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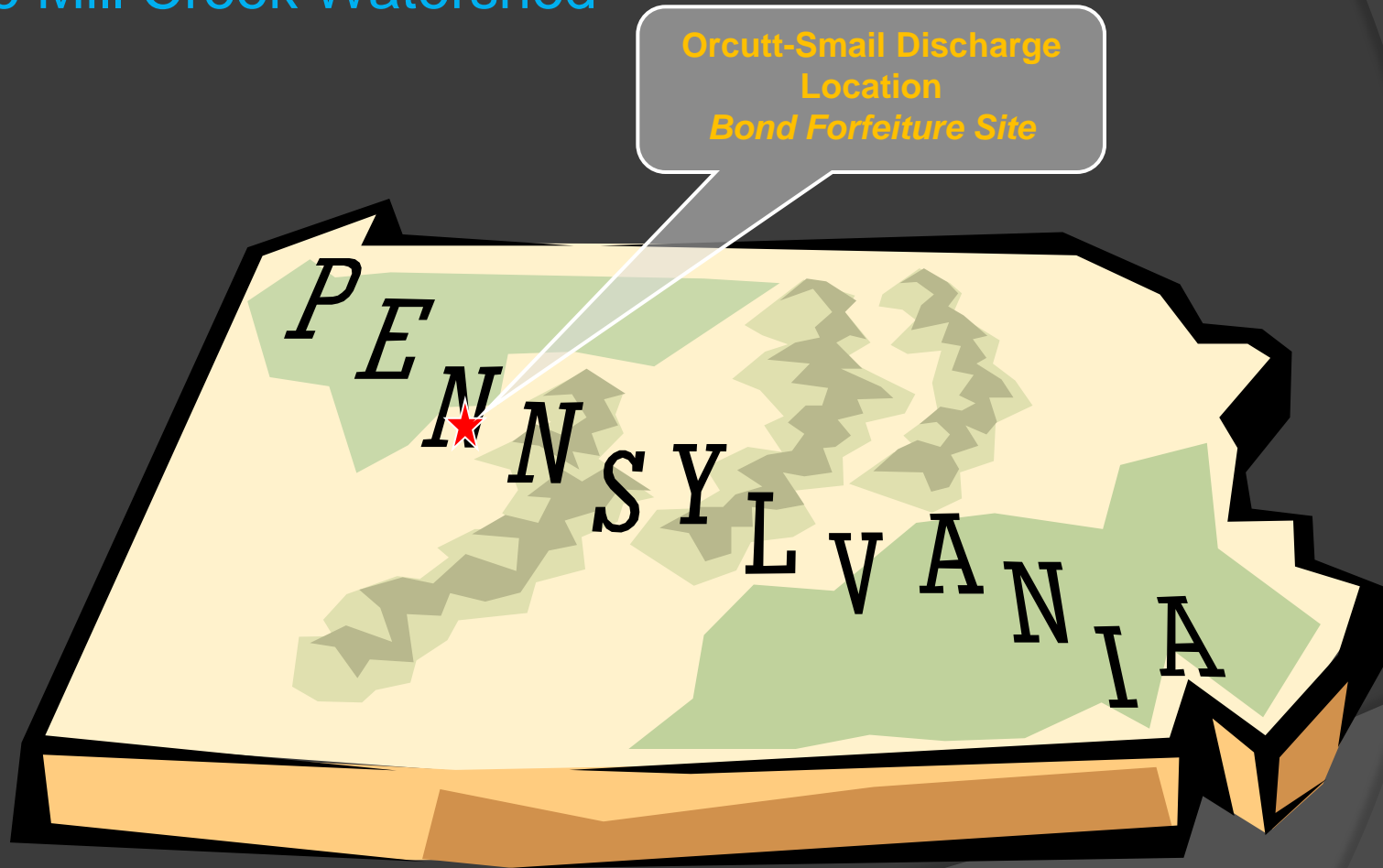
**& Matt Morosetti
W.K. Merriman, Inc.**

AN INNOVATIVE PACKAGE TREATMENT SYSTEM FOR THE ORCUTT-SMAIL DISCHARGES

Who We Are?

IOT provides innovative and cost effective solutions to solve complex treatment challenges with simple and integrated treatment processes.

