Monitoring the Natural Gas Industry Using Trained Volunteer Monitors

Many potential impacts…how to monitor and prioritize

- Groundwater/well monitoring
- Housekeeping and erosion & sediment issues - monitoring of well pad construction, proper disposal, truck traffic, air pollution
- Water withdrawal monitoring
- Stream monitoring

Common Frack Fluid Additives

- (GPC and ALL (2009), Arthur et al (2008)
- Additive
- Common chemicals
- Diluted Acid
- Hydrochloric acid, muriatic acid
- biocide
- Glutaraldehyde
- Breaker
- Ammonium persulfate, sodium chloride
- Corrosion inhibitor
- N,n-dimethyl formamide
- Crosslinker
- Borate saltes
- Friction reducer
- polyacrylamide, mineral oil, petroleum distillate
- Gel

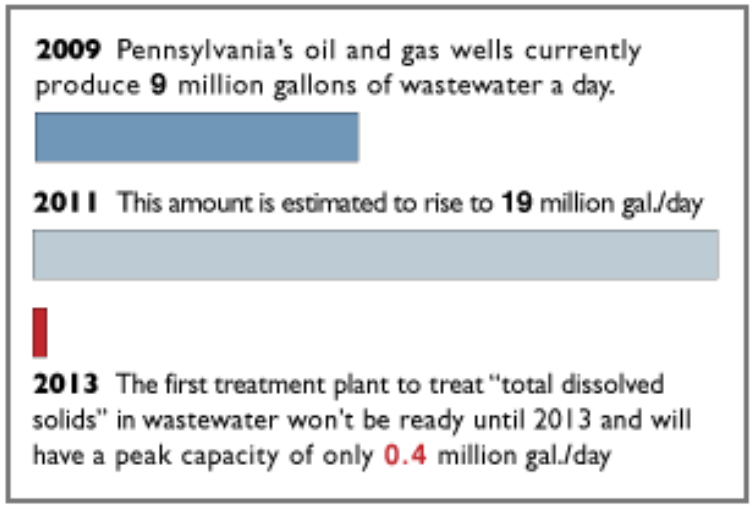
Courtesy of Dr. Tom Meyers Technical Draft Memo

- Guar gum, hydroxyethy cellulose
- Iron control
- citric acid
- Carrier fluid
- Potassium chloride (KCl)
- Oxygen scavenger
- ammonium bisulfite
- ph adjustment
- sodium or potassium carbonate (NaCO4 or KCO4)
- Proppant
- sand
- Scale inhibitor
- ethylene glycol
- Surfactant
- Isopropanol

profit newsroom that produces investigative journalism in the public interest. We strive to foster change through exposing exploitation of the weak by the strong and the failures of those with power to vindicate the trust placed in them.

More...

Workers at a steel mill and a power plant were the first to notice something strange about the Monongahela River last summer. The water that U.S. Steel and Allegheny Energy used to power their plants contained so much salty sediment that it was **corroding their machinery**. Nearby residents saw something odd, too. Dishwashers were malfunctioning, and plates were coming out with spots that couldn't easily be rinsed off.



Pennsylvania's Department of Environmental Protection soon **identified the likely cause** and came up with a quick fix. The Monongahela, a drinking water source for 350,000 people, had apparently been contaminated by chemically tainted wastewater

