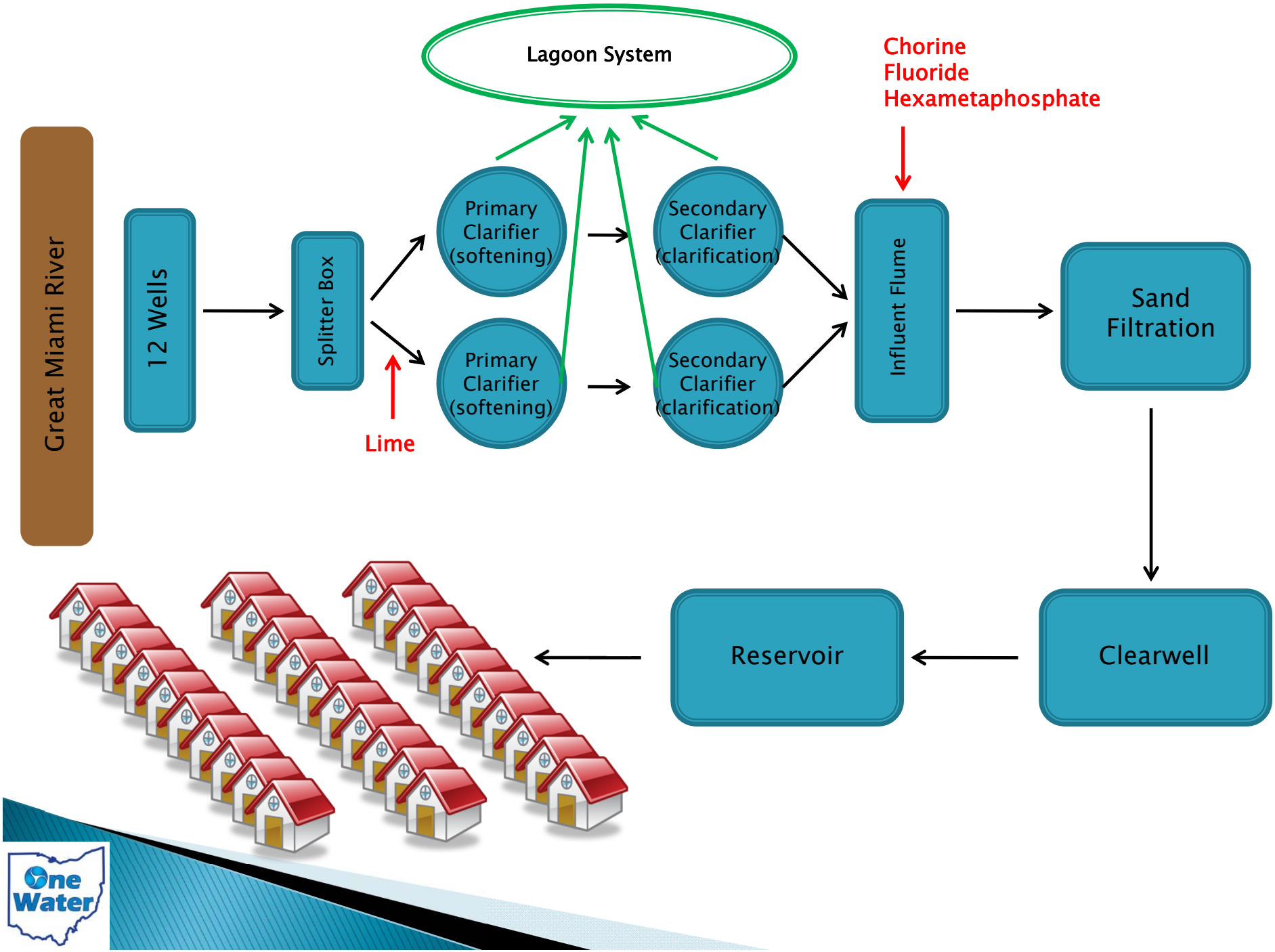
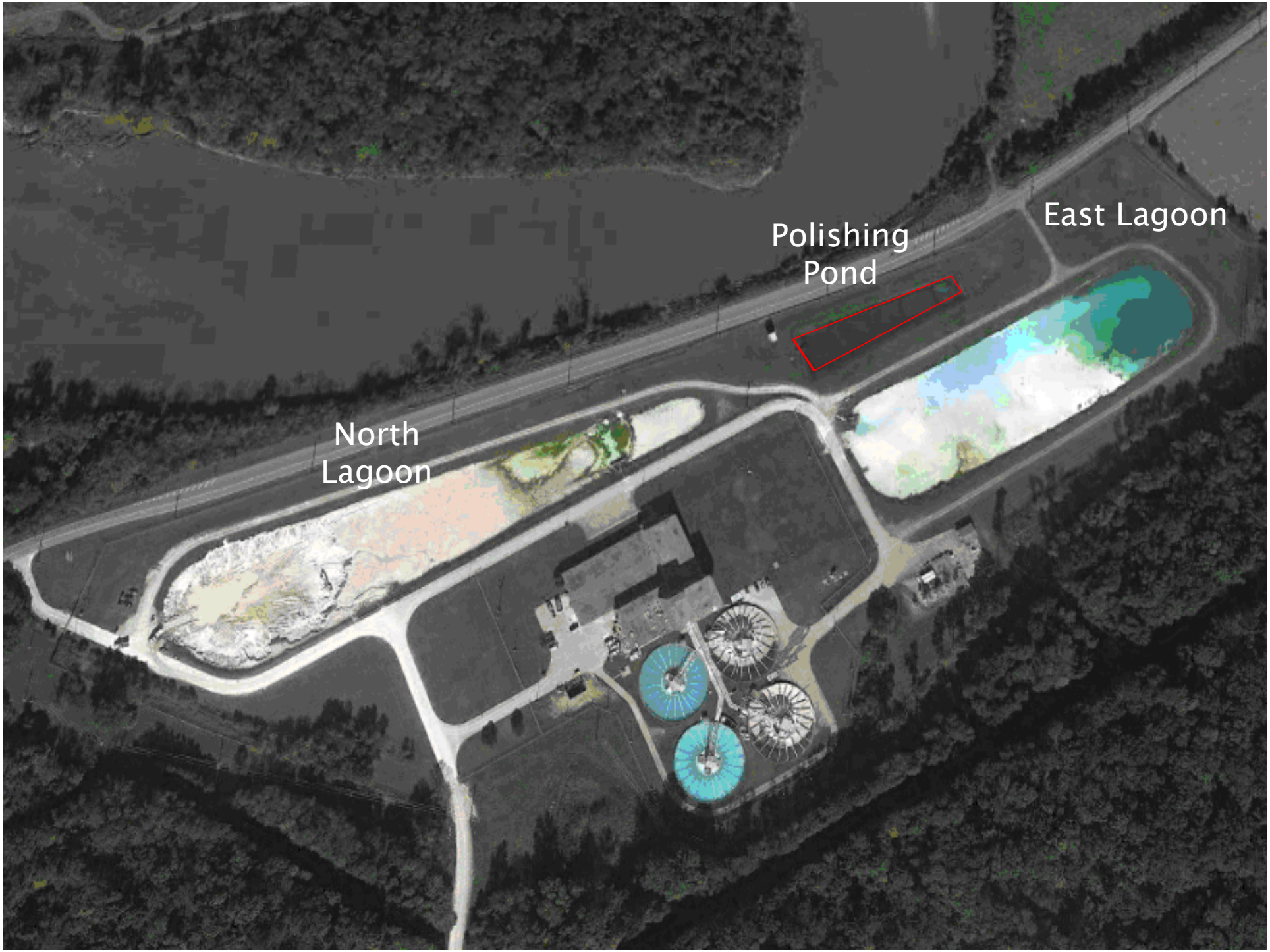
Full Scale Demonstration Studies of Recalcinated Lime

