An Evaluation of Passive Treatment Systems Treating Oxic Acidic Mine Drainage

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The Problem

- Many passive systems treating acidic AMD discharge net acidic water (positive hot peroxide acidity).
- Of 137 systems studied by DEP in 2009-10, 48% discharged net acid water.
- In the DEP "risk" classification, "failure" rates were 52, 40 and 26% for High, Medium and Low Risk categories.
- "Failure" rates were somewhat better for post 2004 systems (improved design concepts)

The Approach

- Why don't these systems produce net alkaline water?
- What are the characteristics of successful systems vs. non-successful systems?
- Focus on net acidic sites, VFP, Bioreactor and Flushable Limestone since 2004.
- Select 18 "failing" systems constructed since 2004 (10 High Risk, 4 Medium, 4 Low Risk) and 6 successful systems.
- Visit sites, sample, investigate design, construction and history.

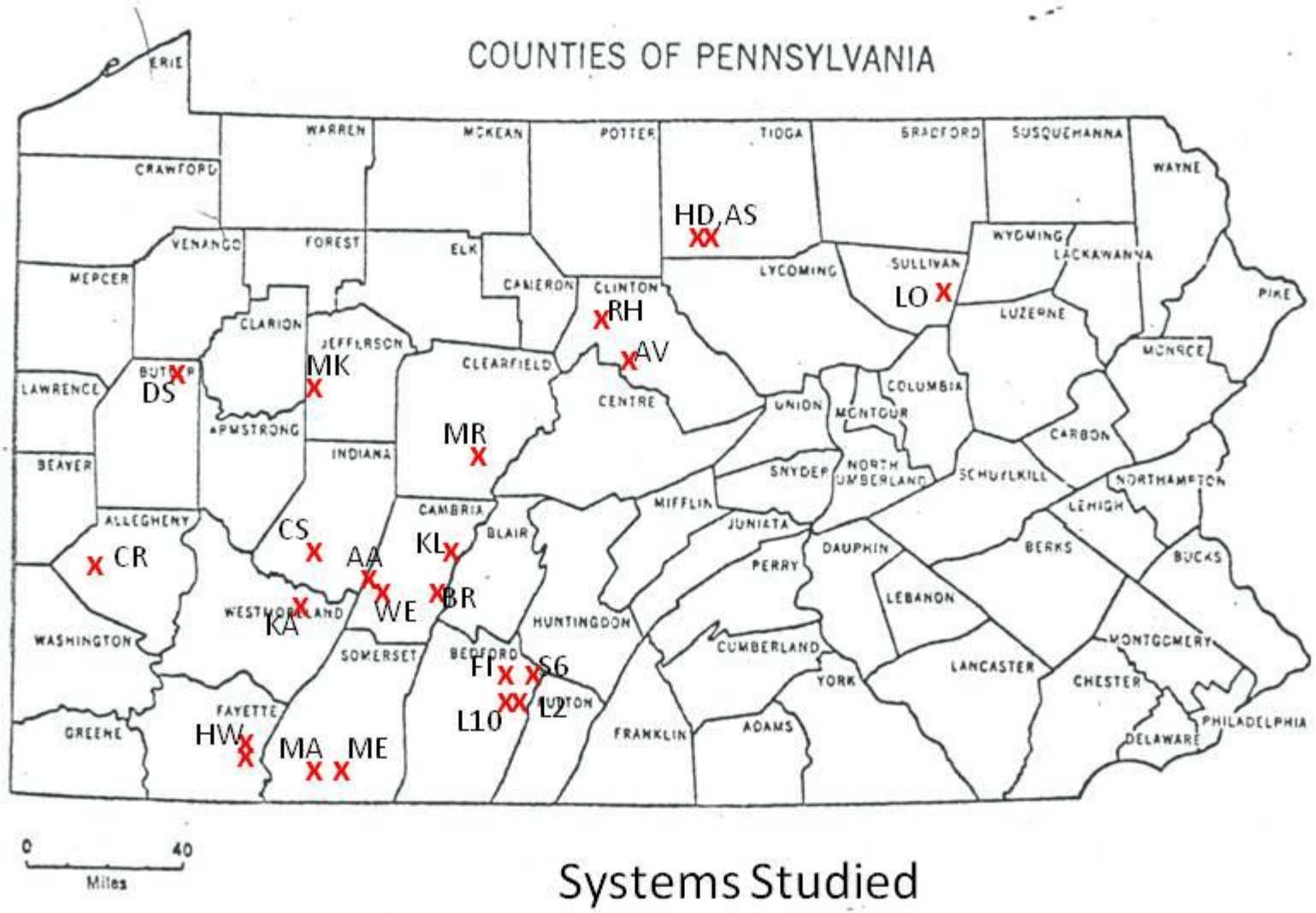
Selected Systems – "Failed"