2009

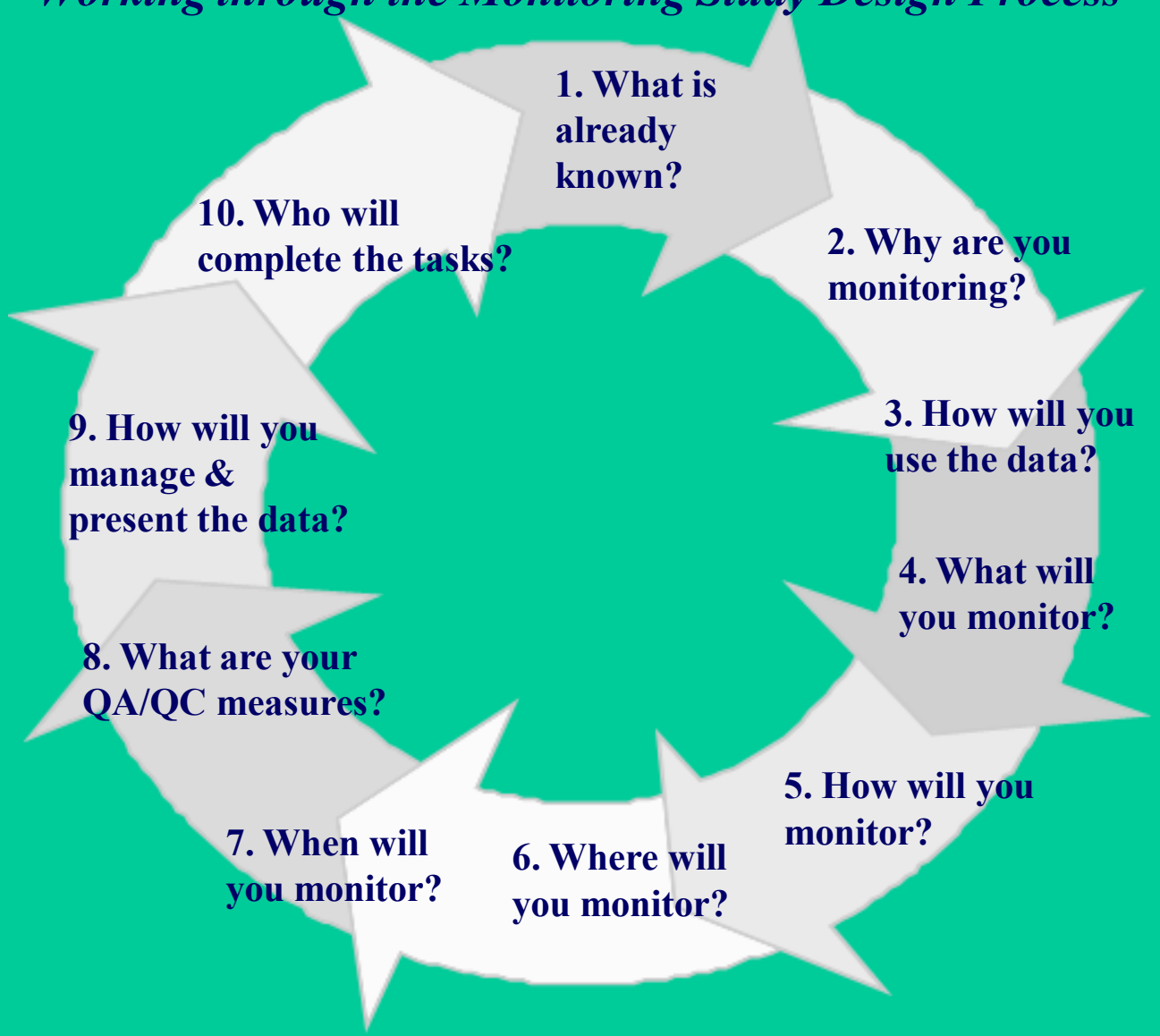
by Abra

2009

2009

The Lackawaxen River Watershed and Upper Delaware River…the source for 15 million people's drinking water

Working through the Monitoring Study Design Process



Riverkeeper Monitoring Goals

- Train citizen monitors to watch-dog the industry
- Collect baseline data in smaller trib streams to detect potential impacts and contamination to due to proposed natural gas development
- Use data to alert enforcement agencies, the press and the public of pollution problems from the industry
- Ensure documentation to indicate any decline of special protection watersheds where hydro-fracturing is planned – baseline important

Monitoring Parameters Selected

Primary Parameters

- Total Dissolved Solids (ppm)
- Salinity (ppt)
- Conductivity (µhoms/cm)
- Macroinvertebrates (partnership w/agencies)
- Chloride
- Temperature
- Sulfates

