

# Case Study: Design and Implementation of the Dream Mountain Passive Treatment System – Northern West Virginia

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# Overview

- ◆ Location / Landowner / Watershed Group
- ◆ Background
- ◆ PTS Design Phase 1
- ◆ PTS Design Phase 2
- ◆ System Performance



# Location / Landowner / Watershed Group

• Northern Wv

• Dream Mountain Ranch

• Friends of the Cheat



Preston County  
(Albright, Wv)



Hunting Ranch  
& Event Venue



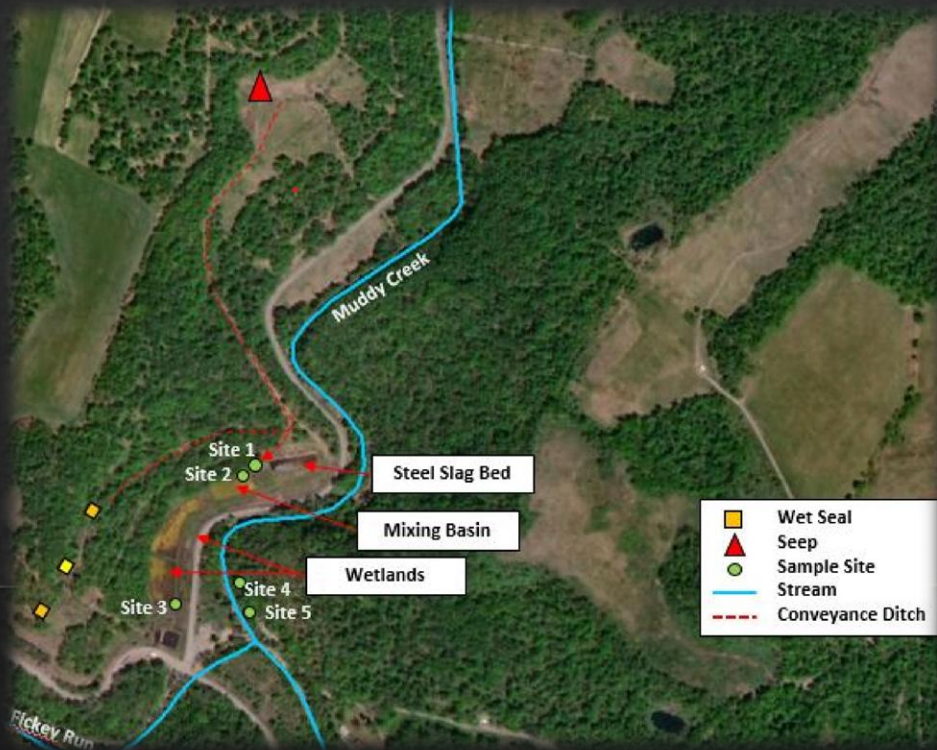
Friends of the Cheat

Project Owner

# Background

## Muddy Creek

- ◇ Viable Trout Fishery Upstream of Dream Mountain



## Dream Mountain Site

- ◇ 1995 – WV AML
  - ◇ Treatment System outside game fencing
- ◇ 2009 – WVU
  - ◇ Steel Slag Bed & Mixing Basin
- ◇ 2012 – WVU
  - ◇ (Two) 1-Ac Treatment Wetlands
- ◇ 2019 – BioMost Inc (Phase 1)
  - ◇ Online Spring 2021
- ◇ 2022 – BioMost Inc (Phase 2)
  - ◇ Online April, 2024

# Water Quality (Influent)

		Flow (gpm)	pH	Acid (mg/L)	Diss. Fe (mg/L)	Diss. Mn (mg/L)	Diss. Al (mg/L)
Site #1 (sources combined)	Avg	124	2.9	423	20	2	31
	Design	251	2.8	625	26	3	41

(4/3/2024)