- High Risk
- Harbison-Walker II (Fayette Co.)
- Kalp (Fayette)
- Metro (Somerset)
- AMD & Art (Cambria)
- Webster (Cambria)
- Yellow Cr. 2B (Indiana)
- Klondike 1 (Cambria)
- Finleyville (Bedford)
- Avery (Clinton)
- DeSale 1 (Butler)

- Medium Risk
- Clinton Road (Allegheny Co.)
- Morgan Run Frog (Clearfield)
- Six Mile Run SX0-D6 (Bedford)
- Longs Run LR0-D2 (Bedford)
- Low Risk
- Bear Rock Run (Cambria)
- Cessna (Indiana)
- Robbins Hollow 10/15 (Clinton)
- McKinley (Jefferson)

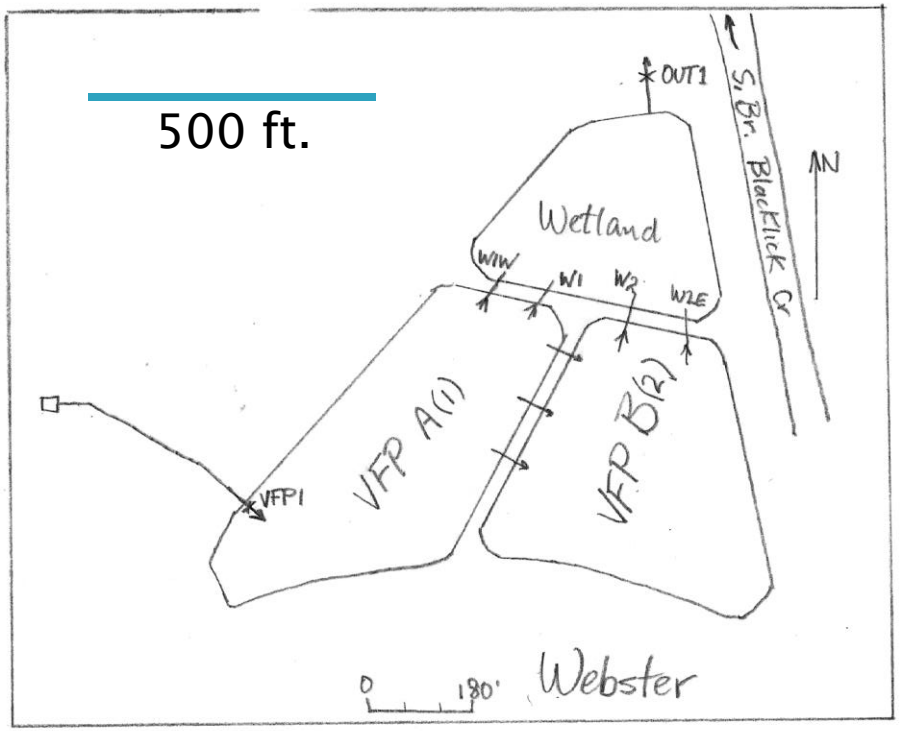
Selected Systems – Successful

- Hunters Drift (Tioga Co.)
- Anna S (Tioga Co.)
- Maust (Somerset Co.)
- Harbison Walker 1(Fayette (Co.)
- Loyalsock C-Vein (Sullivan Co.)
- Longs Run LR0-D10 (Bedford Co.)



