

Getting the Lead out
(and other Trace Metals)
Solving Mine Water Problems with Peat-
based Sorption Media

The Shameless Promotion Continues

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Overview

- ▣ Peat based sorption media
- ▣ The Site
- ▣ Feasibility testing
- ▣ Pilot testing
 - Design
 - Results
- ▣ Full scale treatment
 - Conceptual design
 - Costs
- ▣ Summary
- ▣ Next Steps

What is Peat based sorption media?

▣ APTsorb™

- Patented peat based sorption media
- Hardened granule

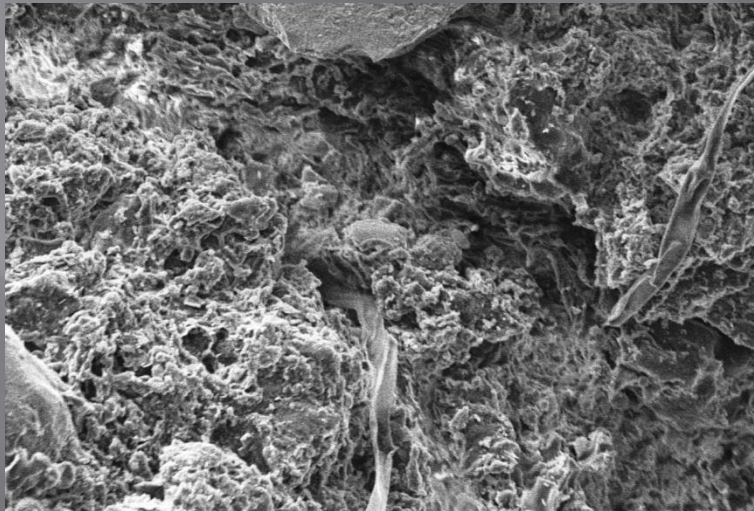


APTTMsorb Granule

Why should I care?

▣ APTsorb™

- Large surface area
- High hydraulic conductivity (~ 1 cm/sec)
- High metal affinity (1-15% max dry wgt)



APTsorb™ Granule 1500x



The Site

- ▣ Base metal mine

Water from
several locations

pH ~ 8
Elevated Pb, Zn, Cd



Feasibility Testing

- ▣ Preliminary laboratory test
 - Can your water be treated with APTsorb?
 - Known operating range
 - ▣ pH 4- 8
 - Recent data at pH up to 9.5
 - Low pH tests starting



Feasibility Testing



Upflow; velocity of 0.4 m/hr;
Column contains 72 g APTsorb
EBCT = 7.5 min

Feasibility Test Effluent Results Pb, ug/l

Green < permit limit

Pb concentration; unfiltered (ug/l)						filtered
Site						
Bed Volumes	1	2	3	4	5	5
0 (Initial)	99	80	102	71	94.1	61.5
5					16.3	4.1
8	83	4.3	11	6.1		
10					17	6.0
20					17.4	3.1
30					17.8	3.4
35	30	4.2	24	3.2		
40					17.9	3.1
64	17	6.5	27	3.0		
99	8.5	3.1	15	2.7		
114	19	3.1	15	2.6		
145	8.7	3.7	20	3.6		
177	8.2	3.0	13	2.2		
205		1.9				
209	8.1			2.2		
236	6.2			2.7		
Permit limit	28	11.5	12.2	12.2	11.0	

Feasibility Testing, Effluents Unfiltered Zinc ug/l

	Site				
Bed Volumes	1	2	3	4	5
0 (Initial)	730	470	270	1000	~ 50
8	40	20	20	20	NA
35	100	20	20	30	NA
64	80	30	20	30	NA
99	80	30	30	30	NA
114	80	30	20	50	NA
145	80	30	20		
177	90	30	20		
205		40			
209	90				
236	100				
Permit limit	216.5	160.7	260.7	260.7	137.3

Green < Permit Limit

Plan

- ▣ Specific site selected
- ▣ developed scope of work
- ▣ Install pilot October 2013

**Prior
Proper Planning
Prevents Poor Performance**

The best laid schemes
of mice and men
often go awry.

Robert Burns



The Challenge

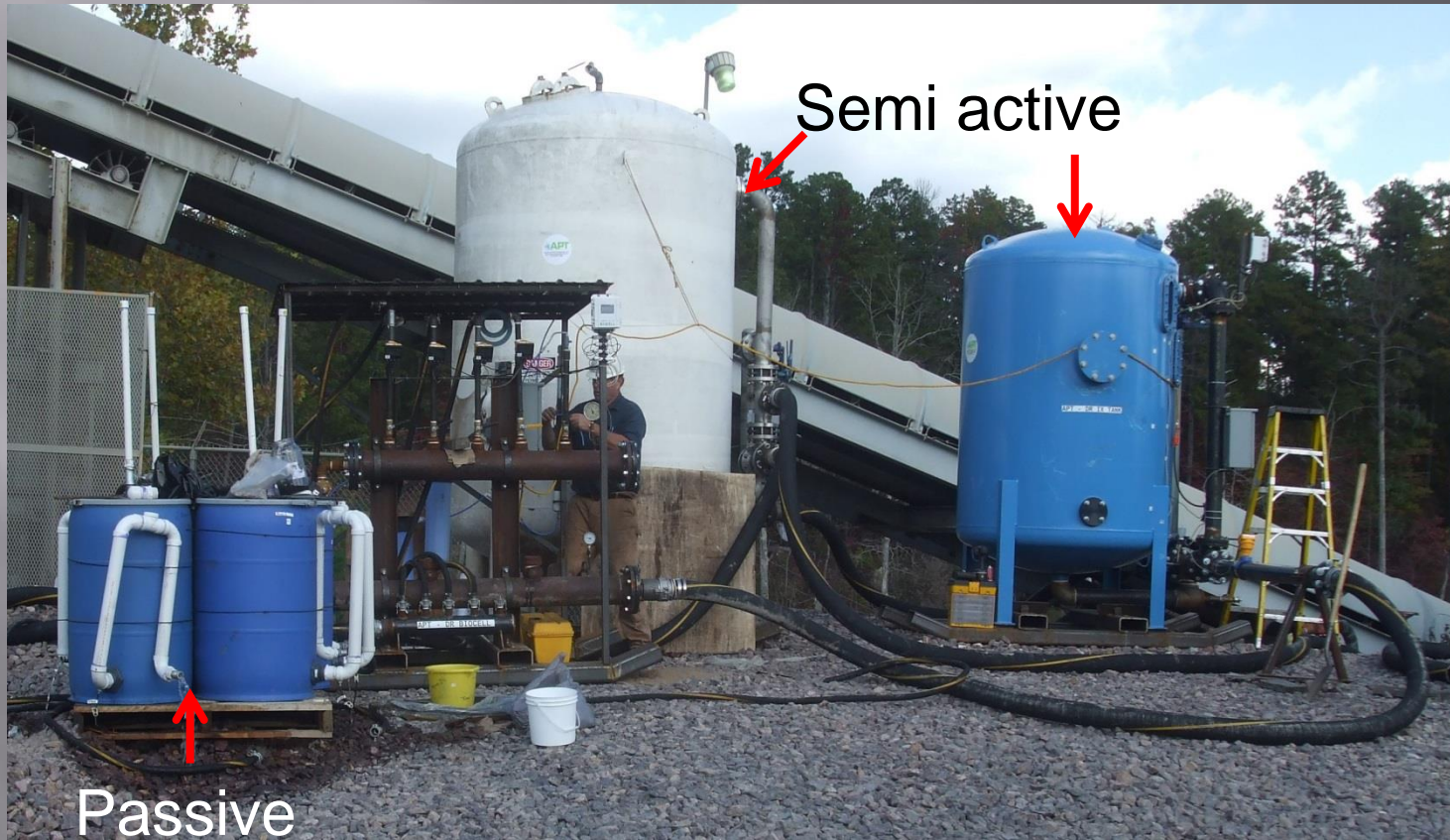
- ▣ Treat direct mine discharge
- ▣ High and variable TSS
- ▣ Low limits
 - Pb 11 ug/l
 - Zn 137 ug/l
 - Cd 0.5 ug/l
- ▣ Treatment cost not to exceed \$0.001/gallon
(\$1/1000 gallons)

Additional Testing

- ▣ On site columns
- ▣ Sand
- ▣ + 30 APTsorb
- ▣ - 30 APTsorb



Pilot Test



“Semi”- Active



Approach

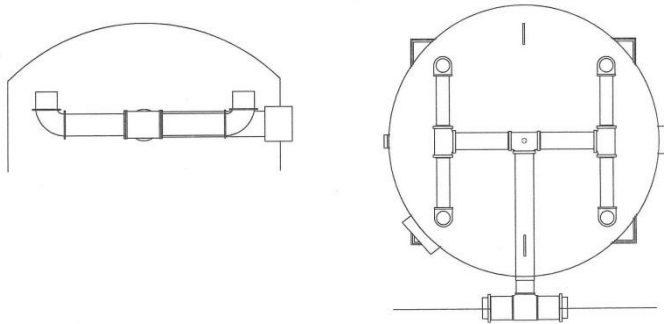
- ▣ Sand filter to remove suspended solids
- ▣ APTsorb Treatment tank
 - 1000 gallon
 - 500 gallons media
 - Design for periodic backwash
 - System remotely monitored



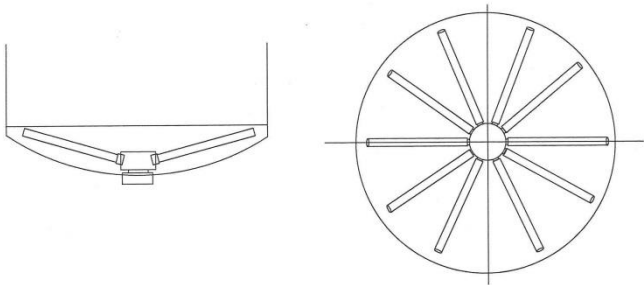
Details

- ▣ -30 mesh material
 - Small column tests
- ▣ Better filtering capacity
- ▣ Hydraulic conductivity ~ 0.1 cm/sec
- ▣ First pilot with this size
- ▣ Operating conditions
 - Mine pressure ~ 50 psi
 - Flow 30 – 100 gpm
 - Typical flow ~ 50 gpm
 - EBCT 10 minutes

