MonRiver QUEST

Monongahela Basin Water Quality Monitoring

USGS science for a changing world

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Monongahela River QUEST: A Collaborative Approach to Monitoring Water Quality in the Monongahela River Basin

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Monongahela River Basin

Originating in north-central West Virginia, the Mon flows northward through south-western Pennsylvania to Pittsburgh where it meets the Allegheny River to form the Ohio River. It is 206 kilometers (128 miles) long, has a drainage basin of 2,970 hectares (7,340 sq. miles) and supplies over 1 million people with drinking water.

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Key Water Issue: Dissolved Solids

Total Dissolved Solids, or TDS, is a general indicator of overall water quality. It is a measure of inorganic and organic materials dissolved in water. Increased TDS may impart a bad odor or taste to drinking water. It also affects residential and industrial users by causing a scaling of pipes and corrosion.

Dissolved Solids of Concern

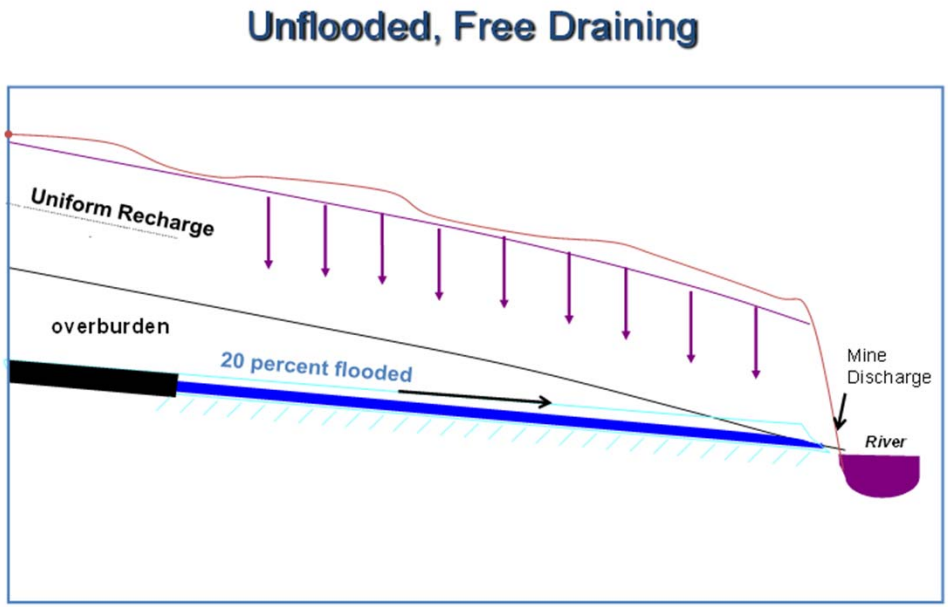
Sulfates (SO4)
Chlorides (Cl)
Sodium (Na)
Magnesium (Mg)
Calcium (Ca)
Bromide (Br)

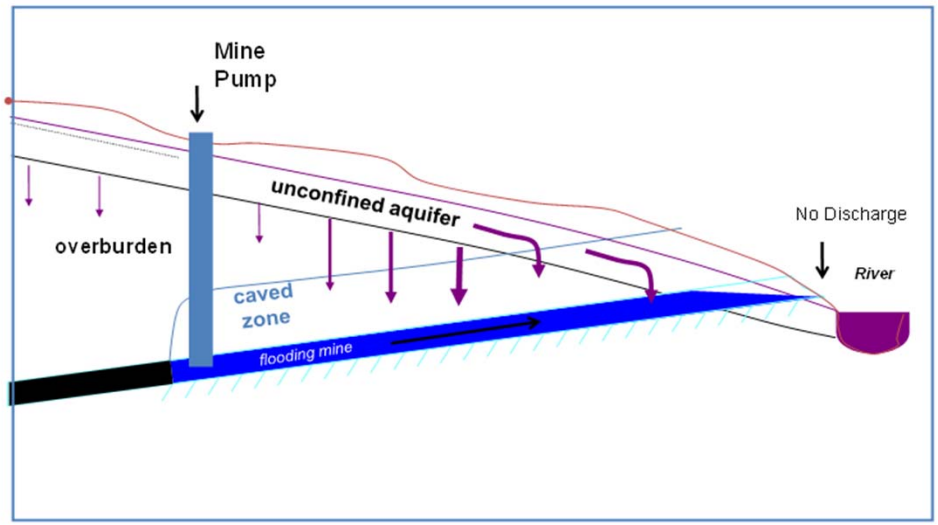
Primary Sources of Dissolved Solids

- Coal Mine Drainage:
  - Abandoned mines
  - Active mines' - treated effluent
- Brine: Gas development
  - Marcellus returned frac water (RFW)
  - Produced water

Coal Mine Drainage

Different
Hydro-geologic settings





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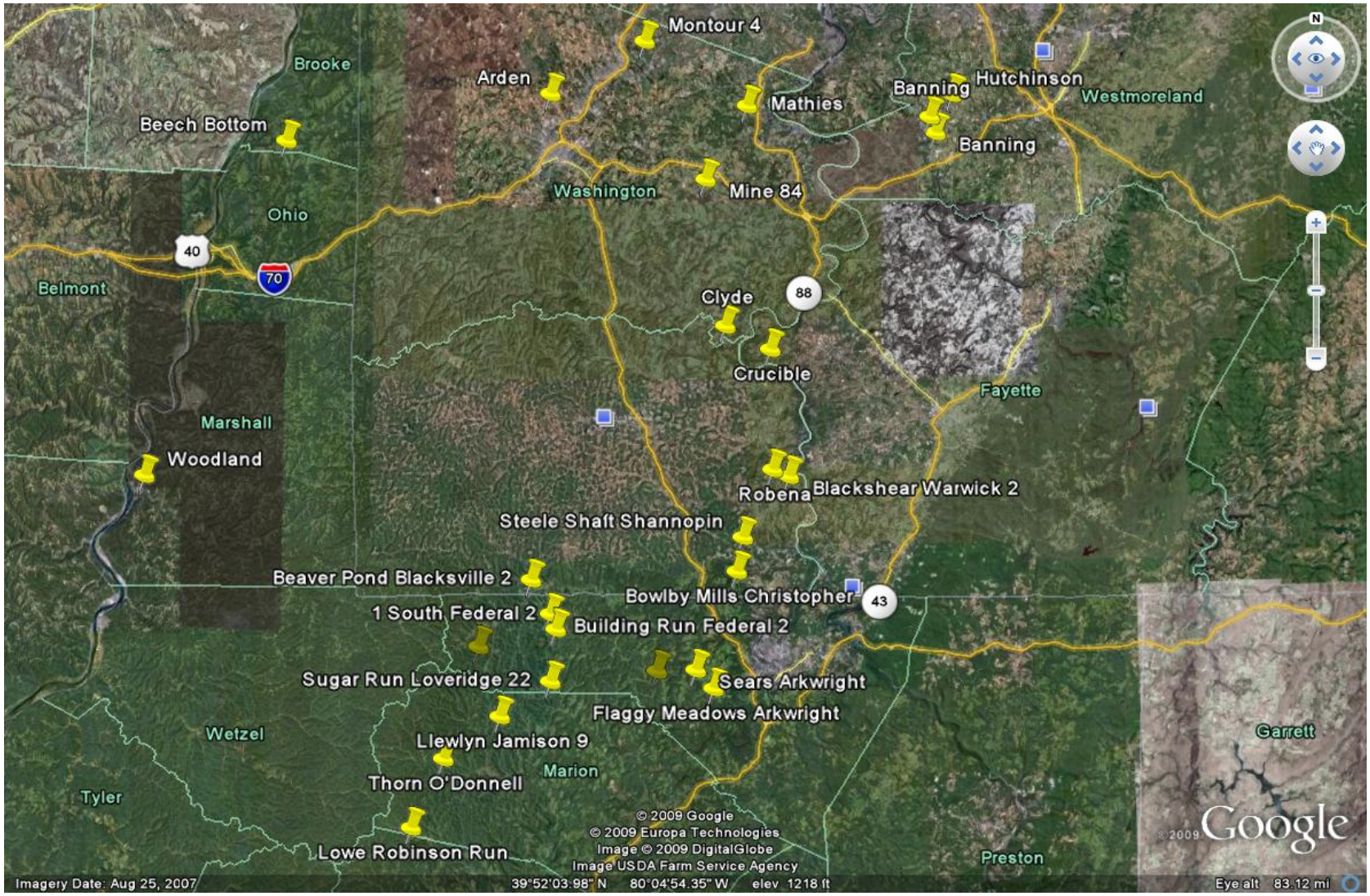
Abandoned Underground Mine Portal

