Unique ID Number that is tracked with Sample.
  - Document water appearance, sediment, odor, and any other information or observations – If possible photo document and have others confirm.

Take Lots of Digital Photos!
The Existing Conditions – Make Sure to Look for Treatment

- Is there a treatment system? Document the type of system, Model Numbers, and make sure to by-pass the unit prior to collection.
- Properly clean and prepare sampling site.
- Field monitoring should include documenting static water level in the well, pH, conductivity, temperature, and turbidity of the water.
- Take Lots of Photos and in Entrance/ Exit Photo

Look for Treatment

- What we have no treatment?
- Make Sure to By-Pass Treatment Systems
Look for Treatment

Reverse Osmosis Unit – Basement
Closet on the Floor
System in Garage – Two Rooms
Away from the Pressure Tank

Wellbore Volume - Volume of Water in Storage (WBV)

- Well Depth from Drillers Log – 300 feet
- Well Diameter – 6 inches
- Static Water Level (no pumping) – 51 feet
- Water Column in the Well – 250 feet
- Water in the Well (250 ft * 1.5 g/ft = 375 gallons)
- WBV – Wellbore Volume = 375 gallons

If pump produces 5 gallons per minute, it will take 75 minutes to purge wellbore volume.

Normally we attempt to purge 3 wellbore volumes as part of a monitoring effort.
Make sure to complete the following:

1. Take Notes and Record Observations
2. Label Each Container Name, Site ID, Date, Time, Parameters, Your Initials, Preservation
3. Prepare Chain-of-Custody
4. Record Field Water Quality Data

1 WBV = 45 minutes
Estimating Specific Capacity

Specific Capacity = Gpm/ft of drawdown

gpm = 5 gpm
Static Water Level – 50 feet
Dynamic Level – 75 feet
Sc = (5 gpm/25 ft) =
Sc = 0.2 gpm/ft drawdown

Nice Break

The Paper Work

- Chain-of-Custody
Chain-of-Custody

- Sampling Procedures
- Sampling Operations
  - Short-Term
  - Long-Term
- Sample Transport
- Receipt, Storage, Transport
- Sample Analysis
- Procedures for Data

What is Chain-of-Custody?

- “This is a legal term that refers to the ability to guarantee the identification and integrity of samples from collection through reporting of test results.
- For the purpose of litigation, it is necessary to prove the legal integrity of all samples and data as part of the chain of evidence. Therefore, it is necessary to have and accurate written history for the sample.
- This history should include sample bottle preparation, bottle possession, handling, and location of samples and data from the time of collection through reporting. This can be conducted by using chain-of-custody procedures.”

When Should We Use Chain-of-Custody

- ALWAYS: “Since there is no way to know in advance which samples and data may be involved in litigation, you should always follow chain-of-custody procedures whenever samples and data are collected, transferred, stored, analyzed, or destroyed.”
- Samples and data are considered to be in your custody when:
  - they are in your physical possession;
  - they are in your view, after being in your physical possession;
  - they are in your physical possession and then locked up so that tampering cannot occur;
  - they are kept in a secured area, with access restricted to authorized personnel only.”
Keep the Process Simple

- As you learn how to conduct chain-of-custody procedures, remember these general guidelines:
  - Keep the number of people involved in collecting and handling samples and data to a minimum.
  - Only allow people associated with the project to handle samples and data.
  - Always document the transfer of samples and data from one person to another on chain-of-custody forms.
  - Always accompany samples and data with their chain-of-custody forms.
  - Give samples and data positive identification at all times that is legible and written with permanent ink.

Step 1. Sampling Preparations

- Reagents and materials that will be used during sampling are prepared. (lab)
- Materials and reagents may be used to calibrate sampling equipment or may become part of the sample itself. (lab and/or sampler)
- Keep records, including the preparation date, name of the preparer, and location of the reagents and materials from preparation through use. (lab)
- Lab-sample custodian starts the chain-of-custody (COC) process by requesting that the laboratory technician prepare the reagents and supplies. The lab-sample custodian takes possession of the reagents and supplies. (lab)
- Field-sample custodian takes possession of the reagents and supplies. (sampler)
- All exchanges of reagents and supplies are documented on the Chain-of-Custody Form.

Step 2. Sampling Operations

- The field-sample custodian gives the reagents and supplies to the field sampler.
- Samples Collected using the proper sampling techniques and methods.
- The collected sample is placed in a non-reactive container and sealed. None use tape, to prevent accidental opening and spillage. I use individual coolers that are closed.
- A legal custody seal is then applied over the top of the lid and down the side of the container to detect unauthorized opening of the sample.
- Each sample container must be labeled with its own unique and permanent identification number to prevent container mix-up.
- Samples should be in the possession of the field sampler or field-sample custodian in limited-access locked storage.
Remember

- Samples and data are considered to be in your custody when:
  - they are in your physical possession;
  - they are in your view, after being in your physical possession;
  - they are in your physical possession and then locked up so that tampering cannot occur;
  - they are kept in a secured area, with access restricted to authorized personnel only (Locked Vehicle).

Record

- Data recordings should be clearly identified with permanent, non-erasable markings that do not interfere with data. Information about the sample should include:
  - what (the parameter to be tested),
  - where (the location site and sample location),
  - when (date and time),
  - how (measurement methodology used, including units for reporting and the instrument’s full-scale setting), an
  - who (signature of the sampler), and
  - Preservation method.