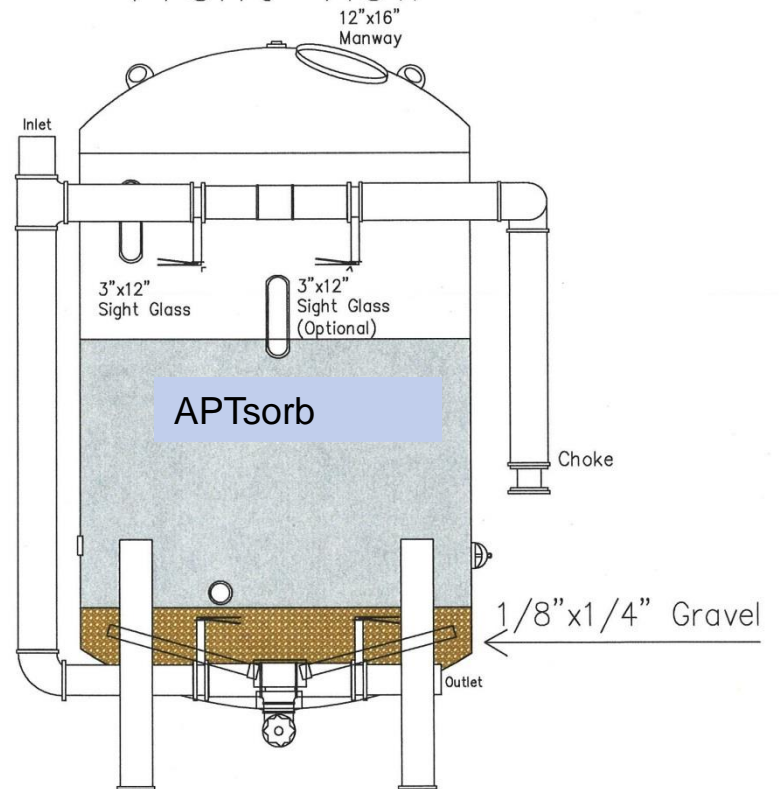
Top Manifold



Bottom Manifold



Front View



Passive - Biocells



Biocells

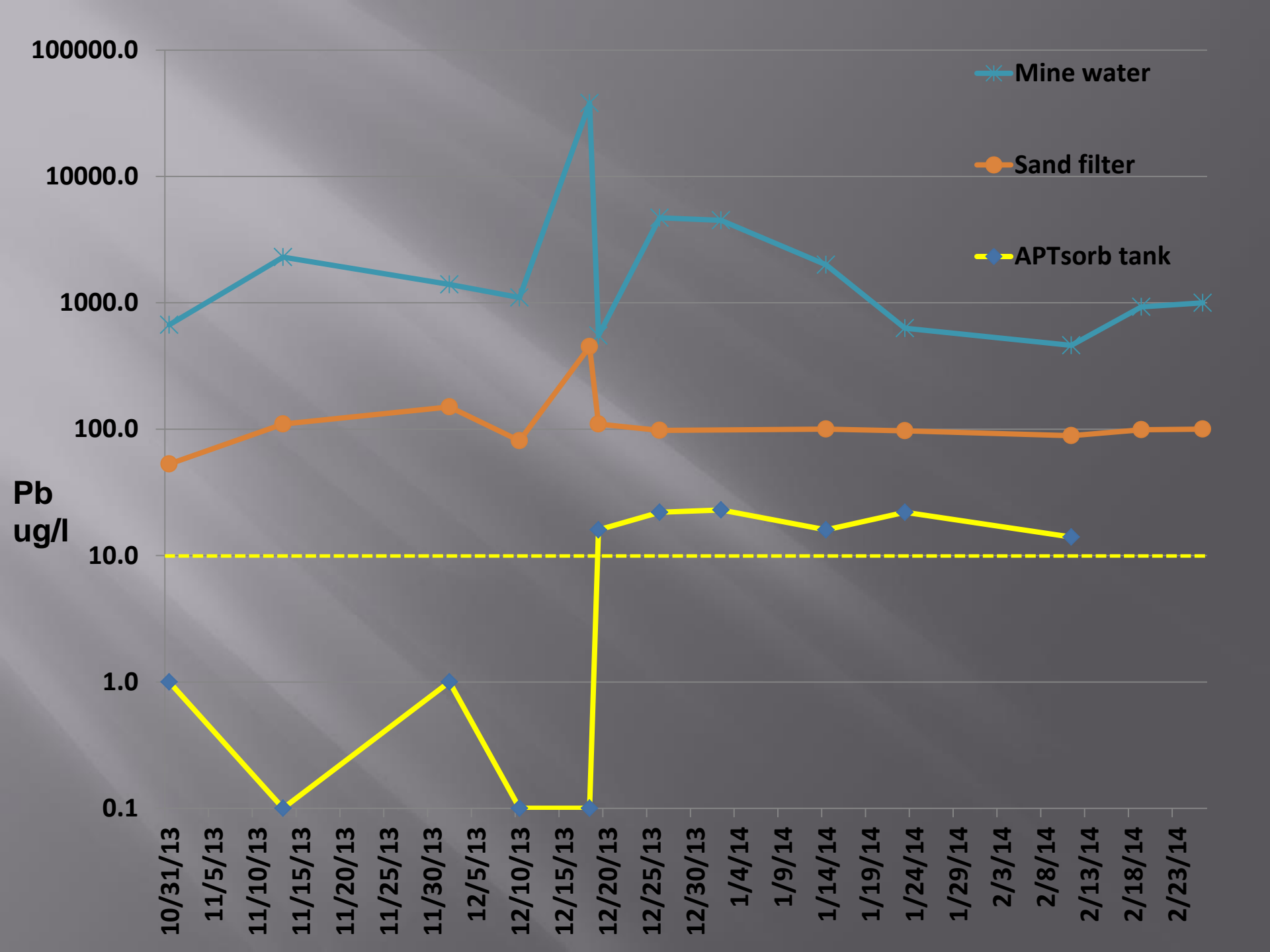
- ▣ Input water filtered through sand filter
- ▣ +30 mesh media
- ▣ Three loading rates
 - 1 gpm/ft²
 - 0.5 gpm/ft²
 - 0.25 gpm/ft²
- ▣ Residence time 15 – 60 minutes

Long term column

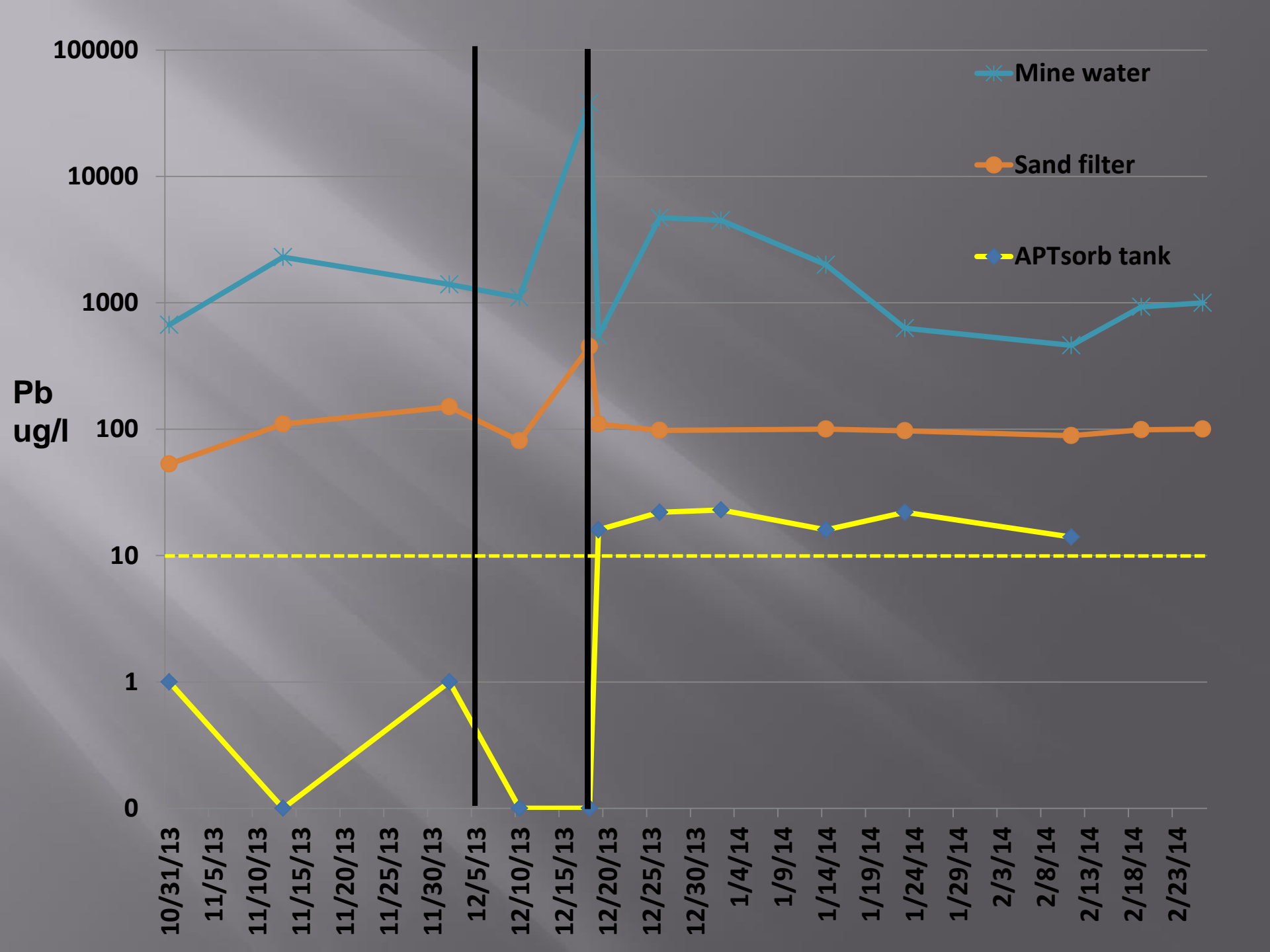
- ▣ Water filtered
 - Sand filter
 - Household filters
 - ▣ Graded (20 -1 micron)
 - ▣ 0.35 micron nominal
- ▣ Media capacity