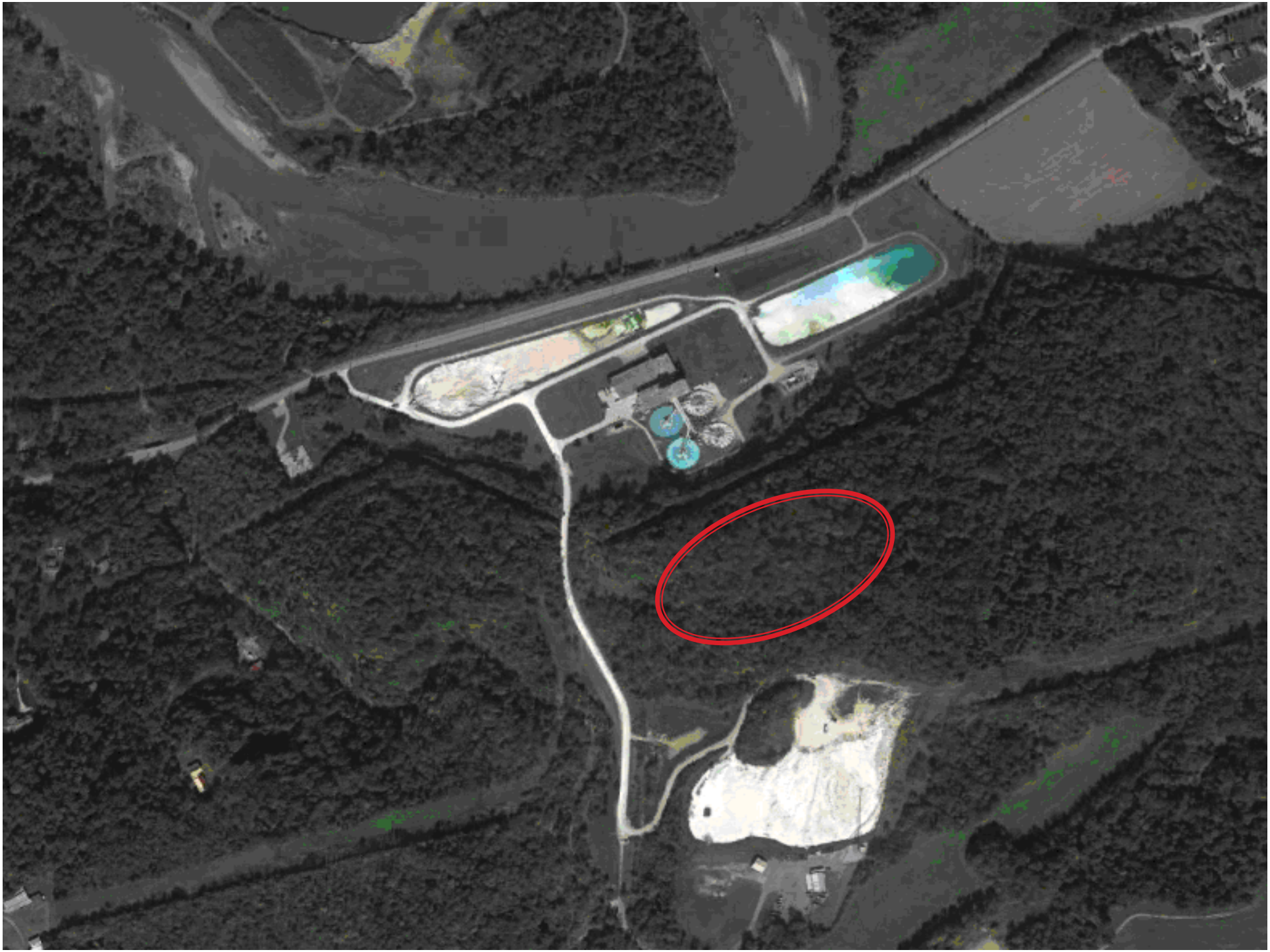
Katie Jamriska
Treatment Supervisor
Greater Cincinnati Water Works