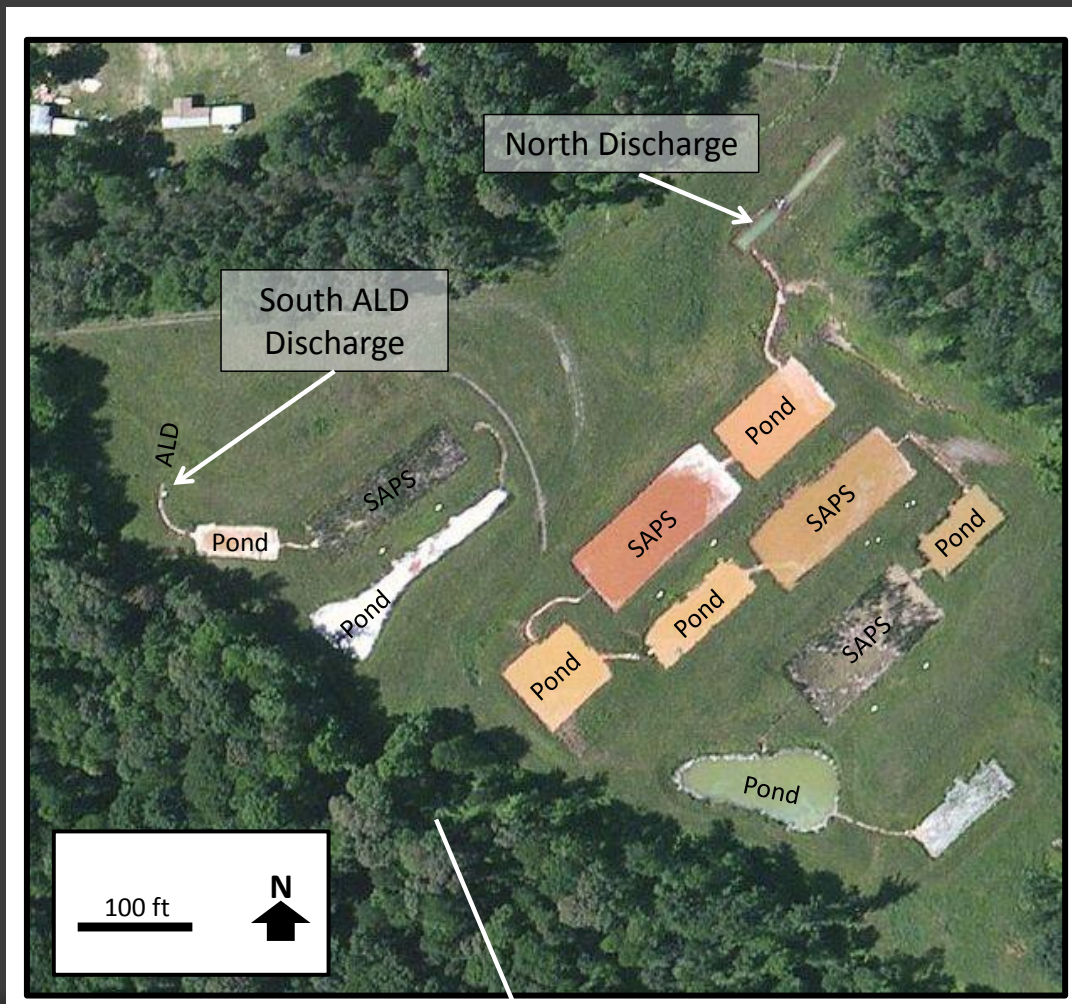
Orcutt-Smail Location in Jefferson County near Corsica, PA in the Mill Creek Watershed



Orcutt & Smail Project

South & North Passive Treatment Systems

2010 Photo



- **Designed by NRCS with assistance from Damariscotta**
- **State-of-the-Art Multi-cell SAPS Flushing System**
- **Constructed in 2006**
- **Construction Cost ~ \$1.1 million**
- **Initial Deterioration Conditions 2009**
- **Effluent Net Alkalinity < 0**
- **System Failure 2011**

Field and laboratory analysis of the South and North Discharges

5 : 2

Parameter	Unit	North	South	North/South Mixture
Field pH	s.u.	4.54	5.76	5.10
Lab pH	s.u.	4.57	6.00	4.99
Temperature	°C	9.8	10.9	10.2
Field Conductance	μS	2800	1810	2430
Lab Conductance	μS	2942	2080	2550
TDS	mg/L	2089	1477	1811
Dissolved O ₂	mg/L	0.8	0.35	0.7
“Cold” Acidity	mg/L as CaCO ₃	877	539	767
“Hot” Acidity	mg/L as CaCO ₃	629	245	481
Alkalinity	mg/L as CaCO ₃	2	90	14
Total Iron	mg/L	309	148	284
Total Manganese	mg/L	111	63.6	103
Total Aluminum	mg/L	12.8	0.80	9.3
Total Calcium	mg/L	159	224	167
Total Magnesium	mg/L	229	135	215
Sulfate	mg/L	2640	1440	2110

Risk Analysis Matrix For Category 4 Passive Treatment Systems

Developed by PADEP with Technical Assistance by OSM

Risk Analysis Matrix				
Summation of Fe and Al Concentration	Design Flow Rate for each treatment cell			
	< 25 gpm	≥ 25 < 50 gpm	≥ 50 < 100 gpm	≥ 100 < 200 gpm
< 5 mg/L	Low	Low	Low	Low
≥ 5 but < 15 mg/L	Low	Medium	Medium	Medium
≥ 15 < 25 mg/L	Low	Medium	Medium	Medium
≥ 25 < 50 mg/L	Medium	Medium	Medium	High
≥ 50 mg/L	High	High	High	High
Summation of Fe and Al Concentration	Design Flow Rate for each treatment cell			
	≥ 200 < 400 gpm	≥ 400 < 800 gpm	≥ 800 < 1600 gpm	≥ 1600 gpm
< 5 mg/L	Medium	Medium	Medium	High
≥ 5 but < 15 mg/L	Medium	High	High	High
≥ 15 < 25 mg/L	High	High	High	High
≥ 25 < 50 mg/L	High	High	High	High
≥ 50 mg/L	High	High	High	High

