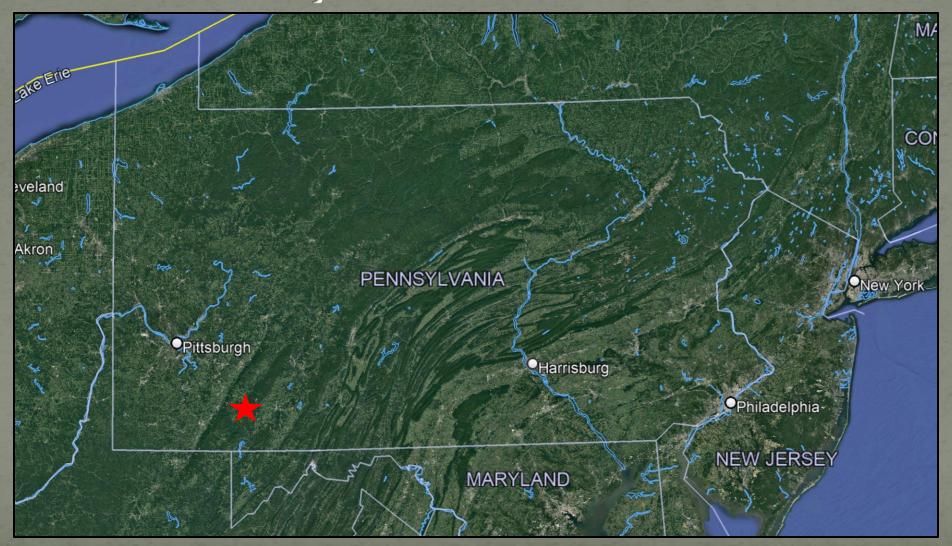
Use of Telemetry at a Passive Treatment System to Monitor Flow, pH, and Water Level¹

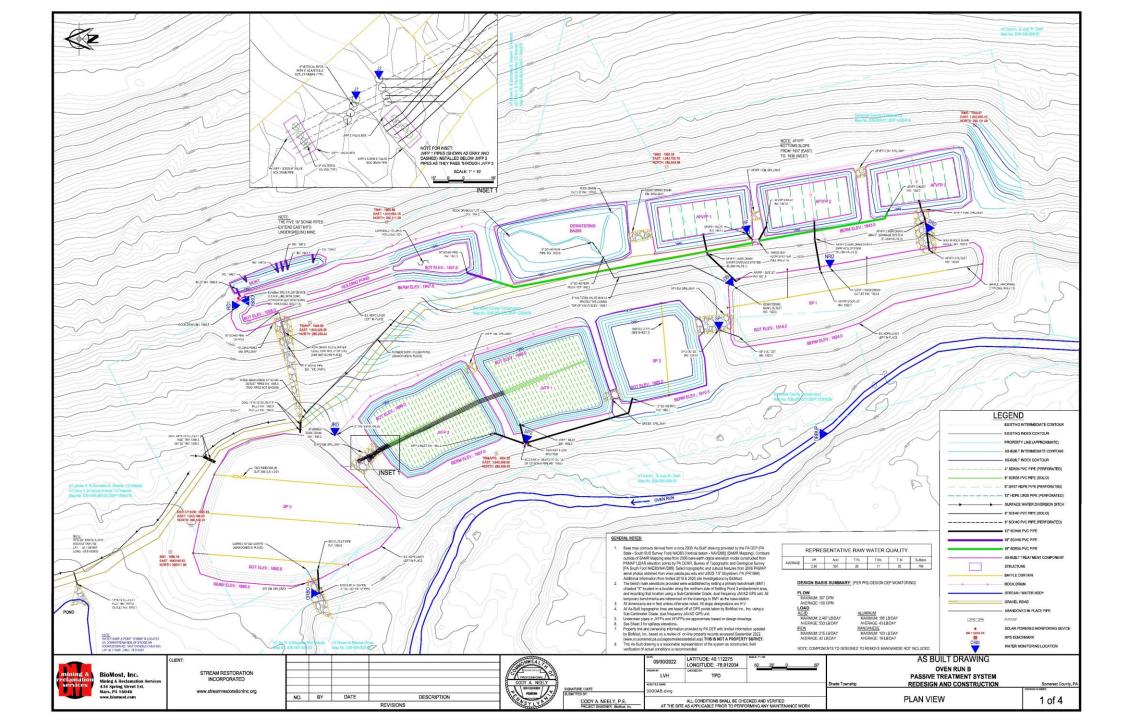
Knoxville Tennessee 2024 D. A. Guy²; T. P. Danehy²; C. A. Neely².