- Equinunk Creek, Summer 2009

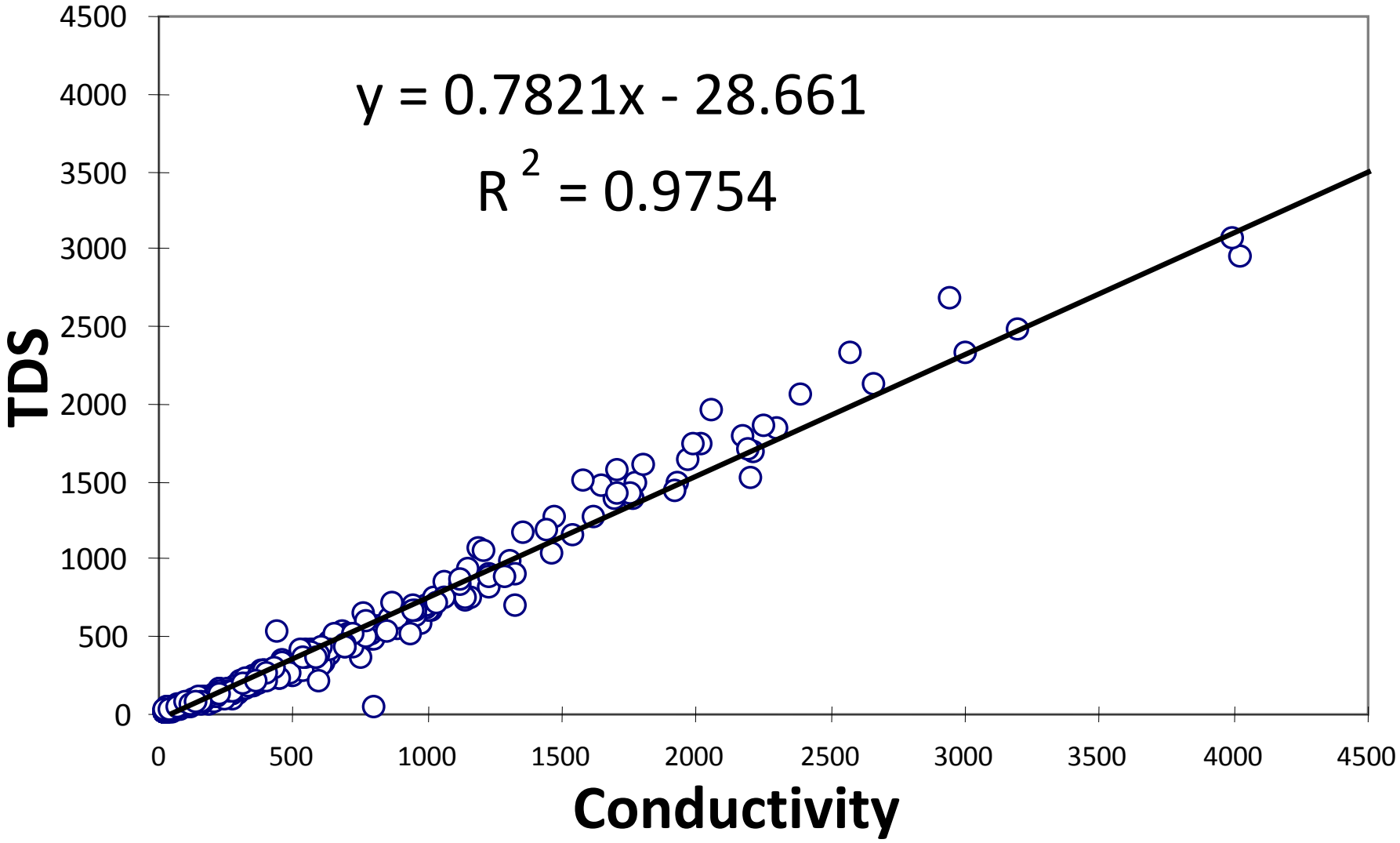
Conductivity and Total Dissolved Solids

There are a wide variety of inorganic substances or dissolved solids in water.

Common dissolved substances are sodium, chloride, sulfates, calcium, bicarbonate, nitrates, phosphates, iron, and magnesium.