Field Treatability Study

Field Equipment/Setup

Step 1 - Lime Addition & Mixing Only



No Aeration Tests



Aeration Tests



Step 1 – Pre-aeration

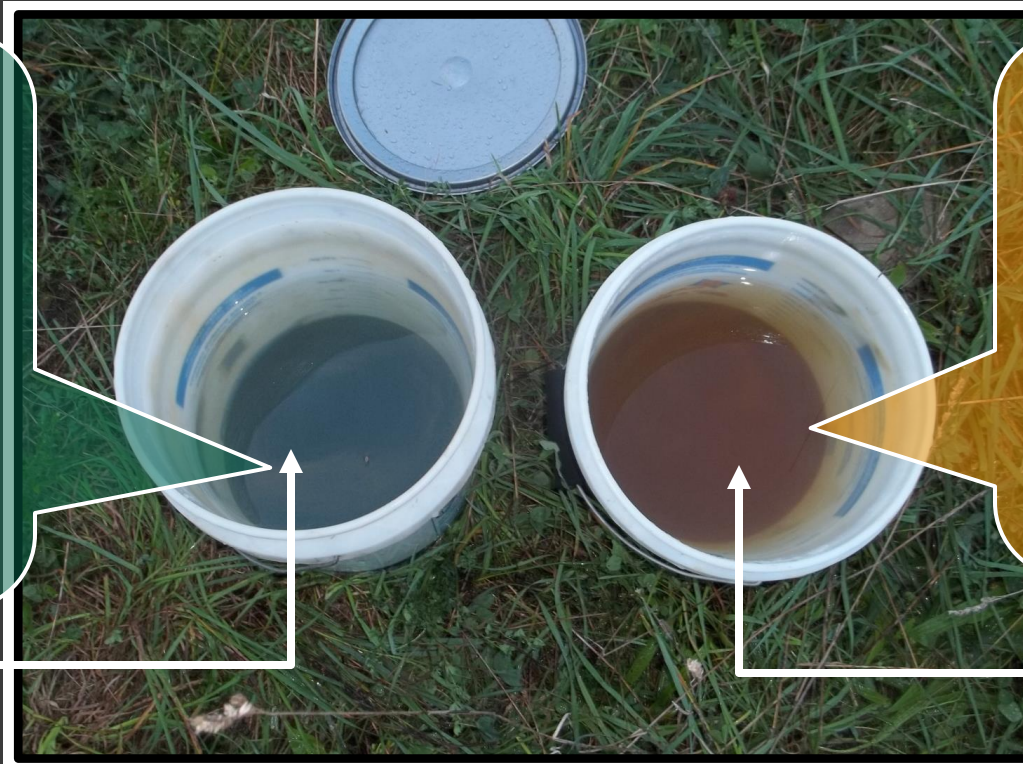


Step 2 – Aeration, Lime Addition & Mixing

Comparison of No Aeration Versus Aeration Hydrated Lime Dose Tests

“Green Rust” or Ferrous Hydroxide- $\text{Fe}(\text{OH})_2$ formation is evident.

Stability of $\text{Fe}(\text{OH})_2$ sludge is a concern as any pH decrease to less than 8 will resolubilize .