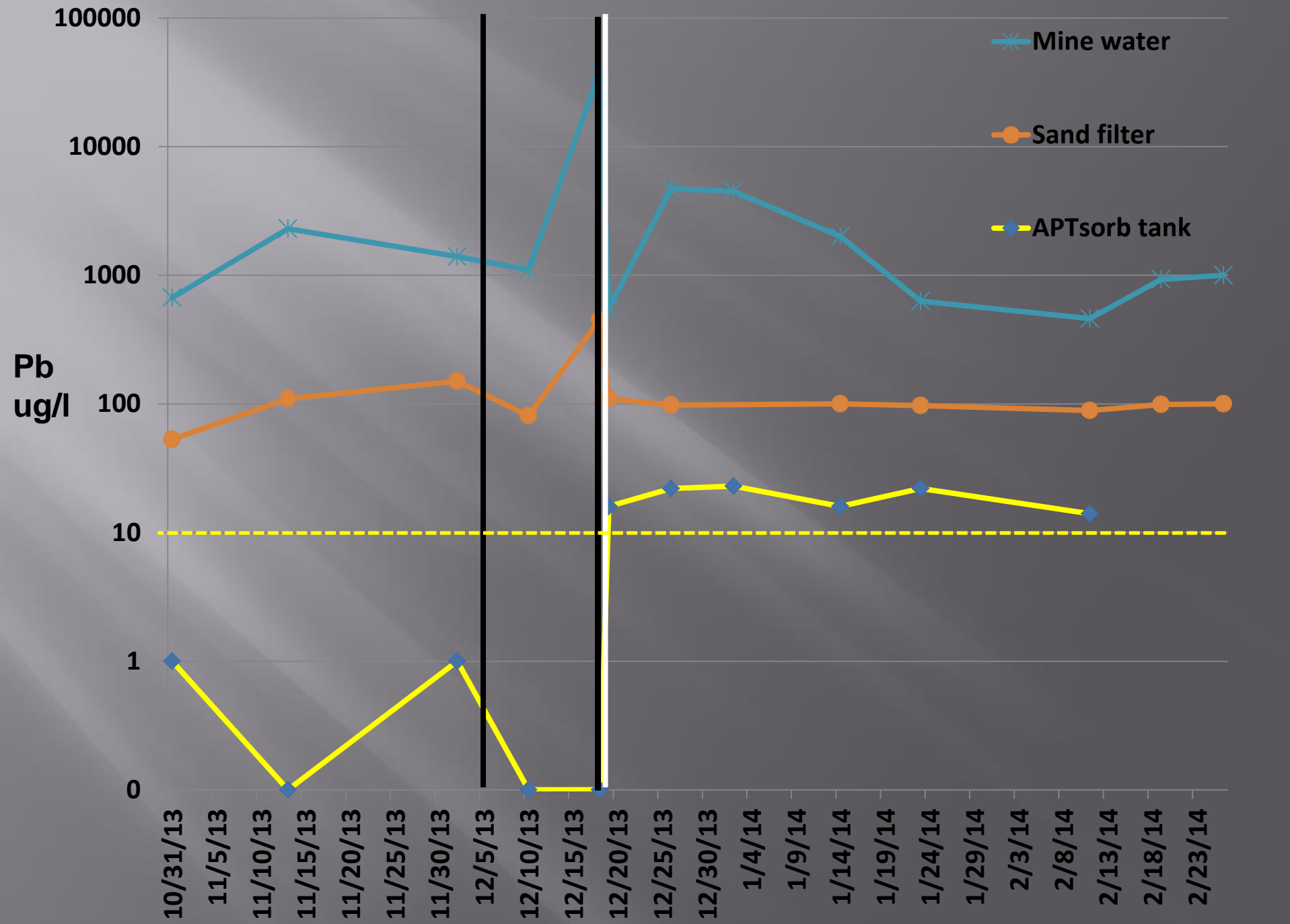


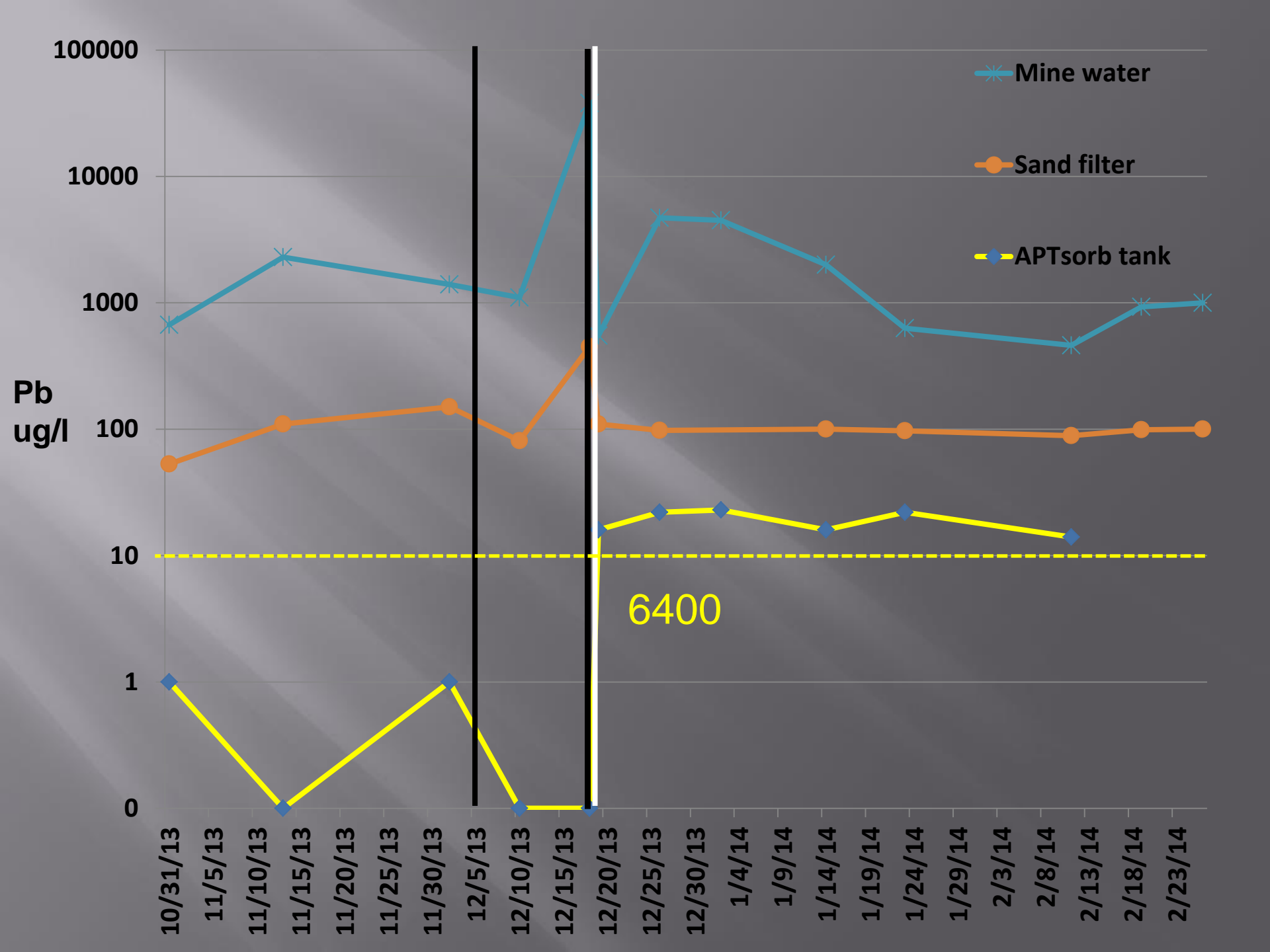
RESULTS







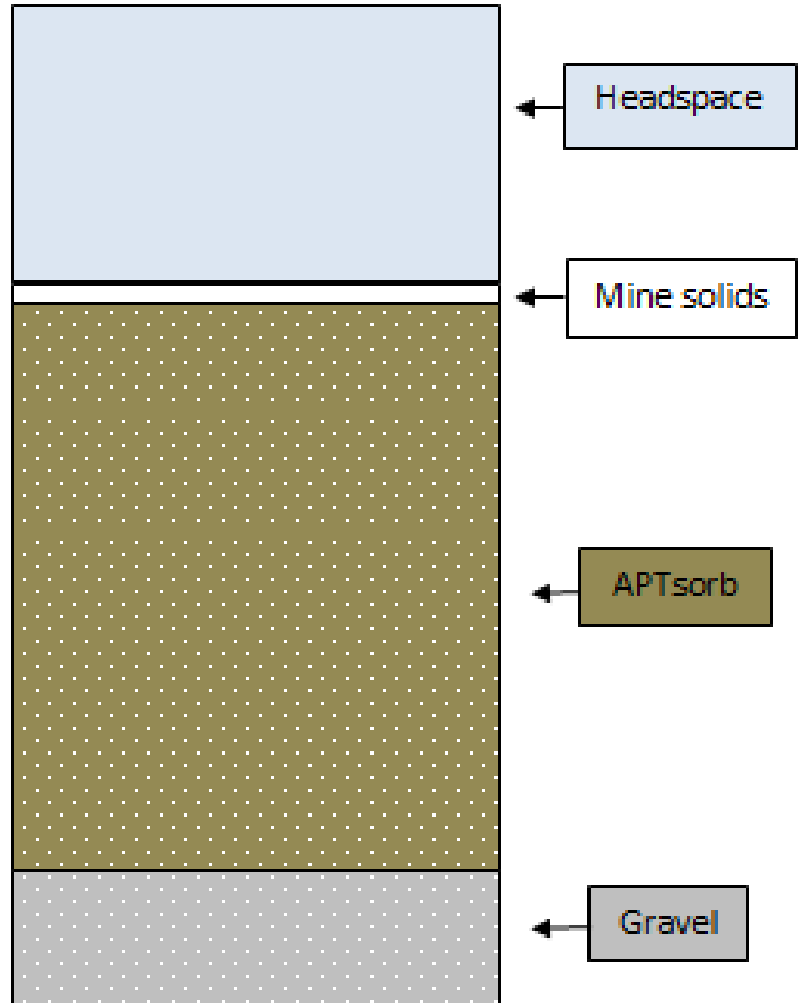
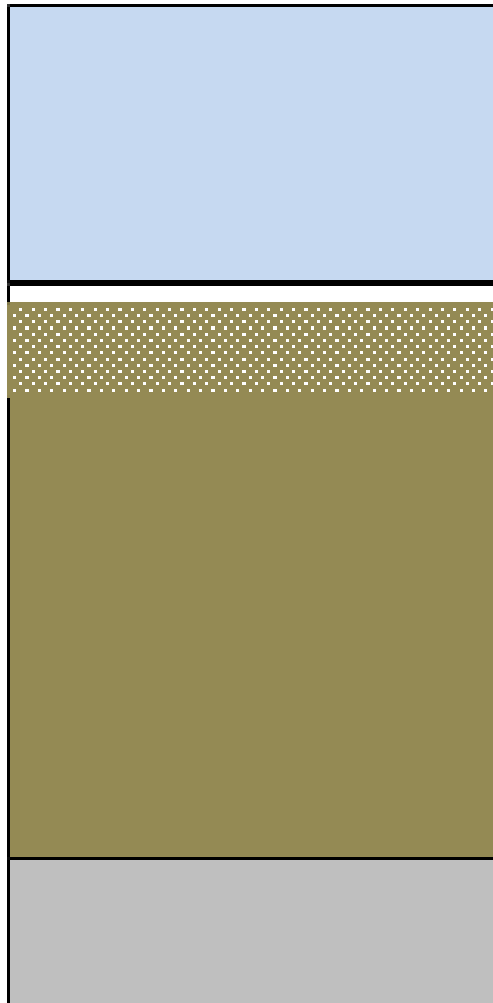




