Watershed-based Strategy for Treating AMD

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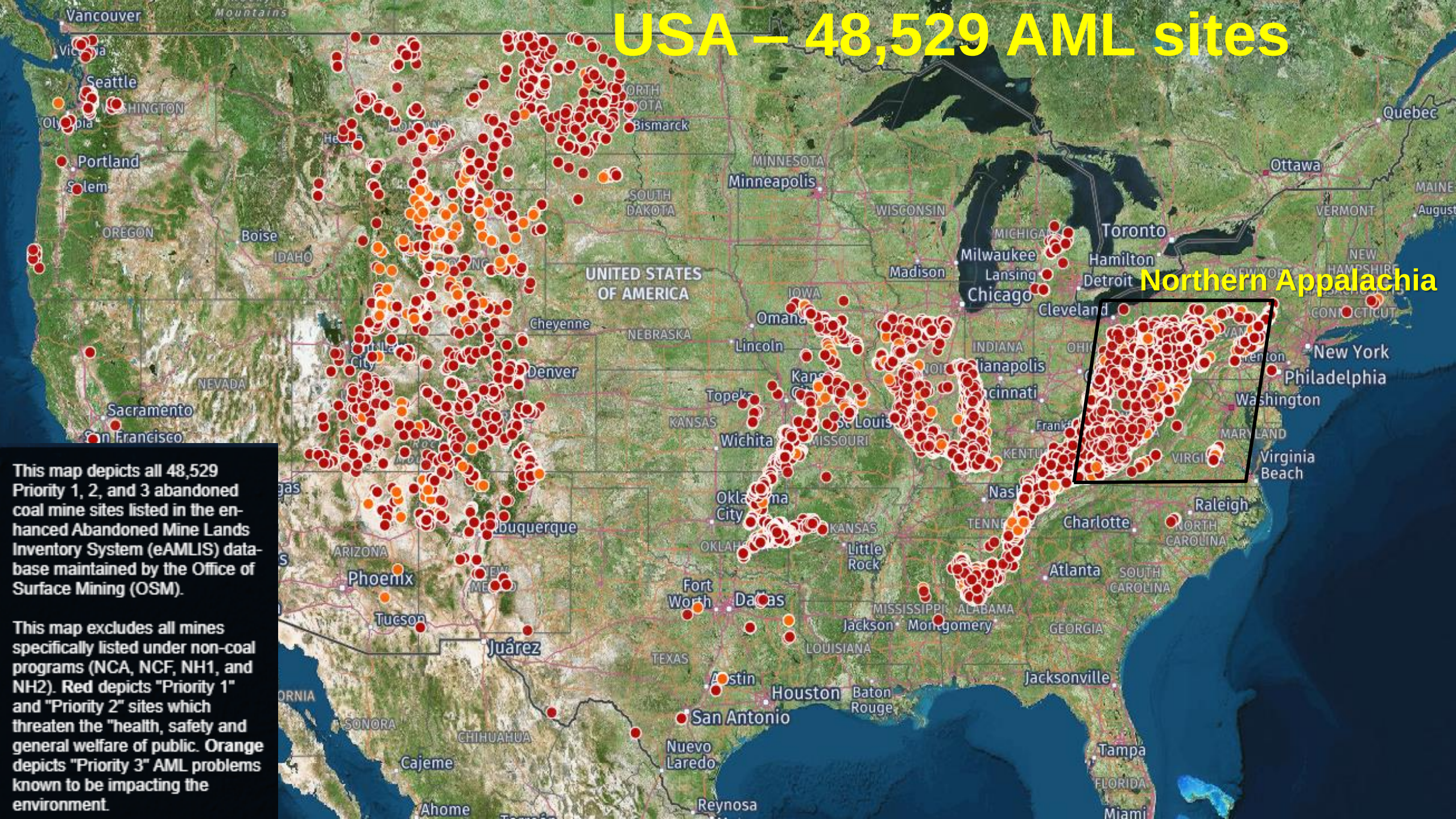
Paul Ziemkiewicz

West Virginia University

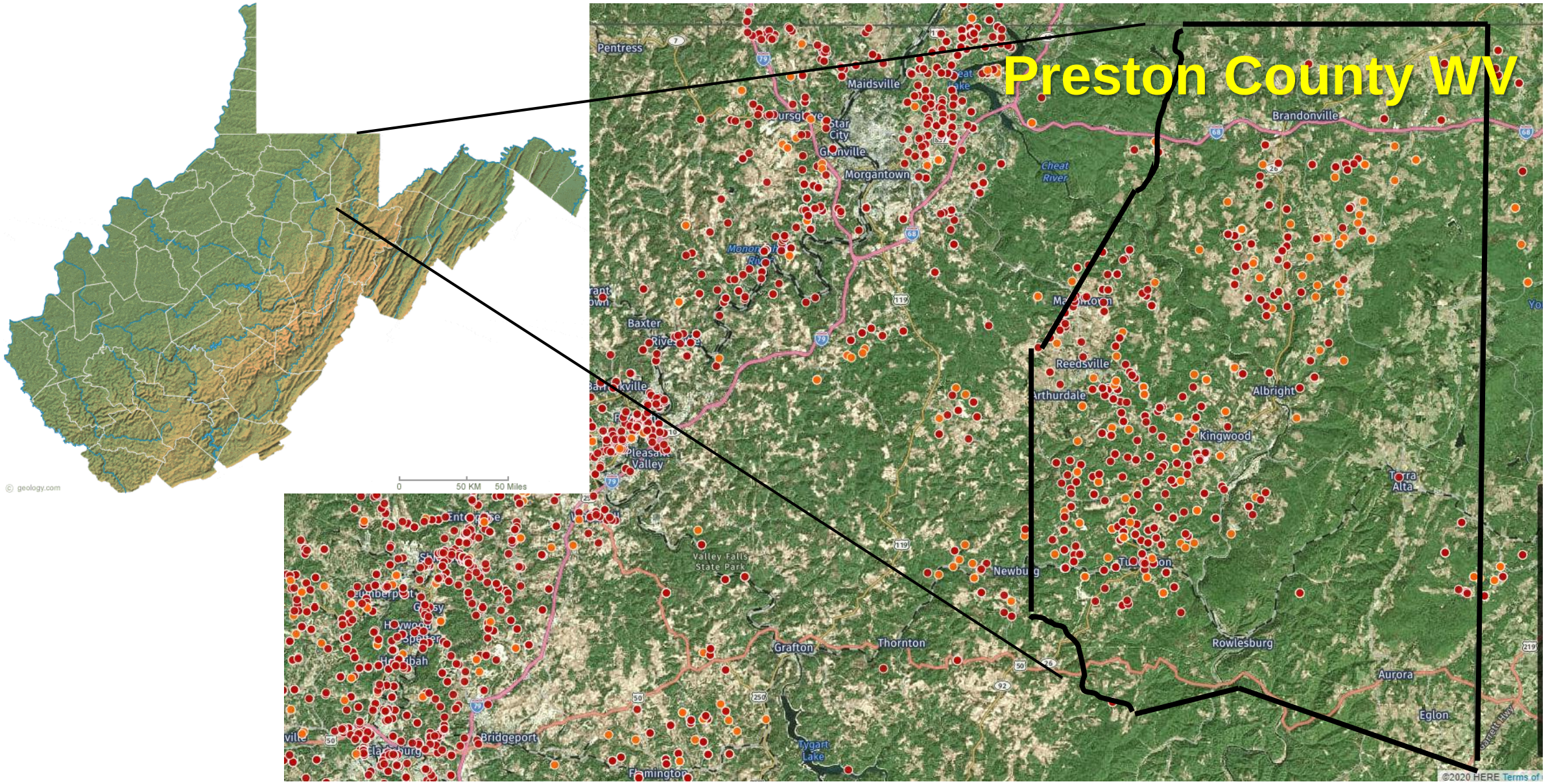
Thousands of point-source discharges of acid mine drainage in Appalachia

USA – 48,529 AML sites



This map depicts all 48,529 Priority 1, 2, and 3 abandoned coal mine sites listed in the enhanced Abandoned Mine Lands Inventory System (eAMLIS) database maintained by the Office of Surface Mining (OSM).

This map excludes all mines specifically listed under non-coal programs (NCA, NCF, NH1, and NH2). **Red** depicts "Priority 1" and "Priority 2" sites which threaten the "health, safety and general welfare of public. **Orange** depicts "Priority 3" AML problems known to be impacting the environment.


