Long-term Performance and O&M Costs for the Marchand Passive Treatment System

Bob Hedin
Hedin Environmental
Iron Oxide Recovery

Elements of a Successful Treatment System

- Effluent quality meets expectations
- Routine operational needs are satisfied
- Major maintenance needs are satisfied
- The total cost of treatment is affordable

Marchand Passive Treatment System

- Pittsburgh coal seam deep mine abandoned in 1940's
- Discharge into Sewickley Creek (Youghiogheny River)
  - 1,500 – 2,500 gpm; high metals
- Since 1990s, alkaline Fe chemistry
  - pH 6.3, Fe 60-80 mg/L, Mn 1 mg/L, Al <1 mg/L,
- Passive system installed in 2005/06 by Sewickley Creek Watershed Association
- $1,250,000 for design, permitting, construction


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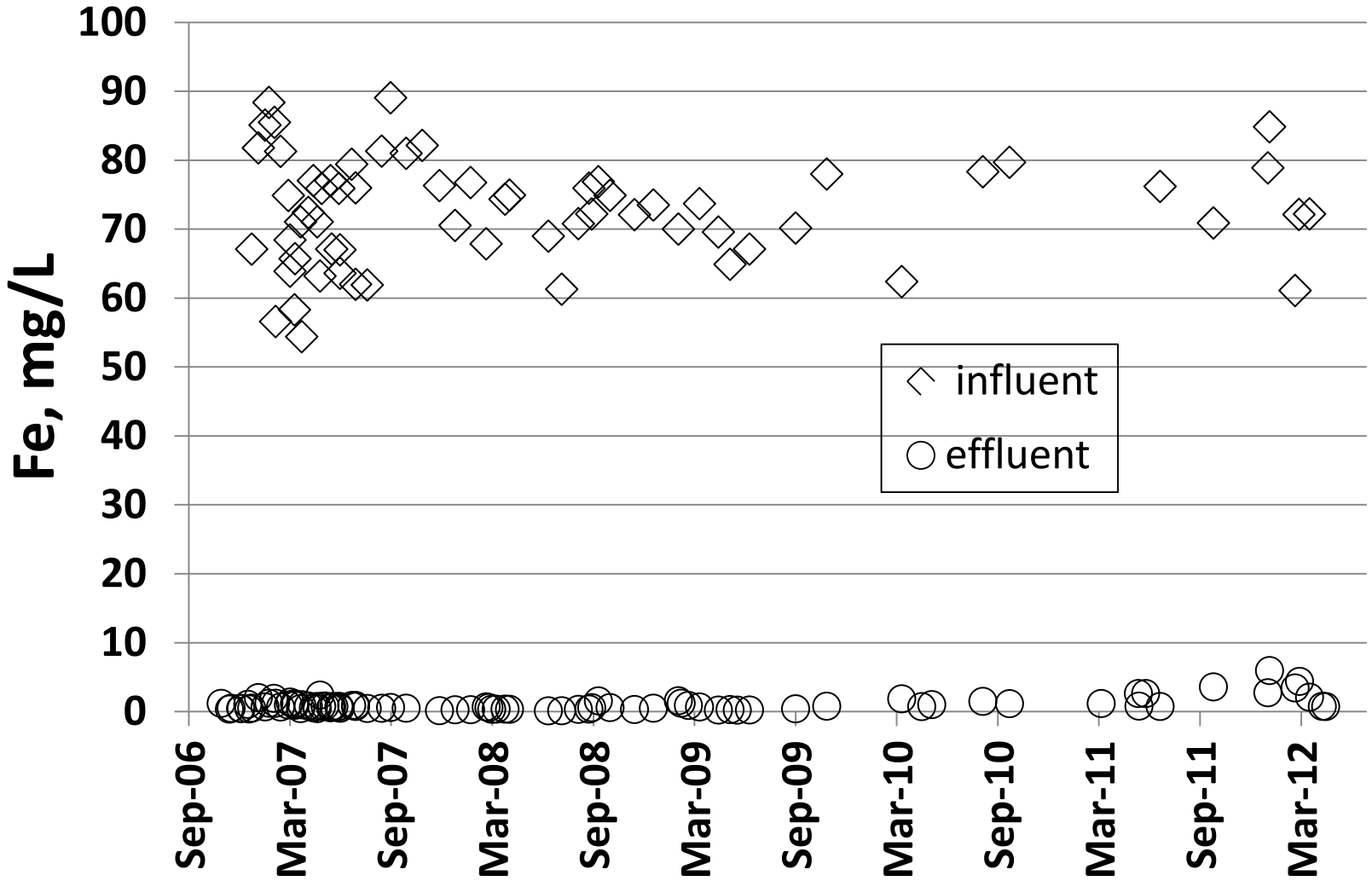
Imagery Date: 7/2/2010
1993
40°14'55.40" N 79°45'56.89" W elev 767 ft
Eye alt 3072 ft