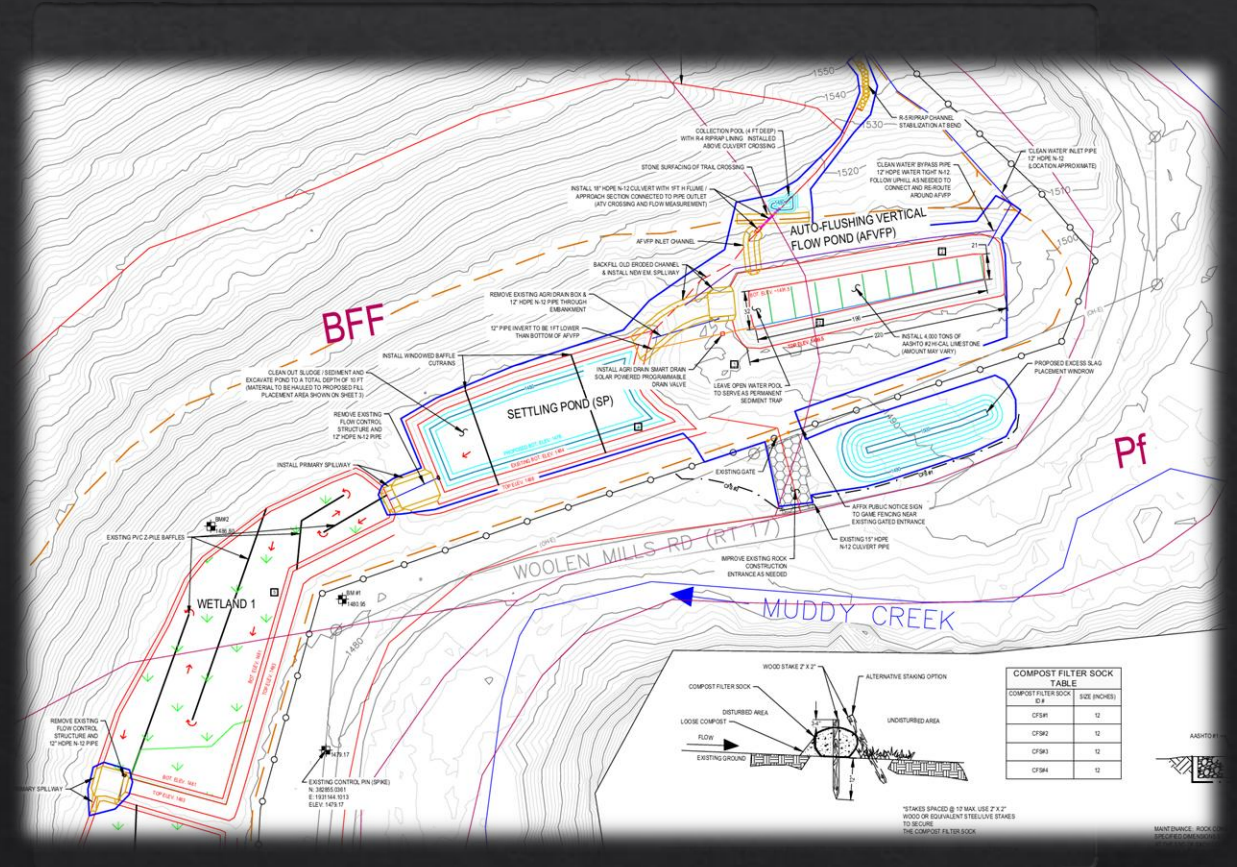
861 GPM (Measurable)  
Estimated at >1,000 GPM

Construction: \$232,800

# PTS Design Phase 1

## Construction Items

- ◆ Stabilize Inlet Channel (Erosion)
  - ◆ Collection Pool
- ◆ Install 1-FT H Flume
- ◆ Slag Bed converted to AFVFP
  - ◆ 4,750 Tons Hi-Cal LS
  - ◆ Re-route Clean Water Diversion to SP
- ◆ Mixing Basin / SP Clean Out Sludge & Over – Excavate for Increased Storage
  - ◆ 10 FT Total Depth
- ◆ Install Rock Lined Spillways
  - ◆ Remove Ex Flow Control Structures