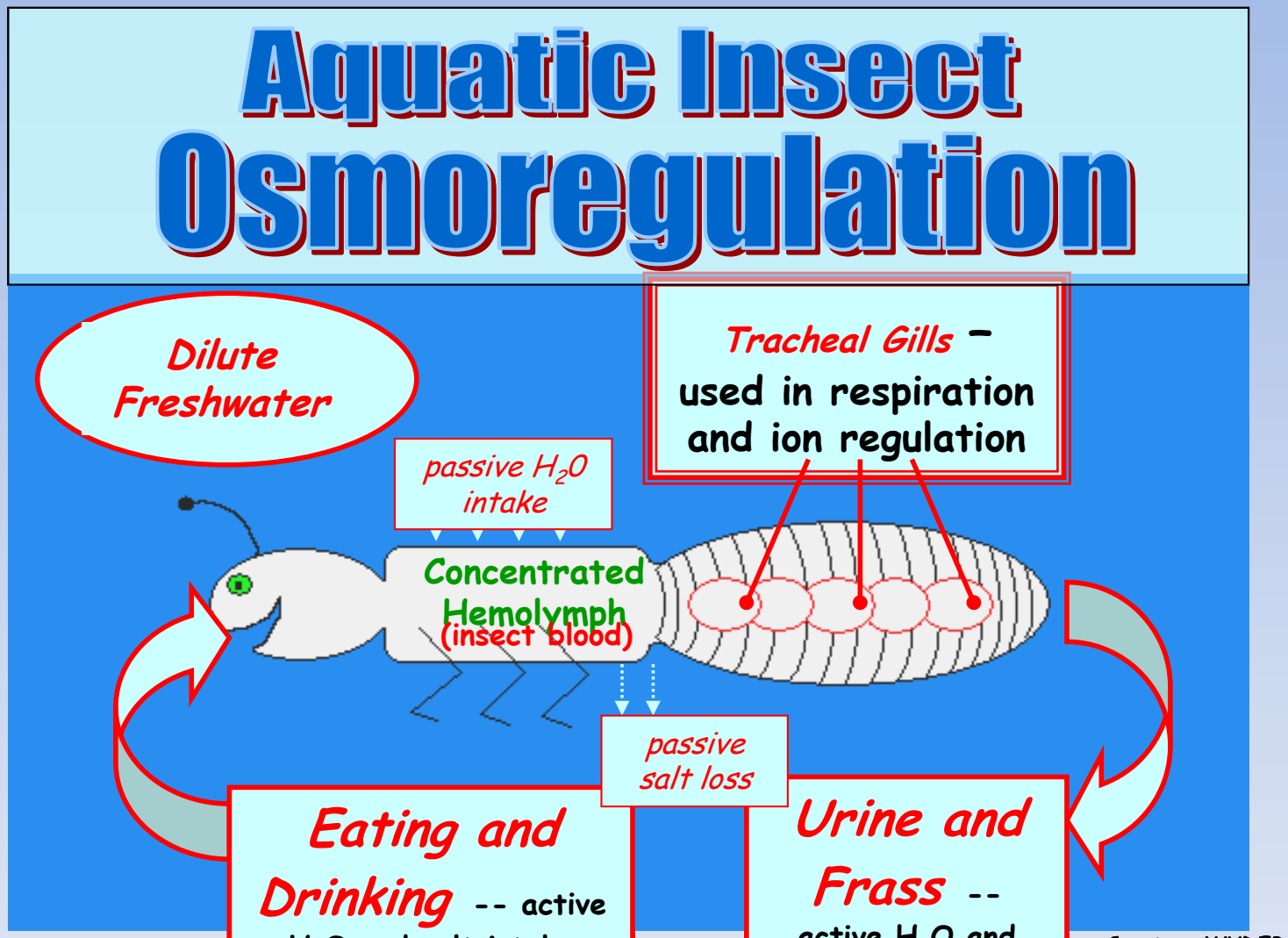
These inorganic ions can conduct an electric current (conductivity)

As TDS rises, so does conductivity

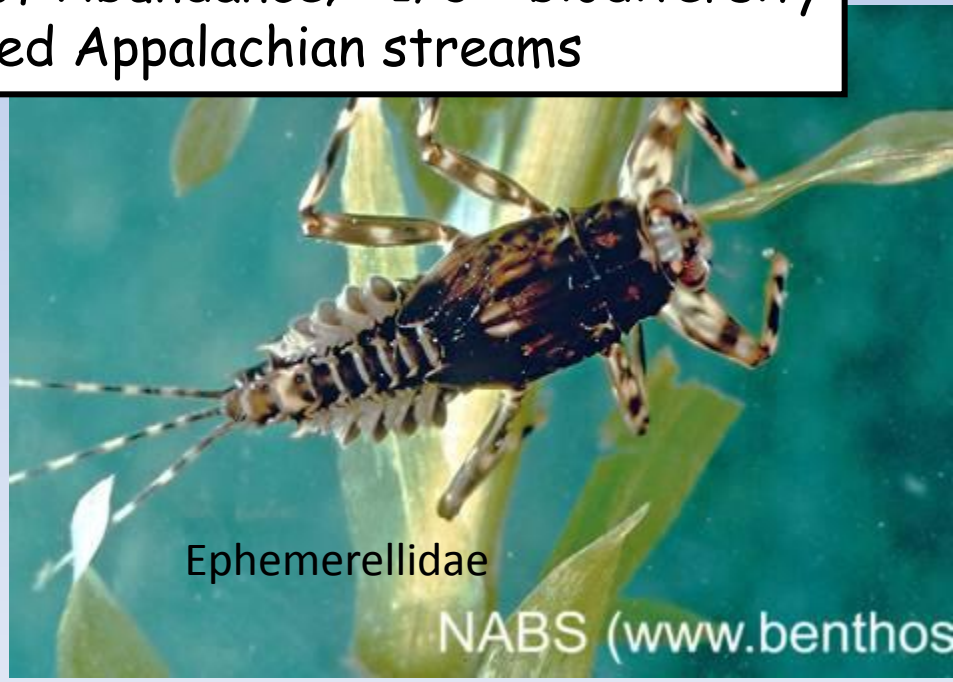


Compliments of EPA Region 3

Keeping the amount of water and dissolved solids in balance



Mayflies represent ~25-50% of Abundance; ~1/3rd biodiversity
In natural, undegraded Appalachian streams