Coal Mine Drainage:

Abandoned mines

Coal Mine Drainage:

Active mines-Major Mine Drainage treatment Plants



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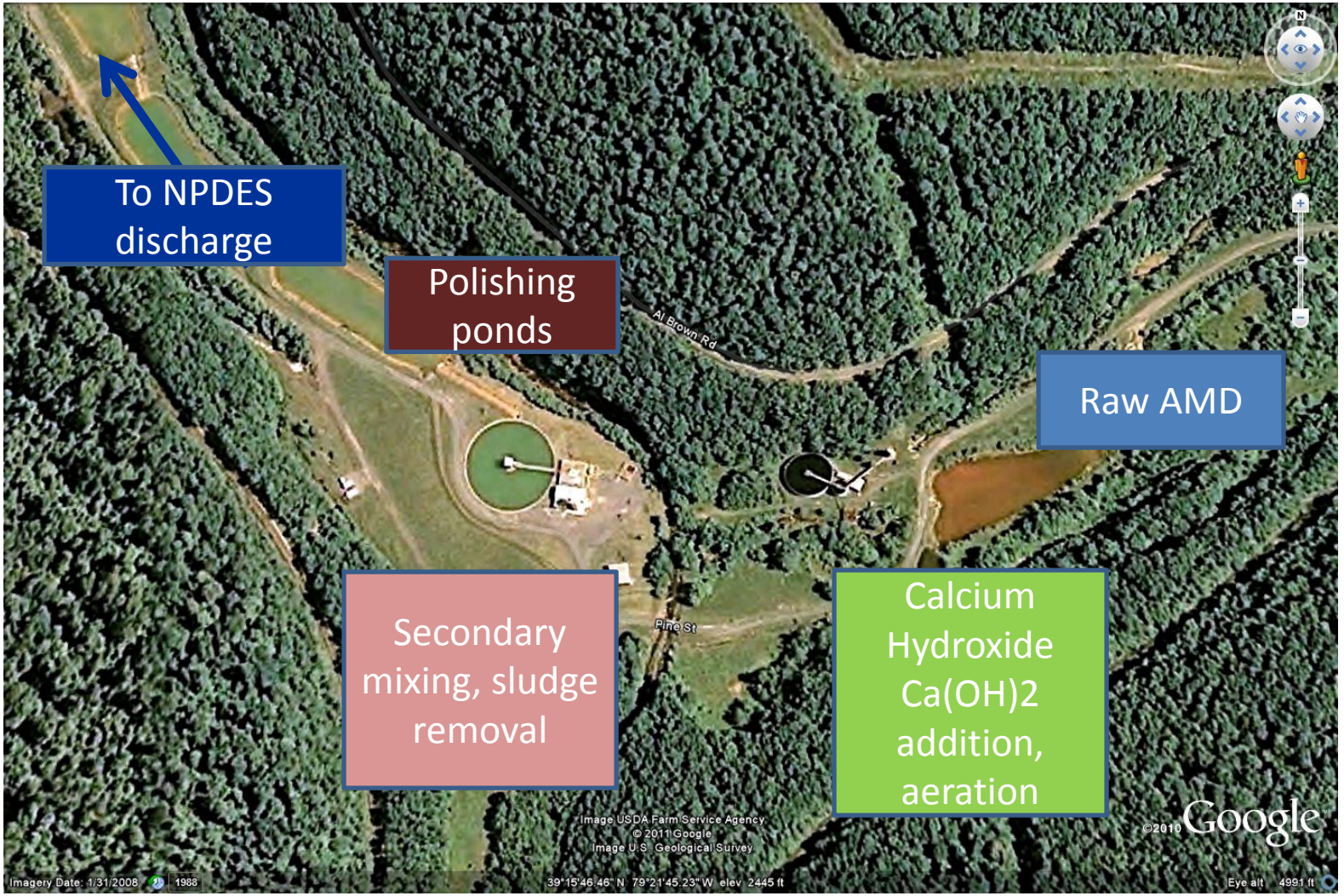
Typical, large AMD treatment plant



Gas Well Drilling
and
Hydraulic Fracturing

The recent boom in gas exploration and extraction, using the water intensive (4-6 million gallons/well) *hydraulic fracturing* method, from the Marcellus and Utica Shales within the Basin, generates highly concentrated brines which put additional stress on an already strained ecosystem.

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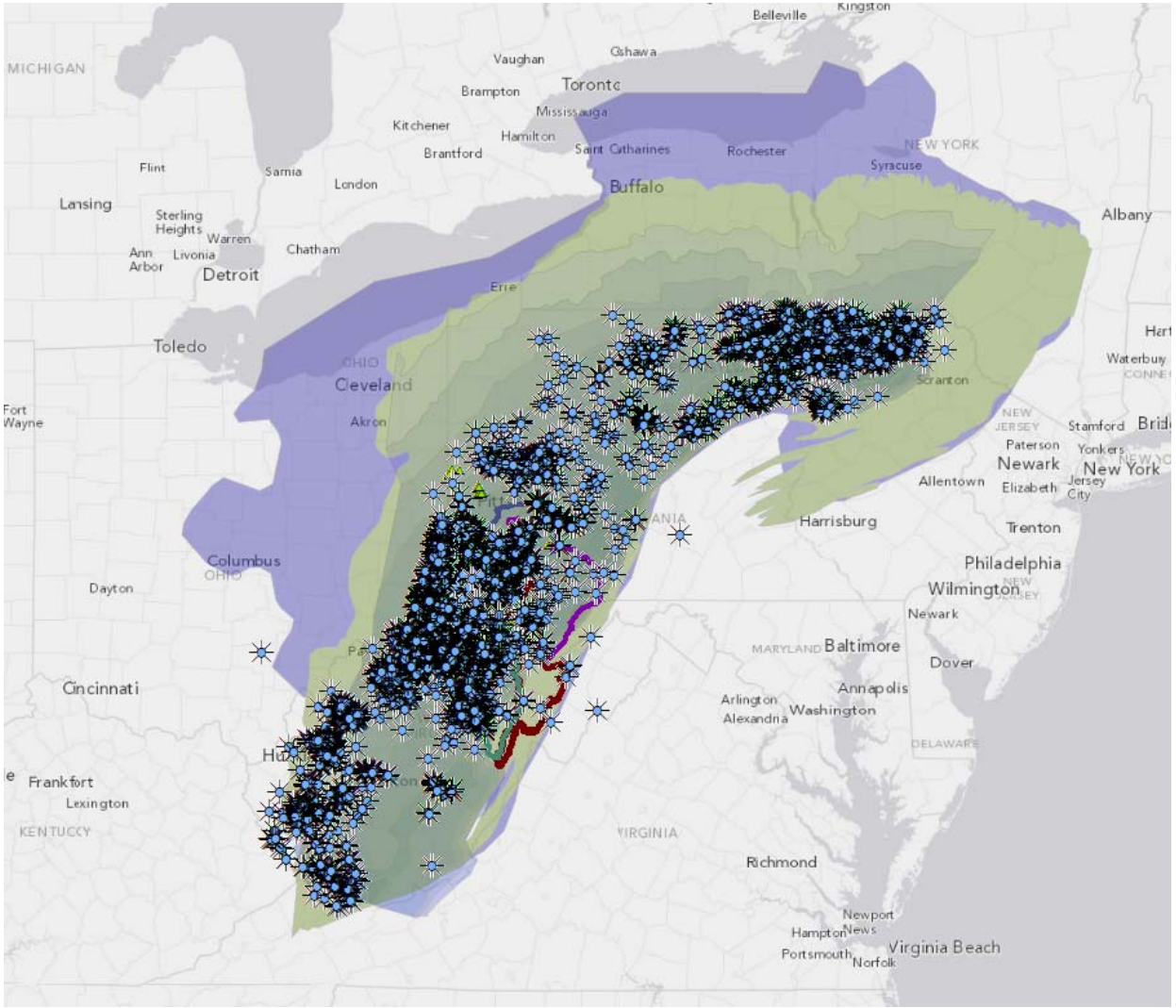
Map of Marcellus and Utica Shales