BEFORE AIR SPARGING

AFTER AIR SPARGING

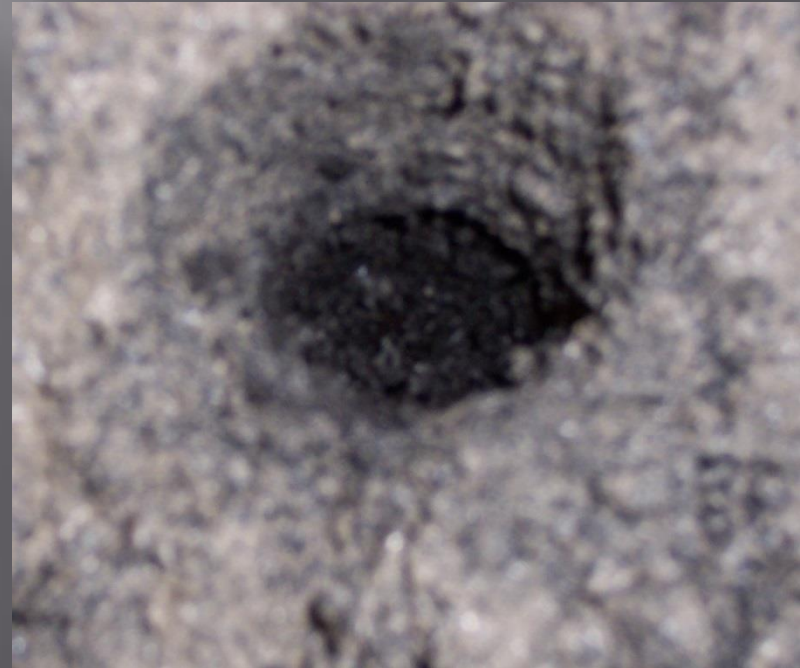
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Solids, Pressurized tank