Lagoon System
Chorine
Fluoride
Hexametaphosphate
Great Miami River
12 Wells
Splitter Box
Lime
Primary Clarifier (softening)
Primary Clarifier (softening)
Secondary Clarifier (clarification)
Secondary Clarifier (clarification)
Influent Flume
Sand Filtration
Clearwell
Reservoir


Polishing
Pond
East Lagoon
North
Lagoon

Lime solids disposal alternatives

- New Monofill
- Land Application
- Recalcinating
- Other beneficial uses
  - Regional power plant (scrubbers)

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City of Dayton Lime Recovery Facility

Philip Van Atta, City of Dayton Water Department
David Cornwell, President, EET, Inc.

City of Dayton water plants use calcium oxide (quick lime) to soften extremely hard well water. Dayton is one of two water utilities in the U.S. that creates calcium oxide from recovered lime softening residuals. The Lime Recovery Facility, aka Lime Plant, reclaims calcium carbonate from the lime softening residuals of both water treatment plants and produces more lime for softening. Because calcium from Dayton's well water precipitates into the lime softening residuals, more lime is produced than is consumed.

There are advantages and disadvantages related to operating the Lime Recovery Facility (LRF). Operating the LRF normally eliminates the need for purchasing lime for softening, it produces excess lime that can be sold, and it eliminates the need and associated costs for disposing of over 700,000 gallons of lime softening residuals produced by Dayton's water plants on an average day. The disadvantages include the high labor costs for running the Lime Plant 24/7, the cost of natural gas to heat the kiln, costs for maintenance and capital improvement projects, and the large water usage for cooling water.