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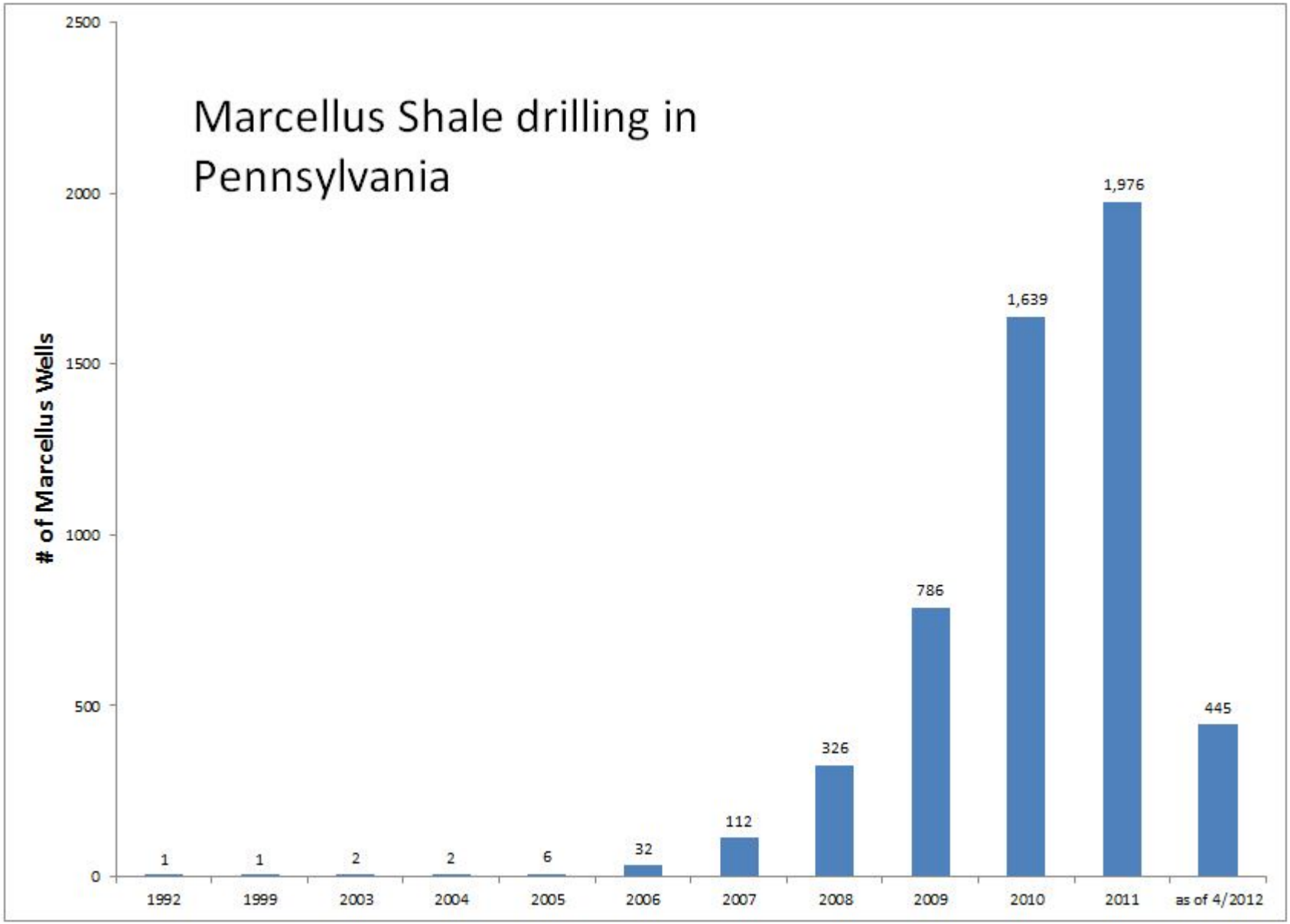

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Number of WV active wells by inspector

Inspector	Number of active wells
Ed Gainer	7047
Bryan Harris	6597
Dave Cowan	5265
Ralph Triplett	5189
Joe McCourt	4772
Dave Scrange	4678
Tristan Jenkins	4576
Barry Stollings	4462
Terry Urban	4207
Gary Kennedy	3074
Bill Hatfield	3026
Jamie Stevens	2947
Joe Taylor	2490
Bill Hendershot	422

from: http://apps.dep.wv.gov/oog/wellsearch_new.cfm 02/13/2011

Returned frac water

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Salt concentrations increase as flow decreases

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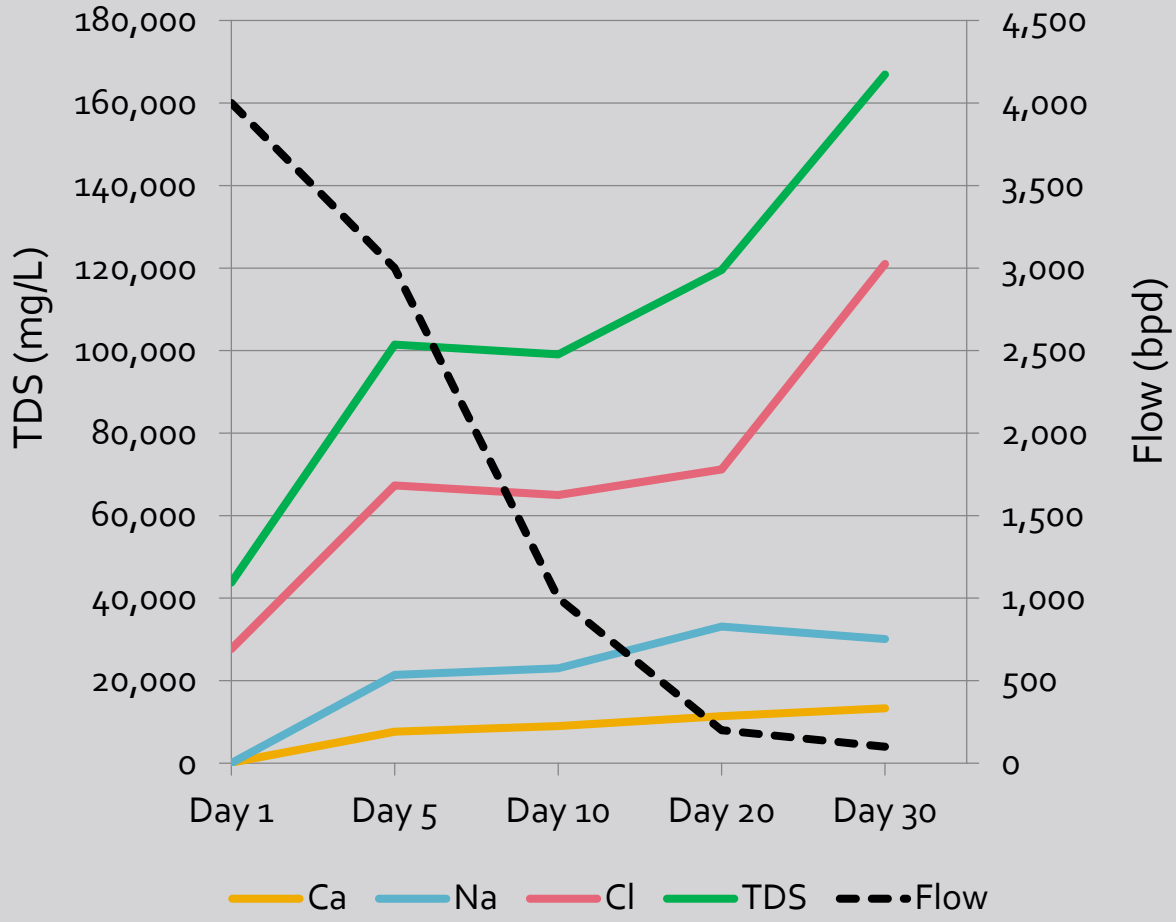
The flow back from an horizontal Marcellus well greatest initially (~ 5,000 barrels per day or 150 gpm)

It slows to about 500 bpd after the first couple of weeks.