Effluent quality meets expectations?

Marchand System Average Performance, Nov '06 – May '12							
	Flow	pH	Alk	Fe	Mn	Al	SO_4
	gpm		mg/L	mg/L	mg/L	mg/L	mg/L
Influent	1,887	6.3	334	72.5	1.2	<0.2	1,137
Effluent	na	7.8	215	1.0	0.5	<0.2	1,166


Fe, mg/L
100
90
80
70
60
50
40
30
20
10
0
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
influent
effluent

Routine Operation

- Inspections every 2-3 months by volunteers
- Sampling when funding allows
- Trough and pipe cleanouts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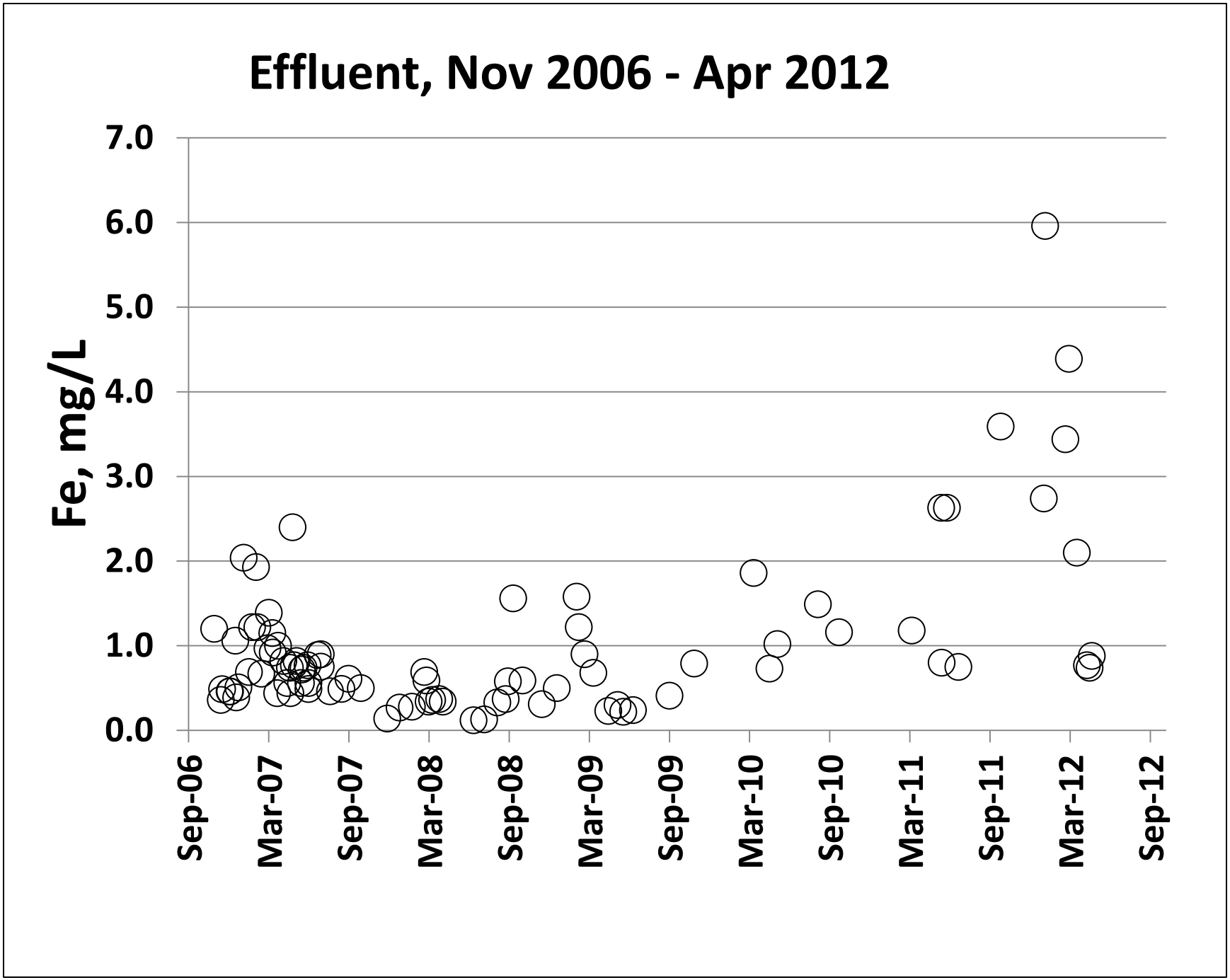
Routine Operation