# PTS Design Phase 1

◆ Metered Expectations

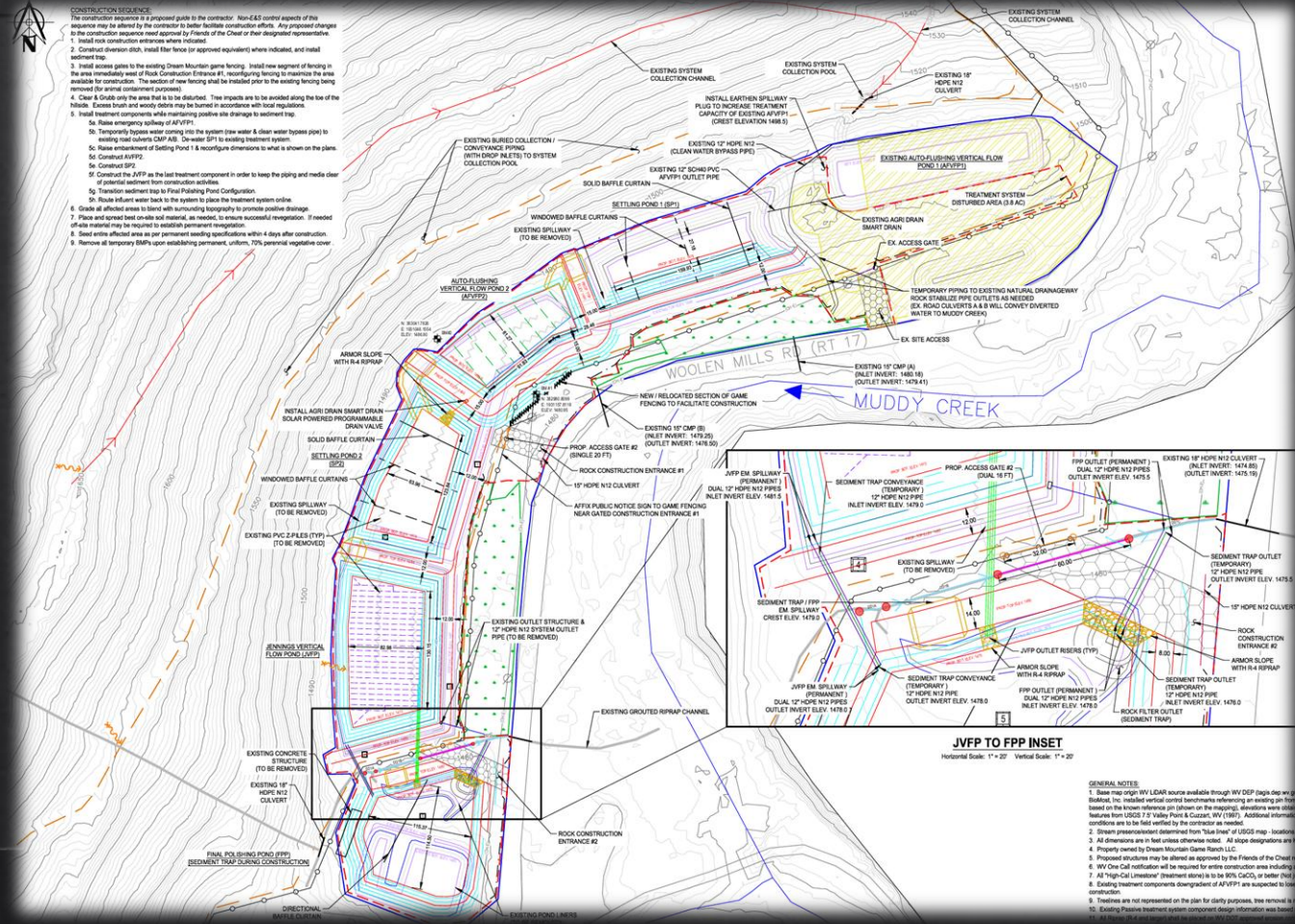


Construction: \$982,700

# PTS Design Phase 2

## Design / Construction Features

- ◆ AFVFP1 – Increase ‘Active’ Stone Ratio
  - ◆ Em Spillway Raised 1.5FT
- ◆ SP1
  - ◆ Rise Embankment (Avoid Wetlands)
  - ◆ 3 Baffle Configuration
- ◆ AFVFP2 – 2,500 Tons LS
- ◆ SP2
  - ◆ 3 Baffle Configuration
- ◆ JVFP – 3,000 Ton LS
- ◆ Final Polishing Pond – Directional Baffle