 ¹ Oral paper presented at the 2024 National Meeting of the American Society of Reclamation Sciences, Knoxville, TN. June 3 - 6, 2024. Published by ASRS, 1305 Weathervane Dr., Champaign, IL 61821.
 ² Daniel A. Guy, (PG); Tim P. Danehy, (QEP); Cody A. Neely, Environmental Engineer (PE) BioMost Inc., 434 Spring Street Ext., Mars PA 16046.

Oven Run B – Stoystown, PA





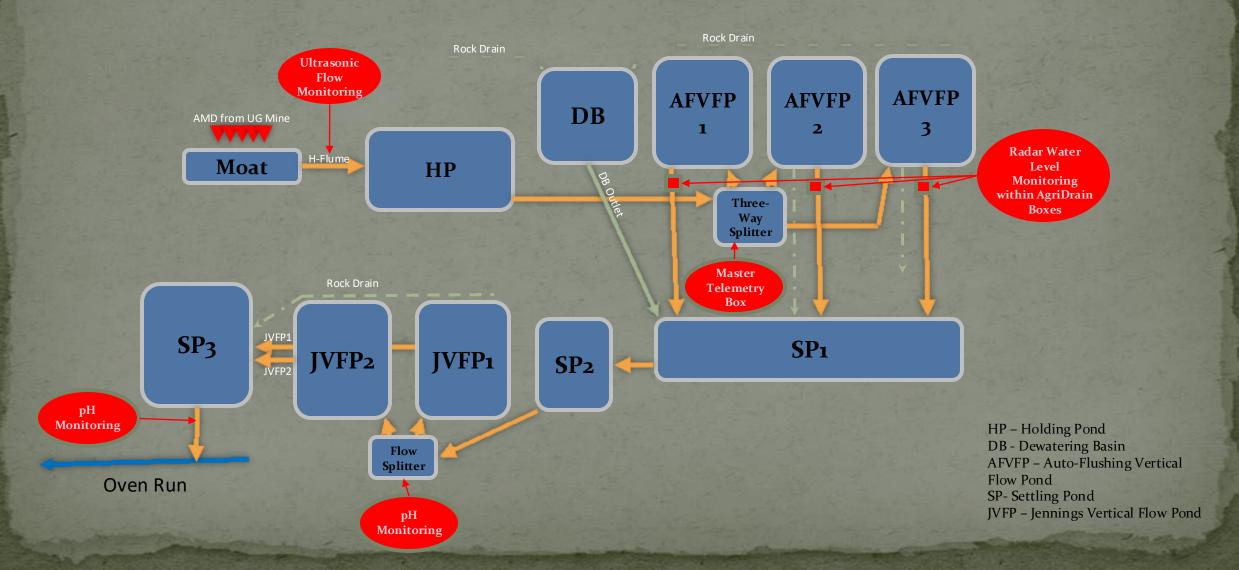
Google Earth Imagery



Telemetry...What's being monitored and why?

pH Monitoring System Performance (Effluent Monitoring) BOLTS Performance (Settling Pond 2 Monitoring) Flume Monitoring (Flow Rate) Flow Must Be Taken Before BOLTS Components Flow Readings Every 5 Minutes Radar Monitoring of BOLTS Agri-Drain Drain Box 1,2,&3

System Schematic



Batch Operated Limestone Treatment System... BOLTS



Automatic Flushing Vertical Flow Pond 1 (AFVFP1) Holding Pond (HP)