Empirical Data are Compelling

Even in the absence of other stressors (pH, organic enrichment, habitat quality, metals) TDS/conductivity significantly explains impairment of aquatic life use (especially in mayflies)

Courtesy of EPA

Upper Delaware River

SPW Waters (2000-2004 dataset)

TDS readings (ppm)

- N= 1028 samples on main stem and 15 trib streams
- MINIMUM 10
- MAXIMUM 618
- MEDIAN 160
- AVERAGE 183
- DRBC dataset

Secondary drinking water standard – 500 ppm

- The McKeesport Sewage Treatment Plant, one of nine plants on the Monongahela River that has treated wastewater from Marcellus Shale drilling operations. (Joaquin Sapien/ProPublica)

Compliments of ProPublica

- Drilling wastewater contains so much TDS that it can be five times as salty [8] as sea water. (sea water ~ 30,000 – 40,000 ppm TDS)
- 2013 – projected completion of first plant -- And at its peak that plant would be able to treat only 400,000 gallons of wastewater a day [14]. The DEP would need 50 plants that size to process all the wastewater expected by 2011.

How will we monitor?

Lamotte TRACER (1749)

$85.00

Conductivity, TDS, salinity, temperature

Waterproof and replaceable probes

TDS RANGE – 0-9,990 ppm
SALINITY RANGE – 0-9,990 ppm
CONDUCTIVITY RANGE - 0-1999µs

Accuracy - +/- 2%

Chloride test kits

HACH kits – Model 8-P Cat No. 1440-01 – 100 tests at $41.69

Lamotte kits – Code 4503 – 50 tests at $41.90 (24.00 refill)

Lab cost: $10/sample

Kit Range – 0-20,000 ppm chloride

CHLORIDE TEST KIT
Model 8-P
Cat. No. 1440-01

HACH

High Range, 0-400 mg/L Chloride

1. Fill the plastic measuring tube level full with the water that is to be tested. Pour it into the mixing bottle.
2. Add the contents of one Chloride 2 Indicator Powder Pillow. Swirl to mix as shown in *Figure 1.*
3. Add the Silver Nitrate Titrant drop by drop to the water in the mixing bottle. Hold the dropper in a vertical position and swirl the bottle to mix after each drop is added. Count each drop as it is added until the water changes from yellow to orange in color. (An orange - red rust color indicates the end point has been

Macroinvertebrate Sampling

- Modified Rapid bioassessment protocol (RBPII)
- PA DEP Method
- Volunteers collect – agencies help analyze
- Special attention to mayfly metrics

Secondary Parameters…if suspect readings of TDS occur and baseline

- ALLARM recommends barium, strontium, and total alpha (an indicator of the presence of radioactive materials) as robust signature chemicals.
- Oil & Grease (SM1664 AGM) - $50/sample
- Iron, manganese - $15/sample
- Detergents - $25/sample
- Benzene & Toluene ($200/sample)
- Assistance from Wilkes University

Electronic meters…automatic data loggers—potential future option?

pH, dissolved oxygen, temperature, and conductivity

Screw on DO caps for easy changing

$1,475.00

YSI 85, YSI 650

REMOTE WATER QUALITY MONITORING NETWORK

Susquehanna River Basin Commission

Project Description
The Susquehanna River Basin Commission (SRBC) initiated the establishment of the Remote Water Quality Monitoring Network (RWQMN) in January, 2010, in the Pennsylvania and New York portions of the Susquehanna basin. SRBC plans to have Phase 1 of the network, which will consist of thirty (30) stations, completed by June 2010. The stations will continuously monitor and record the following water quality parameters:

- Temperature
- pH
- Conductance
- Dissolved oxygen concentration
- Dissolved oxygen saturation
- Turbidity

These data will enable water resource agencies, water users, and the public to make informed decisions regarding management and use of the resource.

For more information, visit the SRBC web page:
http://www.srbc.net/programs/remotenetwork.htm.

Meshoppen Creek
near Kaiserville, PA
at 03/12/10 2:00PM

Temp	**2.15**	C
Sp Cond	**0.101**	mS/cm
pH	**7.19**	
Turb+	**71.00**	NTU+
ODOSat	**101.4**	%
ODO	**13.96**	mg/L

ALL DATA | Powered by NexSens Technology

Limitation & Data Disclaimer
* Please note, ice conditions may disrupt data feed and/or alter parameter readings. *

Uncertainty and potential for error can be associated with environmental monitoring data. Data users are cautioned to consider carefully the provisional nature of the information before using it for decisions that concern personal or public safety or the conduct of business that involves substantial monetary or operational consequences.