Systems Studied

Webster (Cambria Co.)



Inflow: 480 gpm, pH 2.8, Acidity 326, Fe 23, Al 34.

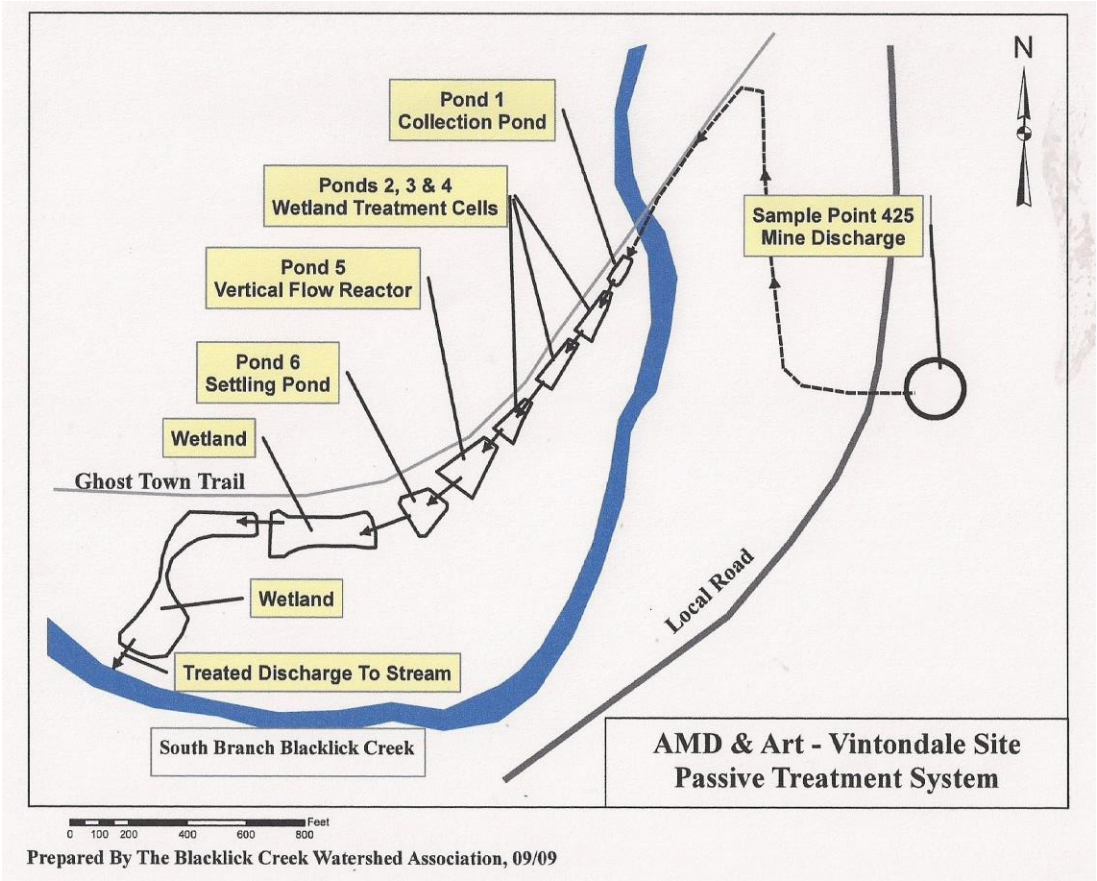
Outflow: pH 3.4, acidity 206, Fe 13, Al 25.

Loading:24 $g/m^2/d$

Designer: GAI, 2004

System is largely plugged by Al, No apparent provision for flushing.