The Lime Recovery Facility has operators that work on shifts 24 hours per day. The Operator II position has overall responsibility for operating the plant. The Operator I is responsible for the feed end of the kiln and minor maintenance. The plant has a maintenance employees and an electrician on staff during the day. The plant supervisor oversees 24/7 operations, ensures that Dayton's water plants receive sufficient lime for water softening, sells excess lime to other water systems, and coordinates importation of lime sludge.

Both of the City of Dayton's water treatment plants pump calcium carbonate/magnesium hydroxide lime softening residuals to our Lime Recovery Facility (LRF). The LRF is located next to the Ottawa Water Treatment Plant. At the LRF, carbon dioxide produced by the lime recalcination process selectively dissolves and separates magnesium from the lime softening residuals. Then, relatively pure calcium carbonate is dewatered in centrifuges and pumped into a rotary lime kiln.

During the recalcination process in the kiln, heat at approximately 2000 degrees F converts the calcium carbonate into calcium oxide and carbon dioxide. The carbon dioxide is used for carbonation of lime softening residuals. The final product of the recalcination process is calcium oxide. The Lime Recovery Facility produced over 23,000 tons of lime in 2012.

Calcium oxide, in a pebble form, is conveyed pneumatically from the LRF to the adjacent Ottawa Water Plant. Because lime is easily conveyed to the plant, the Ottawa Water plant has only approximately 80 tons of calcium oxide storage capacity. An LRF employee drives a dedicated truck to the Miami Water Plant on a daily basis during the week and on weekends as needed. The Miami plant has a storage capacity of approximately 740 tons of calcium oxide. At the water plants, the calcium oxide is mixed with water in slaking machines to create calcium hydroxide for water softening.

To prepare for Ohio EPA's adoption of NSF/ANSI Standard 60 requirements for water additives, Dayton completed all NSF International requirements to allow Standard 60 certification of Dayton Lime (calcium oxide). To comply with certification requirements, Dayton submitted a Lime Plant Quality Control Plan, a complete description of the recalcination process, NSF certification paperwork, and made arrangements for audits, sampling and NSF testing of the calcium oxide. After testing and toxicological evaluation, Dayton Lime received Standard 60 approval for lime softening


ONROE

Recalcinated Lime

Quick Lime

Study Background

STUDY 1 & 2

Recal

WEST
Primary
Clarifier
(Softening)

Regular

EAST
Primary
Clarifier
(Softening)