# PTS Design Phase 2



SP2

AFVFP2

SP1

JVFP

AFVFP1

FPP



Raise  
Spillway

Smart  
Drain

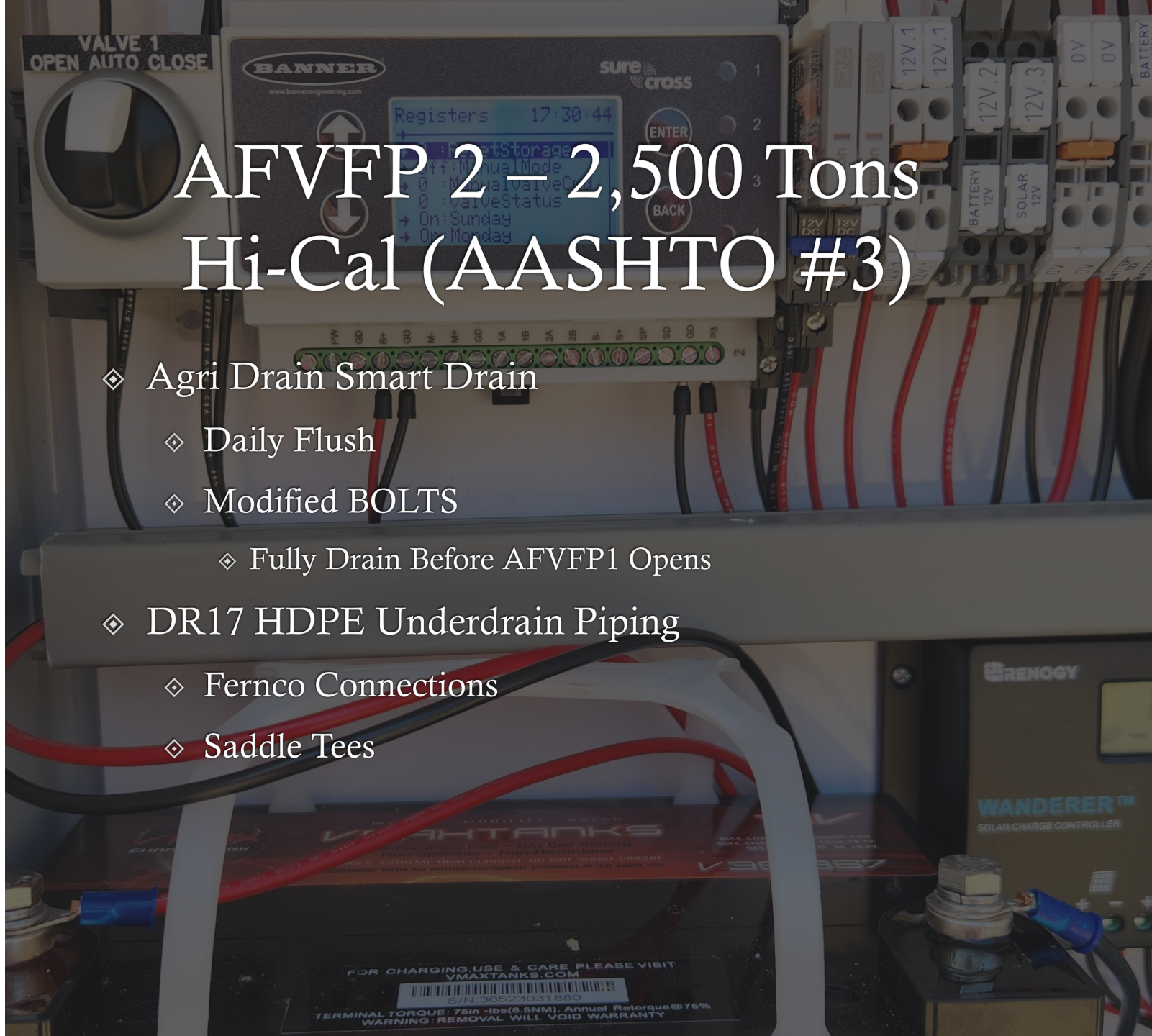
AFVFP 1 – 4,750 Tons Hi-Cal (AASHTO #2)



# Settling Pond 1

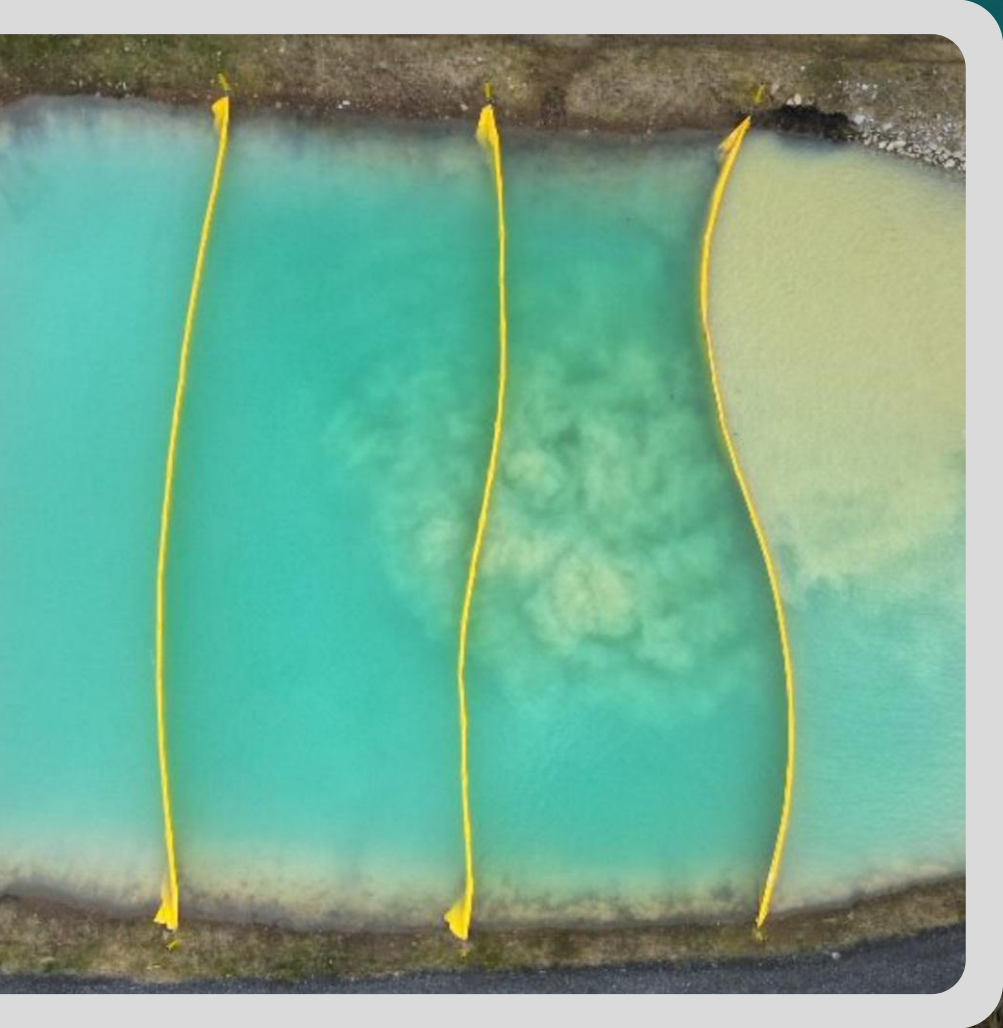
- ◇ 3 Baffle Configuration
  - ◇ Solid – Windowed – Windowed
- ◇ Sorptive Mass / Co-precipitation