Automatic Flushing Vertical Flow Pond 2 (AFVFP2) Automatic Flushing Vertical Flow Pond 3 (AFVFP3)

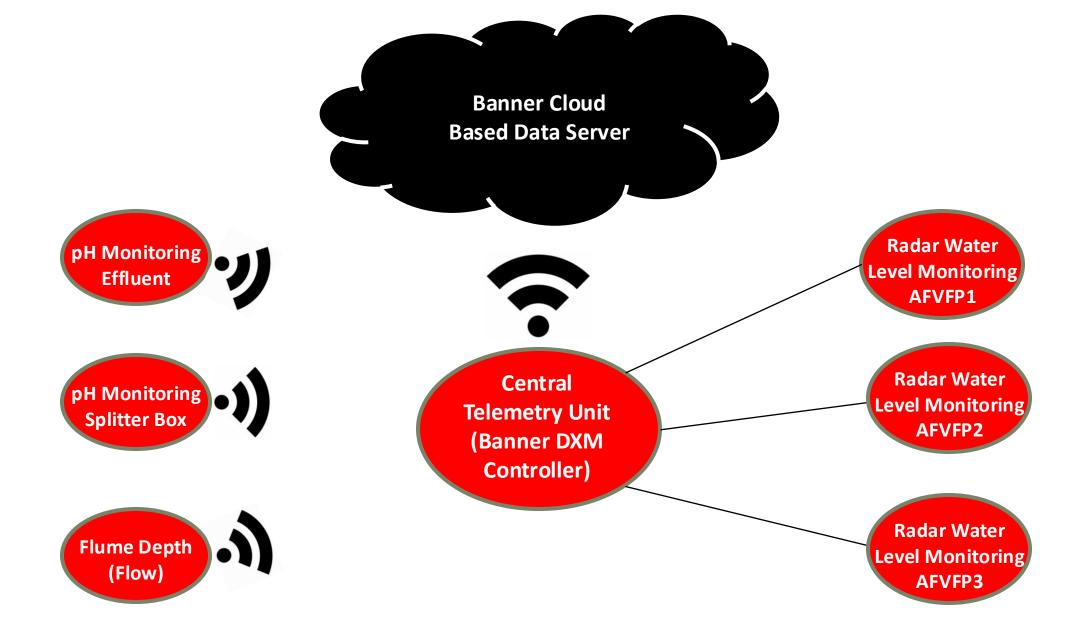
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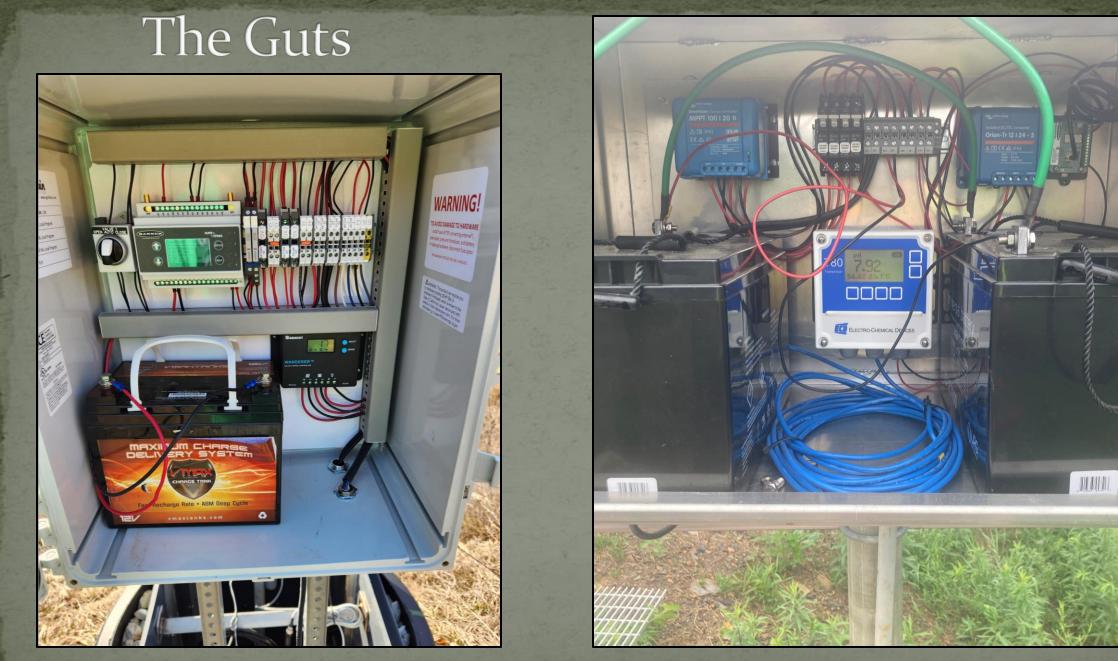
Settling Pond 1 (SP1)