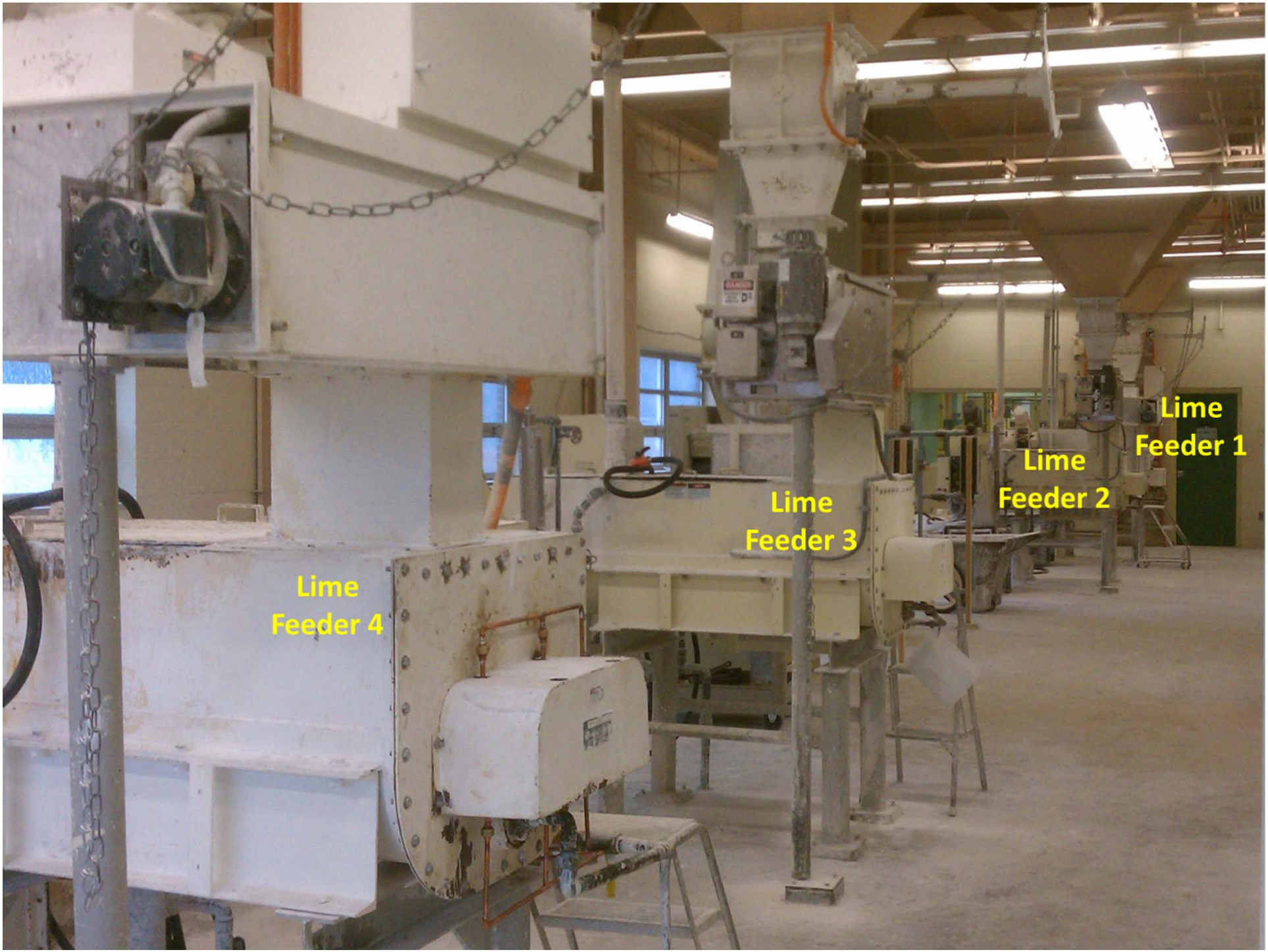
STUDY 3

Recal

WEST
Primary
Clarifier
(Softening)