# AFVFP 2 – 2,500 Tons Hi-Cal (AASHTO #3)

- ◇ Agri Drain Smart Drain
  - ◇ Daily Flush
  - ◇ Modified BOLTS
    - ◇ Fully Drain Before AFVFP1 Opens
- ◇ DR17 HDPE Underdrain Piping
  - ◇ Fernco Connections
  - ◇ Saddle Tees



# Settling Pond 2

- ◆ 3 Baffle Configuration
  - ◆ Solid – Windowed – Windowed
- ◆ Sorptive Mass / Co-Precipitation



# JVFP – 3,000 Ton Hi-Cal LS



## Media Mix

- ◇ Volumetric Mix
- ◇ 3 Parts Hi-Cal LS
- ◇ 2 Parts Woodchips
- ◇ 1 Part Spent Mushroom Compost



## Multi-Cell Underdrain

- ◇ Maximum Control of Media Usage / Flow Distribution



## Odor Control

- ◇ Restrict Flow Thru Media
- ◇ Pass Water Thru Dual Secondary Outlet Pipes
- ◇ Blend Treated Waters in FPP

# Final Polishing Pond

- ◆ Mix JVFP Riser Effluent & JVFP Overflow
- ◆ Directional Baffle Curtain
- ◆ Dual Outlet Pipes Discharge to Ex. Channel
  - ◆ Ex. Culvert Under Public Road
  - ◆ Ex. Channel to Muddy Creek



“ Thank you again for working with us on this difficult project -- we appreciate you all. Just yesterday Garrett and I saw some young of the year fish hanging around the Final Polishing Pond culvert outlet, which seemed unbelievable a year ago. ” – Madison Ball FOC (8/2/2024)

# Site Challenges

- ◊ Working Inside the Game Fence
- ◊ Site Conditions & Landslide Issues
- ◊ Highway Erosion
- ◊ Clean Water Diversion & Water Handling
- ◊ Collection Channels – Long Term Maintenance Issue
  - ◊ Sediment for AFVFP1 / Fouling
    - ◊ Trench or Regular Stone Face Washing



# System Performance

- ◆ Sampling Events (3 full & 2 Partial):

- ◆ 4/2/2024 – Limited Field Data Only

- ◆ 4/9/2024 (Presented at IMWA – Field Tour)