- Inspections every 2-3 months by volunteers
- Sampling when funding allows
- Trough and pipe cleanouts
- Approximately 75 man-hrs/yr

Major Maintenance

2008	Berm modifications in wetland and trough improvements ($6,000)
2010	Wetland discharge channel repairs , wetland bank reinforcement, pipe cleanout ($10,000)
2011	Pipe cleanout ($2,000)
2012	Pipe removal and replacement with troughs ($15,000)
2012	Sludge removal from Ponds A, B, and C ($119,000)


Effluent, Nov 2006 - Apr 2012
Fe, mg/L
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12

Sludge Removal

- June 18 – 29, 2012
- Coordinated with pipe replacement project
- Cleaned out first three ponds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1993
40°14'55.40" N 79°45'56.89" W elev 767 ft
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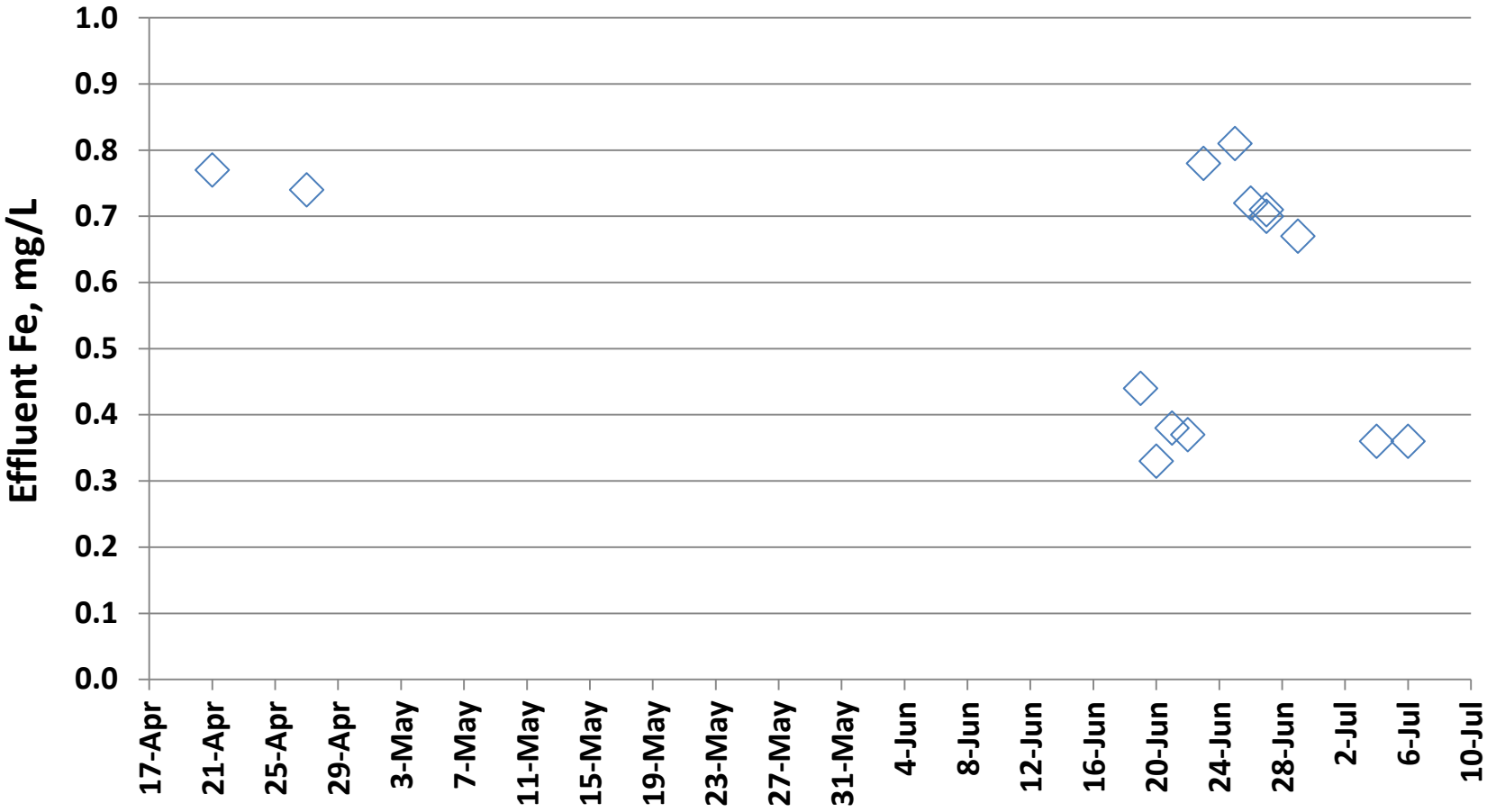
Quicke