Preston County WV
Pentress
Maidsville
Morgantown
Brandonville
Cheat River
Baxter
Reedsville
Albright
Kingwood
Valley Falls State Park
Grafton
Thornton
Rowlesburg
Aurora
Eglon
Bridgeport
Tygart Lake
Flemington
0 50 KM 50 Miles
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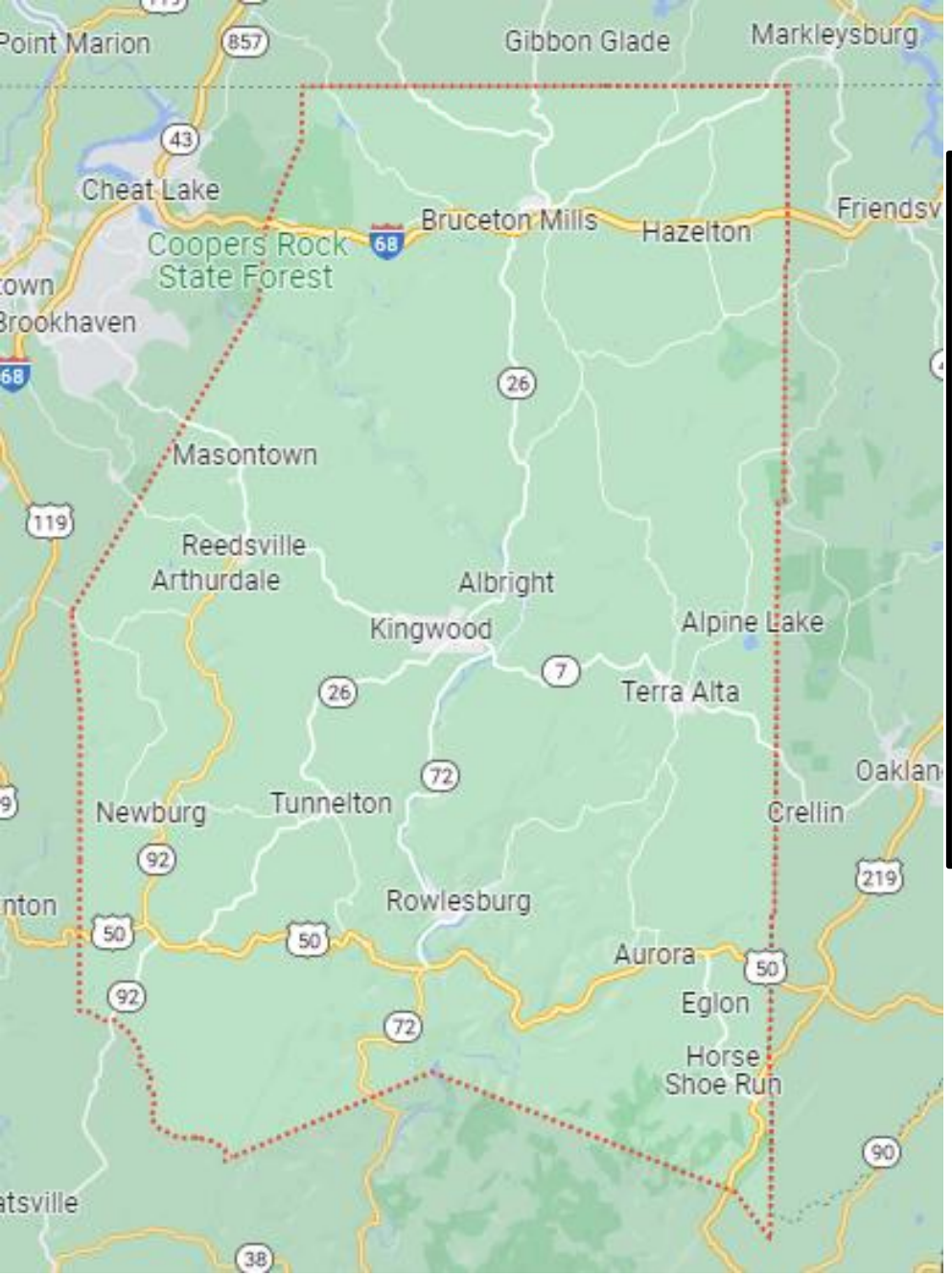
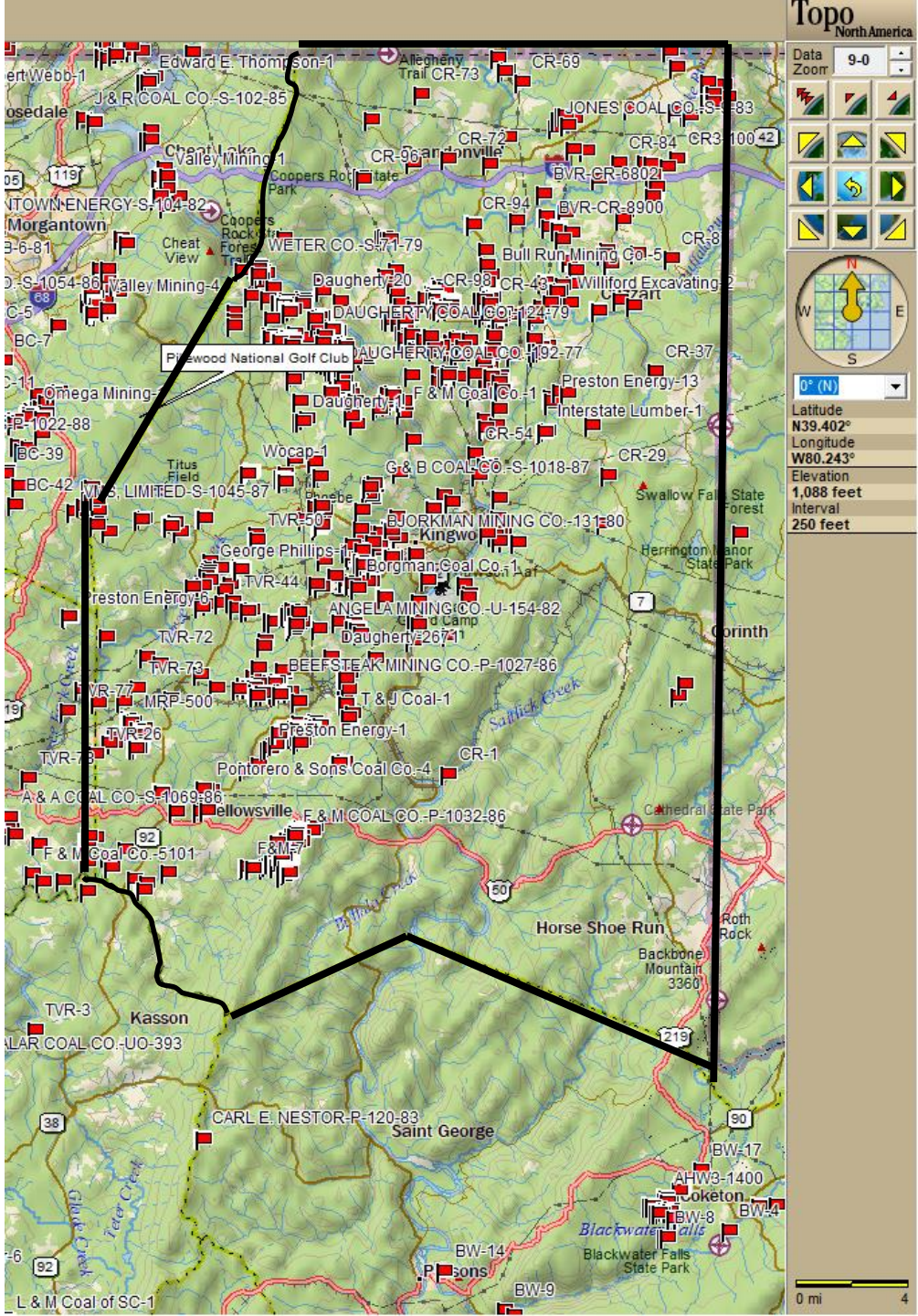
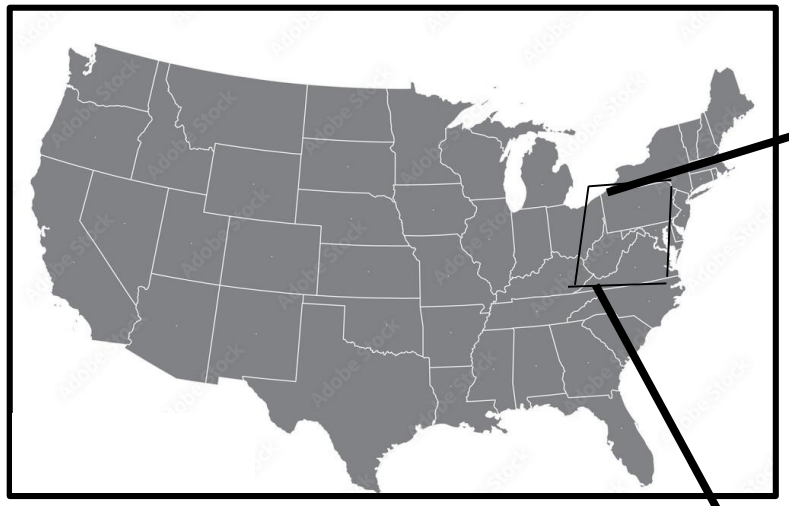


Each red flag represents a WATER SAMPLE LOCATION, most with water quality issues.