Solids, gravity flow

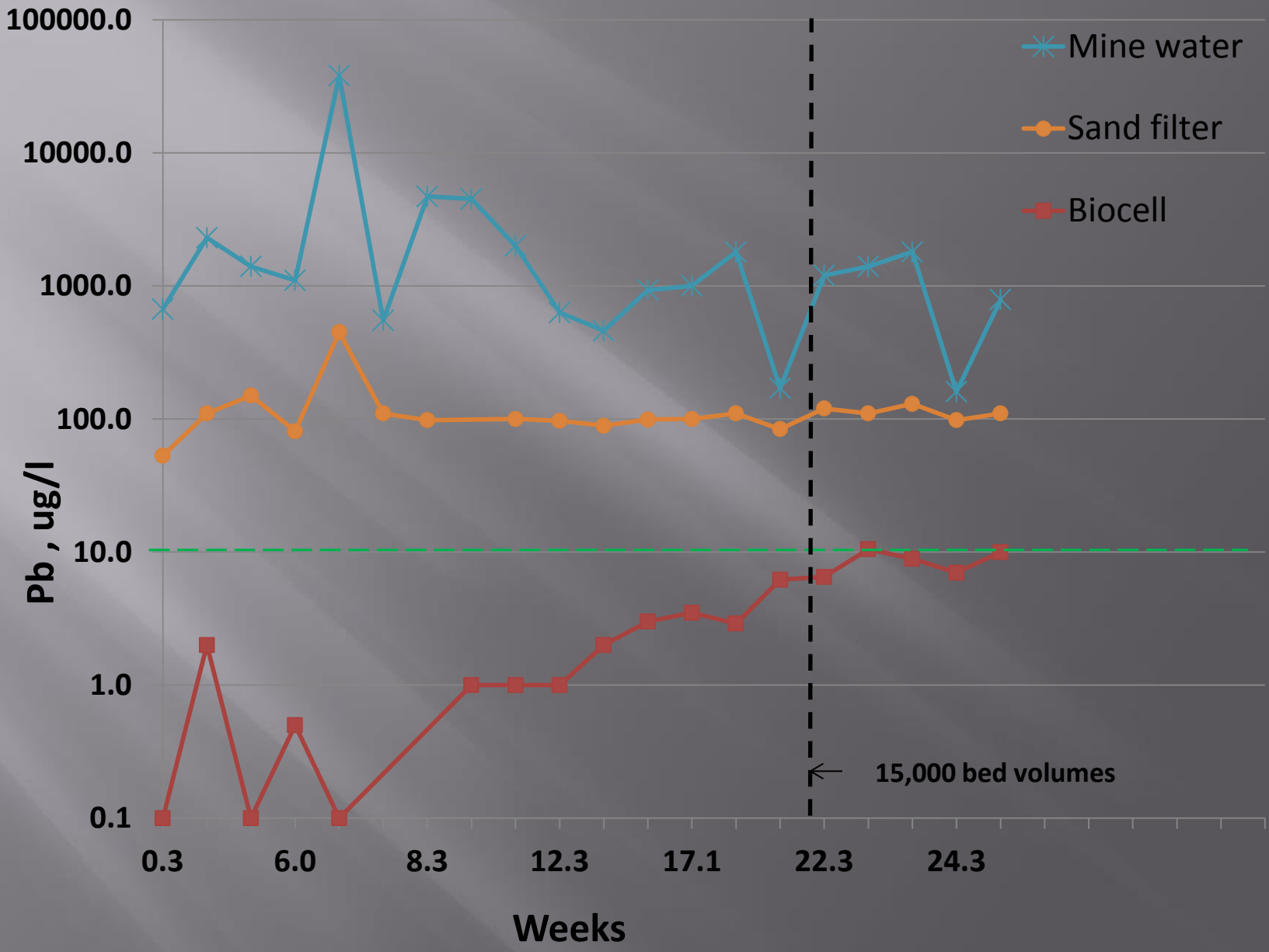


Solids, gravity flow

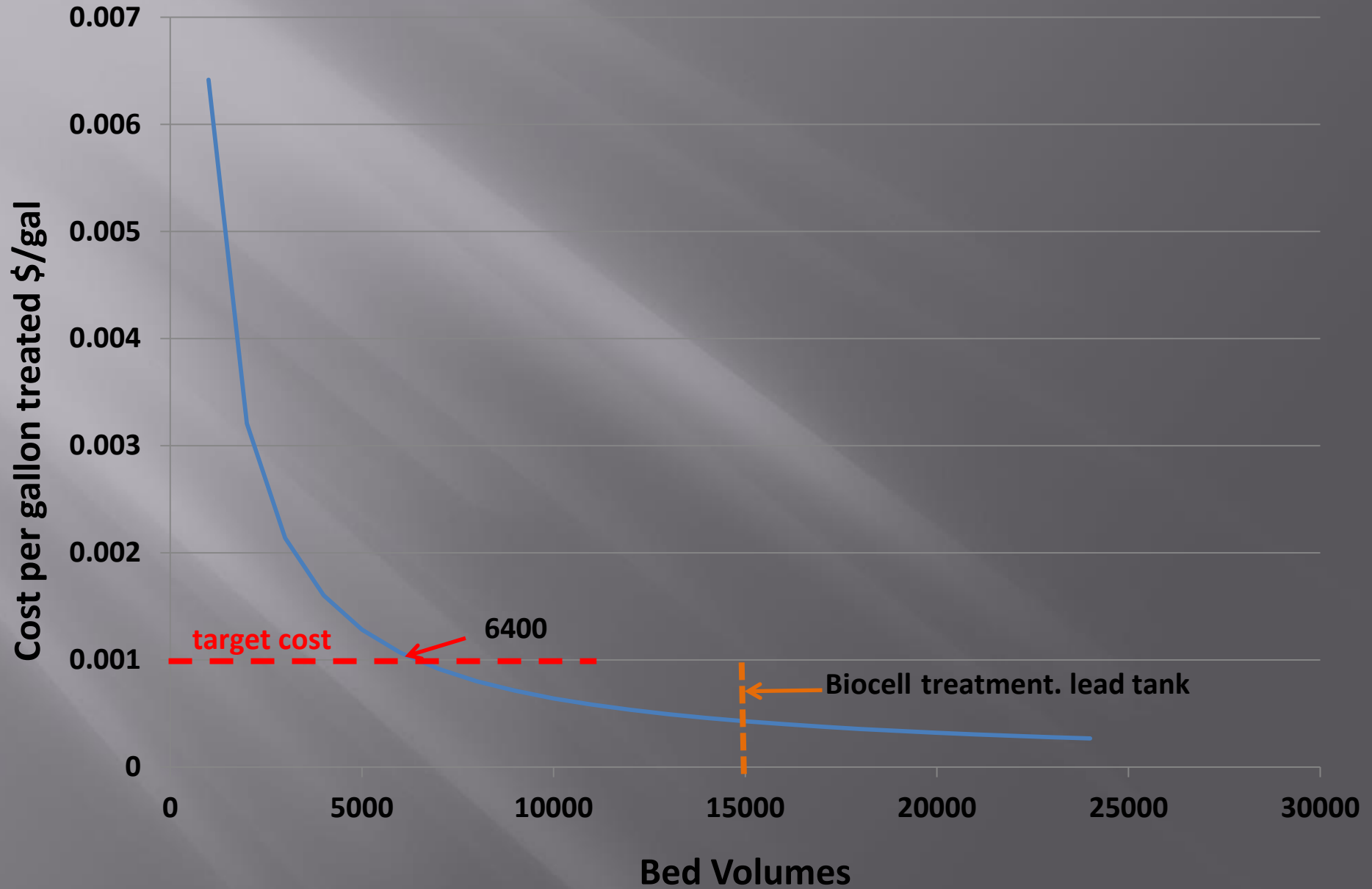


Passive - Biocells





APT sorb, Cost per gallon treated



Results to date

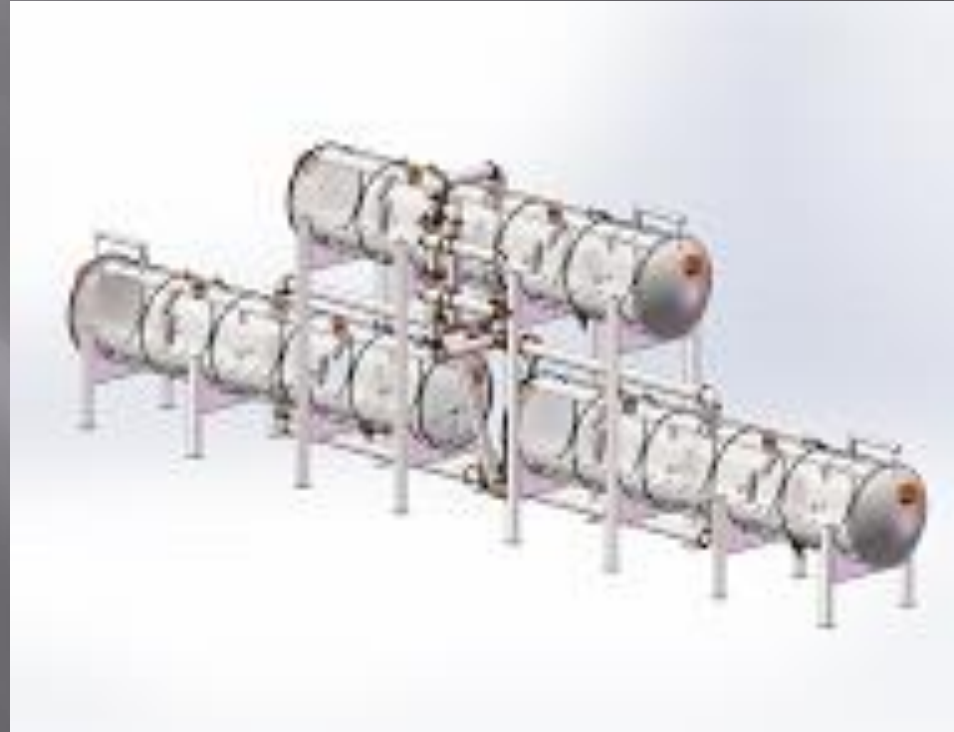
- ▣ Guaranteed treatment cost < \$0.0005
 - Employ 2nd tank to reduce costs
 - Standard lead/lag design
- ▣ Passed all treatment requirements
 - Pb, Cd and Zn substantially below permit limit
 - No toxicity

Long Live the Ceriodaphnia!



Full Scale Treatment

- ▣ Three Tank Module
 - Horizontal Design
 - ▣ 10 feet diameter
 - ▣ 30 feet long
- ▣ Lead/Lag Approach
 - Standard treatment
 - ~1200 gpm per module
 - 7 modules



Full Scale Treatment- 8000 gpm

Costs	Chemical Precipitation	APTSorb
Capital Cost \$ million	10-15	5
Treatment cost (\$/1000 gallons)	1	0.5
Annual cost \$ million	2.6	1.3



Potential Metal Recovery

Summary

- ▣ Peat based sorption media is a cost effective approach for mine drainage treatment
 - Cost < \$0.0005/gallon (50 cents/1000 gallons)
- ▣ Can be used in either active or passive systems
- ▣ Low maintenance
- ▣ May provide opportunities for metal recovery

Next Steps

- ▣ Second pilot started in April
 - Pressurized tank
- ▣ Proposal for third pilot submitted last week
 - ▣ Passive ; Biocell
- ▣ More shameless promotion ASMR 2015



QUESTIONS?