Programming the Telemetry

- Not Exactly Plug and Play For This Application
- All Metering Devices Work on a 4-20 mAmp Signal
 - Devices must be calibrated appropriately onsite
 - Powered by 12v solar
 - Transmitted signal must be scaled and offset
- Remote Devices Must Be Radio Connected or Hardwired to Central Telemetry Unit For Cellular Upload
 - Input, Output, and Local Register Pathways Must be Created Within Central Telemetry Unit to Move Data Through the System
 - Gateways Must Be Created On Banner Data Server Website To Connect Cellular Uploads



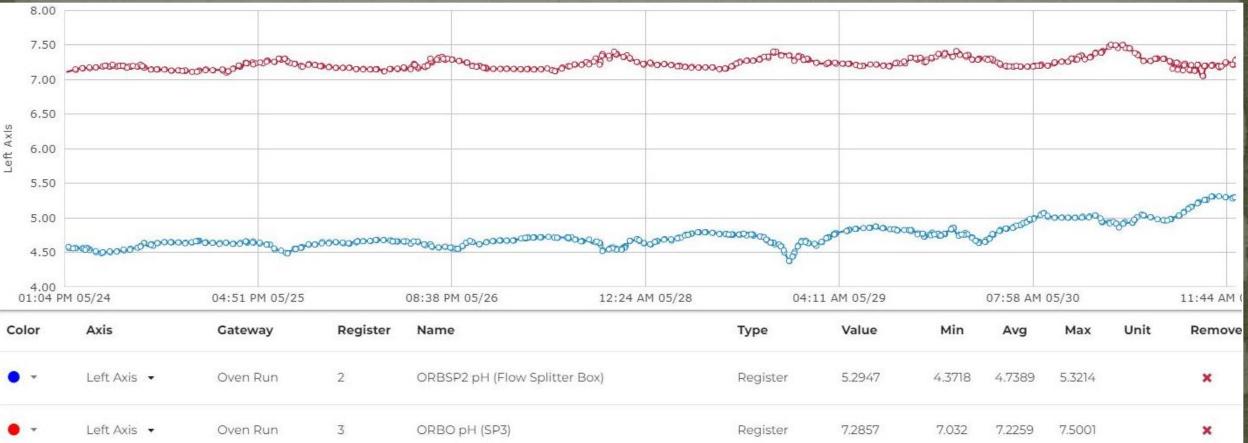
Agri-Drain Smart Drain Box

pH Telemetry

pH Effluent & Flow Splitter Box







pH Probe Drift and Lifespan



Registers Search for:

Alarms

Flume Flow Monitoring



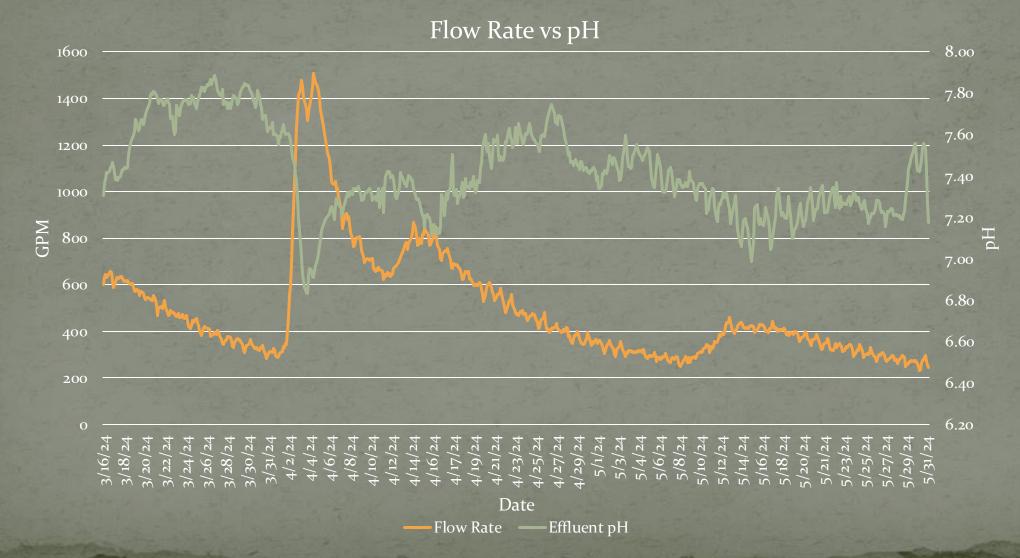




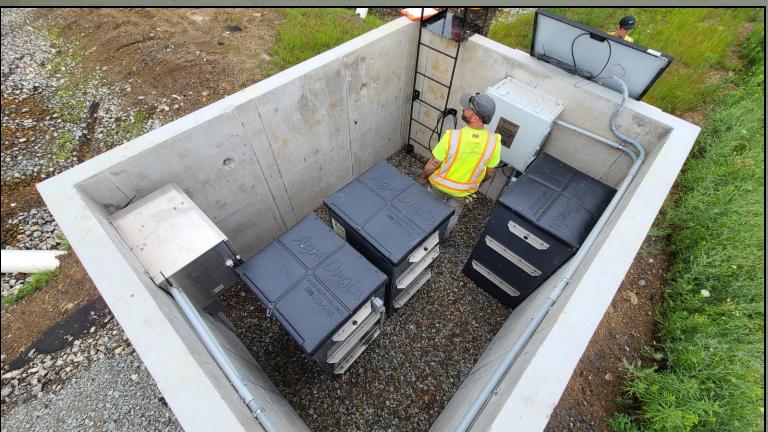
Flume Telemetry Data P Mar 16, 2024, 7:00 PM-May 31, 2024, 7:00 PM 🗶 B Save 🛃 Download Cione 🗷 Edit Graph ORBI (Flume measurement) 53 1600 (GPM) 1400 (GPM) 1200 (GPM) Left AxIs 1000 (GPM) 800 (GPM) APad Sol 600 (GPM) Stool Barboard 1000000 h 400 (GPM) 10adente 9990009599 and form 200 (GPM) 07:04 PM 03/16 05:44 AM 05/25 08:51 AM 03/28 10:37 PM 04/08 12:24 PM 04/20 02:11 AM 05/02 03:57 PM 05/13 Register Min Axis Gateway Name Type Value Unit Remove Color Avg Max ORBI (Flume measurement) Left Axis -Oven Run 1 Register 222.7109 225.6219 499.0876 1520.7299 GPM ×