Step 3. Sample Transport

- The field-sample custodian is responsible for recovering, preserving (for example, with acid, base, or ice), and storing the samples until they are delivered to the lab. Shipment of samples is time critical to ensure their integrity.
- When common carriers are used, packages should be marked “deliver to addressee only.”
- The seal label should read “Chain-of-Custody Sample – Authorization Required to Open.”
- Samples transported by the U.S. Postal Service must be sent by registered mail, return receipt requested. Samples sent by private carriers, such as UPS, require a description of the items on the bill of lading.
- A copy of a Sampling Shipping Form should always accompany the transported samples.
- The field-sample custodian should keep a copy of this form and any other shipping documents for his/her records. If the package is sent by common carrier, make sure the bill of lading or packing information is included on the form so that samples can be tracked if necessary.
Step 4. Receipt, Storage, and Transfer

- The **lab-sample custodian** is responsible for maintaining the chain-of-custody procedures as samples are received and handled at the lab.
- Samples should be in the possession of the lab-sample custodian, or in limited-access, locked storage as they await analysis.
- When samples are received, the lab-sample custodian verifies the number of samples, their identification, and their integrity to make sure they have not been tampered with.
- Check in process may take 5 to 15 minutes per sample.

Step 5. Sample Analysis

- Includes chemical analysis of samples according to the appropriate method.
- Samples should be analyzed in a timely manner to ensure the integrity of the results.
- The **analyst** is responsible for maintaining the chain-of-custody procedures during this step. During analysis, samples and intermediary solutions must be in continuous view of the analyst, or in limited-access locked storage.
- After analysis, some samples will be discarded and others will be returned to the lab-sample custodian for secure storage—depending on the objectives of the project involved. If samples are toxic or hazardous, they must be disposed of safely.
- The **lab-sample custodian** is responsible for maintaining the chain-of-custody procedures during Sample-Data Recordkeeping (Archiving).

Step 6. Procedures for Data

- Chain-of-custody procedures for data are just as important as those for samples.
- If not properly protected and safeguarded, data can be lost, stolen, destroyed, or tampered with.
- Chain-of-custody procedures for data can be broken down into three steps:
  - **Step 1. Data Acquisition**
  - **Step 2. Data Identification**
  - **Step 3. Data Processing and Recordkeeping**
More Information on Setting Up Chain-of-Custody Programs

http://www.epa.gov/apti/coc/

Nice Break

What Parameters

- Baseline Testing
Suggested Baseline- For Citizens from PADEP (11/2010)

- Alkalinity, Chloride, Conductivity, Hardness, Oil and Grease, pH, Sulfate, Total Dissolved Solids, Total Suspended Solids, Total Solids
- Barium, Calcium, Iron, Magnesium, Manganese, Potassium, Sodium, Strontium
- Ethane/Methane
- Total Coliform / E. coli

Other Recommendations at: [http://www.wilkes.edu/water](http://www.wilkes.edu/water) (Fact Sheet - Recommended Baseline)

Baseline Testing – Oram’s Recommendations for Citizens

- Where are you located?
- What is your surrounding land-use?
- Do you have any water quality problems - such as discolored water, odors, or staining?
- Do you have a water treatment system?
- What is the source of your water?
  - Well, Spring, Cistern, etc

Same Baseline Parameters? Quarry Saline Seep Mixed Hazards
Suggested Baseline - For Citizens

- **Testing Package #1 Recommendations**
  Total Coliform with e. coli confirmation, chloride, sodium, bromide, barium, pH, total dissolved solids, MBAS, iron, manganese, and methane/ethane.

- **Testing Package #2 Recommendations**
  Package #1 plus T. Hardness, Magnesium, Selenium, Strontium, Conducivity, Calcium, Zinc, Alkalinity, Arsenic, Nitrate, Total Suspended Solids, Sulfate, Oil & Grease, and 21-VOCs/MTBE.

- **Testing Package #3 Recommendations**
  Package #1 and #2 plus Potassium, Sulfide, Ammonia, Acidity, Nickel, Gross, Alpha/Beta, Lead, and Uranium.

It may be advisable to add Glycols and other organic and inorganic depending on surrounding land-use, use of geothermal wells, and past history.

[http://www.wilkes.edu/water](http://www.wilkes.edu/water) (Fact Sheet - Recommended Baseline)

Suggestions for Gas Companies

- **Bacterial Series**
- **General Water Quality (pH, alkalinity, hardness, turbidity)**
- **Secondary Drinking Water Standards**
- **Oil/Grease**
- **Volatile Organics and regulated SOC (Maybe MTBE)**
- **Radionuclides (Alpha/Beta – Maybe Uranium)**
- **Gases – Methane/ Ethane/ Propane**
- **Major Cations / Anions**
  - Plus Bromide, Sulfide, Potassium, Sodium, Aluminum, Selenium, Strontium, Arsenic, Lithium (?), Lead (?), Mercury (?), Silver (?)

Companies need to take a few extra steps – they are assumed responsible.

In general – I could see a radius from 3000 ft to 1 mile

This is More Opinion/ Judgment - not fact.

Copyright: Brian Oram, 2010
My Primary Concern with Respect to Radius and Assumed Liable is “How is Responsible?”

Company A  Company B

Citizen Database at Wilkes University - Guidelines for Submission

II. Guidelines for Data Submission

1. Third Party Samplers following chain-of-custody to certified laboratory.
2. Submit detailed reports from certified laboratory with a GPS position for the well.
3. The water sample must be collected ahead of any water treatment system.
4. Other conditions - Learn More at the Wilkes University Website.

Learn More –
http://www.wilkes.edu/water

New Community Resource

Download a Free Copy (pdf) or Link to a copy at http://www.wilkes.edu/water

Also:
1. We are Working on a Regional Citizen Water Quality Database.
2. We provide informational water testing - not Certified Test.
Add Your Data to the Citizen Database
Recent Site Tour - Towanda, PA

Presented by:
Mr. Brian Oram, Professional Geologist (PG),
Soil Scientist, Licensed Well Driller, IGSHPA
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