The initial flow back reflects injected water more while later flow back is more influenced by salts in the formation.



Treatment options

- Underground injection
- Pre-treat then send to sewage treatment plant
- Evaporation/crystallization
- Recycle
- Illegal disposal

Background: why manage TDS?

High TDS events in late summer/early fall 2008

- lead to a shut down of some municipal water intakes when the river exceeded the US EPA's secondary drinking water standards of 500 parts per million (or mg/L) of TDS
- complaints from industrial and residential river users
- Dunkard Creek fish kill September 2009
- Evidence that TDS was increasing

WVWRI initiates monitoring program in July 2009

- "If you can't measure it you can't manage it."
- It was not possible to answer the key questions:
  - Source
  - Chemistry
  - Management potential
- Needed to generate a load model for major ions
- Management options to follow
- Gather baseline data in anticipation of the newly exploited shale gas

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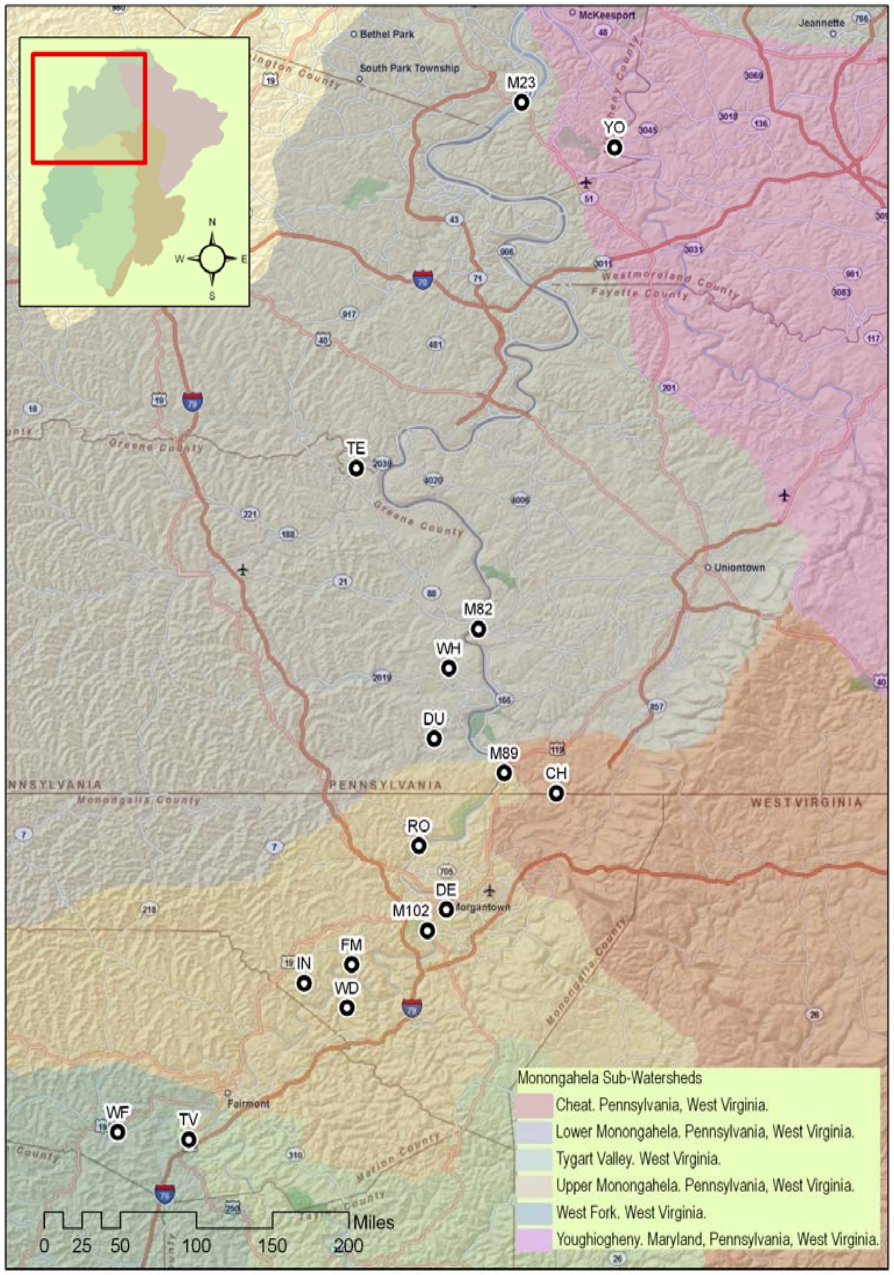
West Virginia Water Research Institute's monitoring network

16 stations

Measuring 18 different water quality parameters in lab-analyzed samples including; pH, Acidity, Alkalinity, Conductivity, ORP, Temperature, TDS, TSS, Al, Br, Ca, Cl, Fe, Mg, Mn, Na, SO4-2, and S.

Samples every two weeks since July 2009

Monitoring at 16 stations including 4 stations on the Mainstem and at the mouths of 12 of the largest tributaries.



Colcom Foundation

- July 2011, WVWRI received a Colcom Foundation grant to expand the Mon River Study to include a volunteer based approach to collect, monitor and disseminate water quality data.

- Through the grant, WVWRI provides assistance to volunteers and volunteer-based organizations that need training, equipment, and/or guidance in their water quality monitoring efforts. The grant also provides an internet-based GIS platform to display the volunteer collected data to the public.

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Goals of the Mon River QUEST

Develop a volunteer water quality monitoring network in the Mon River Basin	• Establish relationships with existing Watershed Groups. • Provide opportunities for individual volunteers to engage in data collection.
Provide volunteer driven baseline and monitoring of TDS (measured as specific conductivity) of tributaries in the Mon River Basin	• Provide training opportunities and monitoring equipment for volunteers/groups. • Assist groups with data collection, management and transfer.
Display volunteer collected data on website for public viewing.	• Incorporate existing data from established monitoring programs. • Display data in a user friendly manner on project website, www.monriverquest.com

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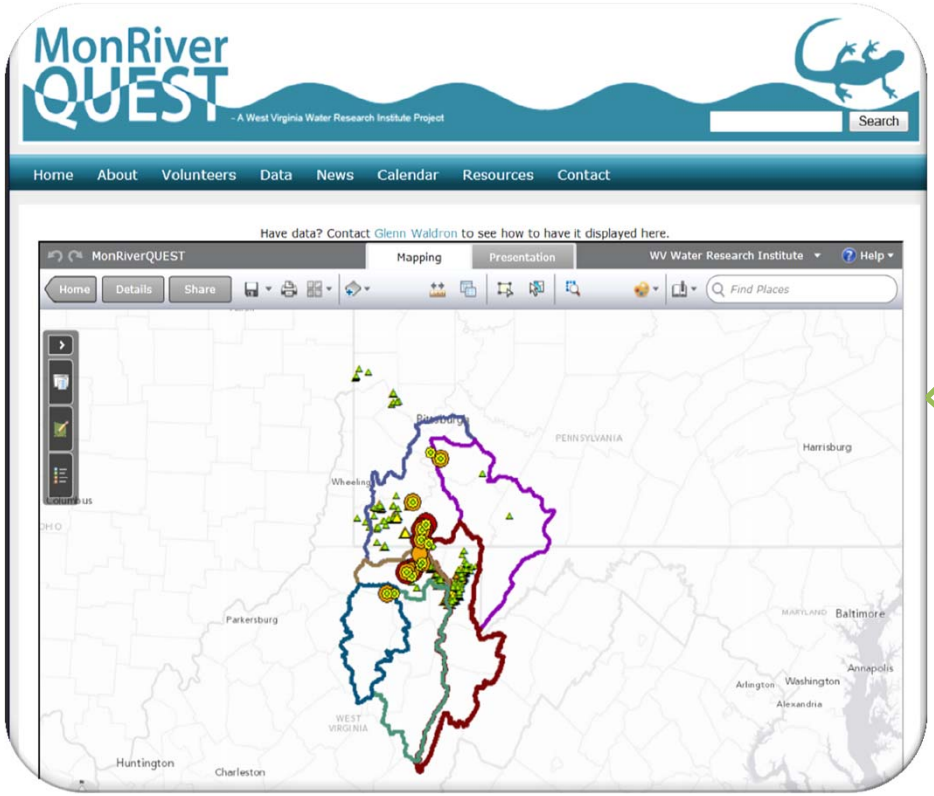
Overview of the Mon River QUEST