AMD & Art (Cambria)

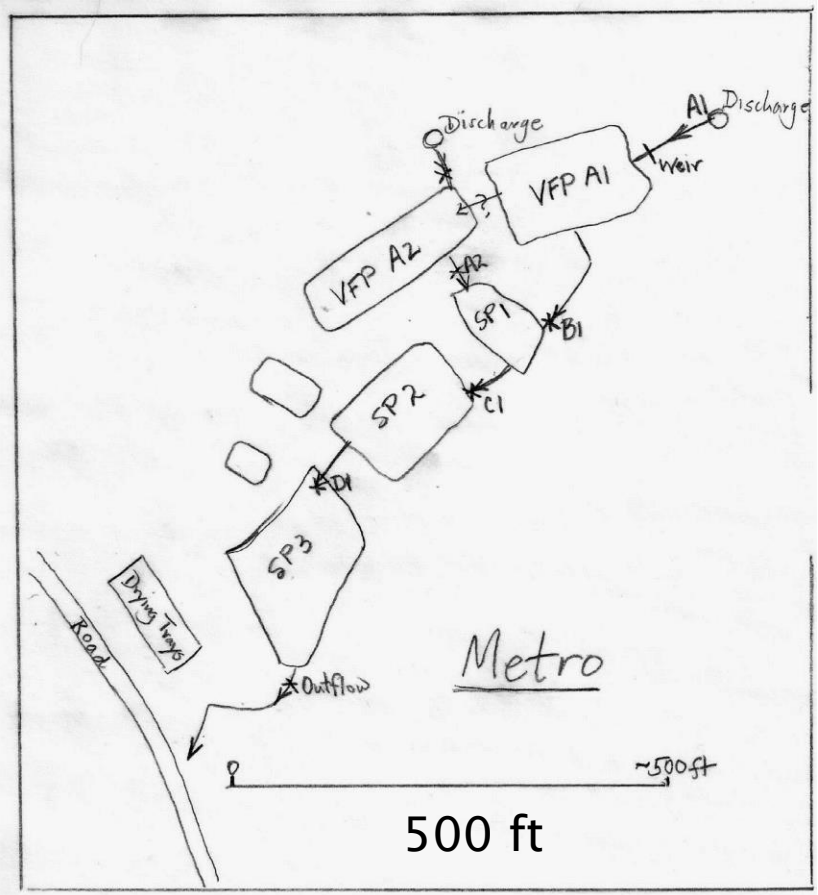


Inflow:210 gpm, pH 3.3
Acidity 352, Fe 17, Al 31.
Outflow: pH 6.6, acidity -38,
Fe 46, Al 2.5 (Poor data,
mostly acidic in 2001-05)

Constructed 2001,
modified 2005, design
by Earthtech.

No maintenance except by kids; inflow blocked several years.
VFP is greatly overloaded (50-400 $g/m^2/d$). Anaerobic wetlands.

Metro (Somerset Co.)



Inflow: 53 gpm, pH3.0, Acidity 621, Fe 120, Al 49.
Outflow: pH 2.8, acidity 510, Fe 60, Al 38.

Built 2003, Designer Damariscotta

The VFP is largely plugged with Al

The system was designed to be flushed and recover the very high Al, but essentially no flushing was done by Southern Alleghenies Conservancy.

Finleyville (Bedford Co.)