Northern Appalachia

Bituminous Coal Region

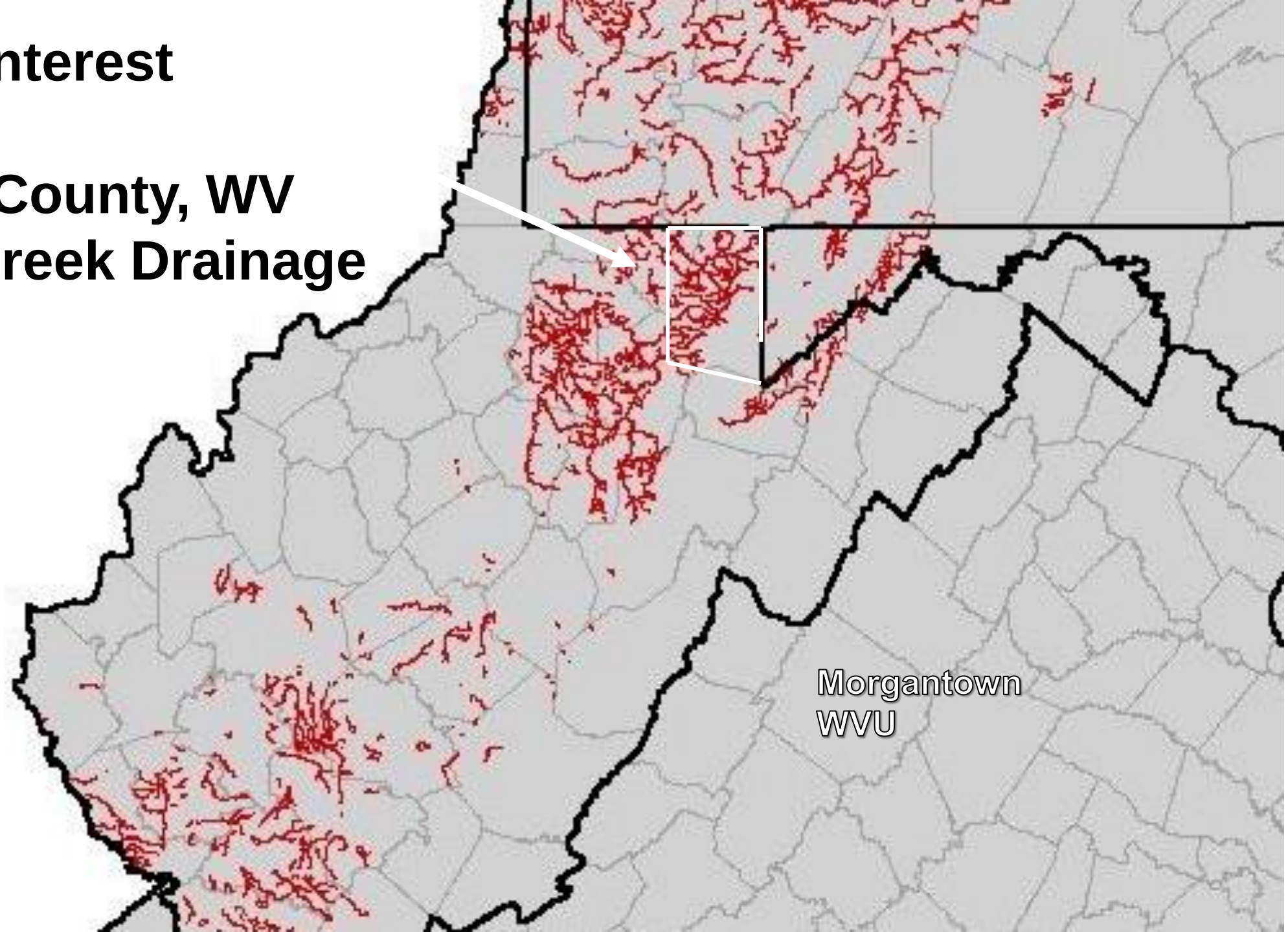
Anthracite

Morgantown
WVU

Streams Impacted by Acid Mine Drainage (EPA, 2005)

Area of Interest

Preston County, WV
Muddy Creek Drainage



AMD staining stream – Muddy Creek


Many km of streams with AMD!


Contaminated Streams flow into larger streams/rivers
Muddy Creek into Cheat River


95% of AMD from
abandoned mine land (AML)

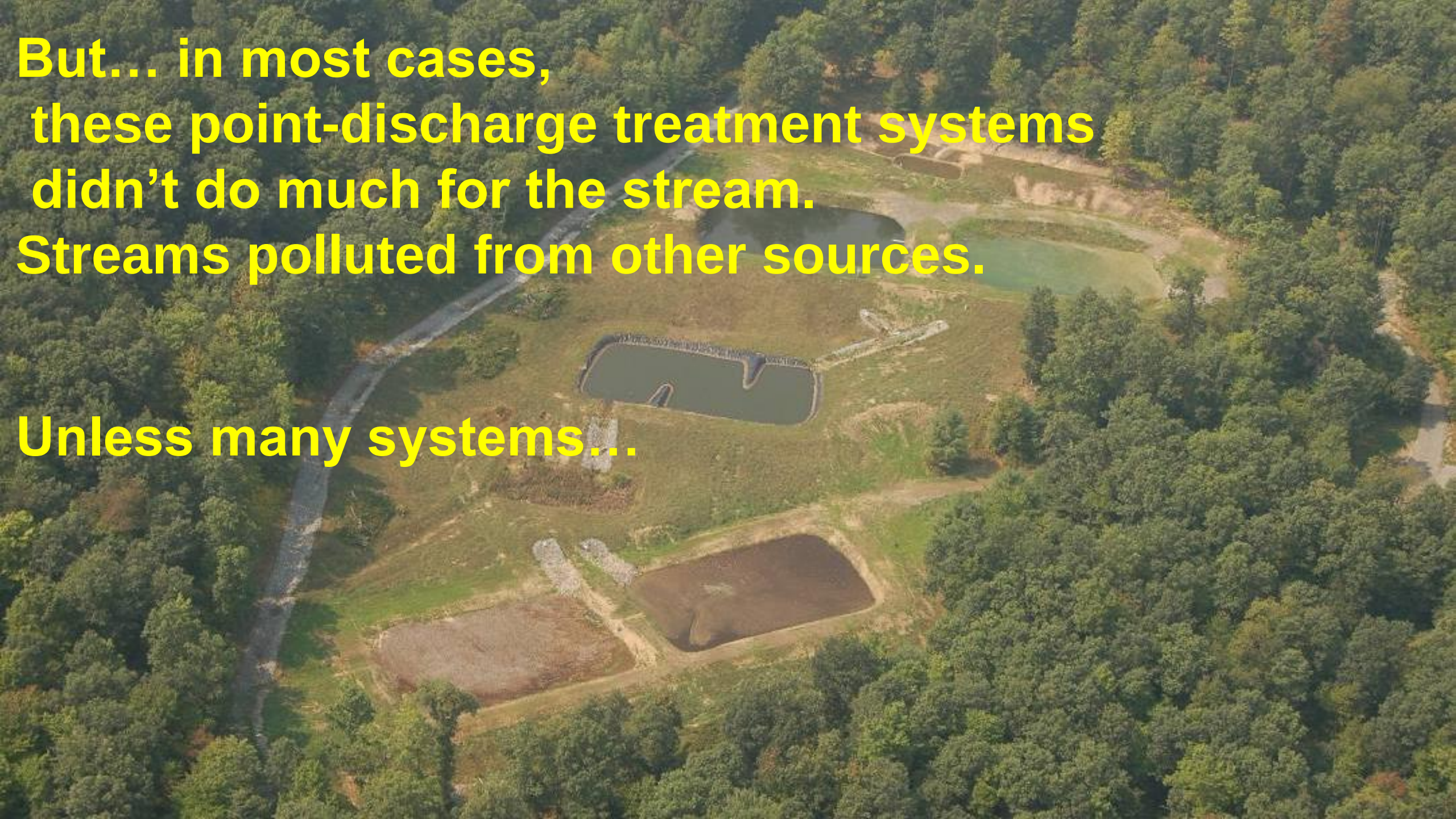
With discoveries in passive treatment,

we had ways to deal with these small AMD discharges.

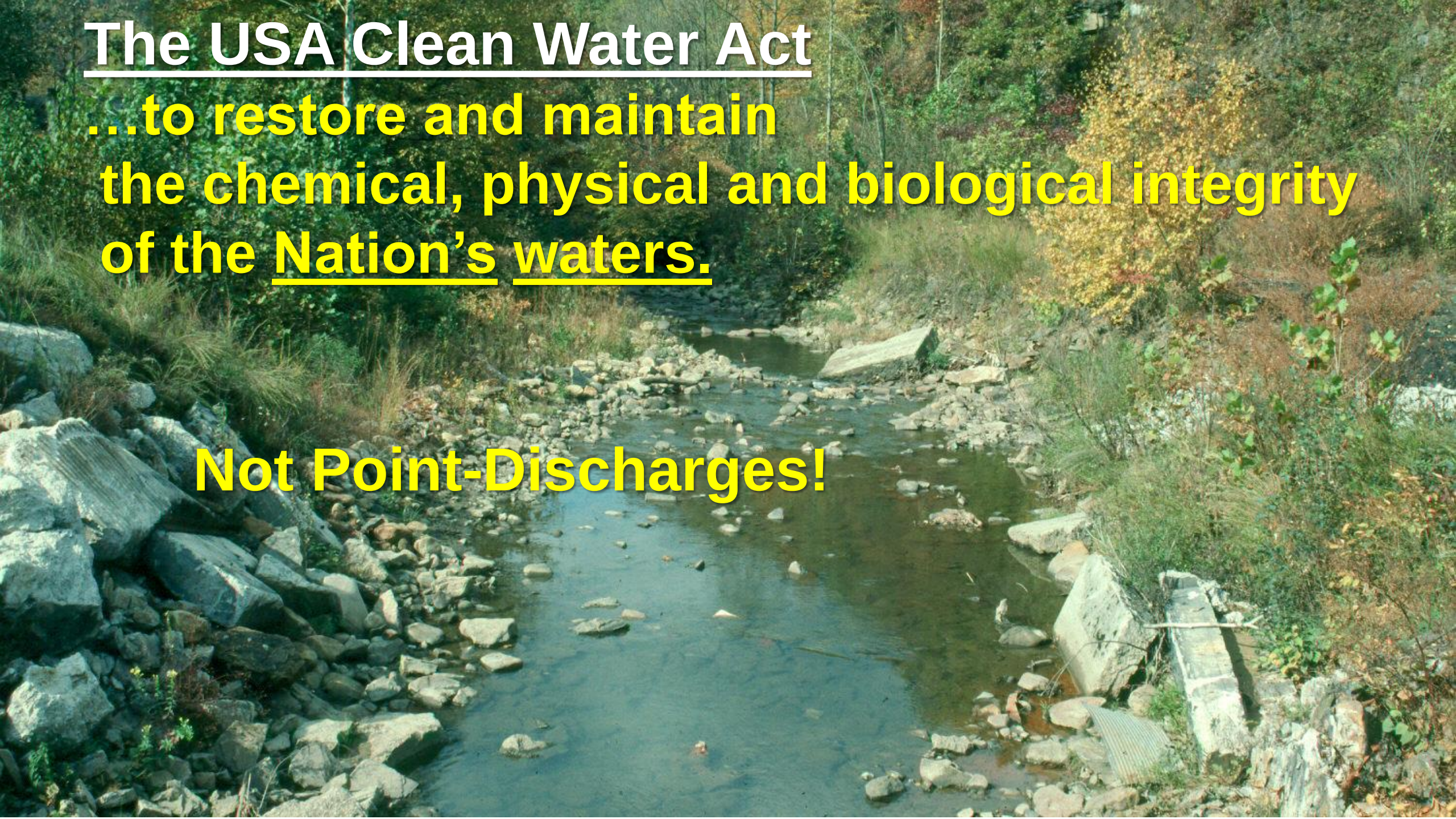

Thousands of these have been constructed
Cherry Creek Wetland, WV


OLC, LLB – WV

Anaerobic Wetland – WV


But… in most cases,
these point-discharge treatment systems
didn’t do much for the stream.
Streams polluted from other sources.
Unless many systems…


All this work, does it restore streams?
…what's the effect?


The USA Clean Water Act
…to restore and maintain
the chemical, physical and biological integrity
of the Nation's waters.
Not Point-Discharges!


If we want to restore streams,
it's got to be more than
treating one small discharge

How do we get from here to here?