WRI Data

QUEST Volunteers

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A Collaborative Approach

Numerous volunteer based watershed organizations contribute to data collection including:

- Friends of the Cheat (WV)
- Friends of Decker's Creek (WV)
- Whiteday Creek Watershed Association (WV)
- Guardians of the West Fork (WV)
- Greene County Watershed Alliance (PA)
- Jacobs Creek Watershed Association (PA)
- Izaak Walton League of America (Washington Co PA)
- Trout Unlimited (PA)
- Youghiogheny River Watershed Association (MD)

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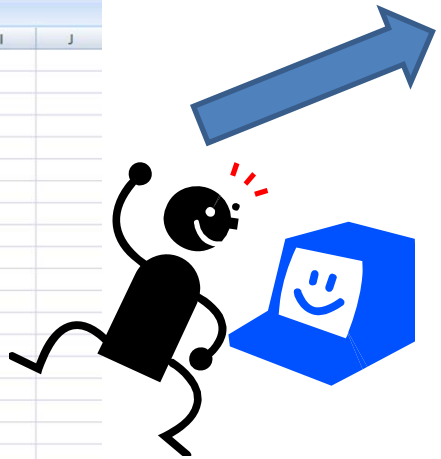
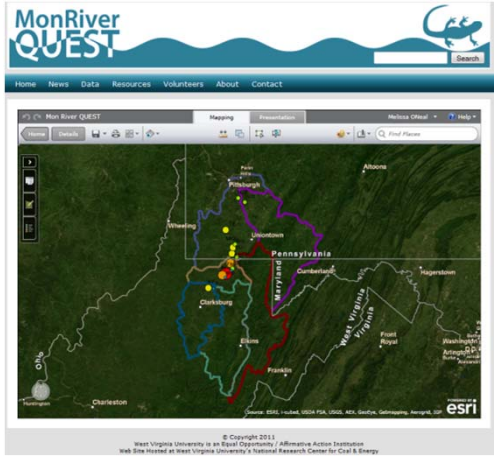
Data Transfer

SampleExcelLayout

	A	B	C	D	E	F	G	H	I	J
1	lat	long	Site_num	Site_nam	Description	Date	Temp	EC_field	ph	
2	39.449	-80.244	1	WF	West Fork River	12-May-11				
3	39.444	-80.181	2	TV	Tygart Valley River	12-May-11				
4	39.569	-80.079	3	IN	Indian Creek	12-May-11				
5	39.549	-80.042	4	WD	Whiteday Creek	12-May-11				
6	39.584	-80.038	5	FM	Flaggy Meadow Run	12-May-11				
7	39.611	-79.971	6	M102	Monongahela R. mile 102	12-May-11				
8	39.628	-79.954	7	DE	Decker's Creek	12-May-11				
9	39.679	-79.979	8	RO	Robinson Run	12-May-11				
10	39.737	-79.904	9	M89	Monongahela R. mile 89	12-May-11				
11	39.721	-79.858	10	CH	Cheat River	12-May-11				
12	39.765	-79.965	11	DU	Dunkard Creek	12-May-11				
13	39.821	-79.952	12	WH	Whitley Creek	12-May-11				
14	39.852	-79.926	13	M82	Monongahela R. mile 82	12-May-11				
15	39.981	-80.034	14	TE	Tenmile Creek	12-May-11				
16	40.273	-79.888	15	M23	Monongahela R. mile 23	12-May-11				
17	40.237	-79.807	16	YO	Youghiogheny River	12-May-11				
18										
19										





expand all | collapse all

* required field

Water Sample Form hide

Water Sample Form

* Group	Admin
Water Temperature (C)	
Conductivity (µS)	
pH	
* Site	
* Sample Date (MM/DD/YYYY)	
* Time of Sample	1 : 00 AM
	add