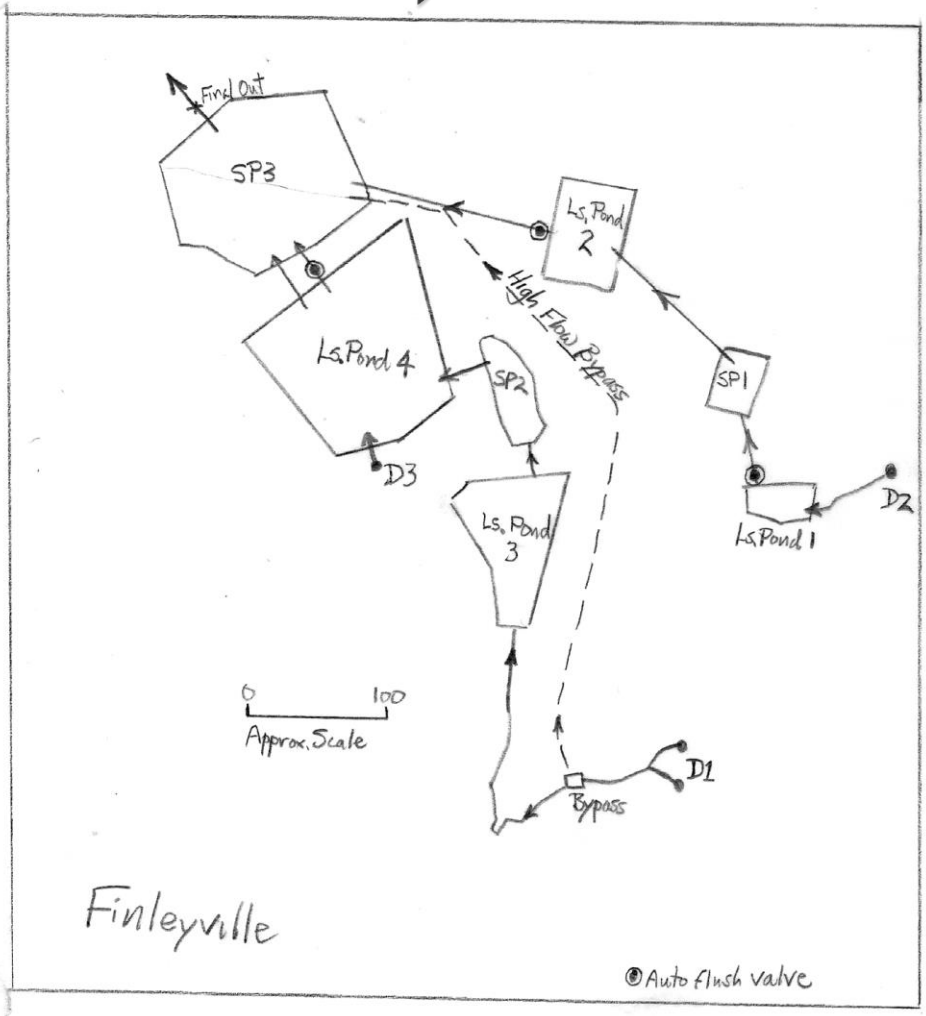
3 Discharges

Inflow (D1):180 gpm, pH 3.1, Acidity 149, Fe 2.5, Al 15
D2, D3 similar.

Outflow: 303 gpm, pH 5.2, Acidity 31, Fe 0.5, Al 4.6.