Objectives, Strategy, Tactics
These must be unified!

The Objective

Restore Stream Miles

- Funds are finite.
- Realistic objectives.
- ID designated uses.
- Metrics: stream length recovered.
- Pass/fail: fishery or no fishery.

Strategy

- **Money**
- **Planning**
- **Political will**

- Develop a strategy that supports objective.
- Build alliances.
- Find funding & support including Capital $$, Operation $$.

Tactics

Treatment methods:

- **Active….**
- **Passive….**

- ID treatment options.
- Cost/Benefit analysis.
- Implement plan.
- Measure results.
- Assess performance.

Objectives, Strategy, Tactics
Reasons for Failure!

The Objective

Restore Stream Miles

Strategy

- **Money**
- **Planning**
- **Political will**

Tactics

Treatment methods:

- **Active….**
- **Passive….**

The project will fail if:

- Muddled objectives.
- Conflicting and competing interests.

The project will fail if:

- Strategy does not support objective.
- Supporters see conflicting, mixed interests.

The project will fail if:

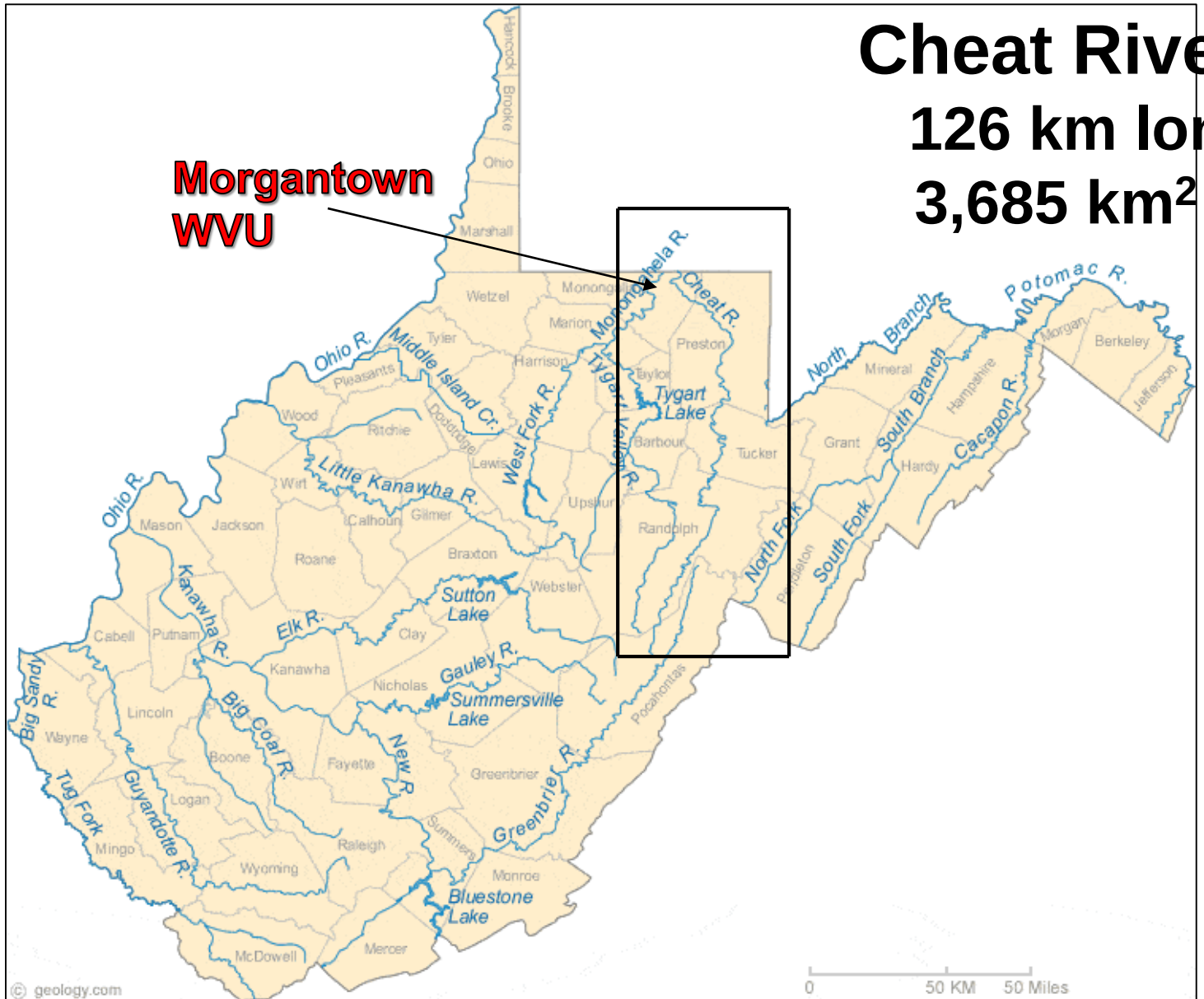
- Tactics do not support strategy.
- Performance metrics not met.

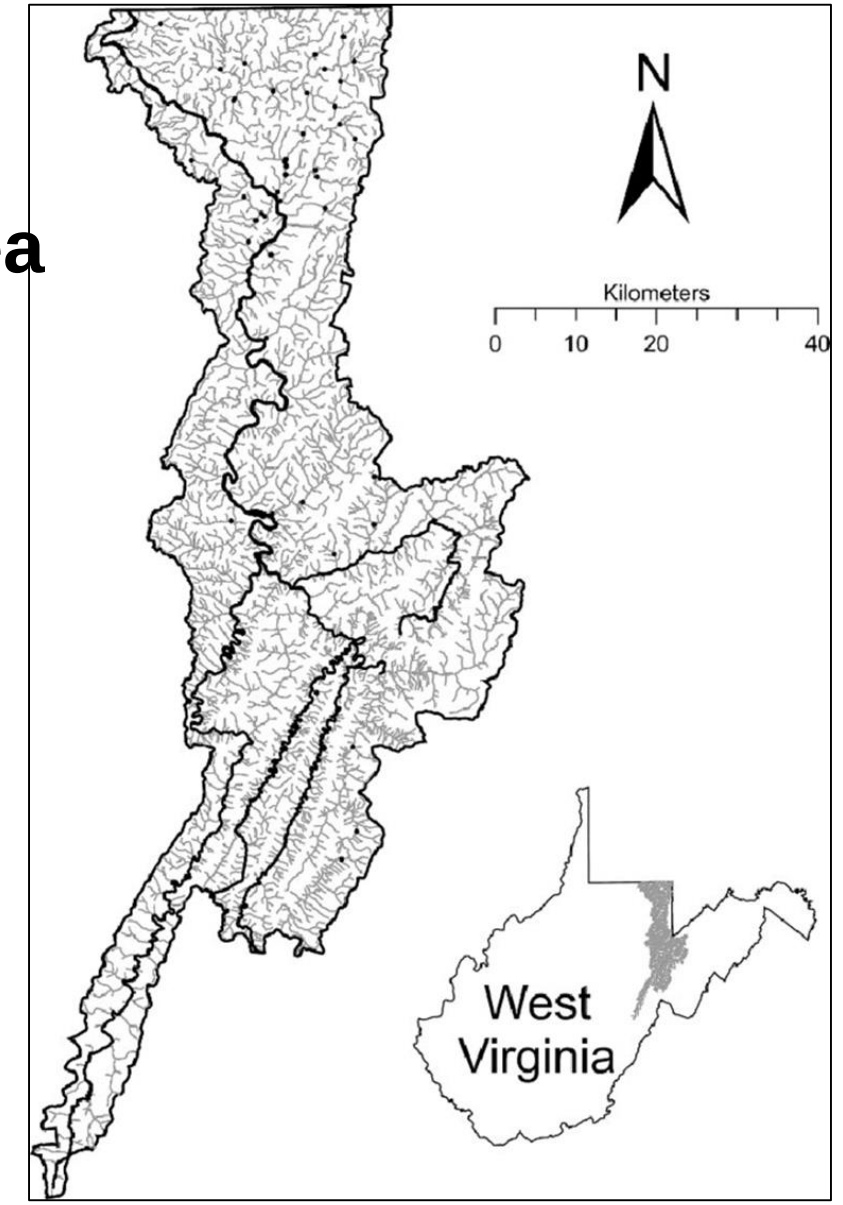
Problems with the Point-Source Strategy

Sustainability

- Declining coal production.
- Less revenue to the Bond Pool (water trust fund).
- Permit holders spend money treating AMD while leaving little to no useful infrastructure behind.
- Funds to rebuild AMD treatment facility.
- Permit liabilities default to the Bond Pool.