Samples

Water Temperature	Conductivity	pH	Site	Sample Date	Time	Actions

save | cancel

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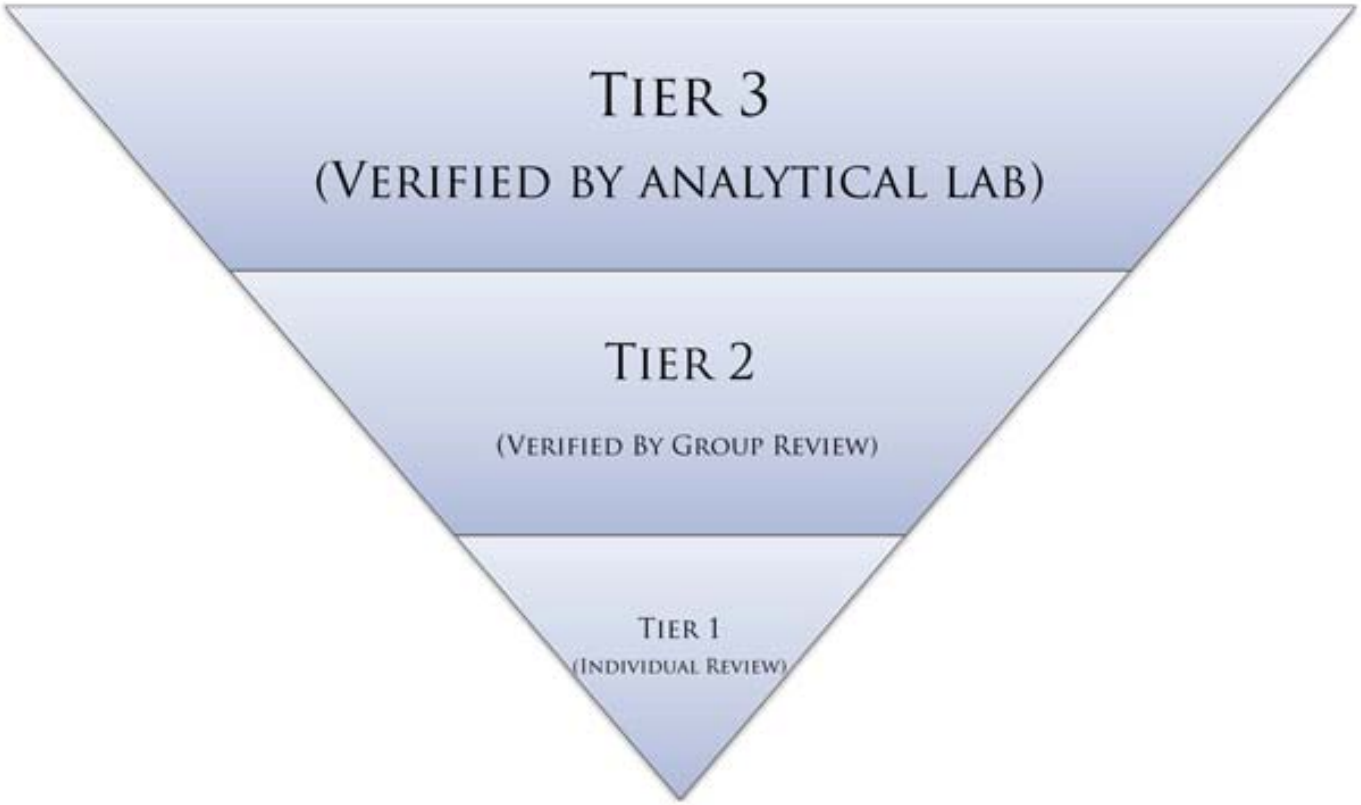
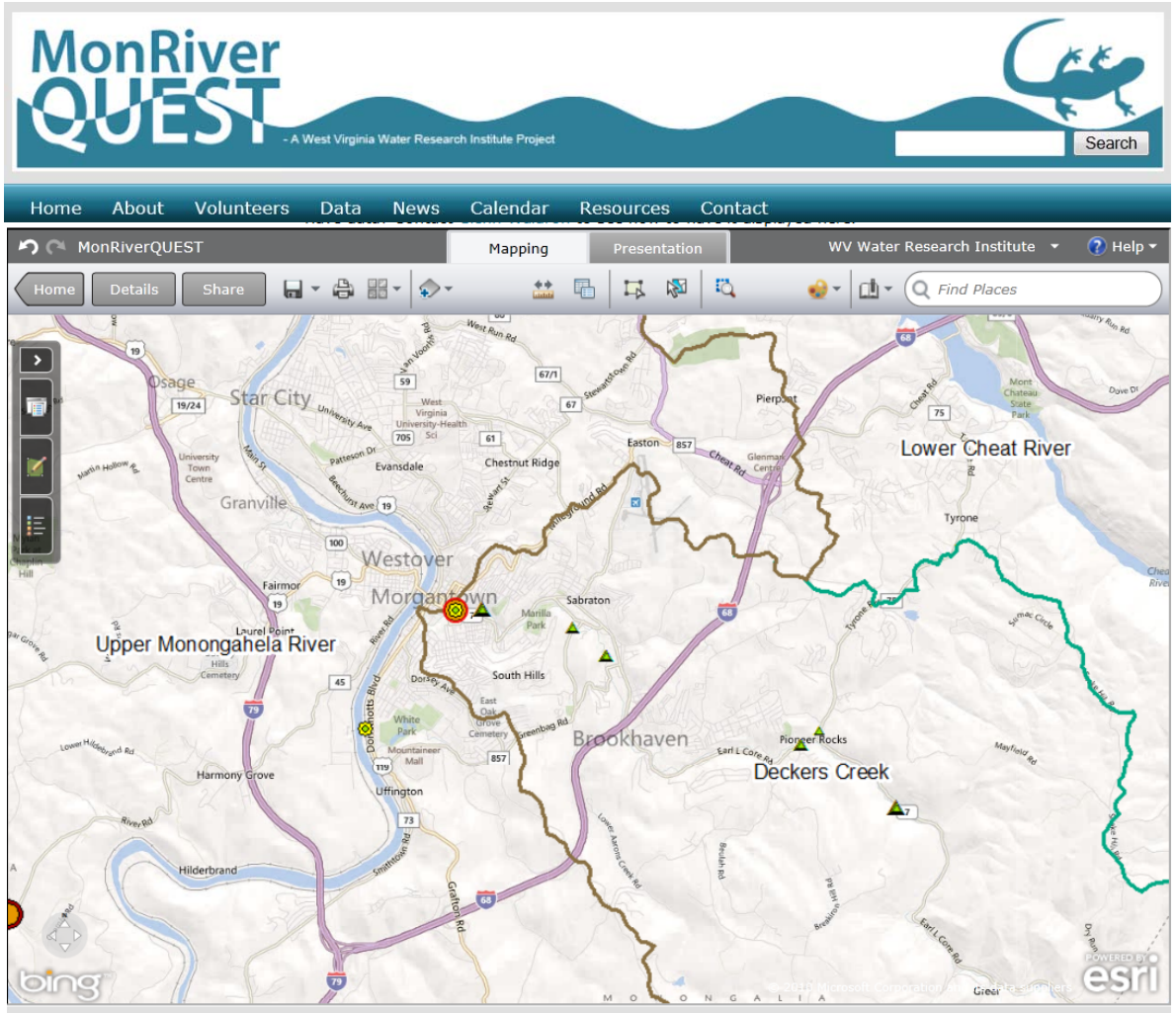
Data Confidence



Data displayed on the website is categorized according to the listed Tiers. Quality Assurance/Quality Control Plans adopted by watershed groups vary throughout the Mon River Basin. The Tier structure was developed to provide some consistency among the various QA/QC plans.

Data Dissemination
MonRiverQUEST.com

- User-friendly website utilizes programming from ESRI's ArcGIS Explorer mapping software, allowing users to visualize the water quality of the MRB at given locations or times.
- Mon River Study – In-depth look at the Total Dissolved Solids (TDS) along the Mon River
- QUEST Project – Data provides much needed information on the health (in terms of conductivity) of the headwaters and smaller tributaries in the MRB.



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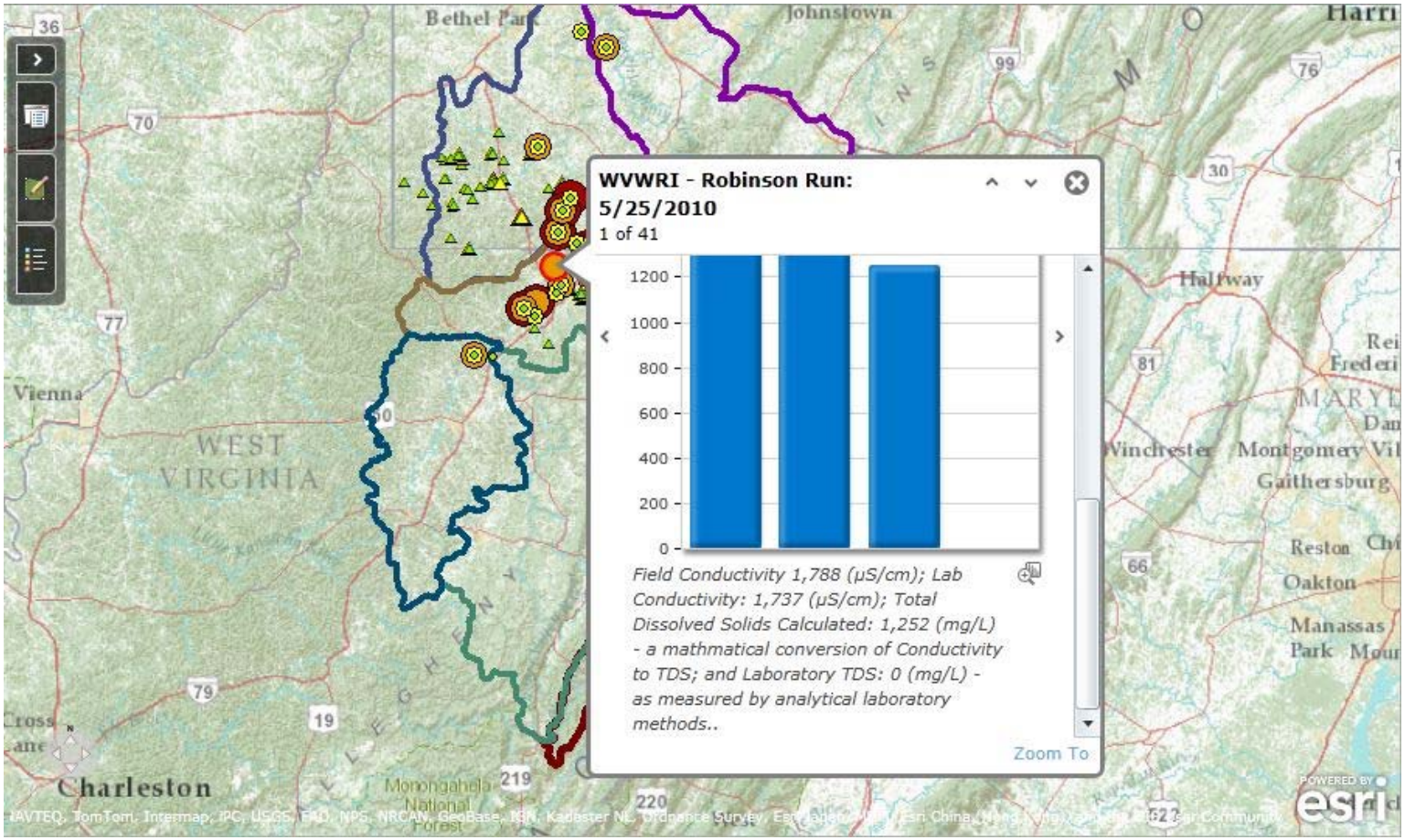
Data Visualization