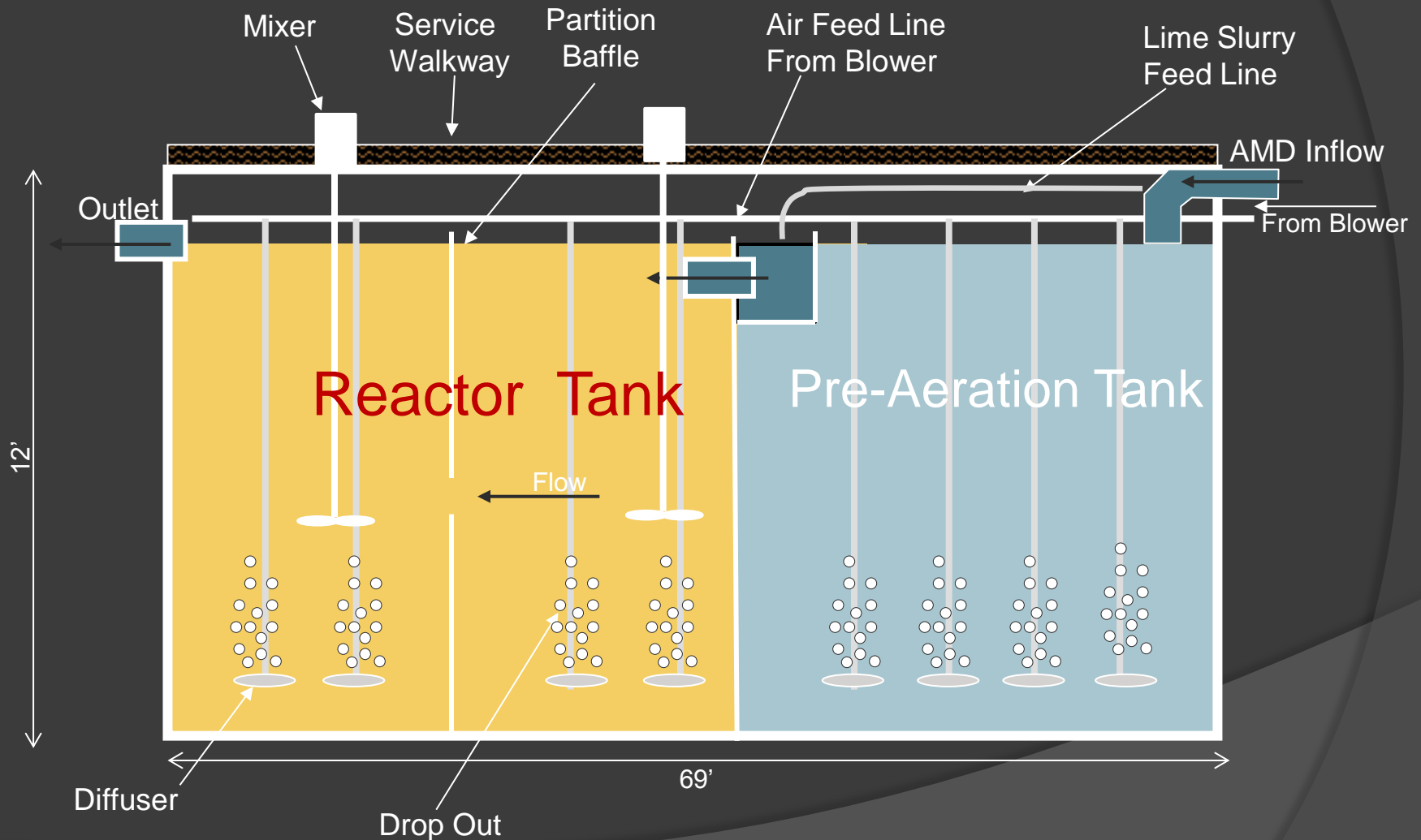
Ferric Hydroxide- $\text{Fe}(\text{OH})_3$ formation is evident.

Stability of $\text{Fe}(\text{OH})_3$ sludge is of limited or no concern a pH less than 3 is required to resolubilize.