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*There are no rules
here.*

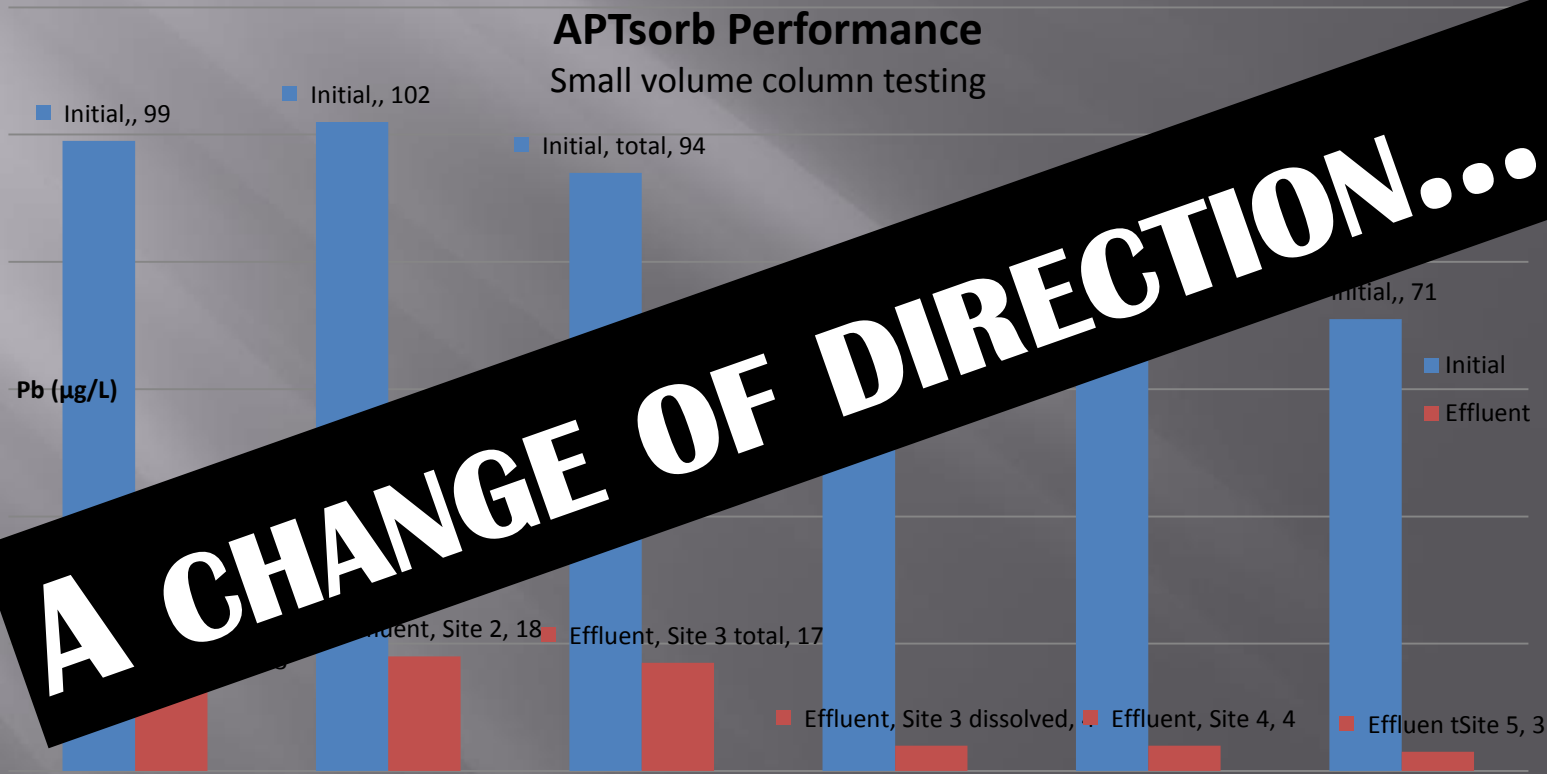
*We're trying to
accomplish
something*

Thomas Edison



**Global Minerals
Engineering**

Proof of Concept Testing

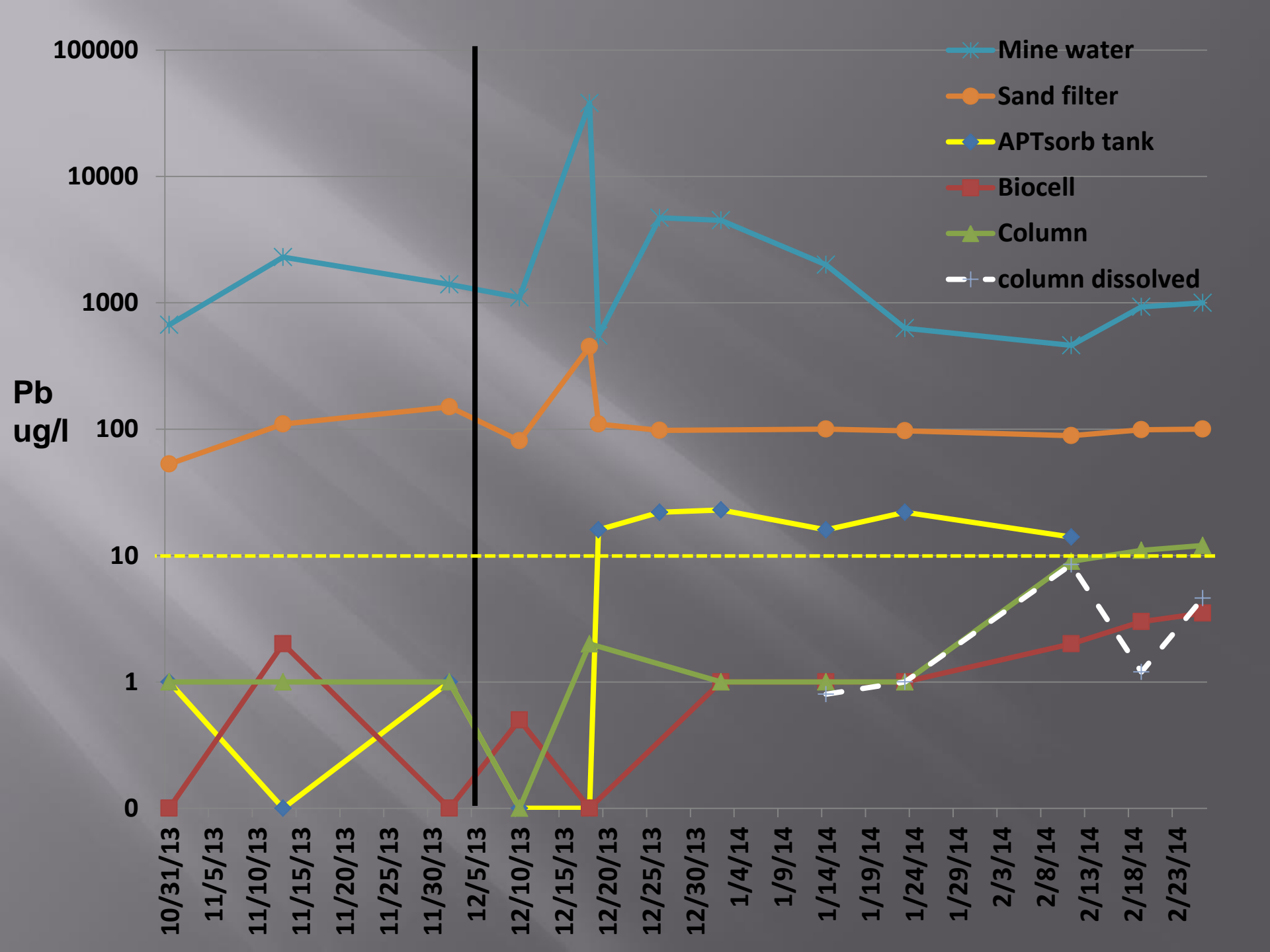


Wet Test

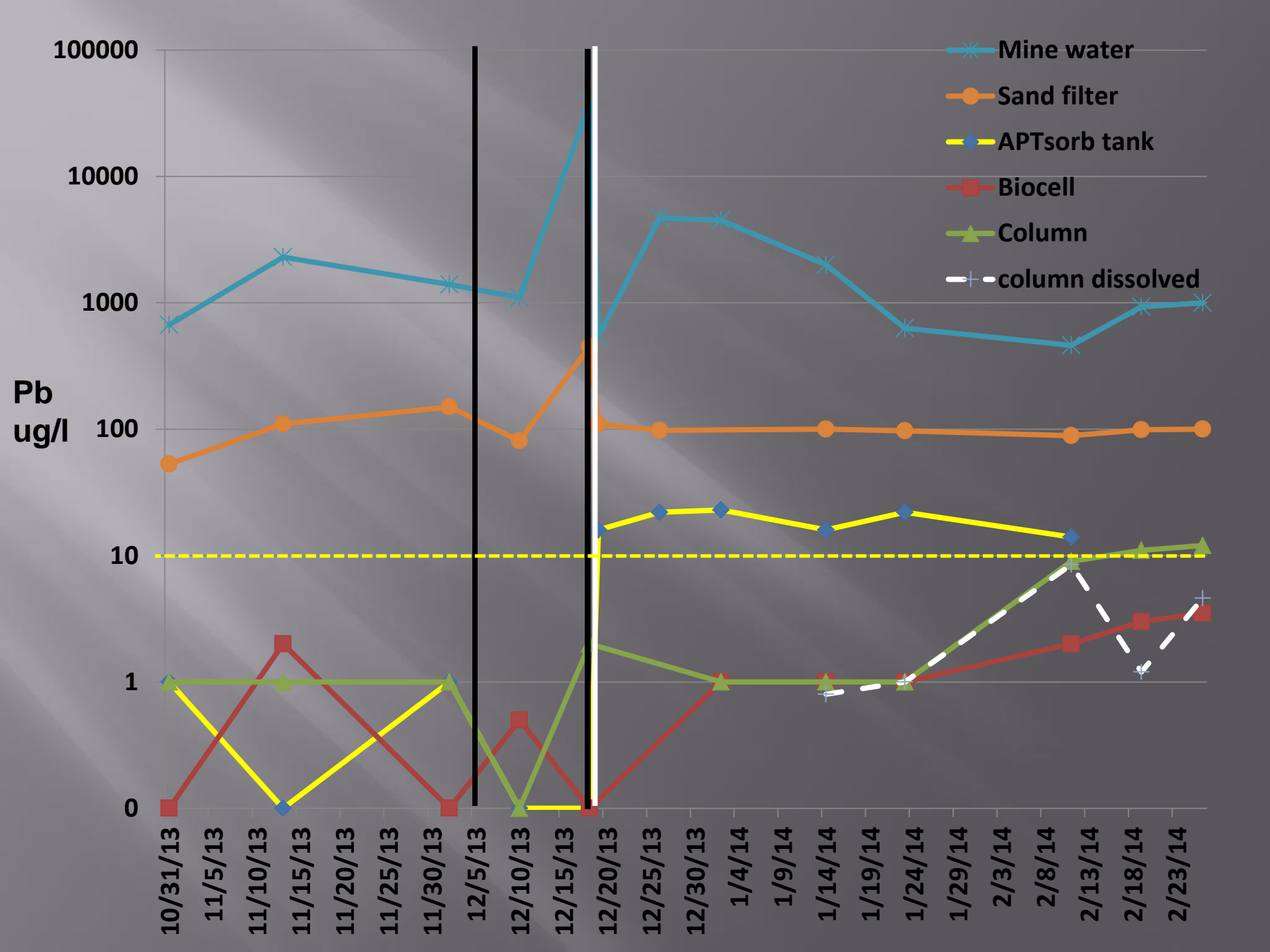


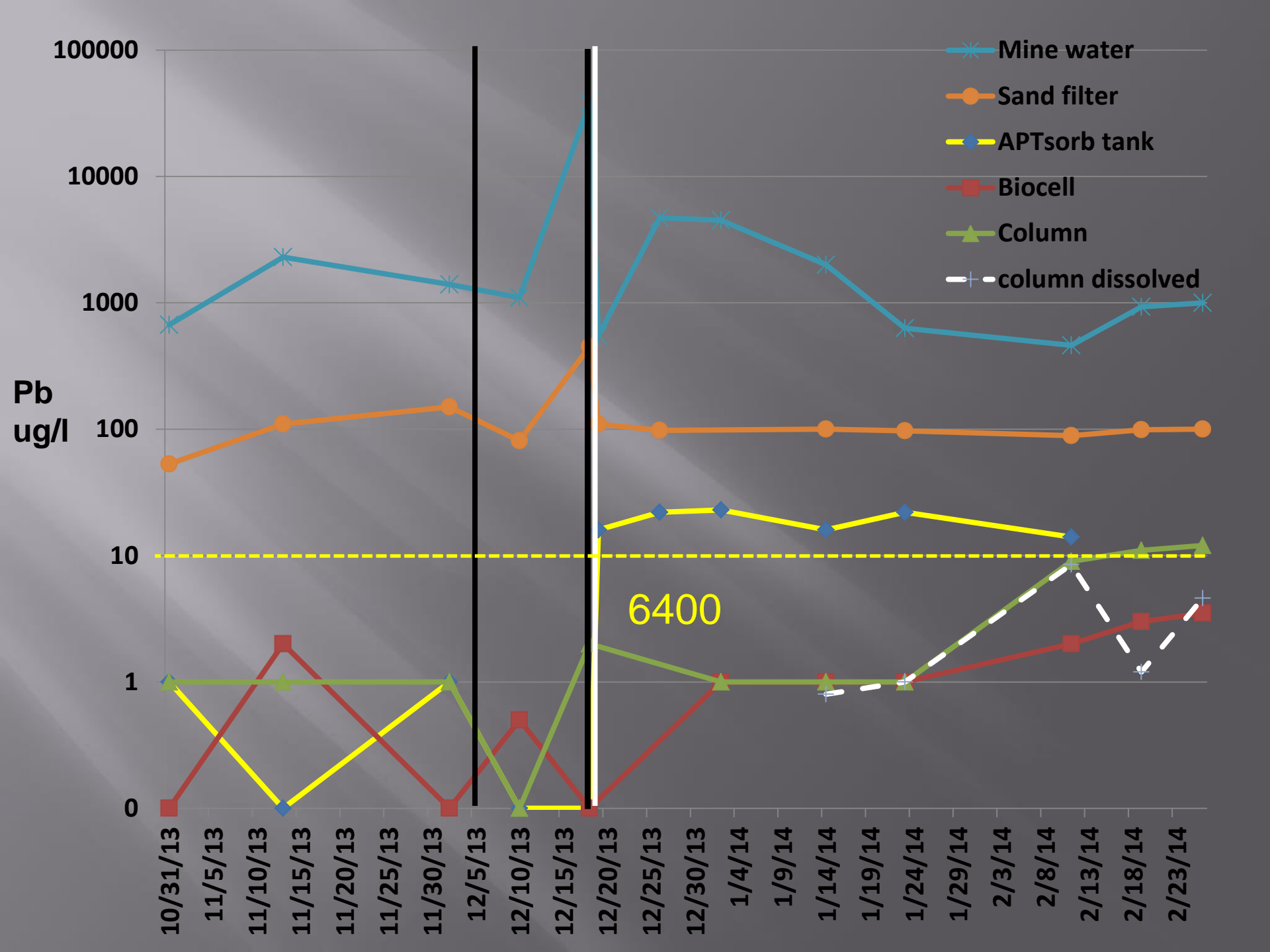
The Cerriodaphnia live!