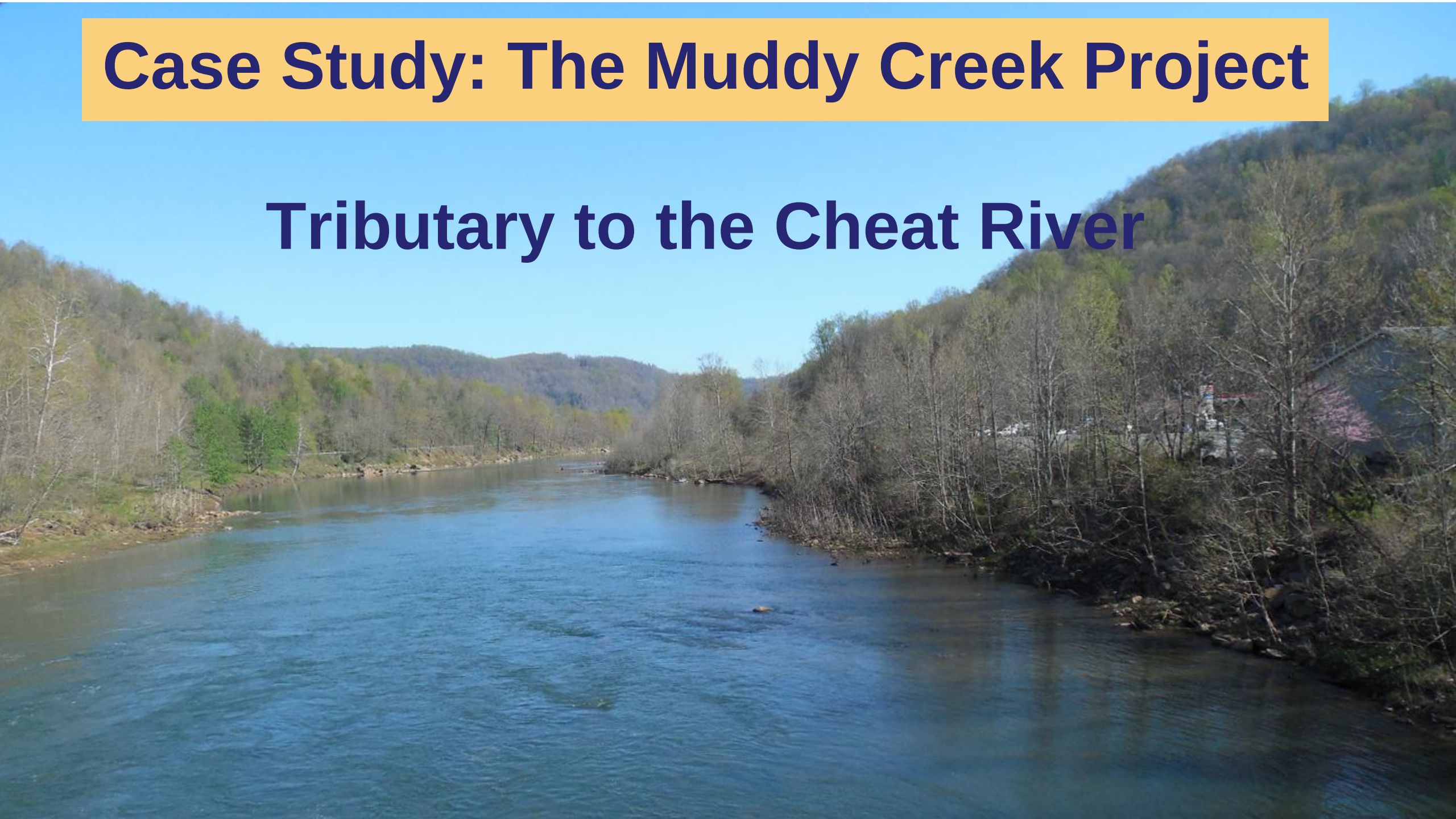
Case Study: The Muddy Creek Project



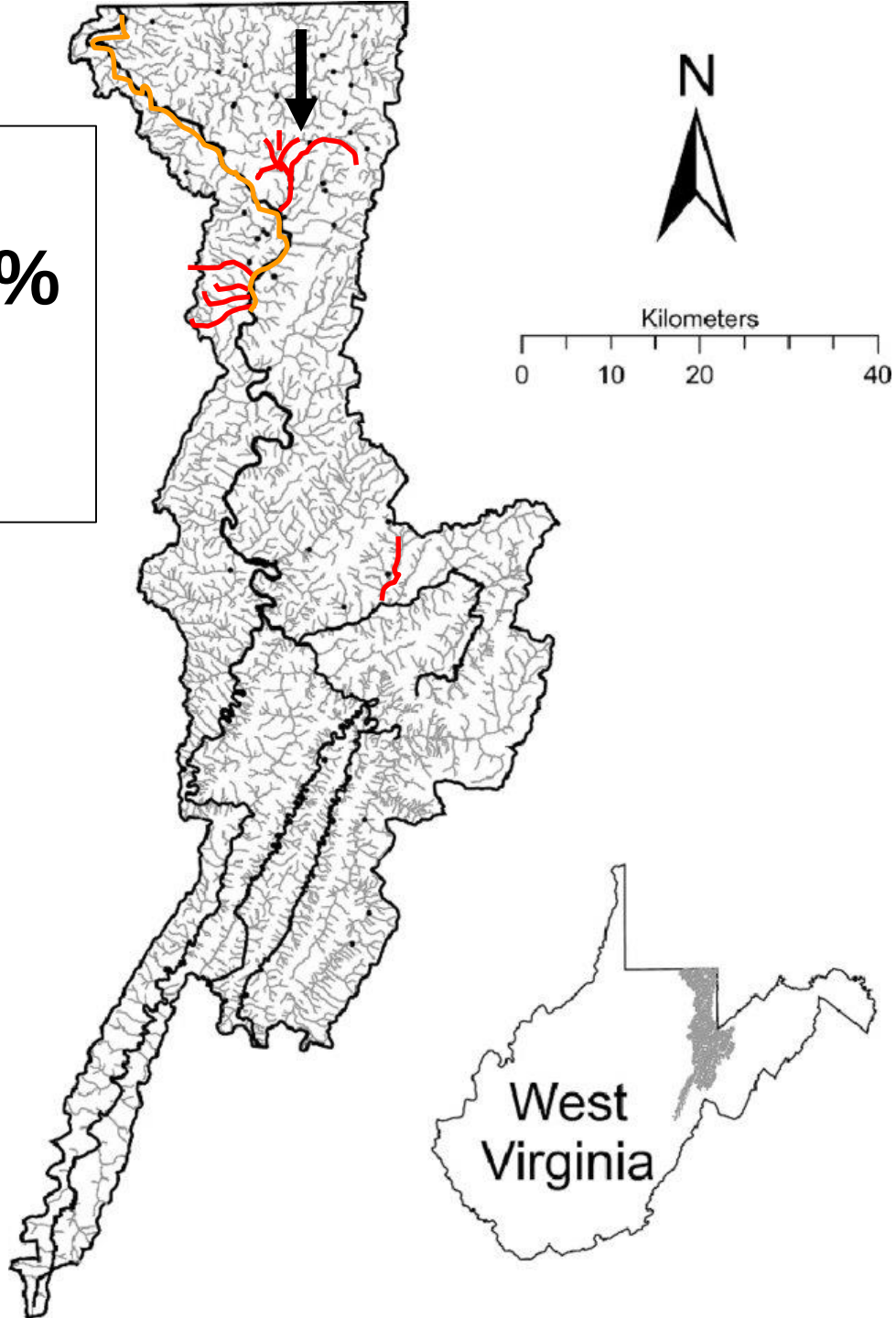


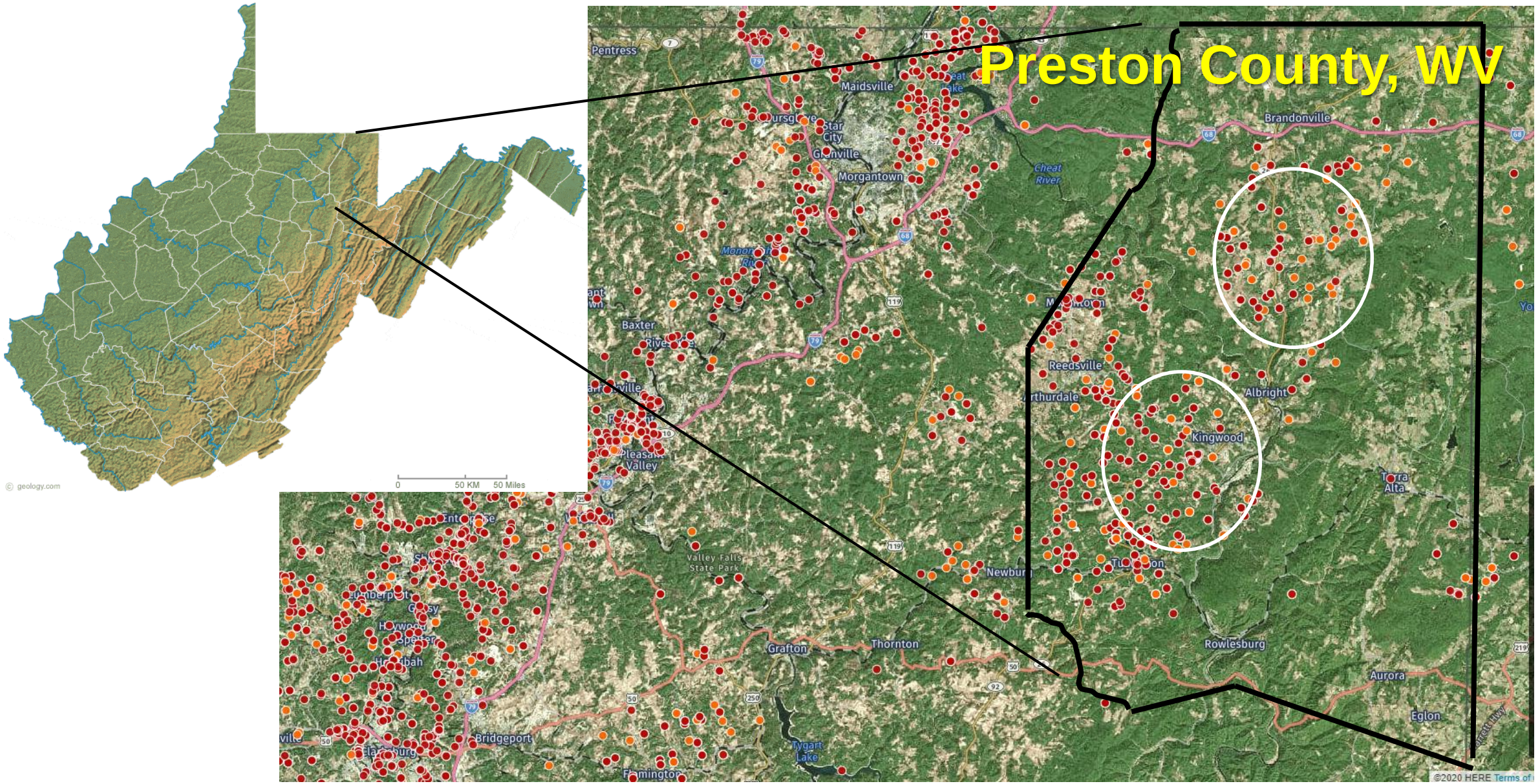
Case Study: The Muddy Creek Project

Tributary to the Cheat River



Muddy Creek was responsible for 50% of the acid load to the Cheat River




Preston County, WV
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Brandonville
Baxter
Reedsville
Albright
Kingwood
Terra Alta
Valley Falls State Park
Grafton
Thornton
Rowlesburg
Aurora
Eglon
Bridgeport
Tygart Lake
0 50 KM 50 Miles
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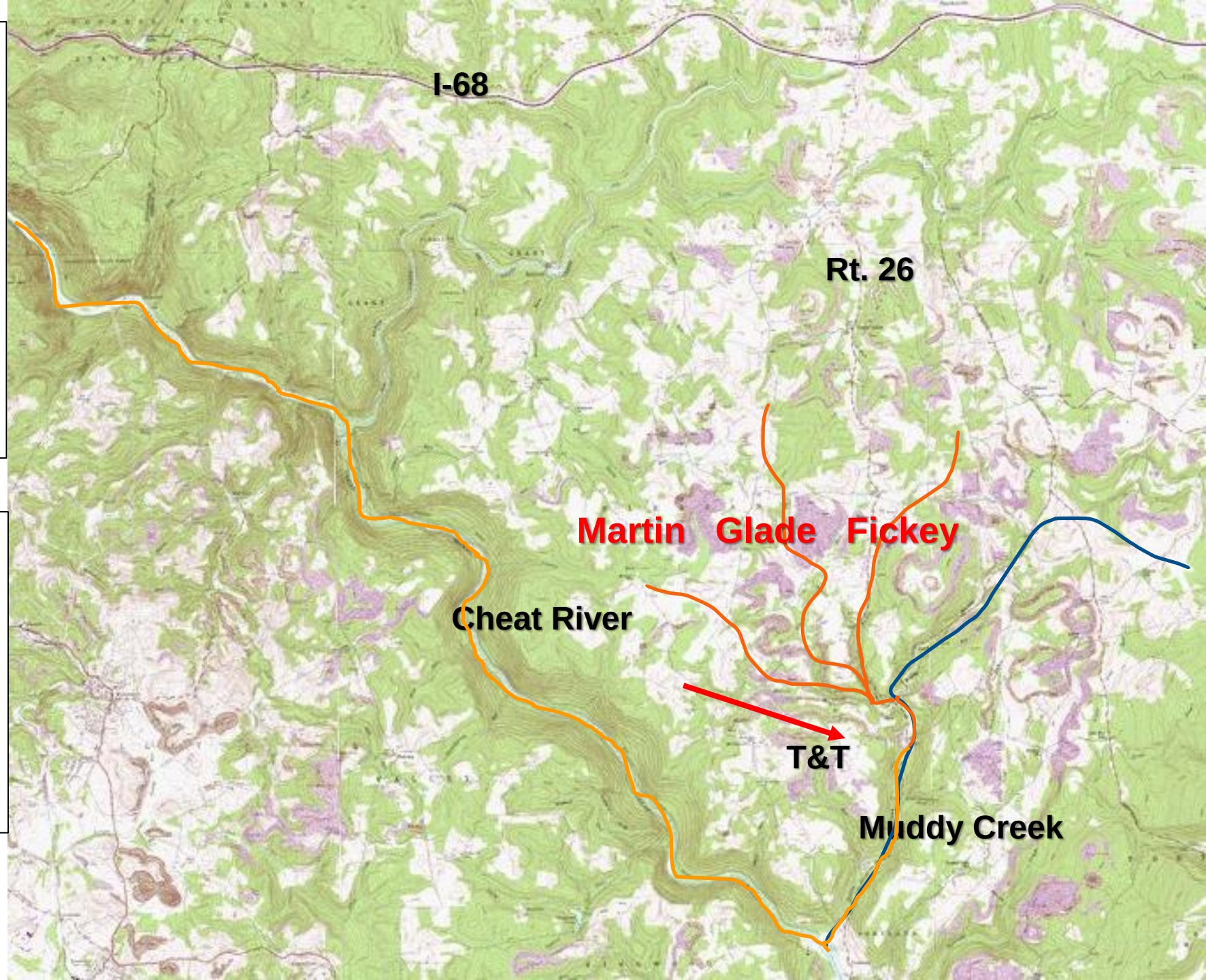
Muddy Creek into
the Cheat River

Three tributaries

- **– Fickey Run**
- **– Glade Run**
- **– Martin Ck**

were severely polluted.

The Cheat River downstream of Muddy Creek was dead as was Cheat Lake.

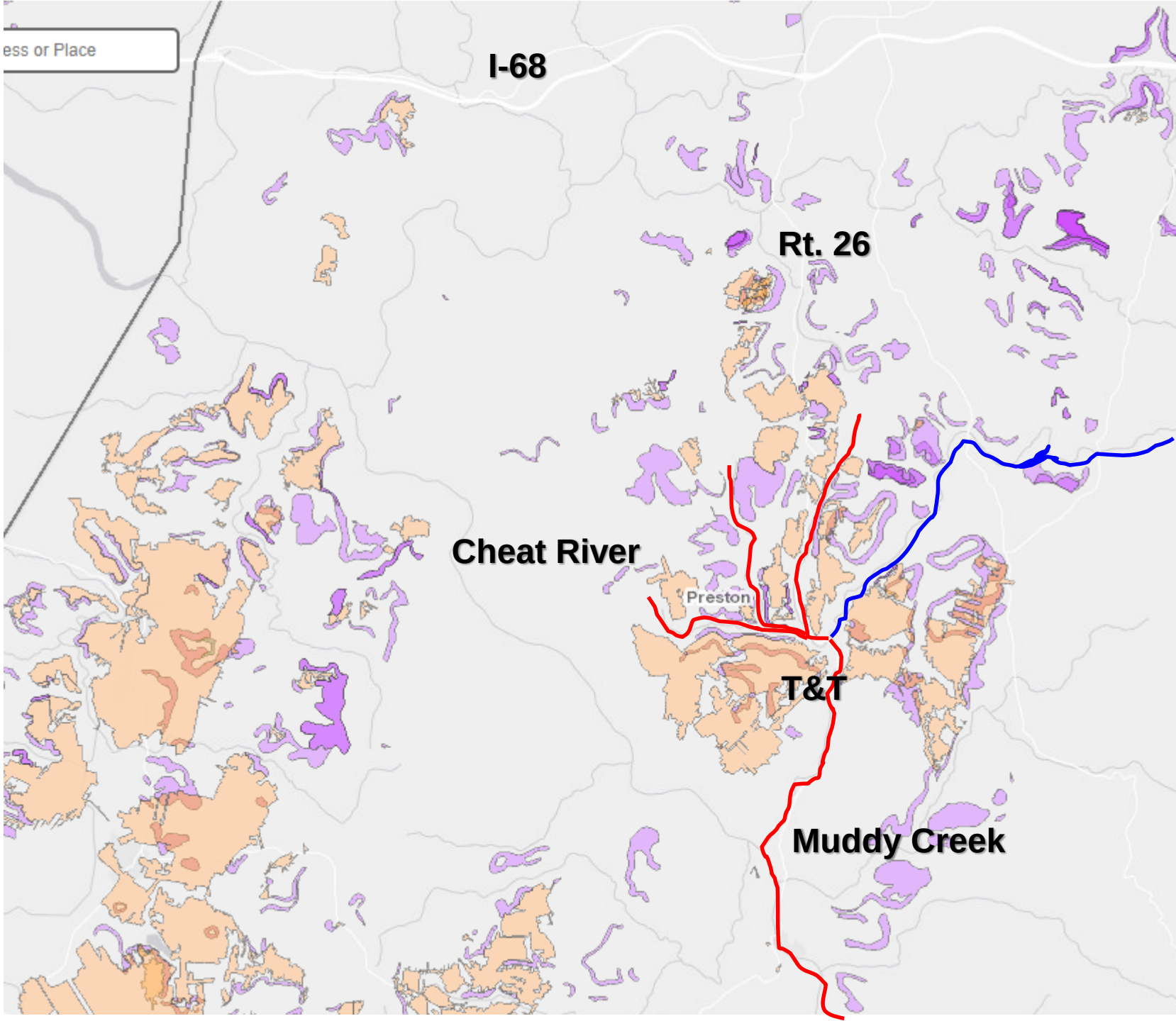


Map of the coal mines in the same area

(Upper Freeport ~ 2% S)

Purple represents surface mines

Brown represents underground mines



Constructed hundreds of point-source discharge treatment systems – $12 M

Anaerobic Wetlands
Anoxic limestone drains
Open Limestone Channels
Vertical Flow Wetlands
Limestone Ponds


Volunteers and
Watershed Groups

Case Study: The Muddy Creek Project

This strategy, at the time, seemed to be the only viable option since there were so many AMD sites, and the liability and funds were so widespread.

The strategy was expensive and did not result in stream recovery.

New idea

A complete stream restoration project was devised for Muddy Creek.

The Muddy Creek project was allowed to move forward because USEPA granted an **in-stream NPDES permit**.

This allowed parties interested in restoring the Cheat River to proceed on a logical basis.