Search for: Registers Alarms

Flume vs pH Comparison



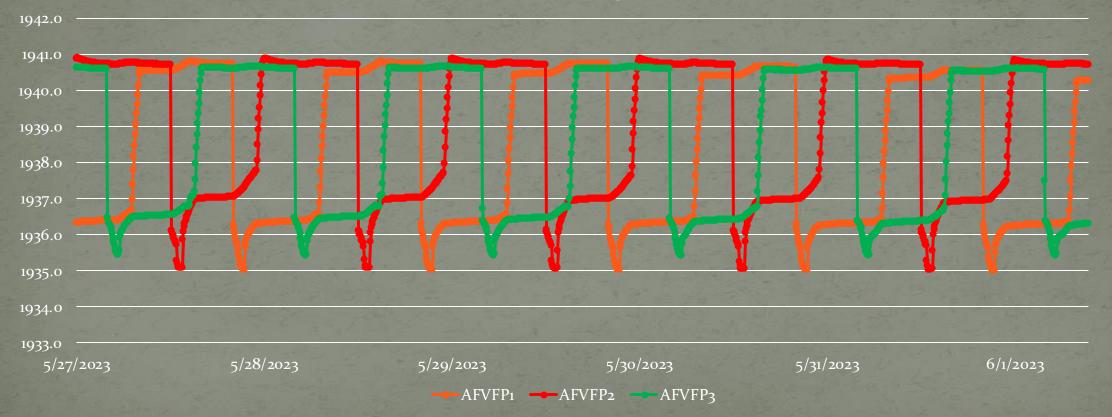
Utilizing Flume Ultrasonic and BOLTS Radar Monitoring to Perform Void Space Analysis





BOLTS Function

Water Elevation Within Auto-Flushing Vertical Flow Ponds (BOLTS)