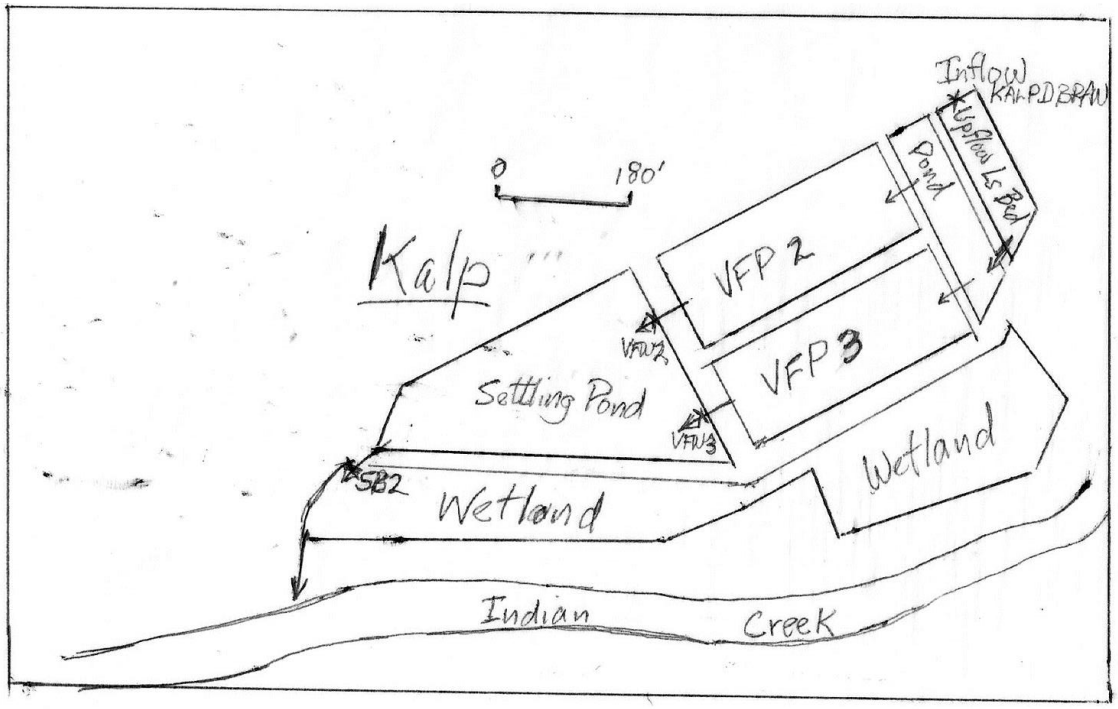
4 flushing limestone ponds

Built 2005, Skelly and Loy, recent limestone cleaning by Broadtop Twp.



Most acidity removed, good maintenance, **stream mostly recovered, being considered for removal from 303d list.**

Kalp (Fayette Co.)



Inflow: 103 gpm, pH 3.1.
Acidity 164, Fe 22, Al 10

Outflow: 82 gpm, pH 6.3,
Acidity -8, Fe 0.9, Al 1.5

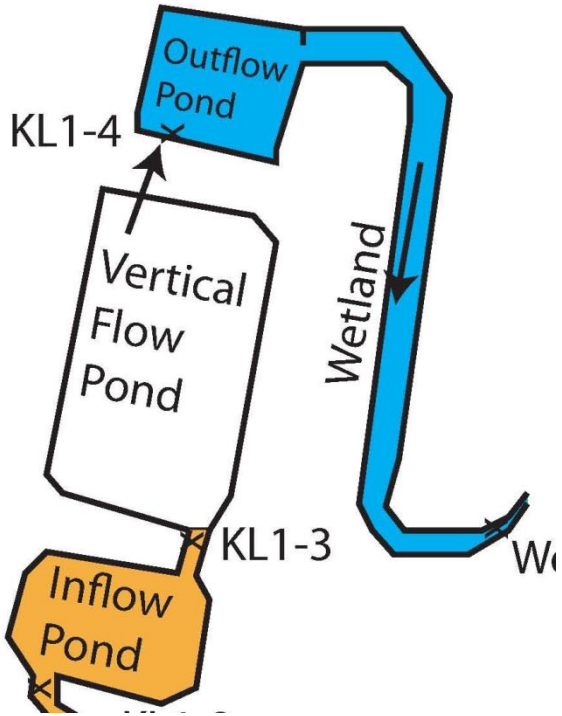
DEP sample from wetland outflow was acid – Leakage from Inflow sys.

Limestone pond and 2 VFP's

Built 2007, designer NRCS.

System appears to be releasing net alkaline water, but leakage from inflow boreholes is untreated so final outflow is acid.
Maintenance underway.