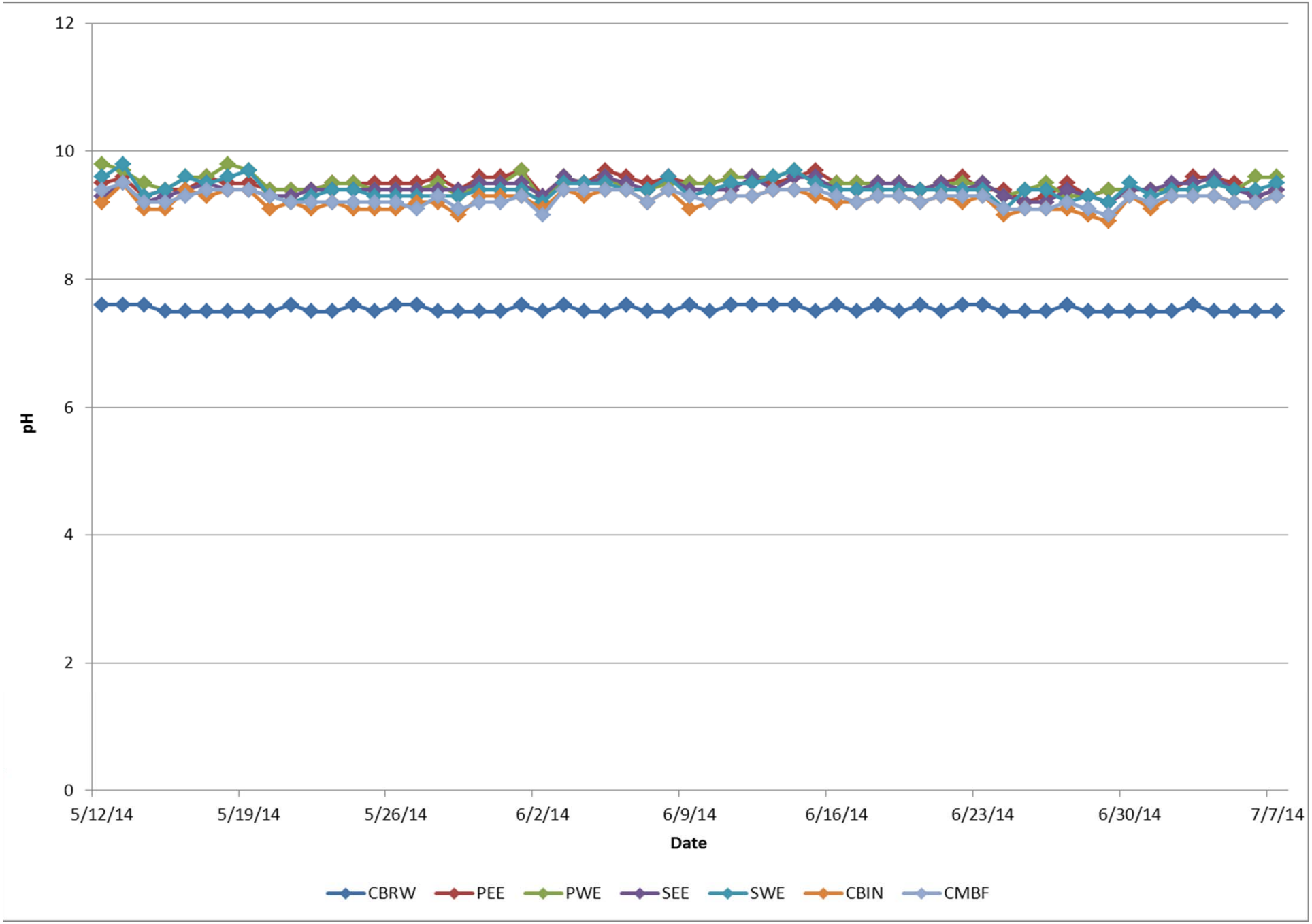
Recal

EAST
Primary
Clarifier
(Softening)