BOLTS System Reconfiguration



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Outlet Control Structure

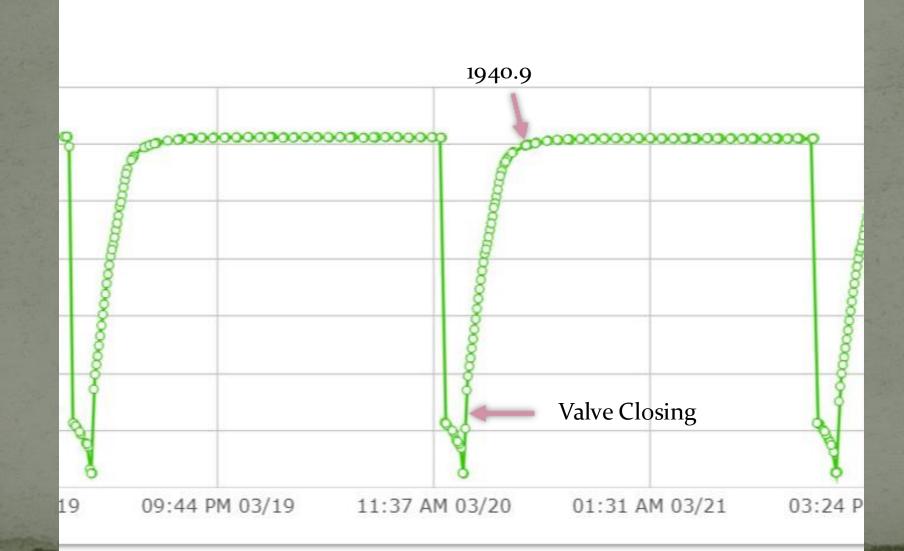


Water Cap Volume: 3,681 ft³

Pond Volume at Stone Elevation: 44,710 ft³ Fill Time: 210 minutes 1941.0 1940.75



Determining Fill Time



Outlet Control Structure



1940.9

Water Cap Volume: 3,681 ft³

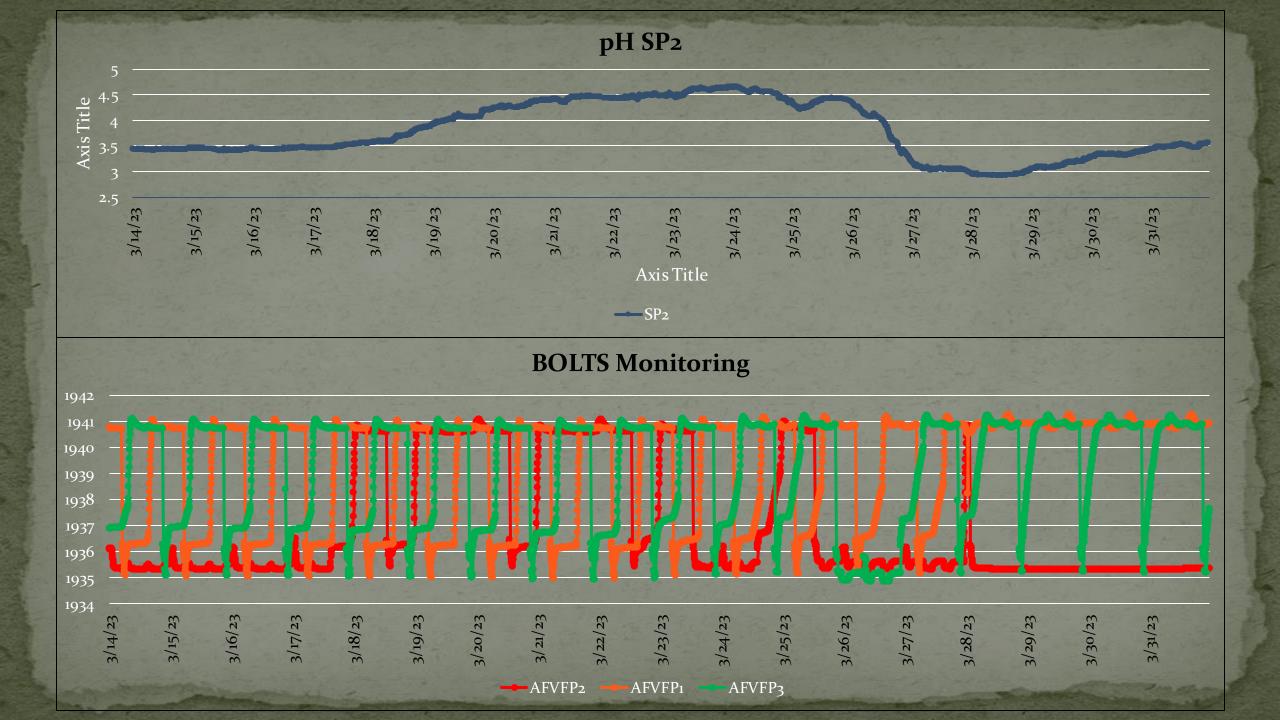
Pond Volume at Stone Elevation: 44,710 ft³ Fill Time: 210 minutes Fill Volume: 111,805 gallons / 14,946 ft³ Water Volume Within Stone: 11,265 ft³

Water Volume / Pond Volume x 100 = 25.2% 1941.0 1940.75

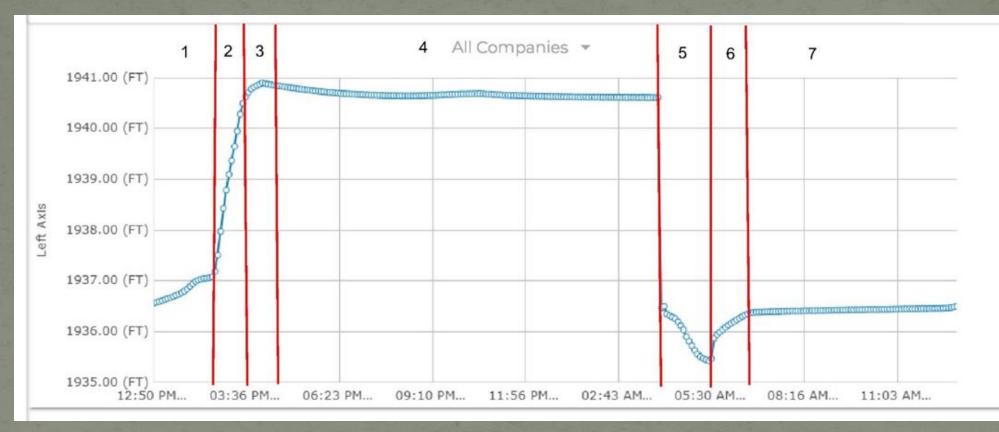
1936.5

How to know when things go bad

pH Below Pre-determined Set Point
Should Be Based on Pollutant Loading
Erratic Flume Elevation Readings
Elevation Reading Too Low, Too High, or Static
Radar Monitoring
Water Elevations Static (i.e. No Filling or Draining)