No warranty, express or implied, is given as to the accuracy, reliability, utility or completeness of the data hosted on this datacenter, and this

Web Interface for Real-Time Data | NexSens WQData v4.01.20 - Windows Internet Explorer

http://v4.wqdata.com/webdblink/srbcremote.php?tab=map&t=classic_lake_user

Google

Web Interface for Real-Time Data | Ne...

Page Tools

REMOTE WATER QUALITY MONITORING NETWORK

Susquehanna River Basin Commission

OVERVIEW | MAP | DATA | GRAPH | STATS | PANEL | GO LIVE | FORUM

- Meshoppen Creek near Kaiserville, PA
- Choconut Creek near Vestal Center, NY
- Hammond Creek near Millerton, PA
- Tomjack Creek near Burlington, PA
- Trout Run near Shawville, PA
- Sugar Creek near Troy, PA

SELECT ALL | GO

DAY

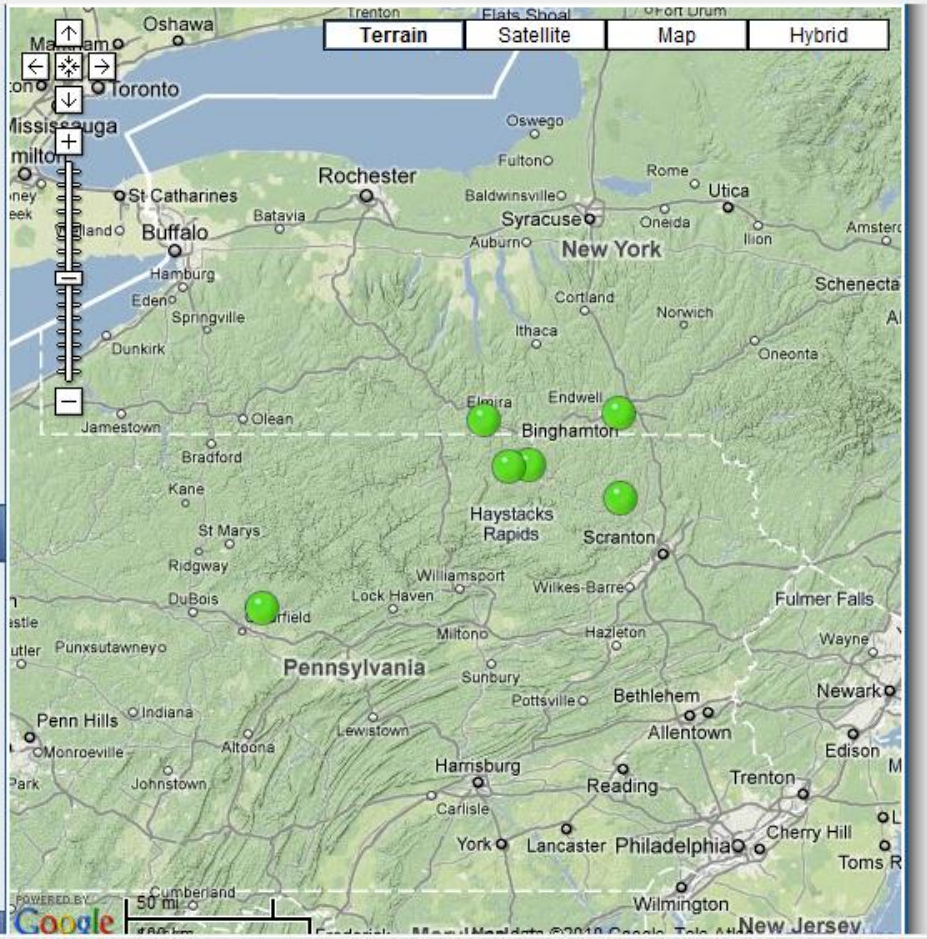
WEEK

MONTH

YEAR

03/05/2010

03/12/2010



Start | Marcellus Shale... | 2 Microsoft O... | Shallenberger_S... | 2 Internet Ex... | 2 Mozilla Thu... | 5:31 PM

Sampling Locations

- Smaller headwater tributaries a focus
- Upstream and downstream of proposed drilling sites
- Near mouth of small tributary streams

Step 6: Where will you monitor?