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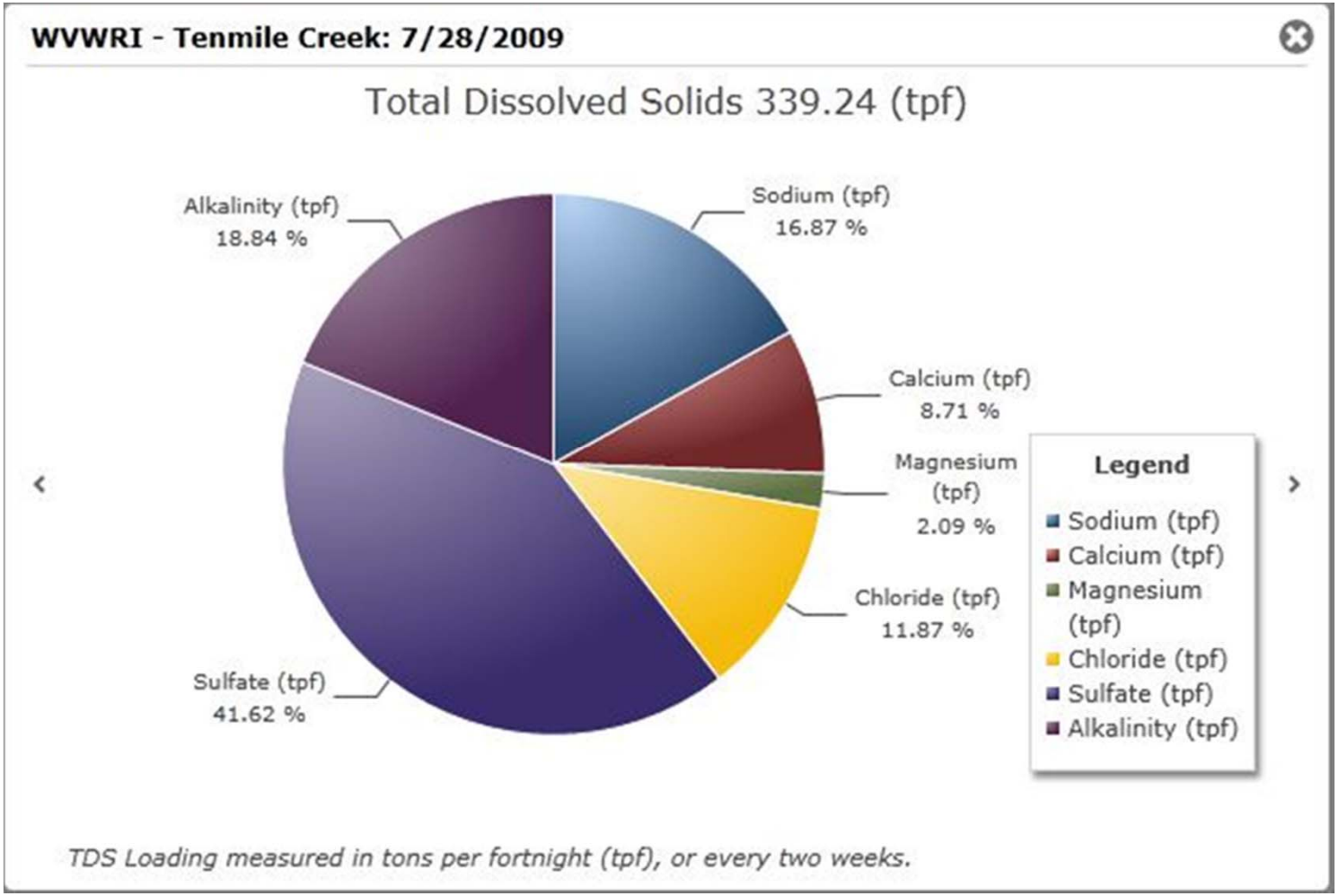

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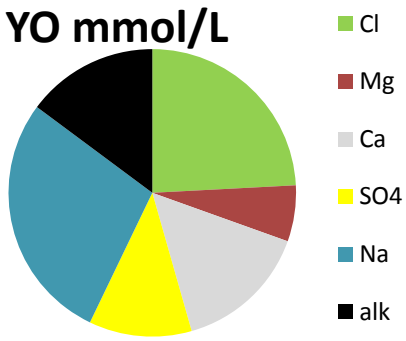
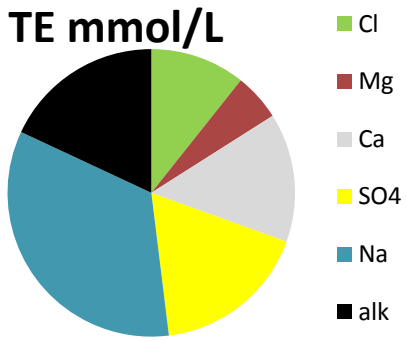
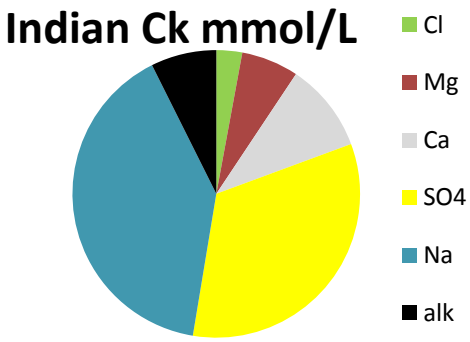
CBM/Marcellus Brine and Mine Water Have Different chemical signatures

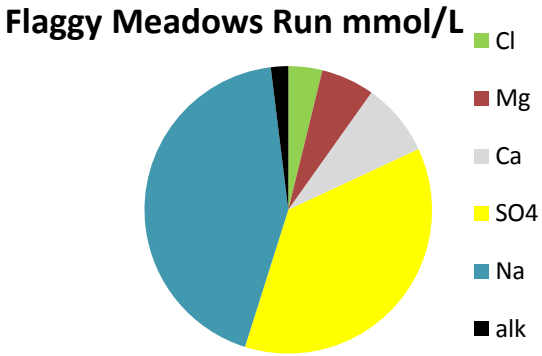
Brine

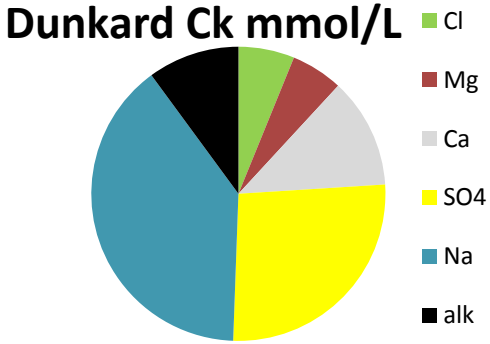




Mine water







Stream effects

Water Research Institute

Is that treated mine water or frac water in my stream?