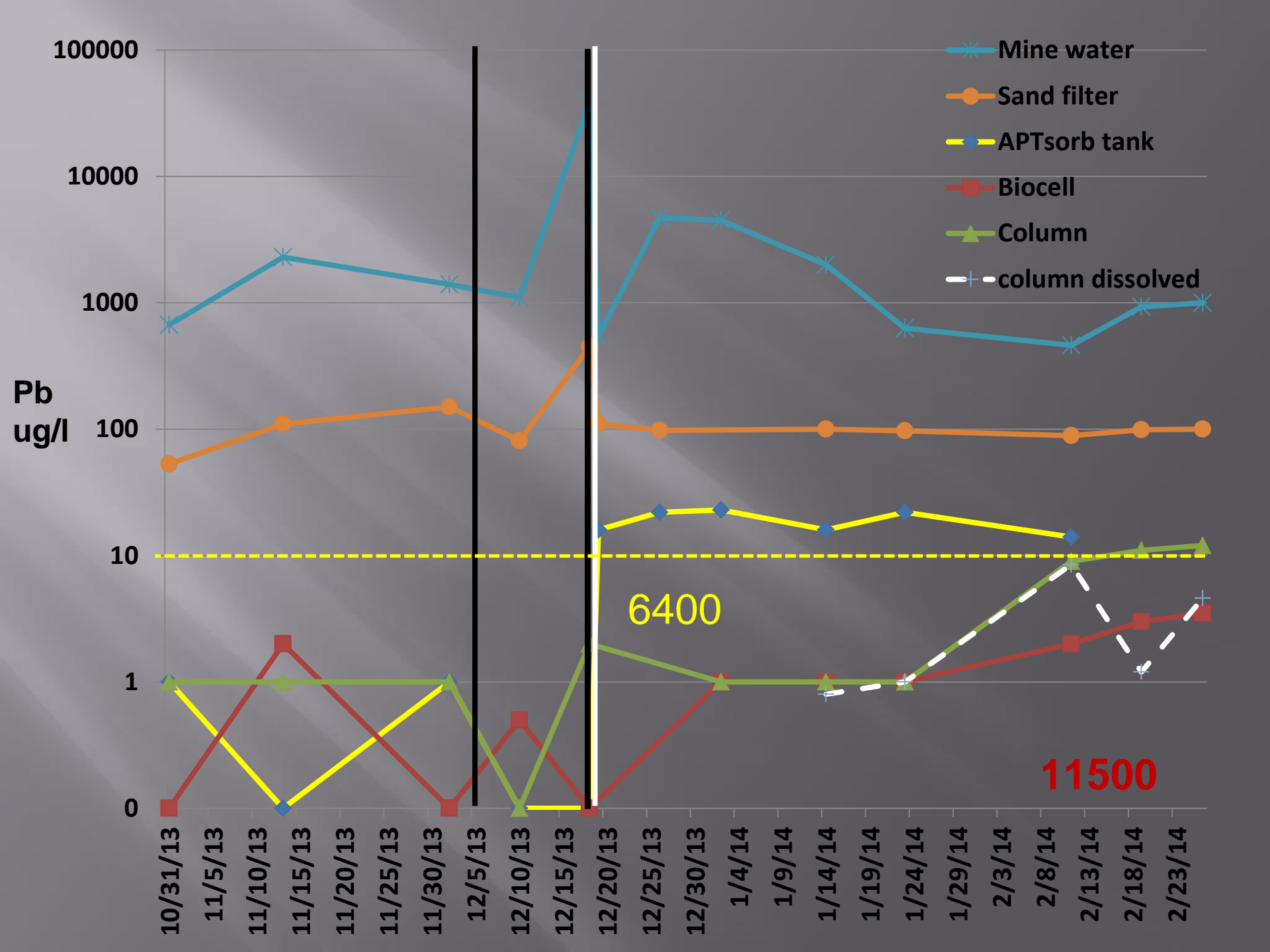














Results to date

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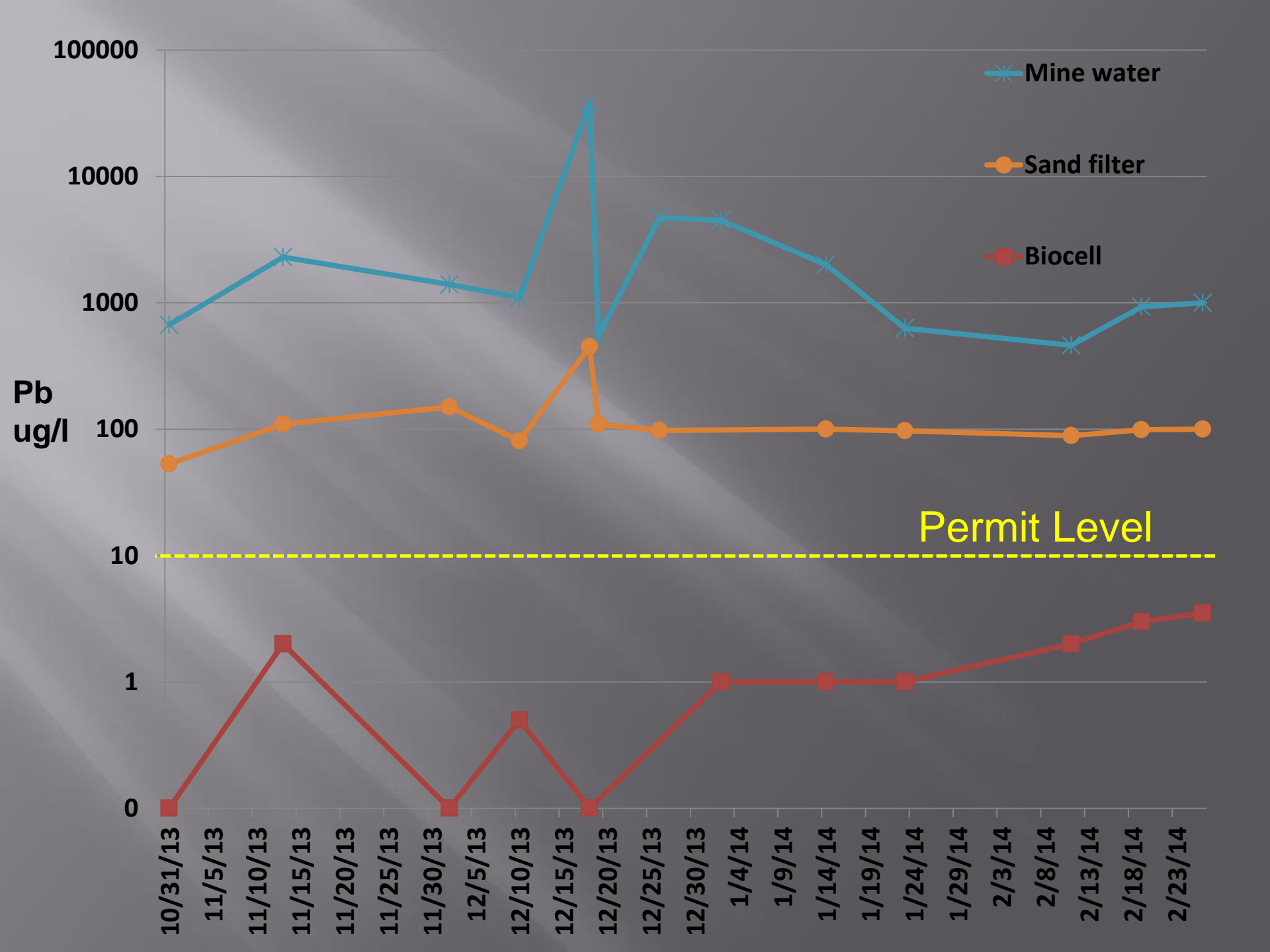
Looking for Answers?