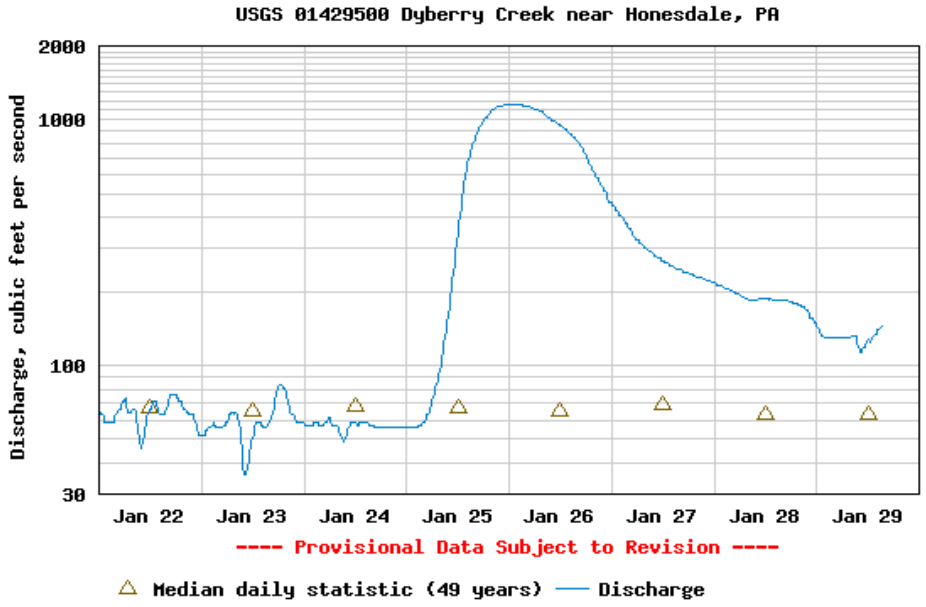
Consider safety & accessibility, potential water quality impacts, reference locations, stream designated uses.

USGS 01428750 West Branch Lackawaxen River near Aldenville, PA

PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site Time-series: Real-time data GO

STATION.--01428750 WEST BRANCH LACKAWAXEN RIVER NEAR ALDENVILLE, PA
LOCATION.--Lat 41`40'28", long 75`22'35", Wayne County, Hydrologic Unit 02040104, on right bank at steel bridge on State Highway 247, 0.3 mi downstream from Johnson Creek, and 2.0 mi northwest of Aldenville.
DRAINAGE AREA.--40.6 mi2.
PERIOD OF RECORD.--



Create presentation-quality / stand-alone graph

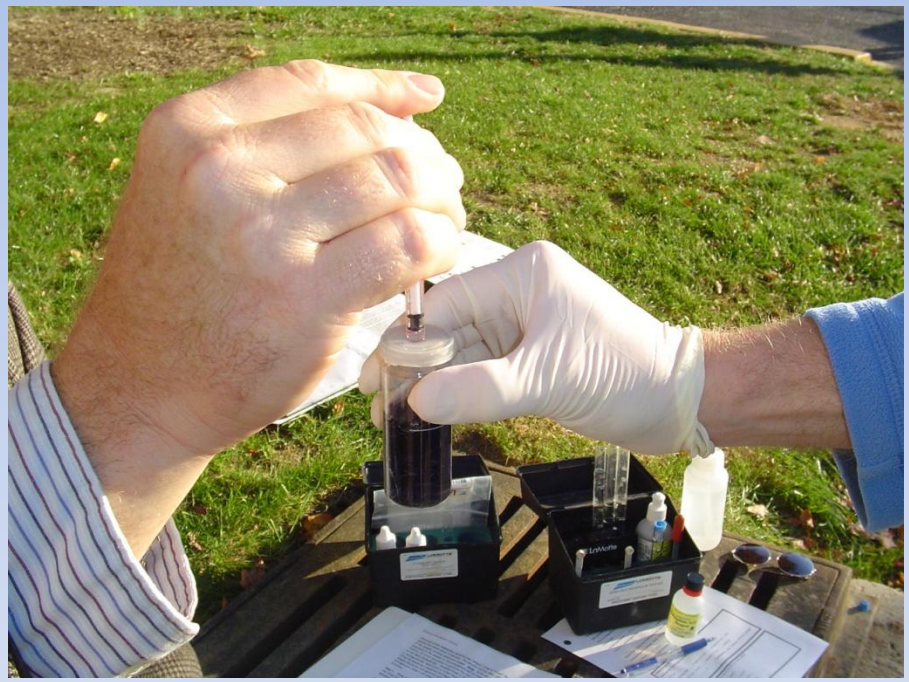
parm 00060 DD01

Daily discharge statistics, in cfs, for Jan 29 based on 49 years of record more

Min	20th percen-			Most Recent Instantaneous	80th percen-	Max

Sampling Frequency

- At least 2 times per month or once a month (weekly when operations begin)
- Supplemented with quarterly lab analysis or lab analysis if primary readings suspect
- Macro sampling – once per year (in coop. with agencies)



When will we monitor?

