Watershed-based versus At-source-based AMD Treatment: Costs and Benefits

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West Virginia Acid Mine Drainage Task Force

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Methods

- A comparison of AMD treatment costs was made related to the following scenarios:
  - Single AMD sources
  - Multiple AMD sources
  - Manganese sources.

Seven Planned Sites Were Selected:

- Daugherty, 192-77, Preston County
- Daugherty, 17-81, Preston County
- Rockville Mining, S-91-85, Preston County
- Hunt Coal, Inc., U-5071-86, Logan County
- Coal X, Inc., UO-396, Logan County
- C&C Co., UO-36, Logan County
- B&S O-43-84, Nicholas County

Cost Factors

- Site access S
- Construction C
- Alkalinity addition A
- Oxidation O
- Sludge disposal D

Parameters

- *AMD Cost = S+C+A+O+D*
- *Environmental efficiency = AMD Cost/ Recovered stream miles*
- *Treatment efficiency= AMD Cost/Tons of acid load removed*

Cost Centers

- Capital Costs:
  - doser installation, pond construction, roads (3,000 ft ea.) land access, ditching, engineering
- Annual Costs:
  - water sampling, labor, operations and maintenance, chemical, sludge removal
- In Stream Dosing
  - Delete pond construction and sludge removal

Acidity (mg/L)

$$= 50*((3x[Fe]/56)$$
$$+(3x[Al]/27)$$
$$+(2x[Mn/55)$$
$$+(1000*10^{-pH}))$$

Pre-construction AMD

Doser Base Construction

Lime Bin Installation

Sludge Pond

Piping/Trenching

Completed WVDEP Special Reclamation Project

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Charging the Lime Bin

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Sludge Cleanout

Portion of AMD Treat Table

acidity	Fe	Mn	Al	pH
501	35	1	70	3.5

acidity	flow	load	capital costs	annual costs
500	10	11	65,698	20,018
500	20	22	65,698	23,557
500	30	33	65,698	27,094
500	40	44	65,698	30,631
500	50	55	65,698	34,169

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Single AMD Discharge

192-77	DAUGHERTY			
WVDEP sample #		acid load (tpy)	Capital cost	Annual cost
2071	Total of seeps flowing into pond #211	1		
2075	outlet of ALD at Site #6	2		
207	Pond on east side of South site	12	65,689	23,344
51	Mouth of UNT of Gum Run	309		
50	Mouth of Gum Run	253		
	totals: At source treatment	12	65,689	23,344
	In Stream Doser in Gum Run	253	146,291	36,944

Multiple AMD Sources

S-91-85	ROCKVILLE MINING					
WVDEP		acid load		Capital		Annual
sample #		(tpy)		cost		cost
2	Discharge pond #3	5	$	65,698	$	18,026
3	Discharge pond #5	5	$	65,698	$	19,790
4	Discharge pond #4	33	$	125,698	$	30,206
5	Discharge pond #5 into sediment ditch	12	$	125,698	$	32,468
55	seep to diversion ditch to Pond #5	3	$	65,698	$	20,018
	totals: At source treatment	58	$	448,490	$	120,508
	In Stream Doser in Martin Ck to Glade	330	$	94,325	$	91,601

Manganese Only

O-43-84	B & S Coal			
WVDEP		acid load	Capital	Annual
sample #		(tpy)	cost	cost
1	Effluent from sediment pond	2	65,689	24,779
10	Downstream Muddlety Creek	32		
	totals: At source treatment	2	65,689	24,779

At-source vs. In-stream costs

Treatment Scenario	acid load (tpy)	20-year Treatment ($)	Stream recovery (miles)	Stream Recovery Cost ($/mi/yr)	Acid Load Removal Efficiency ($/ton)
A. single AMD, in stream	253	885,171	2.0	22,129	175
B. multiple AMD, in stream	330	1,926,345	2.5	38,527	291
C. single AMD, in stream	24	698,445	2.4	14,551	1,478
A. single AMD, at source	12	532,569	0.3	106,514	2,211
B. multiple AMD, at source	58	2,858,650	0.5	285,865	2,468
multiple AMD, at source	27	1,530,547	0.8	102,036	2,875
multiple AMD, at source	13	927,556	0.2	265,016	3,676
C. single AMD, at source	3	459,258	0.1	229,629	8,714
Mn, at source	2	561,269	0.1	280,635	14,635
multiple AMD, at source	2	1,711,175	1.5	57,039	272,314

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Conclusions: In-stream AMD Treatment vs. At-source treatment

- Always treated more acid load
- Recovers more stream miles
- More expensive than at-source, single AMD
- Less expensive than multiple at-source treatment

Conclusions: Environmental efficiency (stream recovery cost).

- Stream recovery costs ranged from $14,500 to $285,000/recovered stream mile.
- Efficiencies were highest in the three in stream settings and were lowest on sites with multiple AMD sources treated at source.
- Treatment at the Mn site resulted in one of the least efficient uses of funds with a cost of $280,000/stream mile recovered.