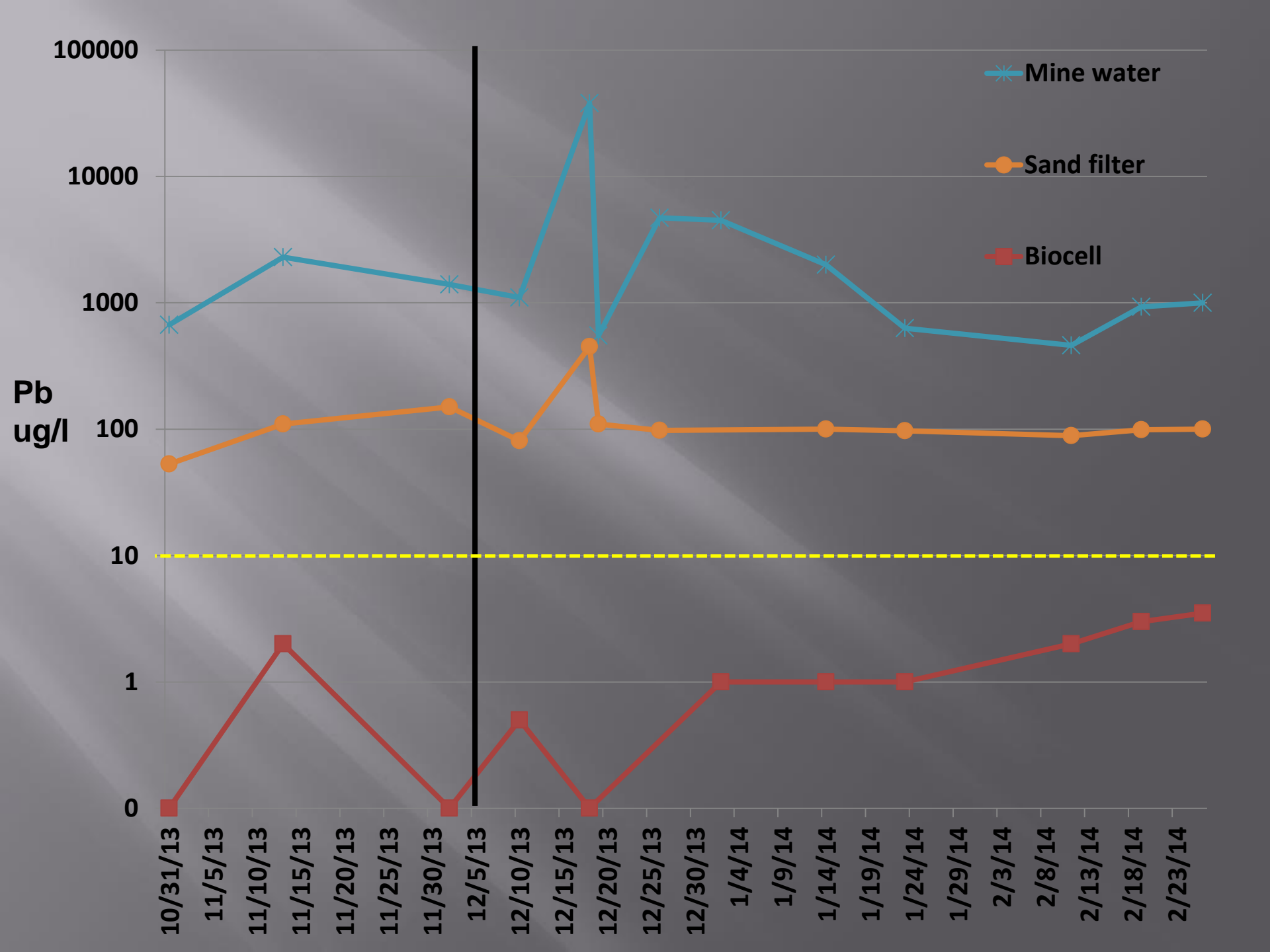


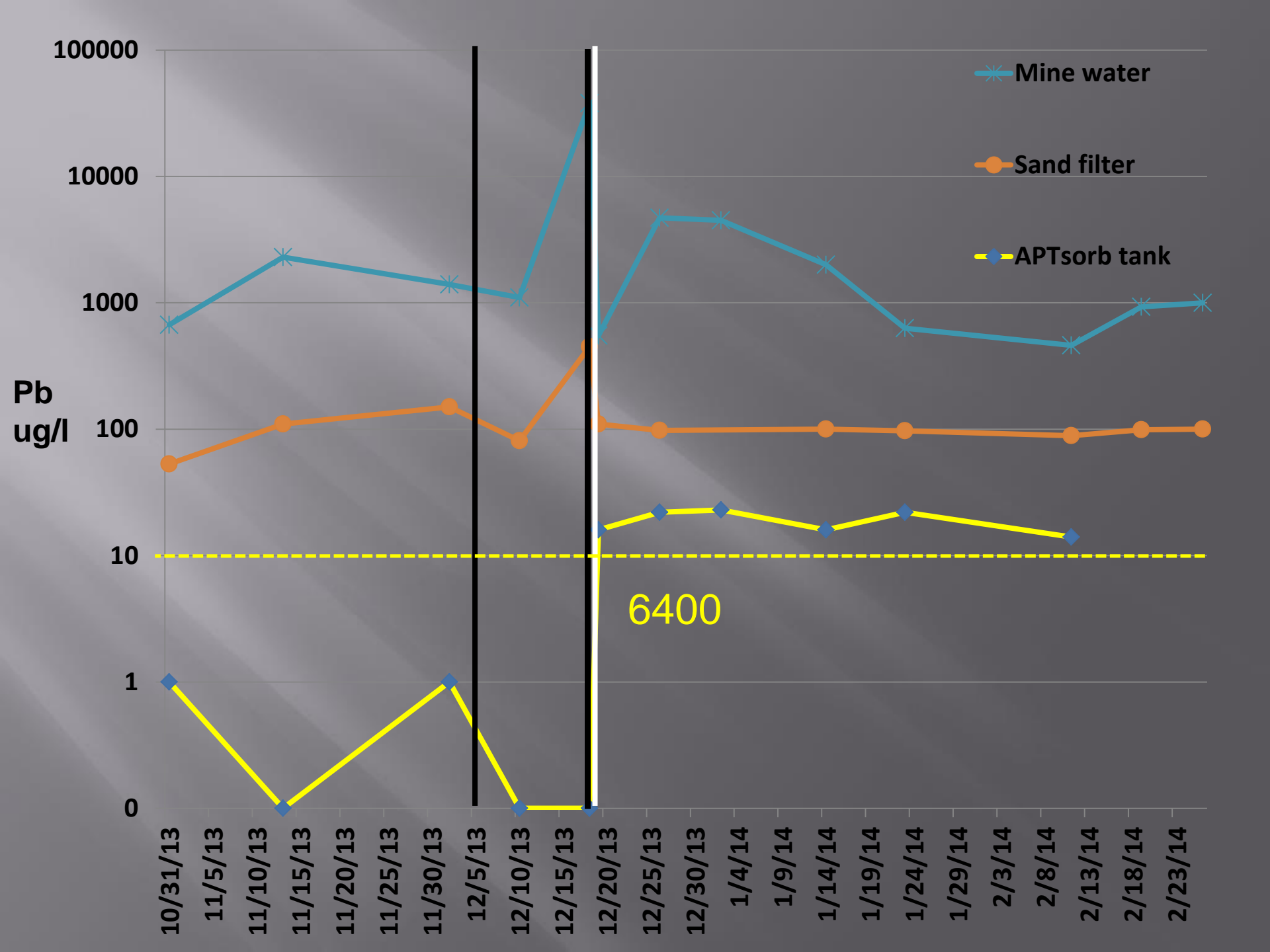
Ask a question!

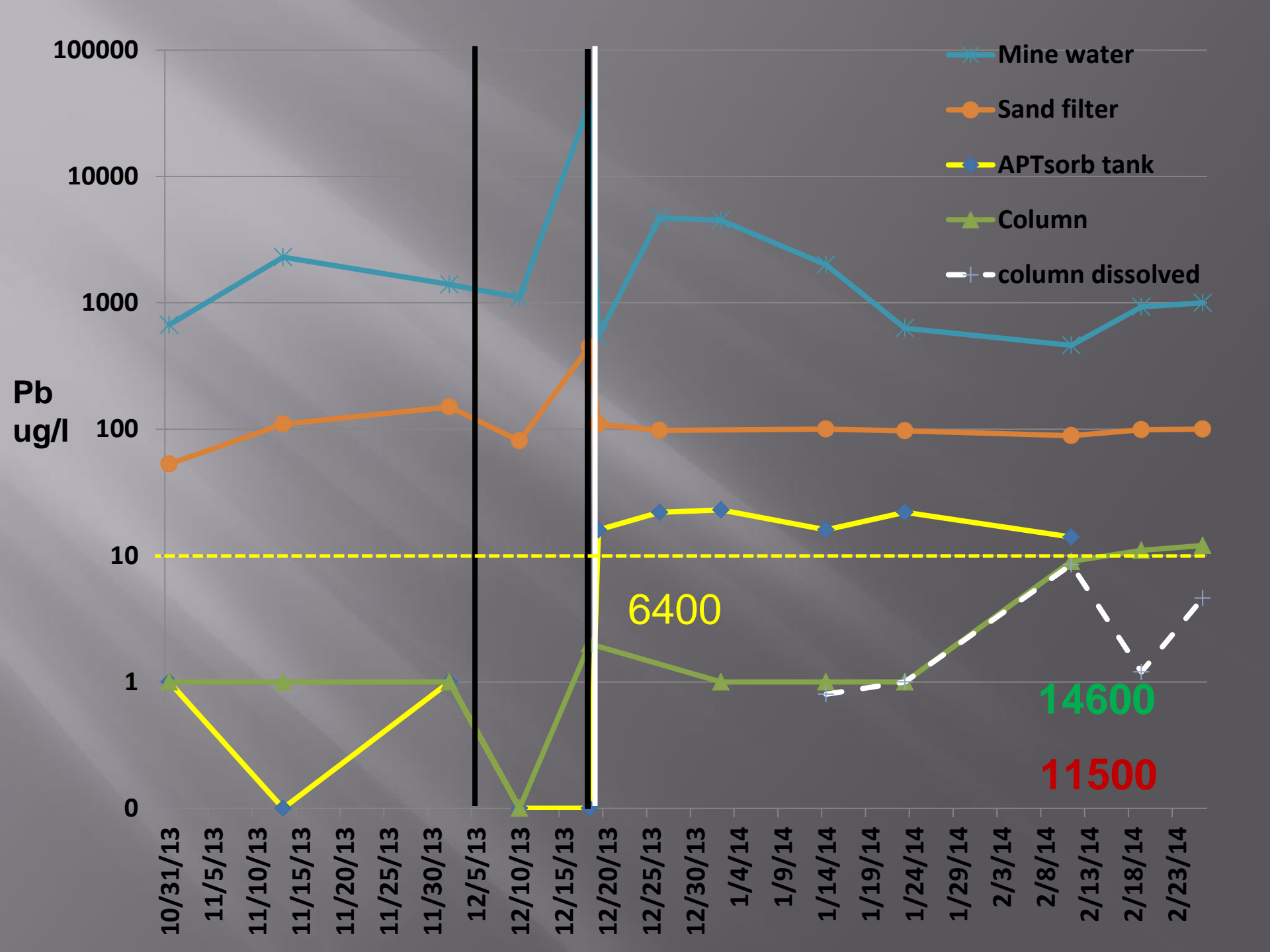
“There are no rules here. We’re trying to accomplish something.”

Thomas Edison









Talk like an engineer

Bed Volume = Volume of reactive media in treatment tank or system (gallons) 500 gallons

Empty bed contact time (min) = $\frac{\text{Volume of reactive media(gallons)}}{\text{Flow rate (gallons/min)}}$
5- 20 minutes