Klondike KL1



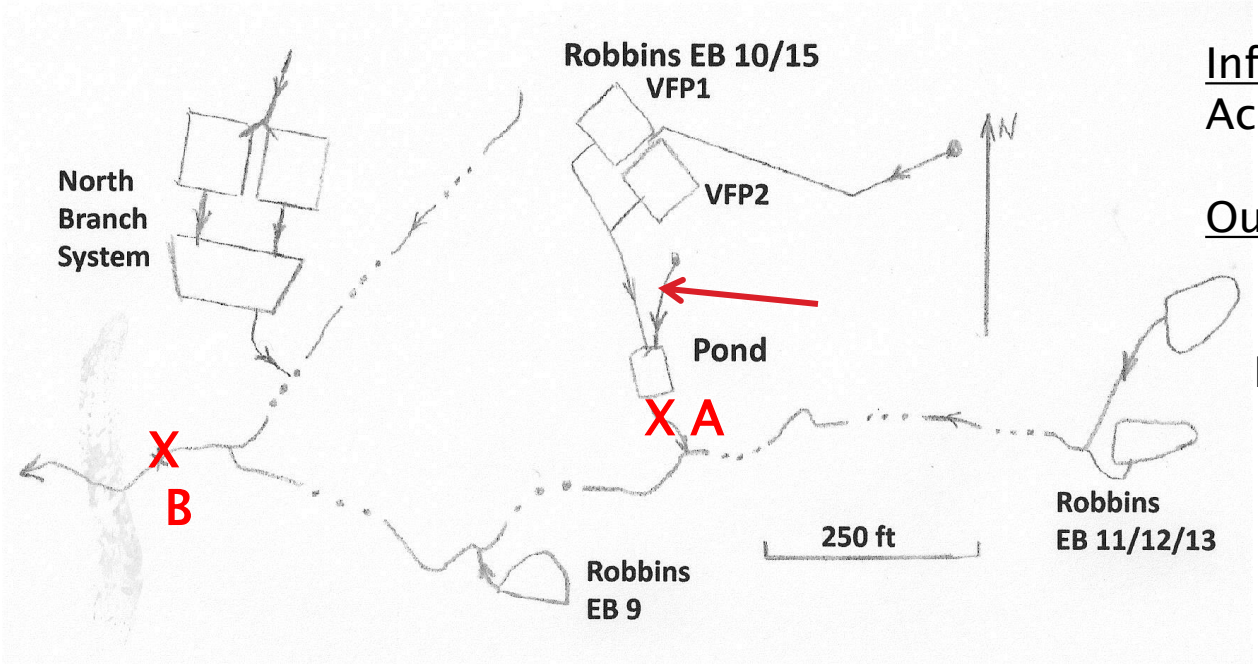
Inflow: 14 gpm, pH 3.0, Acidity 357, Fe 120, Al 2 mg/L
Outflow: 24 gpm, pH 3.8, Acidity 98, Fe 13, Al 1.3 mg/L.

System overflows at 25 gpm. Recent compost removal showed large proportion of impermeable dirt in residual compost, very little organics left.

Built 2007, Designer John Foreman

Permeability problems of compost, probably since construction. Compost contained much soil, and organics largely consumed in 7 years.

Robbins Hollow 10/15 (Clinton Co.)



Inflow: 11 gpm, pH 3.5
Acidity 126, Fe 0.6, Al 20

Outflow: pH 5.3, Acidity 39

Built 2005, Hedin Env.

Part of the 10/15 discharge did not go into the VFP's and was not treated, giving net acid outflow at A, but total set of systems gave net alkaline at B.

Effectiveness & Problems

Site	% Acidity rem.	Problems
AMD & Art	?	**Maint.**, Sampling, Design
Avery	100?	**Constr.**, Maint. Sampling
DeSale	99	**OK**
Finleyville	91	**OK**
Harbison-Walker 2	low	**Design**
Kalp	100	**Design**, Sampling
Klondike 1	73	**Constr.**
Metro	18	**Maint.**, Design
Webster	37	**Design**
Yellow Creek 2A	100	**Maint.**, Sampling
Average % Acidity removed 2008-13		

Downstream Recovery

DeSale 1	Fish, 303d removal underway
Finleyville	Fish, 303d removal underway
LR0D2	Fish, 303d removal underway
Sx0D2	Fish, 303d removal underway
MR Frog	Bugs
Robbins Hollow	Fish
Bear Rock Run	Bugs, net alkaline
Cessna	Net alkaline