650H



Concentrations of Fe at the wetland effluent The project began on June 18. Water was bypassed into Pond B on June 18, into Pond C on June 22, and into Pond D on June 25. The project finished on June 29. The last two data points were collected with the system was again operating as designed. Sludge recovery did not degrade the final effluent

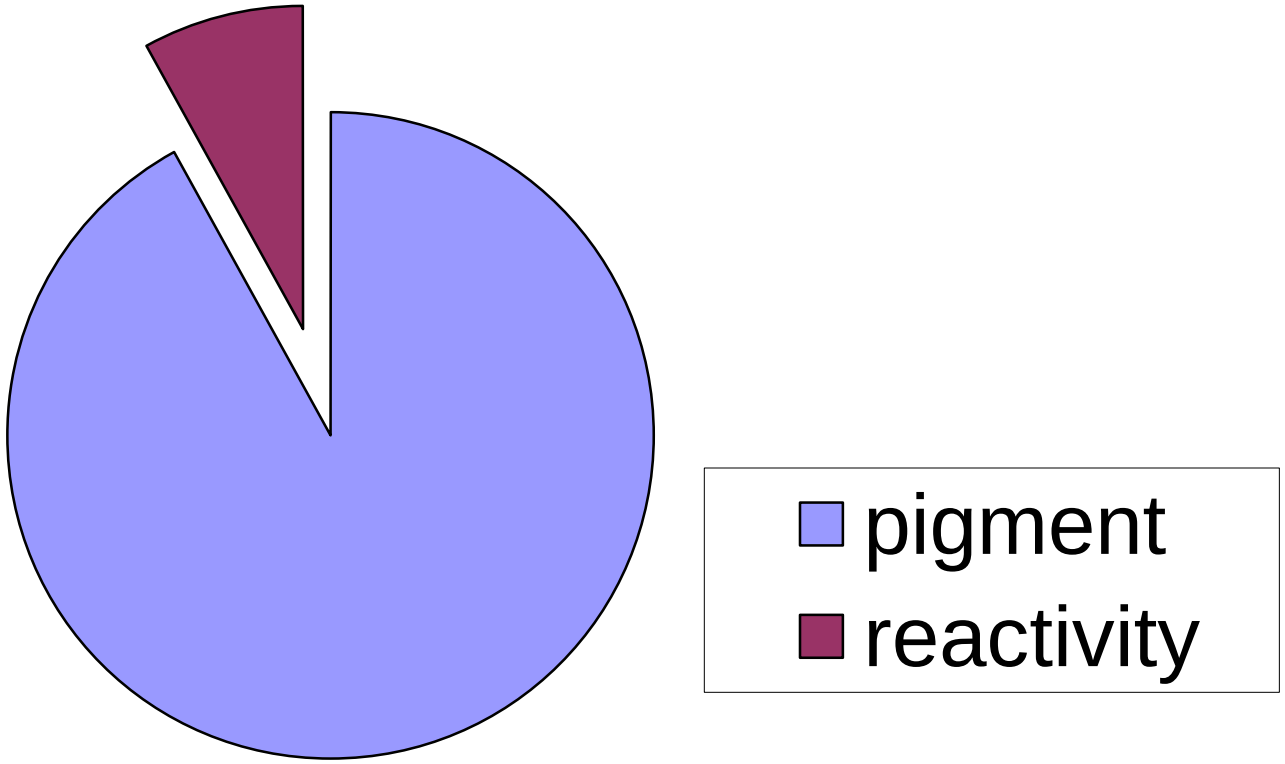
Sludge Removal

- June 18 – 29, 2012
- Coordinated with pipe replacement project
- Cleaned out first three ponds
- Cost
  - Materials $66,000
  - Machinery $20,000
  - Labor $33,000
  - Total $119,000 (Geotubes, $63,000)
- Supported in part by WPCAMR Growing Greener Grant

What Happens to the Sludge?

- Passively dry to 45% solids
- Sell as high purity iron oxide solid
- Landfill

Sales 2001-2012
3,420 tons



Composition of Treatment Solids

	Sludge Composition (dry weight)							
	Si	**Al**	**Fe**	**Mn**	**Mg**	**Ca**	**S**	**C**
Treatment Type and AMD Chemistry	%	%	%	%	%	%	%	%
Lime: pH 3, Fe 70, Al 3	1.3	1.6	10.0	1.1	4.8	21.0	1.7	6.5
NaOH: pH 3, Fe 40, Al 20, Mn 20	3.4	6.6	4.1	8.9	14.7	2.6	na	na
H_2O_2: pH 7, Fe 15, Al <1, Mn <1	1.5	0.1	51.3	0.1	0.0	1.3	0.1	na
Aeration: pH 7, Fe 80, Al <1, Mn 2	1.6	0.2	47.6	0.1	1.7	3.1	na	na
Passive: pH 6, Fe 75, Al <1, Mn 2	2.3	0.2	54.3	0.0	0.0	0.3	0.2	1.4
Passive: pH 5, Fe 115, Al <1, Mn 14	0.3	0.0	57.3	0.0	0.0	0.0	na	na