- During times of low flow main focus
- Periodic storm flow
- Record precip. and flow conditions on datasheets and include gage information to document flow

QA/QC

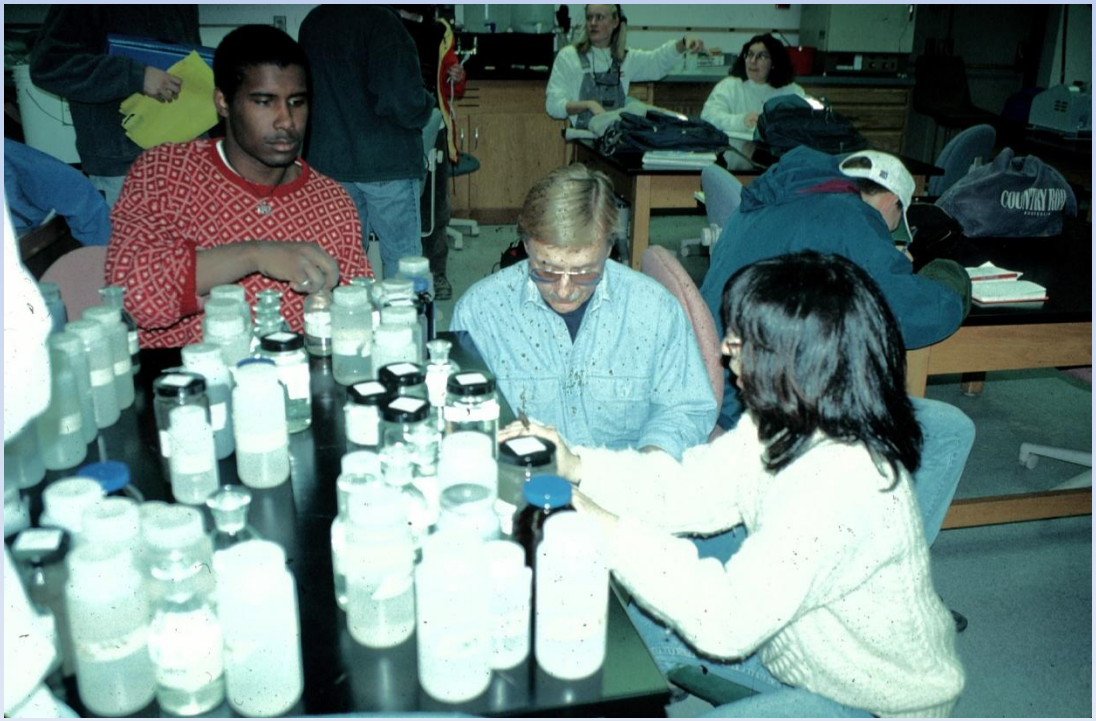
- Quality Assurance: set of operating procedures that documents how your project will ensure that the data collected meets your projects requirements
- Quality Control: the system of technical activities whose purpose is error control

QA/QC Strengthens Data

- Ensures that your results are accurate
- Ensures data users of a known data quality
- Allows for different data users to use data

Basic Concepts

- Internal checks: samples checked by the program
- External checks: samples checked outside your program



DRN's QA/QC Measures

- Initial training of volunteer monitors
- Periodic QA/QC Refresher Trainings
- Standardized Protocols
- Standardized Datasheets
- Datasheet Review by Monitoring Coordinator
- Data Entry Review for Errors (some built in to excel)
- Standardized Excel Database
- Supplemental lab analysis
- Replicates performed
- Kit Care and Maintenance Instructions
- Updated reagents

First Natural Gas Monitoring in the State by Volunteers

- January 30th 2010 Training of 25 volunteer monitors
- ~30 stations established for baseline monitoring
- May 2010 – Stone Energy on docket
- Macro sampling this spring (~10 locations)

Industry does not own our water…15 million people rely on the Delaware River for drinking water..stay tuned for Tracy's Presentation coming up….write letters!!! Sign up for e-activist at www.delawareriverkeeper.org

To get Involved:

Faith Zerbe

faith@delawareriverkeeper.org

215-369-1188 ext 110

Tracy Carluccio,

tracy@delawareriverkeeper.org

215-369-1188 ext 104