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Now that we had a useful objective and strategy

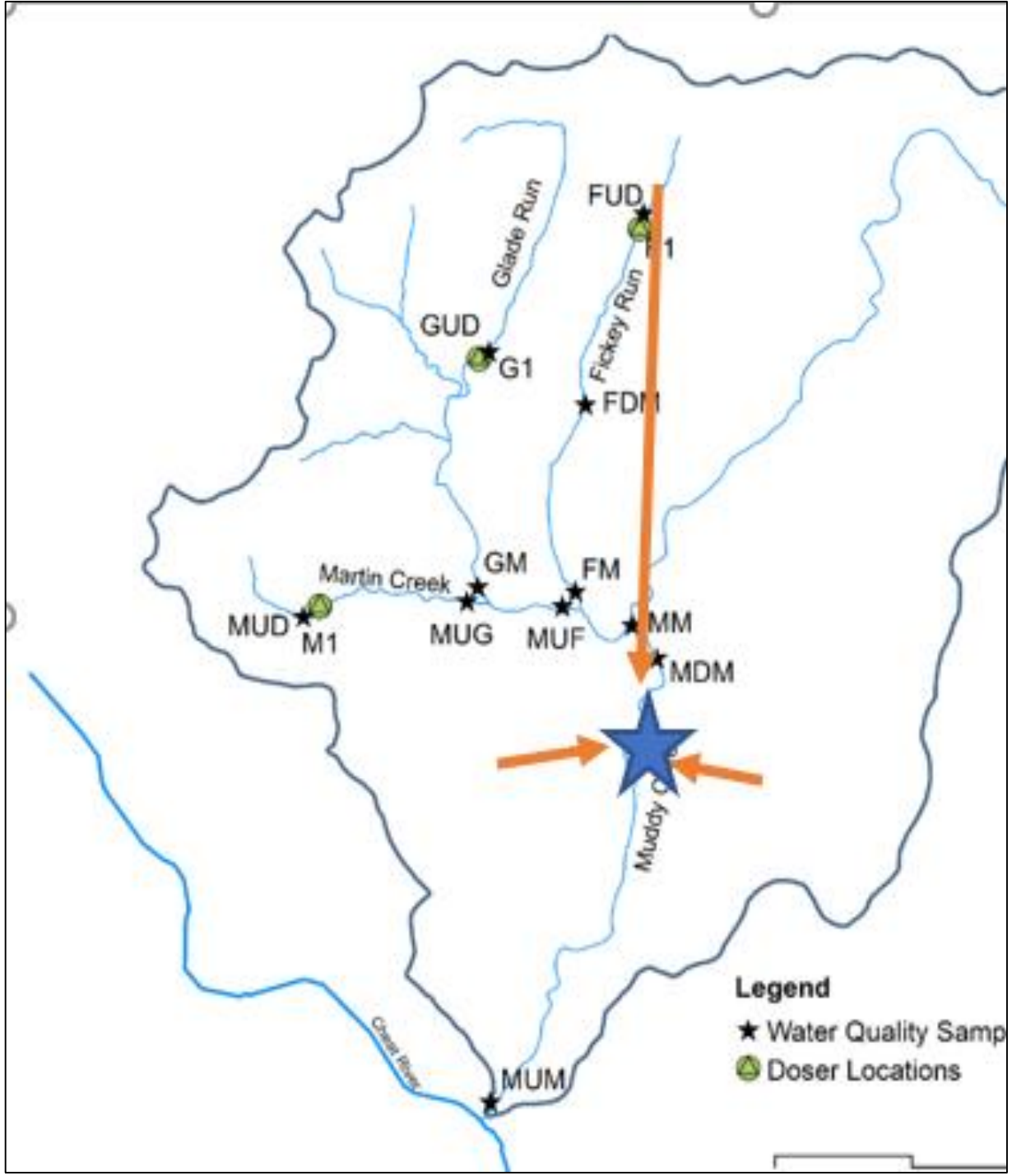
Develop a Watershed Improvement Plan

1. Identify pollutant loads/sources
2. Determine load reduction goals
3. Develop remediation plan
    a. Treatment strategies
    b. Capital and Operation requirements
    c. Financing (AML, Bond Forfeiture, Private)

Rockville Doser

Muddy Creek AMD plant

Many AMD treatment units were replaced by the Muddy Creek AMD plant



The Watershed Strategy

- Higher Cap$: water transfer, central site.
- Lower Op$: road maintenance, compliance monitoring, QC, supplies.
- Southwestern Energy volunteered to help.

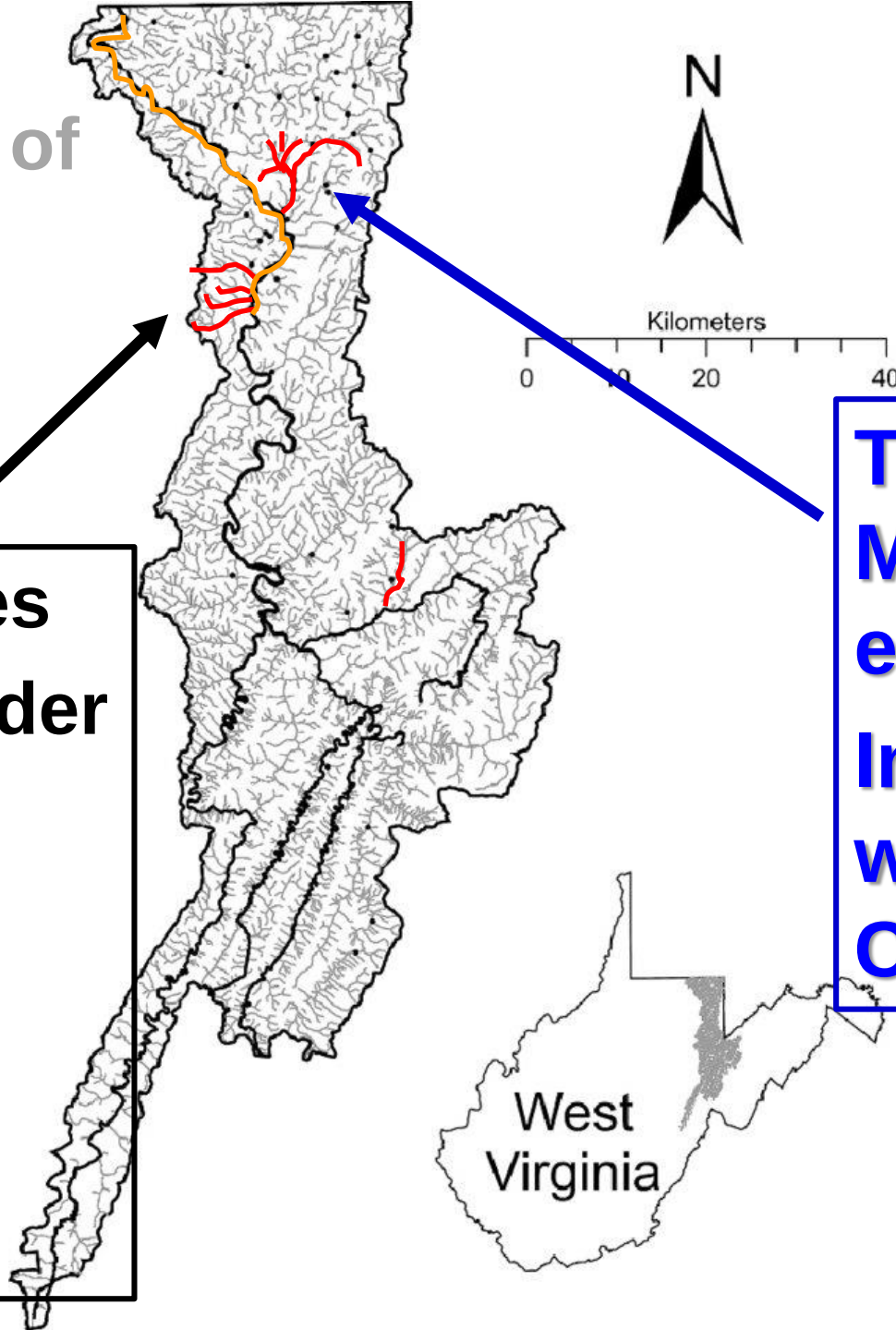
Results

- Stream mile recovery – 30 km.
-
- The Cheat River is now a walleye fishery.
- More attractive to external sponsors.

Point Source vs. Watershed Strategies

	Strategy	
Cost ($ million)	Point Source	Watershed *
CapX	$ 12,500,000	$ 15,920,000
Southwestern Energy Contribution		$ (2,500,000)
Net CapX	$ 12,500,000	$ 13,420,000
OpX per year	$ 1,000,000	$ 530,000
Southwestern Energy Contribution		$ (350,000)
Net OpX (10 yrs)	$ 10,000,000	$ 1,800,000
Total costs over 10 years	**$ 22,500,000**	**$ 15,220,000**
Savings		$ 7,280,000
Stream Length Recovered – km		
Muddy Creek	**0**	**5.1**
Cheat River	**0**	**25.6**
Total Stream Recovery	**0**	**30.7**

Muddy Creek was responsible for 50% of the acid load to the Cheat River



These four tributaries generate the remainder of the acid load:

- **Morgan**
- **Heather**
- **Lick**
- **Pringle**

The acid load from Muddy Creek is now eliminated.

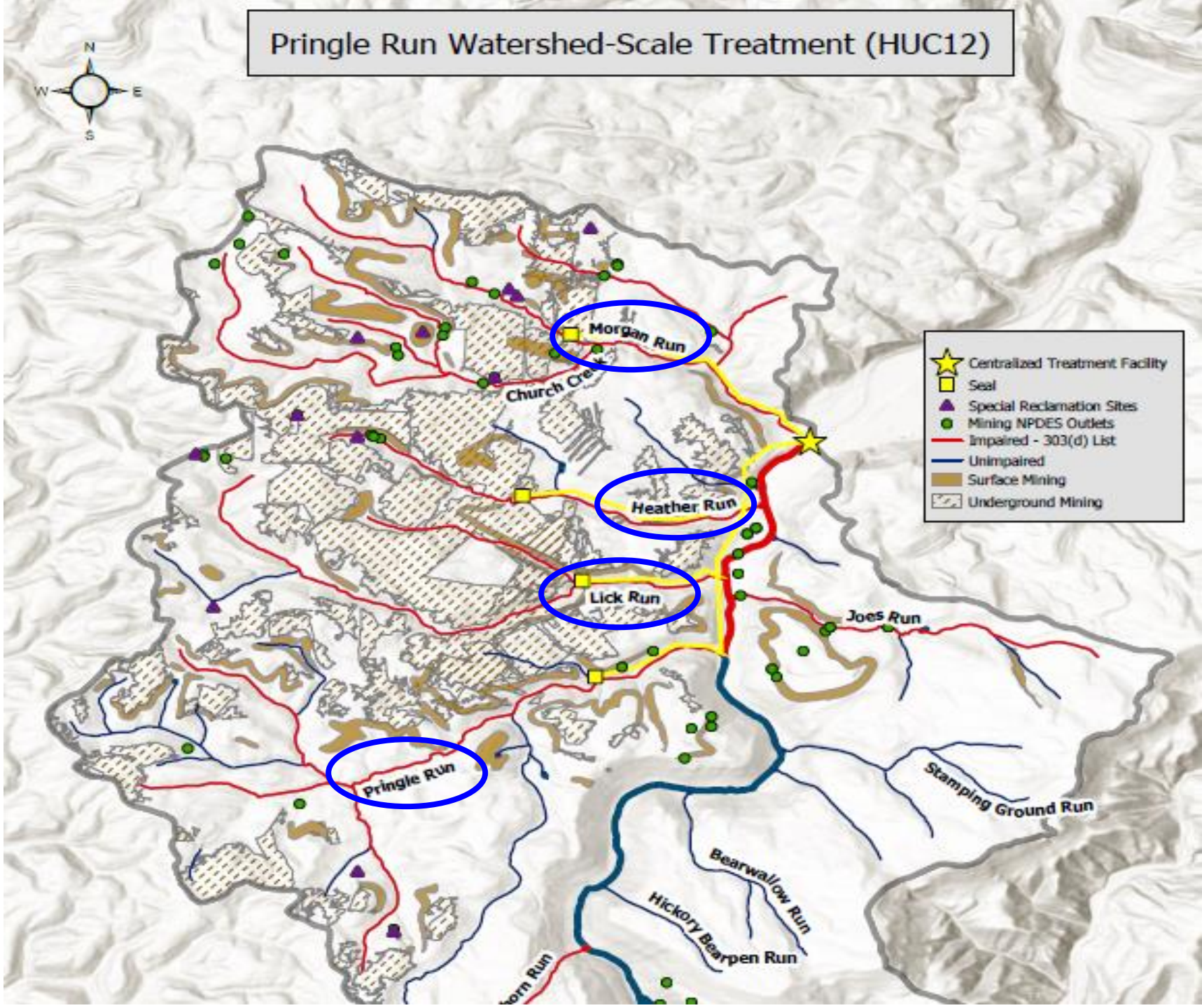
In fact, alkaline water flows into the Cheat River