Passive: pH 4, Fe 40, Al 3, Mn 1	0.7	0.1	54.0	0.0	0.0	0.0	1.8	na
Reference, Goethite ,FeOOH			62.9					
Reference, Calcite, $CaCO_3$						40.0		12.8
Reference, Gypsum, $CaSO_4$ $2H_2O$						23.3	18.6	

Financial Analysis (sludge disposal)

	Cost	Present Value*	$/Fe(ton)	$/1000 gal
Construction	$1,250,000	$1,250,000	$127	$0.032
Operations	$2,000/yr	$47,000	$12	$0.003
Maintenance	$5,000/yr	$117,000	$12	$0.003
Sludge recovery	$41,000/yr	$967,000	$98	$0.024
Sludge sale	($4,000)	($92,000)	($9)	($0.002)
Total, with Sludge Sale		$2,290,000	$232	$0.058
Sludge disposal	$44,000/yr	$1,024,000	$104	$0.026
Total with disposal		$3,405,000	$345	$0.086

*PV Assumptions: 40 years, 0.029% net return on investment

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Maintenance	$5,000/yr	$117,000	$12	$0.003
Sludge recovery	$41,000/yr	$967,000	$98	$0.024
Sludge sale	($4,000)	($92,000)	($9)	($0.002)
Total, with Sludge Sale		$2,290,000	$232	$0.058
Sludge disposal	$44,000/yr	$1,024,000	$104	$0.026
Total with disposal		$3,405,000	$345	$0.086

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These unit costs are 1/3 – 1/2 the unit costs of lime treatment plants.

Elements of a Successful Treatment System
Marchand Assessment

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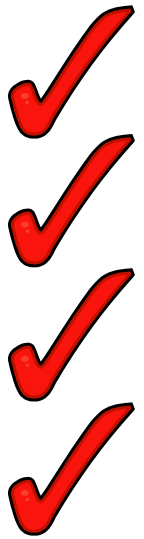

Comments or Questions?