NO AERATION TEST

AERATION TEST

Pre-Aeration/Reactor Tank Conceptual Cross-Section

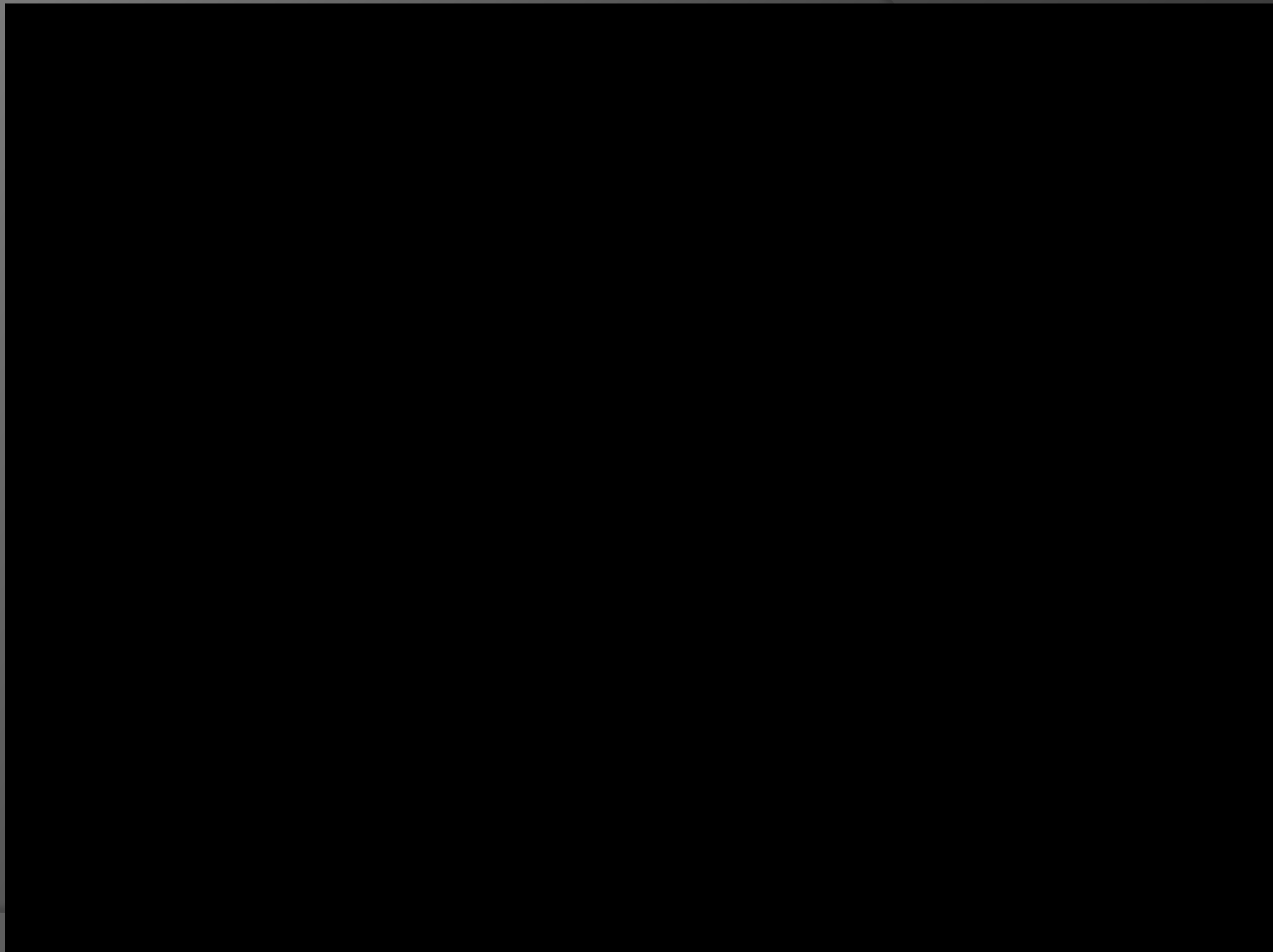


Not-to-Scale

Lime Slurry/Reactor System

Construction Summer/Fall 2014

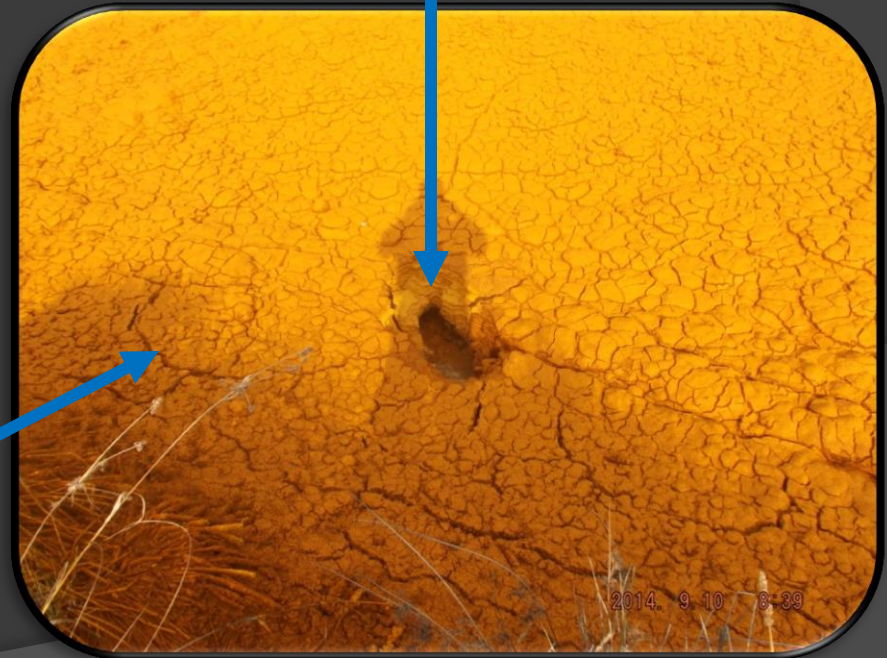
Start-up December 2014



Effects of Iron Accumulation & Repeated Flushing



Repeated Flushing Opens
Drains Through Compost
Directly to Limestone



Thick Iron Oxide Deposits
Limit Permeability of
Compost

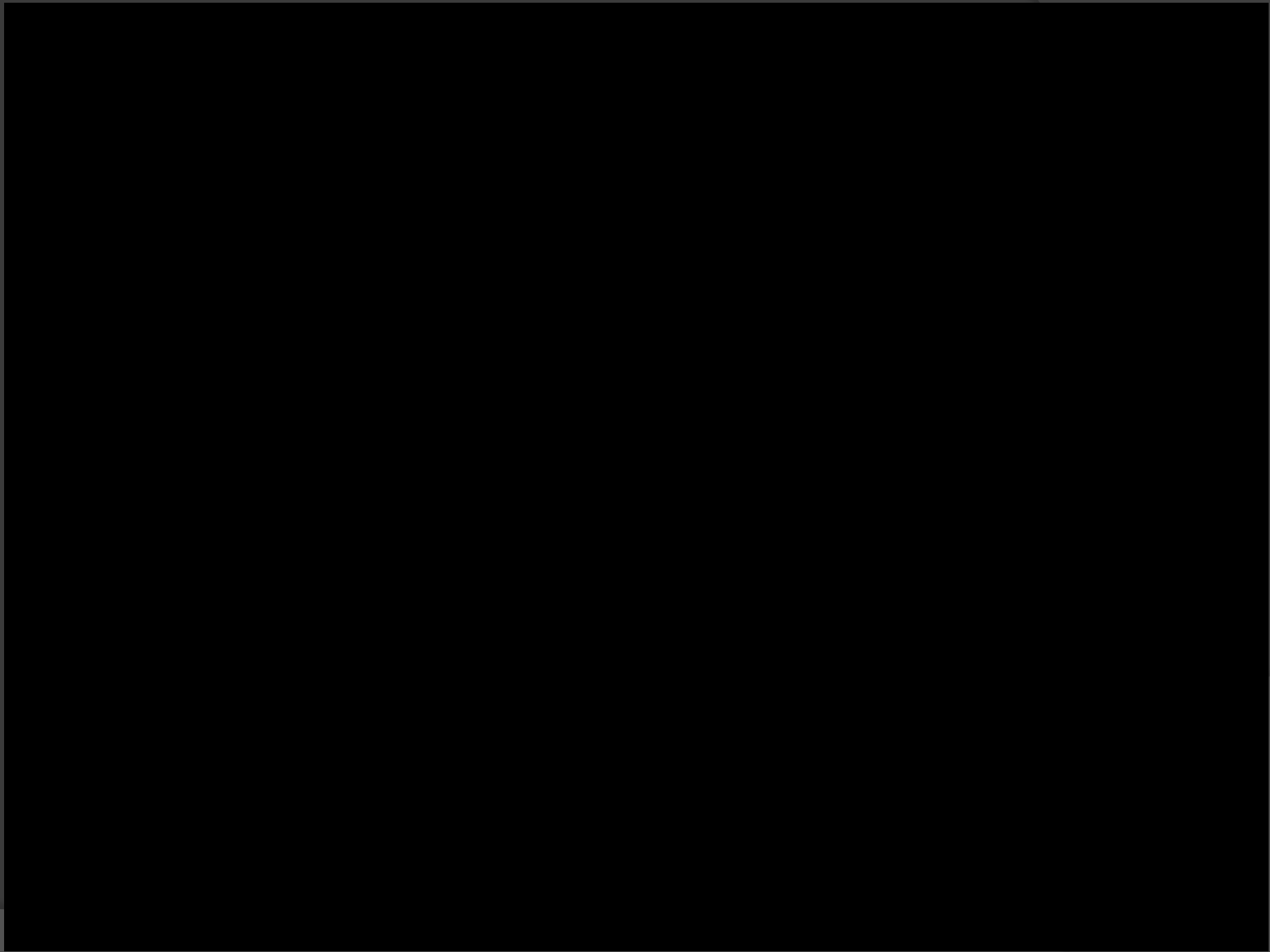
System Installation



Lime Slurry Tank Delivery & Placement

Reactor Tank System Delivery & Placement





System Monitoring & Alarm Via Internet/Smart Phone

Verizon 11:52 AM

Orcutt Small

Device Status

Alarm Inputs

- 1** Blower #1
- 2** Blower #2
- 3** Aeration Mixer #1
- 4** Aeration Mixer #2
- 5** Lime Slurry Mixer
- 6** Pump #1 Hose
- 7** Pump #2 Hose

General Alarms

- Primary Power**
Present
- Battery Status**

Status Pumps Influent Analogs More

Verizon 11:52 AM

Orcutt Small

Device Status

Alarm Inputs

- 7** Pump #2 Hose

General Alarms

- Primary Power**
Present
- Battery Status**
13.25 Volts
- Signal Strength**
-78 db

Analog Inputs

- 1** pH
9.30 pH
- 2** Lime Slurry Level
68.13 %
- 3** Pump #1 Speed
5.25 Hz
- 4** Pump #2 Speed
0.38 Hz