Conclusions: Total treatment cost

- Economy of scale: single, large treatment units always cost less than many, smaller units.
- Twenty year project costs ranged from \$459,000 to \$2,858,000. The Mn site was among the least expensive treatment sites.

Conclusions: Stream miles recovered

- In-stream treatment resulted in much higher stream recoveries (1.5 to 2.5 miles)
- At-source treatment stream recoveries were always less (0.1 to 0.8 miles)
- The Mn treatment project resulted in negligible stream recovery

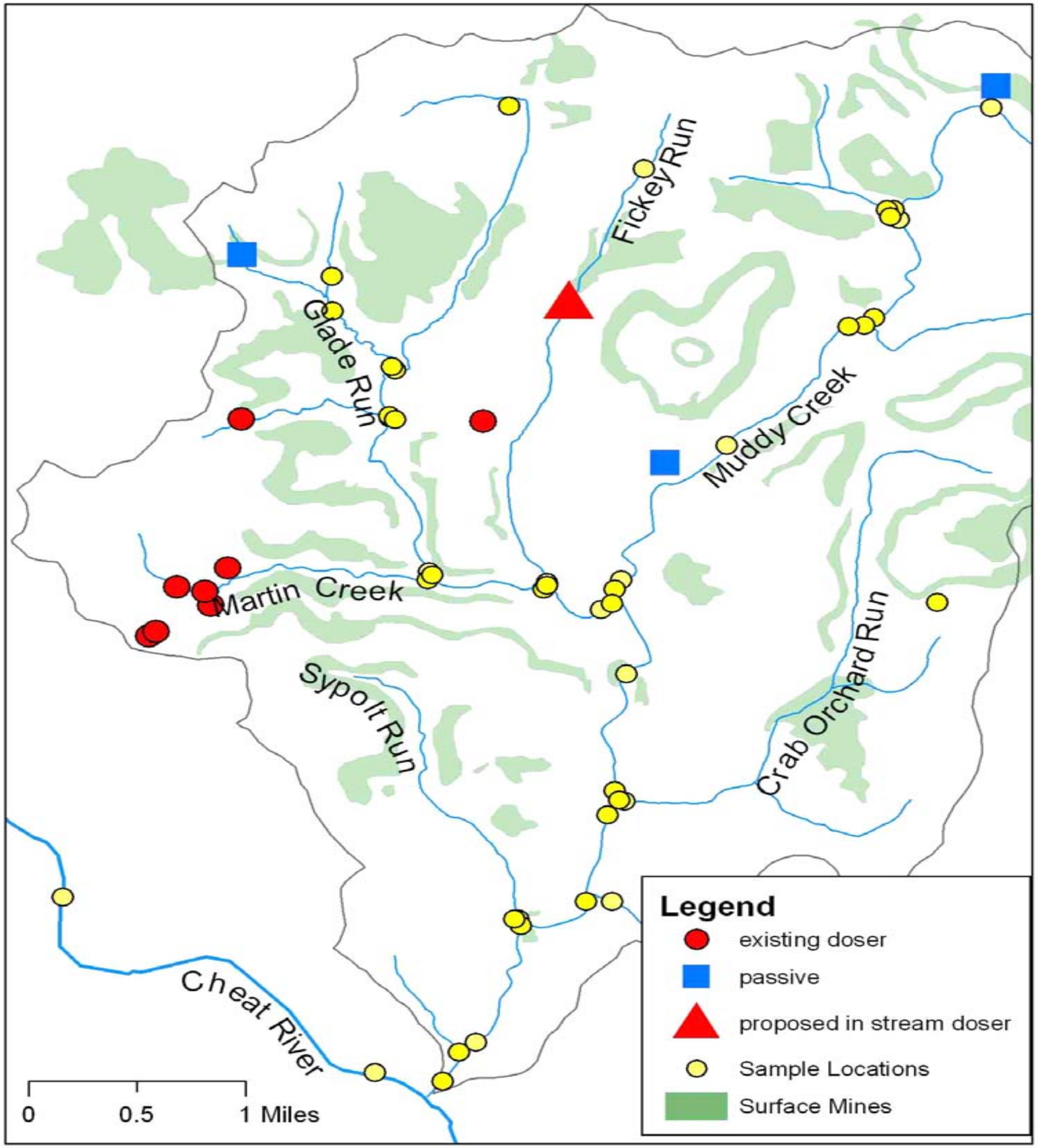
Conclusions: Acid removal efficiency

- All three of the most efficient sites were in stream dosing units.

- In-stream: $175 to $1,478
- At source: $2,200 to $272,000.

With In-Stream Treatment We Need to Know:

- How many miles of stream are actually restored to biological health with in-stream treatment?
- How quickly metal floc comes out of the water column
- Effects of metal loading, stream hydraulics: oxidation and floc settlement



Next: Muddy Creek Project

- Eight existing at-source dosers
- Three passive treatment systems
- One in-stream doser