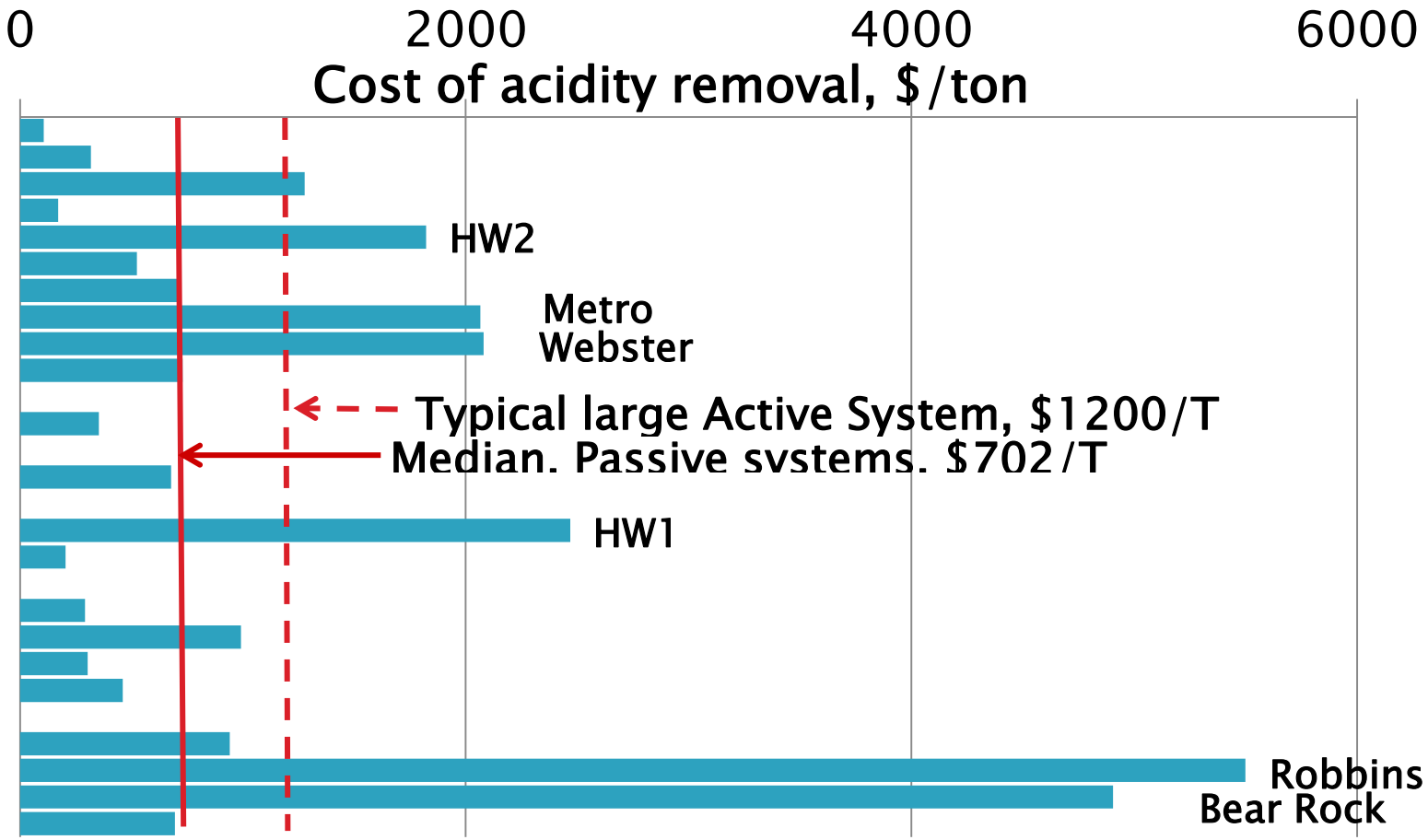
Successful Systems

Site	Built	Flow(gpm)	pH in	Acidity in	Fe in	Al in	Acidity out
Hunters Drift	2004	208	2.8	349	37	37	-95
Anna S	2004	203	3.3	113	5	10	-99
Maust	1998	20	3.2	143	33	2	-39
Harbison Walker 1	1999	14	4.5	77	89	0	-12
Long Run LR0D10	2005	20	3.2	442	145	10	-61

Some systems have successfully treated very bad water for many years.

Hunters, Anna S and Maust: Fine limestone mixed into compost.
Long Run LR0D10: Initial limestone bed followed by VFP.
Harbison Walker 1: Initial ALD followed by VFP.

Cost Passive vs. Active



Conclusions

- Many of the “failures” in the DEP Survey are actually treating well when sampling and effects on streams are considered.
- Some systems suffer from poor design/construction or lack of maintenance.
- Large flows of very bad AMD can be treated successfully with proper designs and maintenance.
- Cost of passive treatment is considerably lower than active for most sites