Analyzing the graphs to monitor hardware function

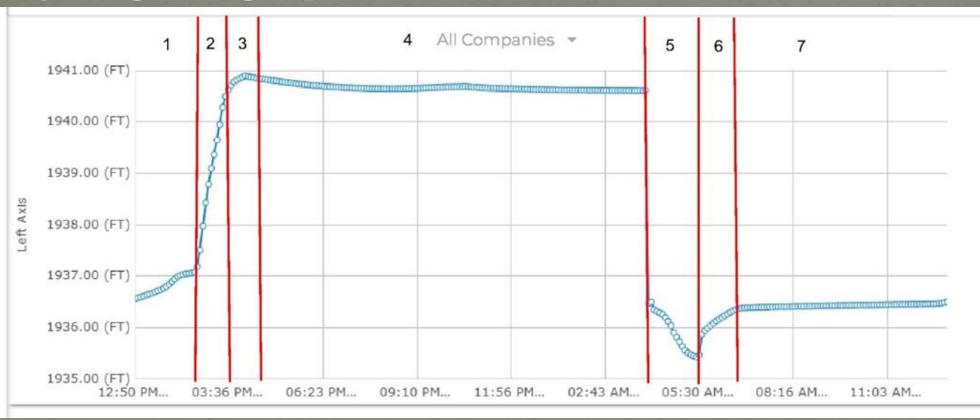


Zone 1 - The Holding Pond has reached capacity, it has begun overflowing the stop logs within the fill Agridrain box and flow into the empty Auto Flushing Vertical Flow Pond 2 (AFVFP2). This is shown by a slow gradual increase in water elevation within the Agridrain box before the quick inflow from the programmed flush.

Zone 2 – The quick increase in water elevation is shown in the graph indicating the fill valve has opened and the Holding Pond is filling AFVFP2.

Zone 3 – The elevation increases above what is seen in zone 4 indicates that the holding pond is still filling AFVFP2 and water is overflowing the stop logs within the flush Agridrain box. This can happen when flow rates are high, and the system can not fully contain all the flow from the Holding Pond. This zone will not be visible during times of lower flow.

Analyzing the graphs to monitor hardware function



Zone 4 – Steady state water level when water is being treated by the pond.

Zone 5 – A rapid drop in water elevation within the Agridrain box indicates that the flush valve has opened. The rapid water level drop drains the box until an equilibrium is achieve between the water coming into the box and the water flushing out of the box. Once equilibrium is achieved the elevation turns into a slower and more steady decline over the 90-minute flush period until the pond drains and water level reaches the bottom of the box.

Zone 6 – The small rapid increase in water level indicated the flush valve has closed and water is being contained within the Agridrain box. A brief slow but steady water level rise is seen before a steady state elevation is achieved. This brief water level rise is because the box invert is at a lower elevation than that of the pond, therefore the small amount of water still filtering through the stone will drain to the box until the box and associate drainpipe fill to an elevation equal to the bottom of the pond.

Zone 7 – Steady state water level during which the pond is empty and waiting for another fill cycle.

Cost Analysis (Installed Prices)

- Central Telemetry Unit \$6,400
- Hardwired Radar Meters 3 Units * \$2,600 = \$7,800
- Remote pH Meters 2 Units * \$7,500 = \$15,000
- Ultrasonic Flow Monitoring 1 Unit = \$8,500
- Annual Cost (year 2 and forward)- \$3,400
 - \$15/month Cellular Data Plan
 - Quarterly pH Calibrations \$300/calibration = \$1,200
 - \$1,000/year/pH Meter = \$2,000

• Total Cost

- 5 year ~\$10,000 per year or \$850 per month
- 20 year- ~5,000 per year or \$400 per month

Conclusions

• Is This an Economical Solution to Monitoring?

- Does your system need frequent monitoring?
- Long travel time to the site?
- Are there ramifications to system failure?

• Do

• Do You Want More Data to Do Cool Science?

Questions?

Thank You & Acknowledgements

PA DEP BAMR Foundation for Pennsylvania Watersheds Stream Restoration Incorporated BioMost, Inc. Earth Shapers, LLC Saint Francis University Landowners