Workshop 1

Our Groundwater and Surfacewaters are Connected and We are What We Drink

Hosted by:
Lackawanna County Conservation District

Sponsored by:
Pocono Northeast RC&D Council
Through the C-SAW Program

Funded by: The PADEP
Growing Greener Program
Project Sponsors
(Providing In-kind Support to This Effort)

- Pocono Northeast Resource Conservation & Development Council
  [http://www.pnercd.org](http://www.pnercd.org)

- Lackawanna County Conservation District
  [http://www.lccc.net](http://www.lccc.net)

- BF. Environmental Consultants Inc
  [http://www.bfenvironmental.com](http://www.bfenvironmental.com)
The Mission: to enhance and improve the ecological, cultural, and economic characteristics of the area through projects and programs that promote the management, protection, and utilization of the area's resources.

http://www.pnercd.org
Coverage Area

Serving the Following Counties in Pennsylvania: Carbon, Columbia, Lackawanna, Luzerne, Monroe, Montour, Northumberland, Pike, Schuylkill, and Wayne
The Council

- The Council is a nonprofit IRS 501c3 organization.
- The Council Board is composed of concerned citizens and stakeholders that work to improve and promote the management, protection, economic development, and utilization of the area's resources.
C-SAW - Areas of Assistance

- **Watershed Specific Technical Assistance**
  - Includes Oil & Gas Issues
  - Education Programs
  - Watershed Education and Stormwater Management

- **Mentoring** – Intensive long-term assistance

- **Quality Control** and **Quality Assurance**
C-SAW Web Site
Assistance is Free

http://www.pnercd.org
B.F. Environmental Consultants Inc.

- Professional Consulting Services in the areas of water quality, soils, stormwater, geology, aquifer analysis, and land-development.
- Baseline – Chain-of-Custody
- Expert Testimony
- Water Treatment Process/ Product Development
- http://www.bfenvironmental.com
Water-Research Center

Education and Outreach Program funded by
B.F. Environmental Consultants Inc.

Outreach Programs

- Environmental and Professional Education and Training for Citizens and Local Municipalities
- Water Quality Help Guides – Information Library
- Community and Business Outreach Programs
- Low Cost – Informational Water Testing Program with National Laboratory
- Citizen Monitoring Programs- Developing Low Cost Water Quality Sensors

Website: http://www.water-research.net
The Water Cycle
Components of the Water Cycle

First The Ins
- Solar Energy Input
- Precipitation
- Condensation
- Well Injection
- Irrigation

The Outs
- Evaporation
- Transpiration
- Infiltration
- Percolation
- Runoff
- Groundwater Flow
- Surfacewater Flow
- Well Pumping

Water Cycle
The Water Cycle
Powered by the Sun - Solar Power

Solar radiation powers the water cycle. How does the water cycle affect the weather?

- Water vapor over the sea
- Net movement of water vapor by wind
- Water vapor over the land
- Evaporation and transpiration
- Precipitation over the land
- Flow of water from land to sea
- Surface water and groundwater
Precipitation

Types of Precipitation

**Natural**
- Rain
- Snow
- Ice
- Hail
- Condensation/ Dew

**Man-Made**
- Irrigation
- Wastewater Applications
Interception
Infiltration / Percolation

Canopy Interception

2/14/2012

Infiltration- Movement Water Into Soil
Percolation - Water Movement Through the Soil
Evaporation / Transpiration
Evapotranspiration

Evaporation- Driven by Thermal Gradient and Moisture Difference
Sublimation!

2/14/2012
Runoff / Overland Flow

When Rainfall Rate Exceeds Infiltration Runoff is Generated

Uncontrolled Runoff
Causes Erosion

Low Infiltration
Causes - Overland Flow- Loss
Organic Material

2/14/2012
Groundwater
Zone of Saturation

Precipitation

Soil zone

Recharge to water table

Water table

Capillary fringe

Saturated zone below the water table
(Ground water)

Soil-Moisture Belt

Zone of Aeration

Water Table

Zone of Saturation

River or Lake

Impermeable Rock
The Water Cycle
When We Put this All Together for PA
Water Budget for PA

In
Precipitation – 42 inches

Out
Evapotranspiration – 22”
Total Streamflow – 20”
Baseflow – 13”
Surface Runoff – 7”

Therefore, 65% of streamflow is groundwater discharge.