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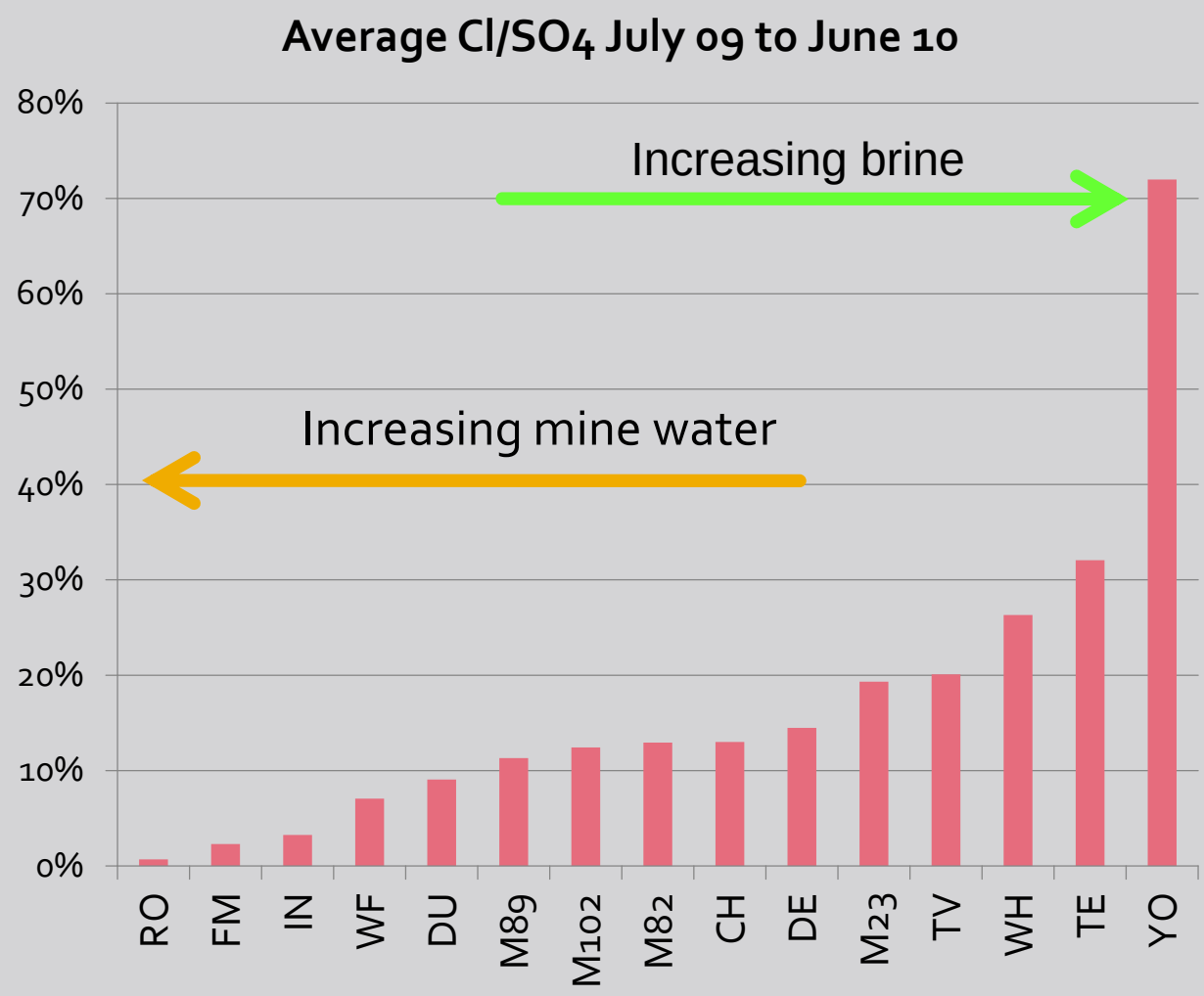
The ratio to chloride to sulfate ions looks like a good way to distinguish water from coal mines from frac water.

Coal mining influence increases to the left

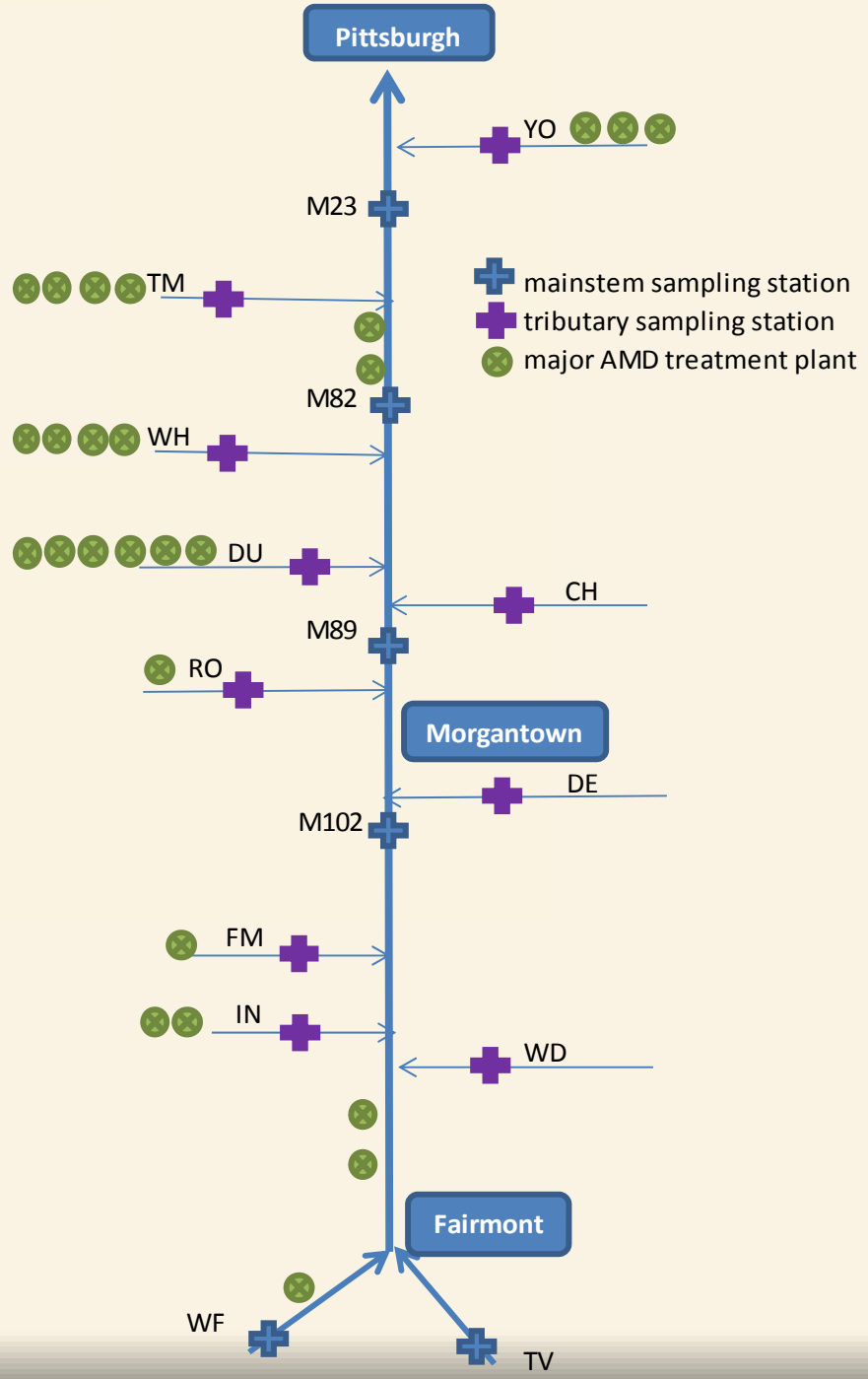
Frac water influence increases to the right



Monongahela River Managed Discharge Program Initiated January 2010 Objectives:

- Monongahela River
  - maintain TDS below 500 mg/L
  - maintain SO_4 below 250 mg/L
  - Manage discharge from active AMD treatment plants
  - Reduce pumping during low flows and increase pumping during high flow periods
  - Identify and maintain target TDS levels in receiving streams
- Tributaries
  - prevent fish kills
  - identify sources of dissolved solids
- Monitor system performance

Monongahela River
sampling stations and major AMD treatment plants



QUESTIONS?

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