Morgan Run

Pringle Run

Lick Run

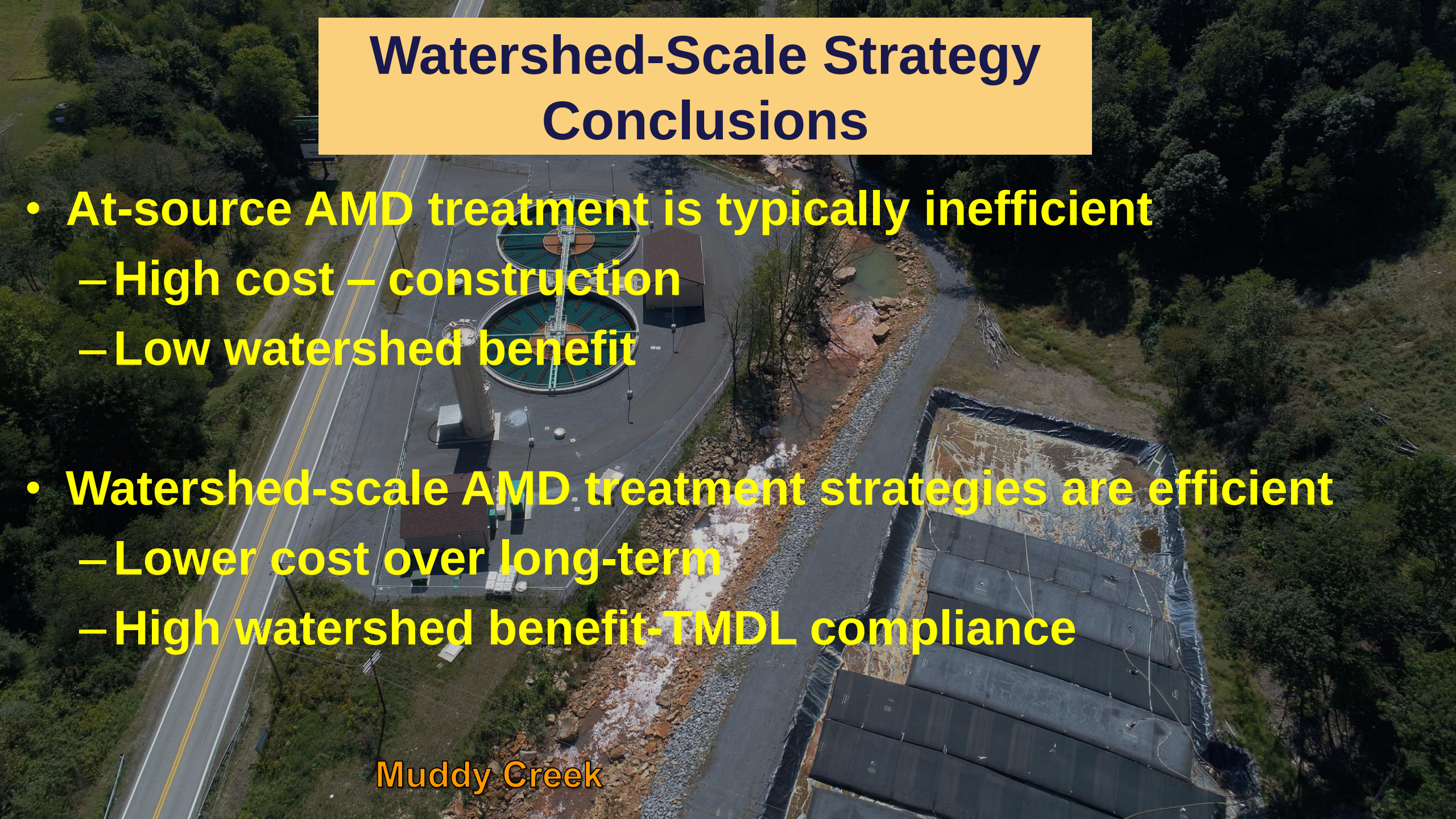
A plan is designed to treat these four tributaries



Watershed-Scale Strategy Conclusions

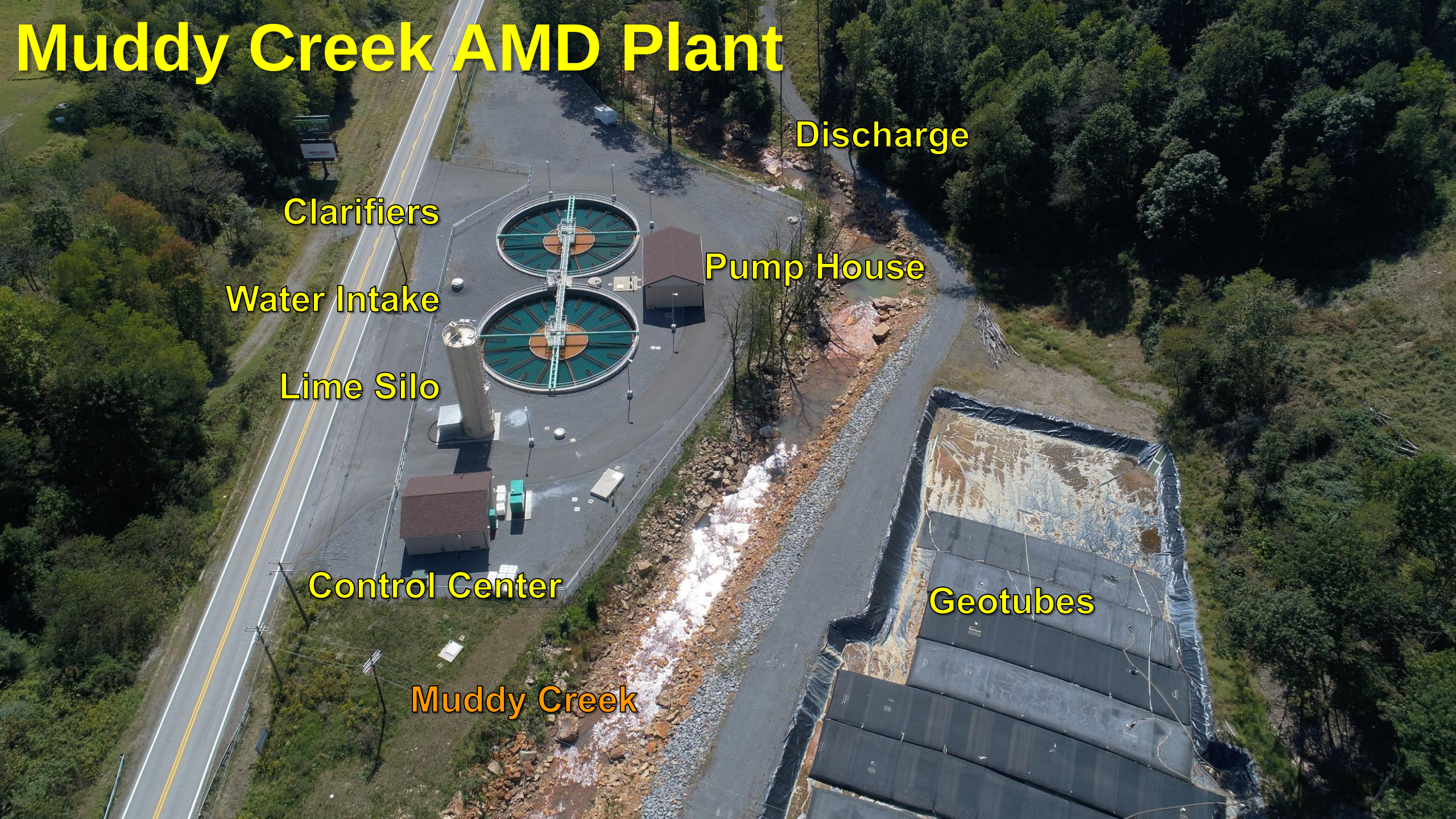
- At-source AMD treatment is typically inefficient
  - High cost – construction
  - Low watershed benefit

- Watershed-scale AMD treatment strategies are efficient
  - Lower cost over long-term
  - High watershed benefit-TMDL compliance




Muddy Creek into Cheat River
April 6, 2010 – Before
Greens Run


Muddy Creek into Cheat River
April 4, 2019 – After, alkaline
Greens Run


Muddy Creek AMD Plant
Discharge
Clarifiers
Pump House
Water Intake
Lime Silo
Control Center
Geotubes
Muddy Creek


Primary Care You Can Trust


Anaerobic Wetland
15 years later
Maintenance?