Status Pumps Influent Analogs More

System Monitoring & Alarm Via Internet/Smart Phone

Verizon LTE 10:30 AM

Orcutt Smail

✕ **AVG Analog Readings** ↻

Monday - 6/8/15

pH	Lime Slurry L...	Pump #1 Sp...	Pump #2 Sp...
9.21 pH	68.11 %	5.90 Hz	0.15 Hz

Sunday - 6/7/15

pH	Lime Slurry L...	Pump #1 Sp...	Pump #2 Sp...
9.28 pH	68.84 %	5.25 Hz	0.19 Hz

Saturday - 6/6/15

pH	Lime Slurry L...	Pump #1 Sp...	Pump #2 Sp...
9.27 pH	69.96 %	5.25 Hz	0.18 Hz

Friday - 6/5/15

pH	Lime Slurry L...	Pump #1 Sp...	Pump #2 Sp...
9.17 pH	70.96 %	4.98 Hz	0.17 Hz

Thursday - 6/4/15

pH	Lime Slurry L...	Pump #1 Sp...	Pump #2 Sp...
9.39 pH	72.22 %	5.24 Hz	0.14 Hz

Wednesday - 6/3/15

pH	Lime Slurry L...	Pump #1 Sp...	Pump #2 Sp...
9.40 pH	73.57 %	5.24 Hz	0.14 Hz

Status Pumps Influent **Analogs** More

Verizon LTE 10:30 AM

Orcutt Smail

◀ **Back** **Monday - 6/8/15**

09:59 AM

pH	Lime Slurry L...	Pump #1 Speed	Pump #2 Speed
9.30 pH	67.50 %	5.25 Hz	0.00 Hz

09:44 AM

pH	Lime Slurry L...	Pump #1 Speed	Pump #2 Speed
9.21 pH	67.50 %	5.25 Hz	0.00 Hz

09:32 AM

pH	Lime Slurry L...	Pump #1 Speed	Pump #2 Speed
9.21 pH	67.50 %	38.63 Hz	0.38 Hz

09:30 AM

pH	Lime Slurry L...	Pump #1 Speed	Pump #2 Speed
9.21 pH	68.13 %	0.00 Hz	0.00 Hz

09:29 AM

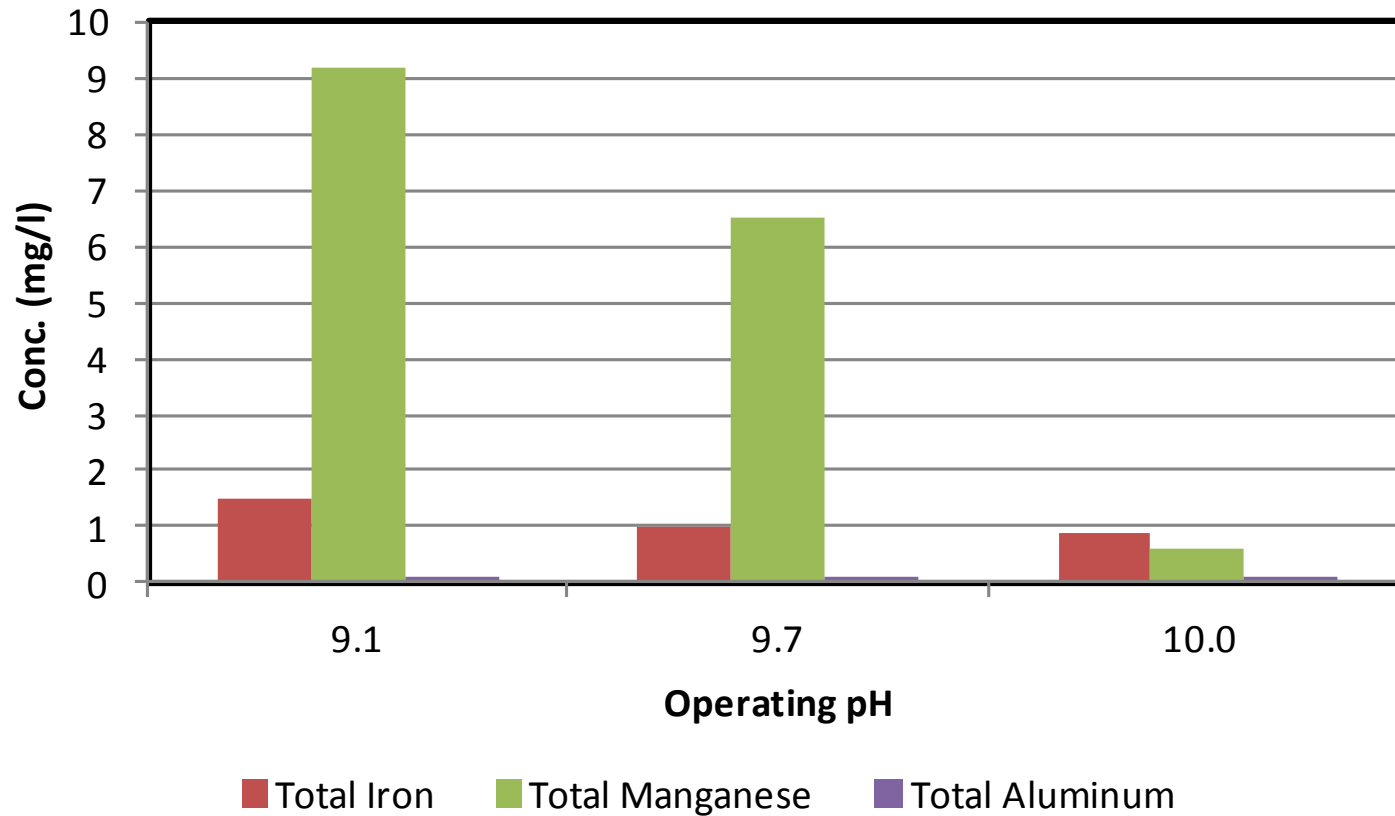
pH	Lime Slurry L...	Pump #1 Speed	Pump #2 Speed
9.21 pH	68.13 %	5.25 Hz	0.00 Hz