Other
Storage in Groundwater
Aquifers over 100 inches*

* This is our “Water” Cushion.
Primary Aquifers in PA

- Sand and Gravel (unconsolidated)
- Sandstone (consolidated)
- Shale (consolidated)
- Limestone (consolidated)
- Crystalline Rocks (consolidated)

Water table
Well Geology

Unconfined and confined ground-water conditions.
Groundwater Flow and Aquifers
Surface Water & Groundwater
They Are Related and Connected!
Groundwater Moves - Slowly

feet per year
Hydrology Under Natural Conditions

Typical Annual Water Budget

- Interflow: 25.7%
- Evaporation-Transpiration: 37.4%
- Groundwater: 36.6%
- Surface Runoff: 0.3%

Forested Land Cover

Courtesy May, U of W
Developed Conditions

Typical Annual Water Budget

Urbanized Land Cover

- 25% Evaporation-Transpiration
- 30% Surface Runoff
- 15% Groundwater
- 30% Interflow

Courtesy May, U of W
Stream Flood Flow

Adapted from Paul DeBerry, PE (2007)
Stream Base Flow

Adapted from Paul DeBerry, PE (2007)
Types of Water in PA

- **Freshwater** – Typically 600 to 1200 feet
  - < 1000 mg/L

- **Saline Water** – Where?
  - 1000 to < 35,000 mg/L

- **Brine Water** – Where? > 35,000 mg/L
  - Connate Water - This would include water that has been trapped in the formation when it was deposited.

PADEP – Protects – Freshwater; EPA – Protects Water with a Total Dissolved Solids ≤ 10,000 mg/L – UIC Program
What is the Purity of the “Protected” Water?

- Regulated Drinking Water – Typically has a Total Dissolved Solids of 500 mg/L or 99.95 % pure water.
- Freshwater actually includes – water with a TDS of 1000 mg/L or 99.9 % pure
- EPA Protects Water is up to 10,000 mg/L or 99% pure water.
Most Contamination appears to be associated with Total Coliform Bacteria

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

Therefore – In some cases - the Private Wells are Facilitating Groundwater Contamination.
Properly Constructed Wells and Poorly Constructed Wells

Proper Construction

- Confined aquifer
- Confining bed
- Unsaturated Zone

Poorly Constructed

- Confined aquifer
- Confining bed
- Sea Level

Water Levels:

- Fresh Water
- Saline Water
- Brine Water
- Stagnant Water – no to little flow

Depth:

- 600 to 1200 ft
How Contaminants Can Get In to the Aquifer (Surface)
Components of a Well

- Well Cap
- Electrical Service
- Delivery Line
- Pitless Adapter
- Drop Pipe
- Driveshoe
- Pump and Motor

Casing
Components of a Well

- Drop Pipe
- Pump and Motor

2/14/2012
Components of a Well

Pressure Tank
Treatment
Us
This is Drinking Water in PA?

- Iron / Manganese
- Sediment / Gases
- Corrosion
- Bacteria

50% Other 50%

2/14/2012
1. Which ways can groundwater move?
   a. Up
   b. Down
   c. Sideways
   d. All of the above

1. d. All of the above

Although most movement is lateral (sideways), it can move straight up or down. Groundwater simply follows the path of least resistance by moving from higher pressure zones to lower pressure zones.
Groundwater Moves

2. How is the speed of groundwater movement measured?
   a. Feet per day
   b. Feet per week
   c. Feet per month
   d. Feet per year

2. d. Feet per year
Groundwater movement is usually measured in feet per year. This is why a pollutant that enters groundwater requires many years before it purifies itself or is carried to a monitored well.
Surfacewater Moves

3. How is stream flow usually measured?
   a. Feet per second
   b. Feet per minute
   c. Feet per hour
   d. Yards per hour

3. a. Feet per second
Water flow in streams/rivers is measured in feet per second.
Groundwater Moves

4. What determines how fast groundwater moves?
   a. Temperature
   b. Air pressure
   c. Depth of water table
   d. Size of materials

4. d. Size of materials

Coarse materials like sand and gravel allow water to move rapidly. (They also form excellent aquifers because of their holding capacity.) In contrast, fine-grained materials, like clay or shale, are very difficult for water to move through. Thus, water moves very, very slowly in these materials.
5. Can the water table elevation change often?
   a. Yes
   b. No

5. a. Yes
Water table elevations often fluctuate because of recharge and discharge variations. They generally peak in the winter and spring due to recharge from rains and snow melt. Throughout the summer the water table commonly declines due to evaporation, uptake by plants (transpiration), increased public use, industrial use, and crop, golf course and lawn irrigation. Elevations commonly reach their lowest point in early fall.
6. Does aquifer storage capacity vary over time naturally?
   a. Yes
   b. No

6. a. Yes

*Just like the water level in rivers and streams, the amount of water in the groundwater supply can vary due to seasonal, weather, use and other factors.*
Regular Maintenance

- Divert Surfacewater Runoff Away from Wellhead
- Annual Water Test
- Annual Maintenance on Water Treatment Systems
- Conserve Water/ Fix Leaks
- Proper Use and Storage of Chemicals and other Hazards

Remember We ALL Live Downstream
Educating the Community

Download a Free Copy (pdf) or Link to a copy at http://www.bfenvironmental.com

Also:
1. New Booklet available March/ April 2012.

2. New Web-portal on Methane Gas Migration And Mitigation (available now)

Help Promote the Citizens Groundwater Surfacewater Database to Your Community Partners.

2/14/2012
Workshop 2
Groundwater – Citizen Homeowner Monitoring
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Through the C-SAW Program

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Attend Workshop 2
Get Free Water Sample Kit
For Workshop 3

Attend Workshop 3
Free Screening of Your Well Water