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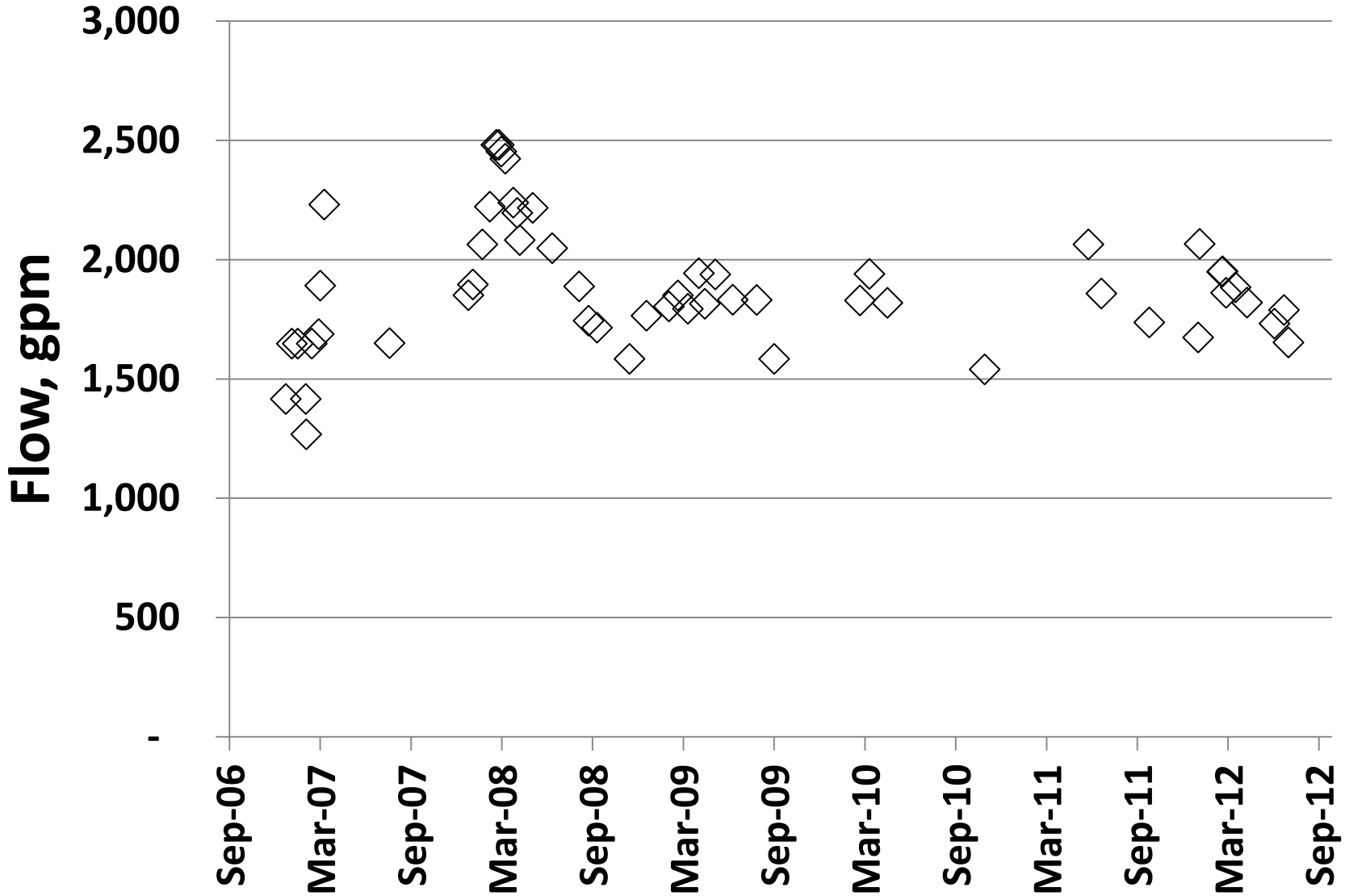
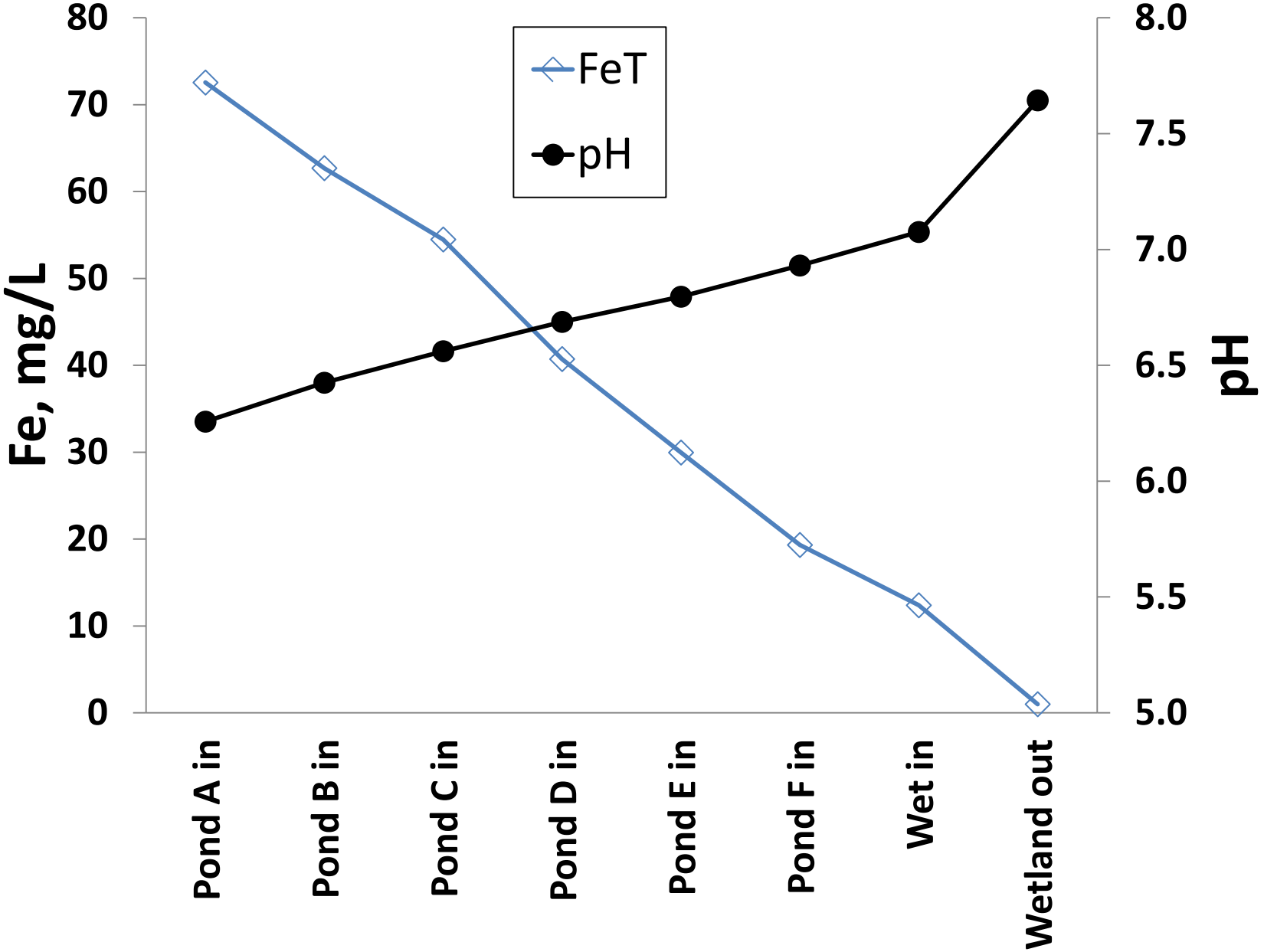
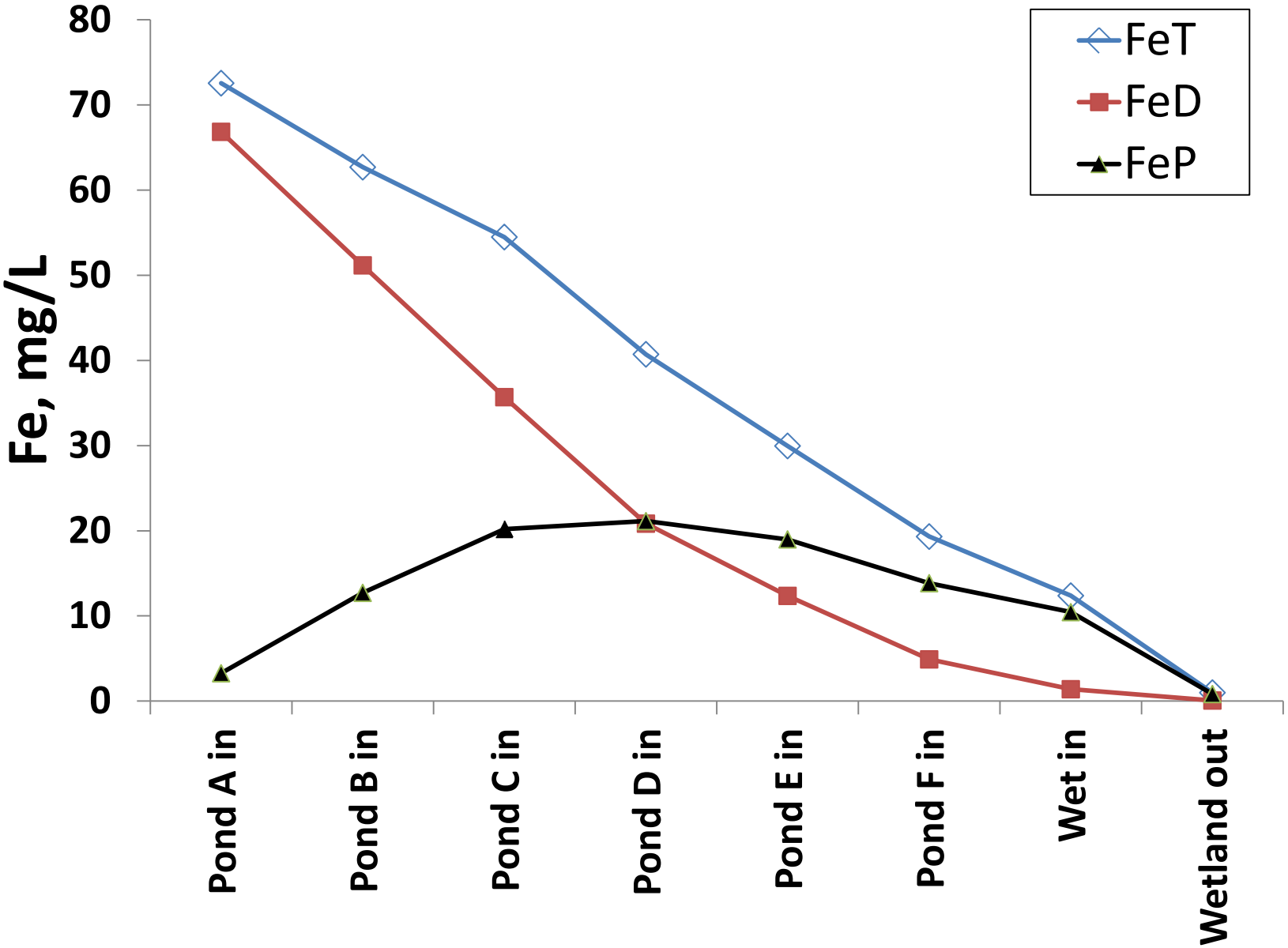
How do these costs compare?

- Marchand: total cost is $0.062 / 1000 gallons
- LTV Lime Treatment Plants
  - 7,000 gpm, Fe discharges
  - $1,000,000/yr
  - $0.160 / 1000 gallons for operational costs
- Lancashire
  - 6,000 gpm, Fe discharge
  - $13,000,000 construction
  - $300,000/yr (???)
  - $0.159 / 1000 gallons for construction and operation


Flow, gpm
3,000
2,500
2,000
1,500
1,000
500
-
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12


80
70
60
50
40
30
20
10
0
Fe, mg/L
8.0
7.5
7.0
6.5
6.0
5.5
5.0
pH
FeT
pH
Pond A in
Pond B in
Pond C in
Pond D in
Pond E in
Pond F in
Wet in
Wetland out


80
70
60
50
40
30
20
10
0
Fe, mg/L
FeT
FeD
FeP
Pond A in
Pond B in
Pond C in
Pond D in
Pond E in
Pond F in
Wet in
Wetland out