09:14 AM

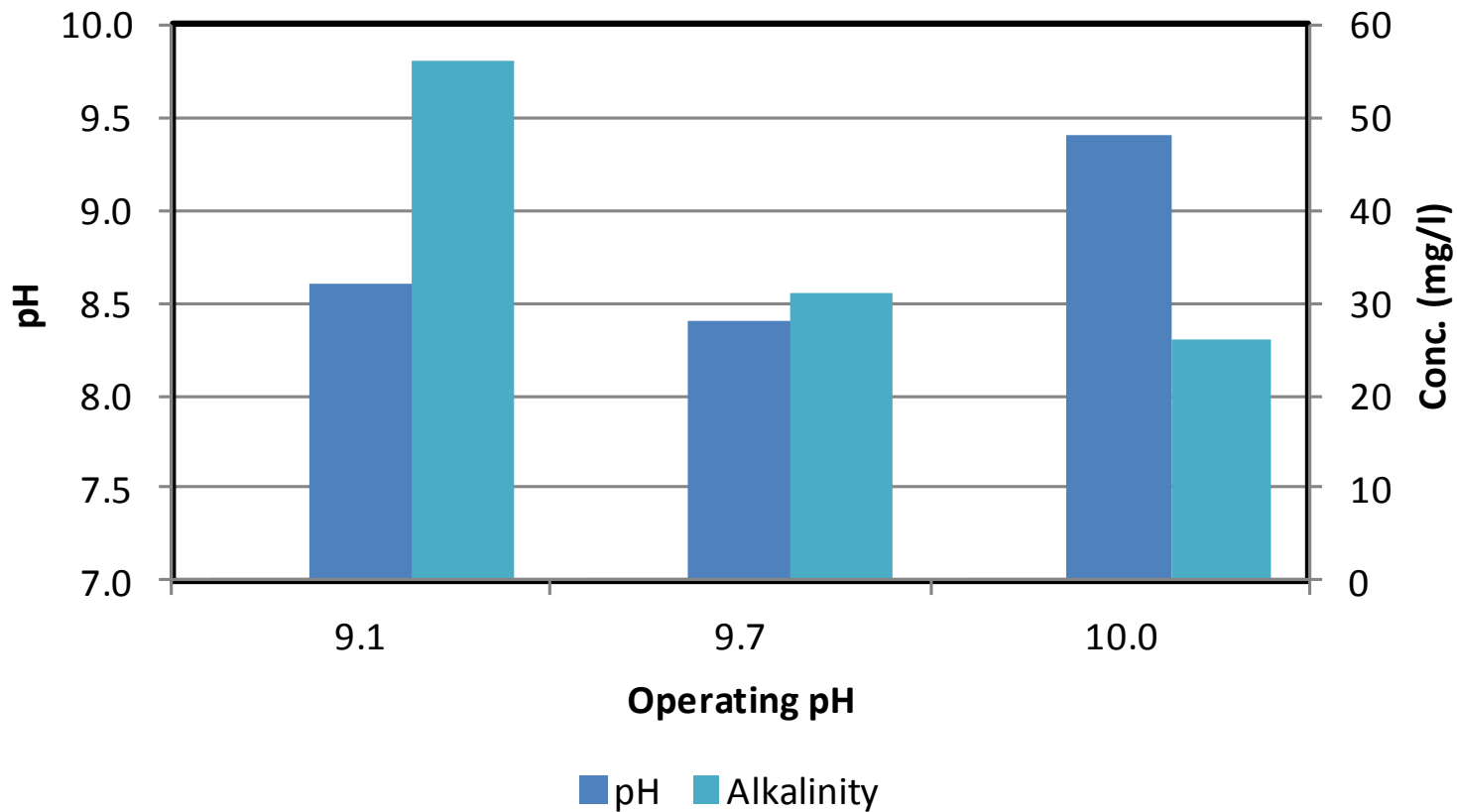
pH	Lime Slurry L...	Pump #1 Speed	Pump #2 Speed
9.21 pH	68.13 %	5.25 Hz	0.00 Hz

Status Pumps Influent **Analogs** More

Treatment System Operating & Effluent Quality



Treatment System Operating & Effluent Quality



Summary of Estimated/Actual Operation & Maintenance Costs.

Item	Unit	Estimate \$/yr	Actual² \$/yr
Lime Slurry	Tons as Ca(OH) ₂	\$20,352.00	\$18,450.00
Electricity	KwHr	\$12,410.00	\$9,400.00
Omnisite Service	NA	\$275.00	\$275.00
Routine Operation Labor	Hours	\$10,400.00	\$7,200.00
Routine Maintenance Labor	Hours	\$3,670.00	\$2,700.00
Routine Maint. Materials	\$	\$1,028.00	\$1,028.00
Sludge Removal	Per event	\$15,000.00	\$15,000.00
Snow Plowing – Access	Per Event	\$800.00	\$400.00
<i>Equipment Replacement¹</i>	<i>Varies</i>	<i>\$11,500.00</i>	<i>\$11,500.00</i>
ANNUAL O&M TOTAL		\$63,935.00	\$54,453.00

¹ Not included in annual O&M cost

² Based on 1st 6 months Operation

Can New Active Treatment Designs Operate at Lower Costs than Passive Treatment Systems for High Strength AMD



Special Thanks to:

Joe Ferrara, Mark Odenthal, Eli Heferle – PADEP, Knox Mining Office
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Janie French – Headwaters Charitable Trust