- ◆ 7/2/2024

- ◆ 10/16/2024

- ◆ 2/13/2025



# 4/2/2024 Field Data

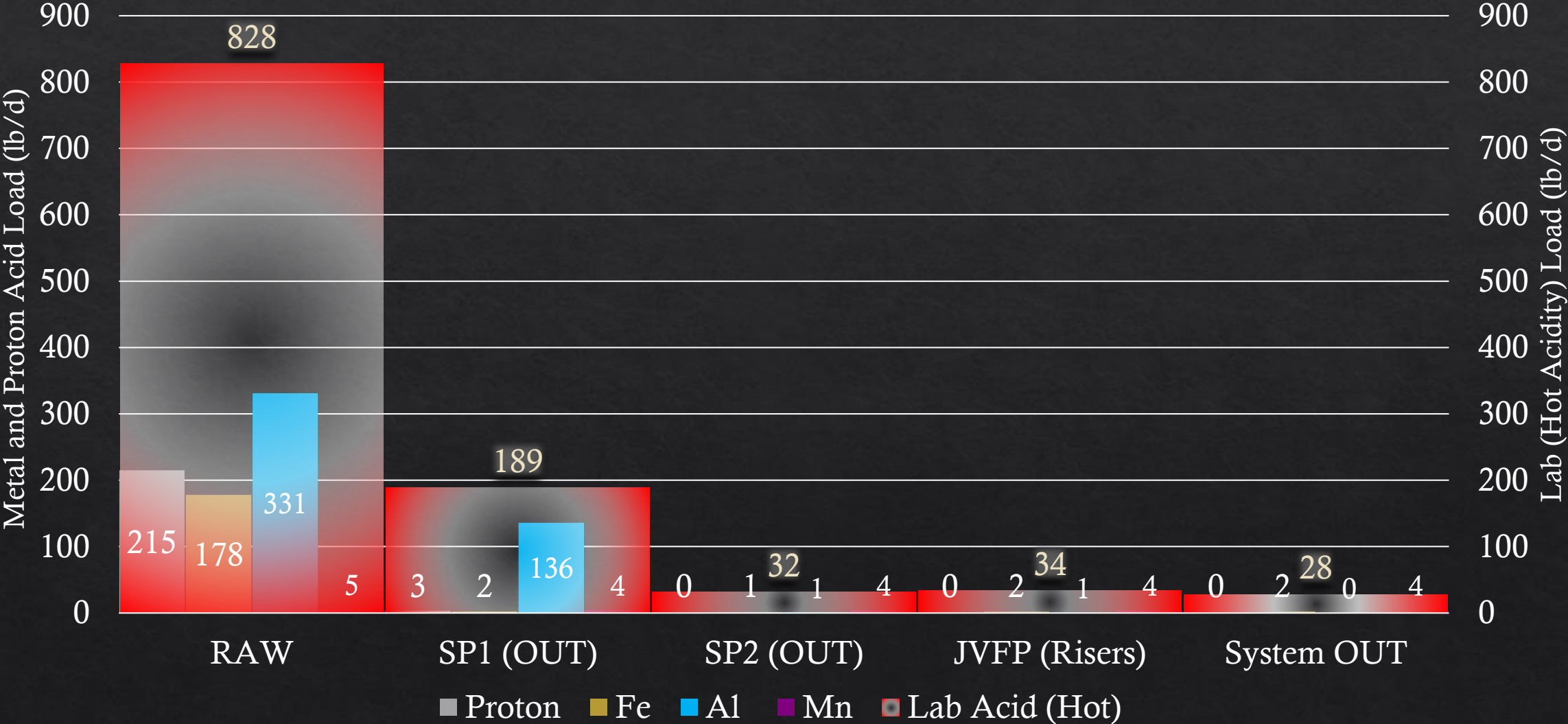
Location	Flow (gpm)	pH
Raw	583	2.9
SP1 Out		4.6
SP2 Out		6.3
JVFP Out		6.9
System Out	[583]	7.0

# 4/9/2024 Results

Location	Flow (gpm)	pH	Alk (mg/L)	Acid (mg/L)	Cond. (µS/cm)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Diss. Mn (mg/L)	SO <sub>4</sub> (mg/L)
Raw	179	2.7	0	385	1620	30.8	27.7	1.3	573
SP1 Out		4.5	0	88	960	0.4	11.4	1.0	518
SP2 Out		5.9	0	15	933	0.1	0.1	1.0	463
JVFP Out	189	6.8	153	16*	1030	0.3	<0.1	0.9	397
System Out	[189]	6.6	89	13*	991	0.4	<0.1	0.9	470

\*Lab was not reporting negative acidity values in accordance with the Standard Method for Hot Acidity SM2310B(4a)

# Acid Load by Component



# 7/2/2024 Results

Location	Flow (gpm)	pH	Alk (mg/L)	Acid (mg/L)	Cond. (µS/cm)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Diss. Mn (mg/L)	SO <sub>4</sub> (mg/L)
Raw	40	2.8	0	461	2030	30.9	46.5	2.4	912
SP1 Out	(not sampled)								
SP2 Out	(not sampled)								
JVFP Out	(not sampled)								
System Out	[40]	7.3	105	10*	1437	<0.1	<0.1	1.0	707

\*Lab was not reporting negative acidity values in accordance with the Standard Method for Hot Acidity SM2310B(4a)