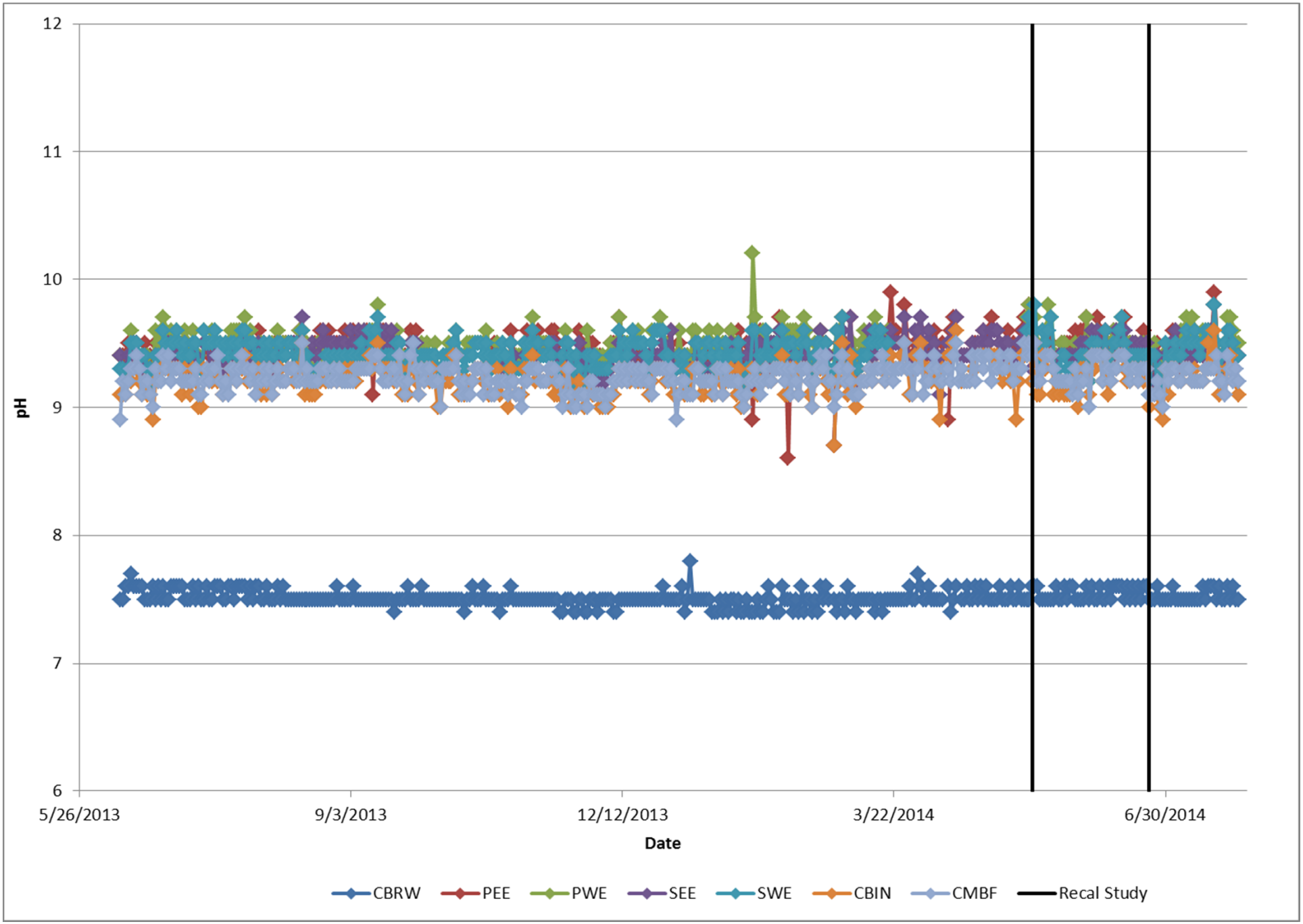

Lime
Feeder 4
Lime
Feeder 3
Lime
Feeder 2
Lime
Feeder 1

Study Results

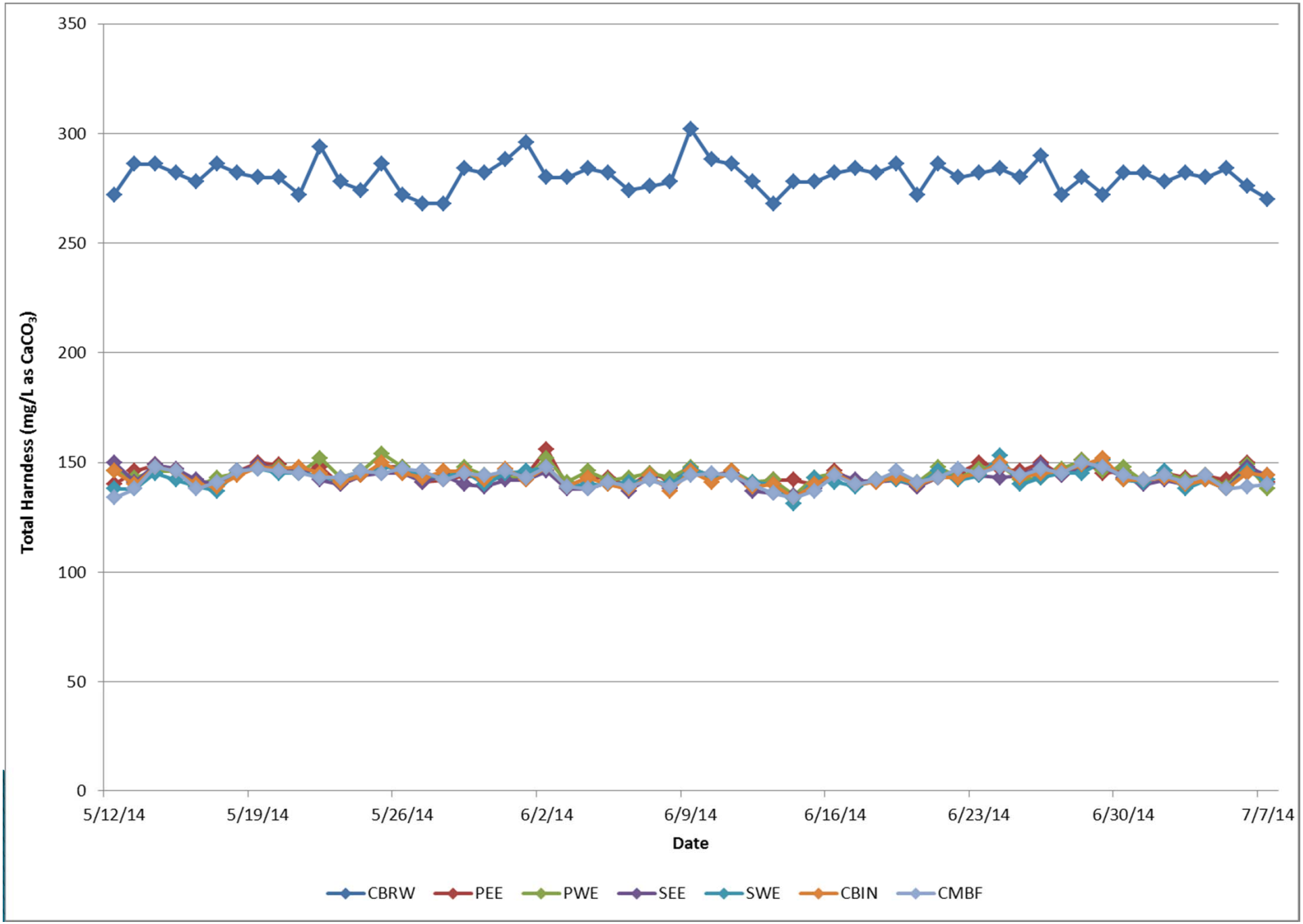
Study 3 pH


12
10
8
6
4
2
0
pH
5/12/14
5/19/14
5/26/14
6/2/14
6/9/14
6/16/14
6/23/14
6/30/14
7/7/14
Date
CBRW
PEE
PWE
SEE
SWE
CBIN
CMBF