# Acid Load (lb/d) In – Out

## System Influent

- ◇ 221 lb/day Acid

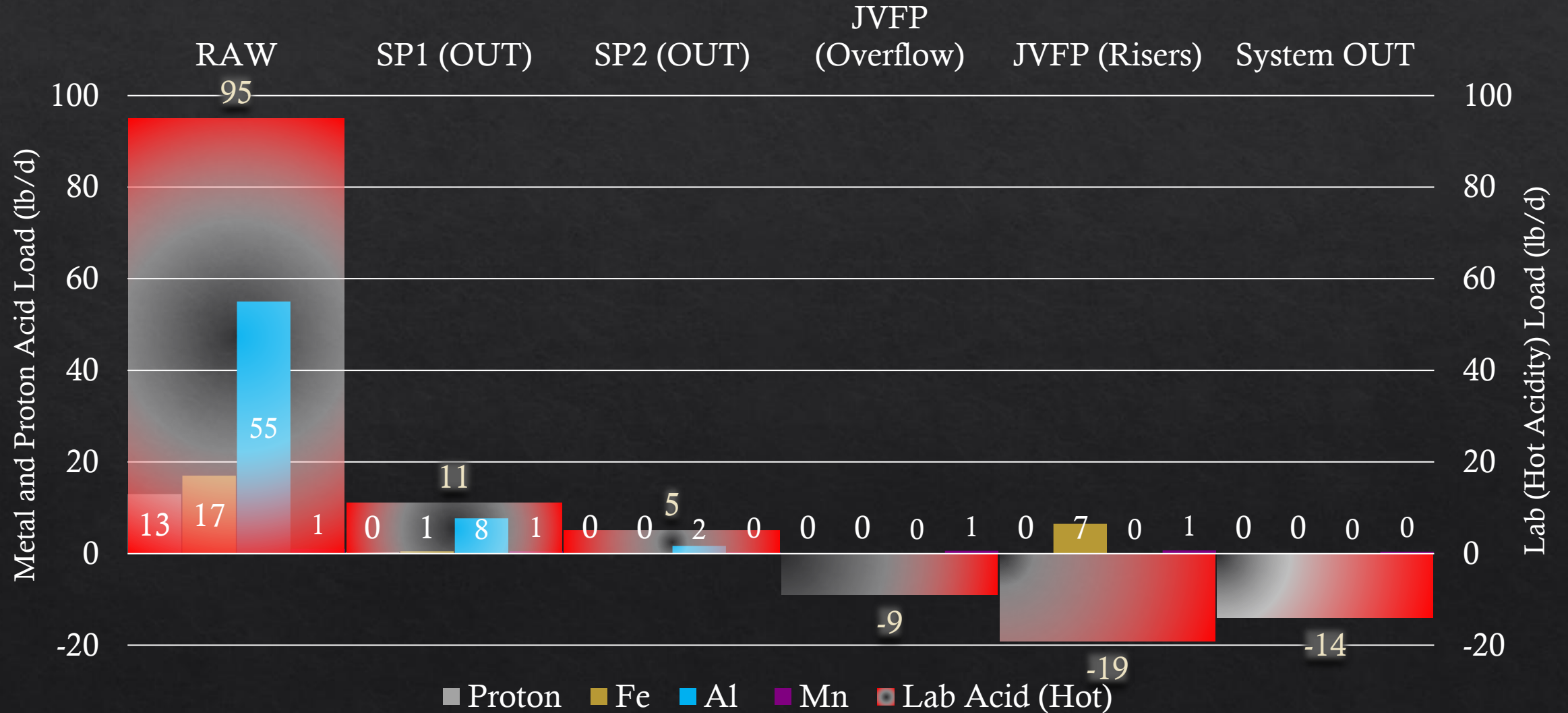
## System Effluent

- ◇ >220 lb/day Acid Removed
- ◇ Appx -50 lb/day Acid

# 10/16/2024 Results

Location	Flow (gpm)	pH	Alk (mg/L)	Acid (mg/L)	Cond. (µS/cm)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Diss. Mn (mg/L)	SO <sub>4</sub> (mg/L)
Raw	15.2	2.8	0	520	1880	34.2	54.4	2.9	975
SP1 Out		4.5	0	61	1480	1.0	7.6	1.5	870
SP2 Out		4.8	0	28	1390	0.2	1.7	1.0	786
JVFP Overflow		7.1	73	-50	1320	0.1	<0.1	1.9	681
JVFP Effluent	1.7	7.0	988	-937	1580	13.3	<0.1	2.0	43
System Out	[15.2]	7.7	99	-78	1320	<0.05	<0.1	1.2	657

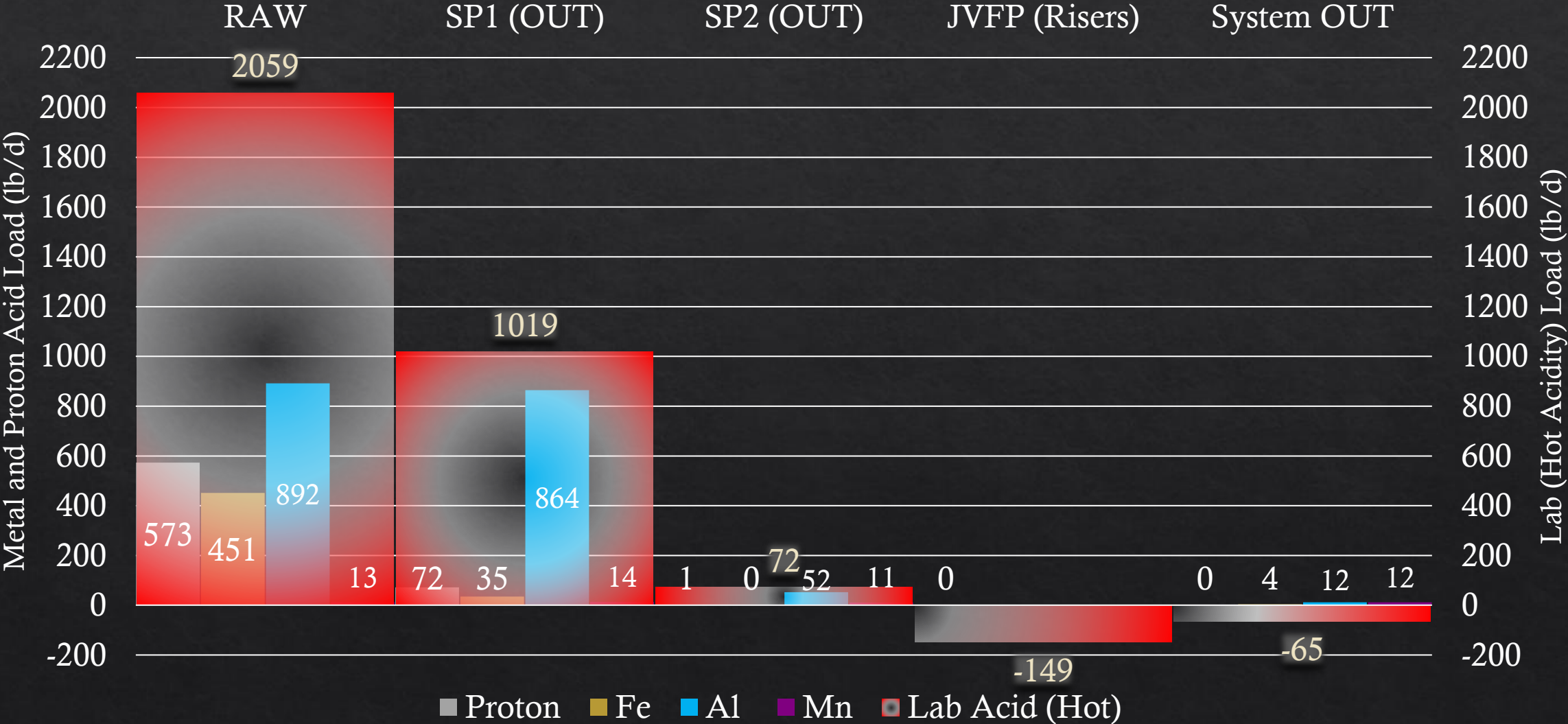
# Acid Load by Component



# 2/13/2025 Results

Location	Flow (gpm)	pH	Alk (mg/L)	Acid (mg/L)	Cond. (µS/cm)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Diss. Mn (mg/L)	SO <sub>4</sub> (mg/L)
Raw	601	2.8	0	285	1173	23.2	22.2	1.1	484
SP1 Out		3.7	0	141	1057	1.8	21.5	1.2	582
SP2 Out		5.7	7	10	1048	<0.1	1.3	0.8	533
JVFP Out	56	6.7	220 (field)	<i>(not sampled)</i>					
System Out	[601]	6.4	26	-9	1001	0.2	0.3	0.9	473

# Acid Load by Component



# Acid Load Removal Summary

- ◇ 4/9/2024: **>800 lb/day (~1,000 lb/day)**
  - ◇ 179 gpm
  - ◇ (Full JVFP Use)
- ◇ 7/2/2024: **>221 lb/day (~270 lb/day)**
  - ◇ 40 gpm
  - ◇ Partial JVFP
- ◇ 10/16/2024: **109 lb/day**
  - ◇ 15 gpm
  - ◇ Partial JVFP
- ◇ 2/13/2025: **2,124 lb/day**
  - ◇ 601 gpm
  - ◇ Partial JVFP



# Design vs Actual Raw Loading

## Max Design (Treatment)

- ◇ 251 gpm
- ◇ 1,886 lb/day Acid Load
- ◇ 78 lb/d Fe Load
- ◇ 124 lb/day Al Load

## Actual Known Max (2/13/2025)

- ◇ 601 gpm
  - ◇ But Documented to Pass ~1,000 GPM
- ◇ 2,059 lb/day Acid Load
- ◇ 168 lb/day Fe Load
- ◇ 161 lb/day Al Load

Design Life 15 – 25 Years

# Acknowledgements

- ◆ Dream Mountain Ranch
- ◆ Friends of the Cheat
- ◆ Blue & Gold Development LLC
  - ◆ Contractor (Phase 1)
- ◆ Solid Rock Excavating Inc.
  - ◆ Contractor (Phase 2)