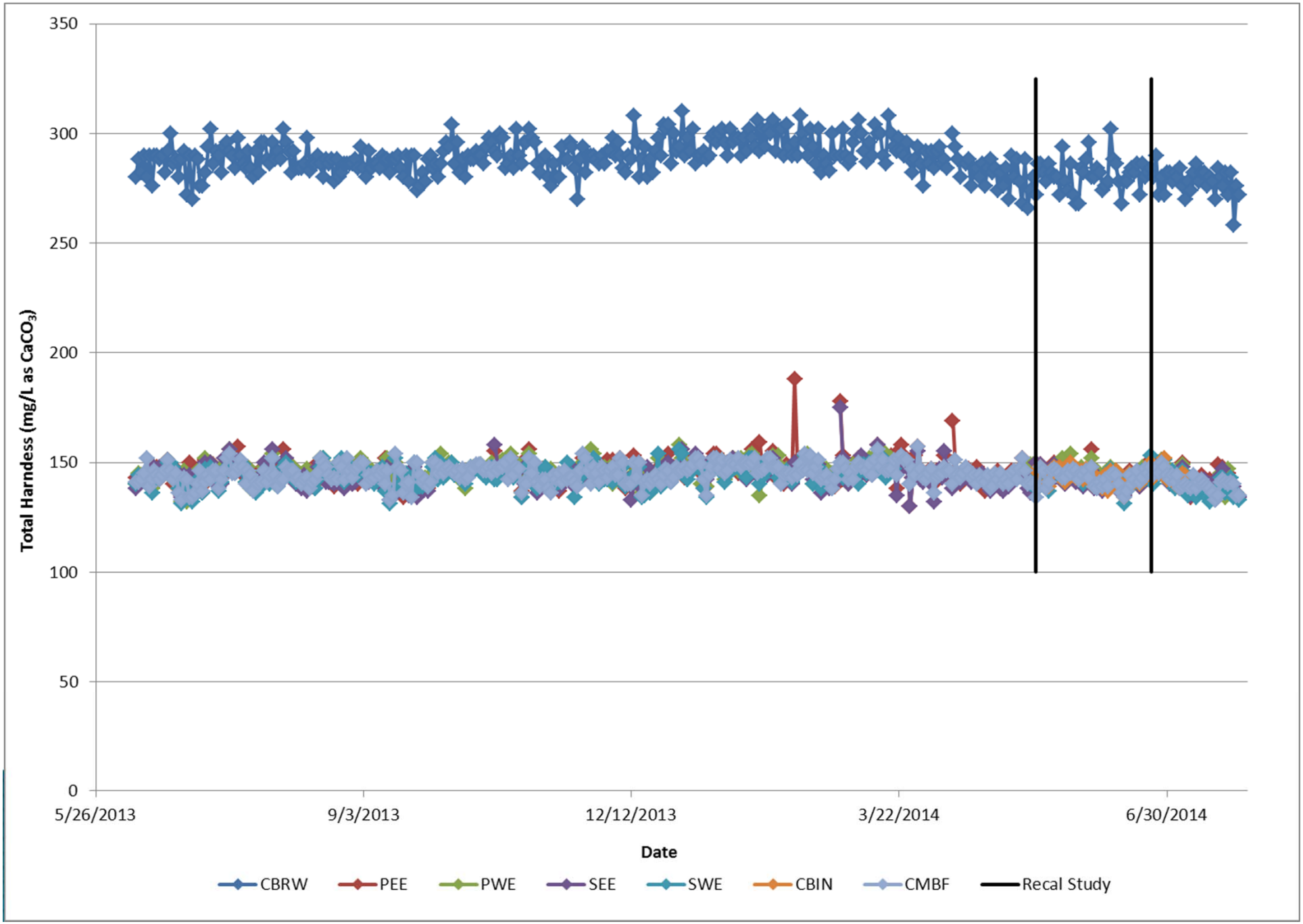
Background pH



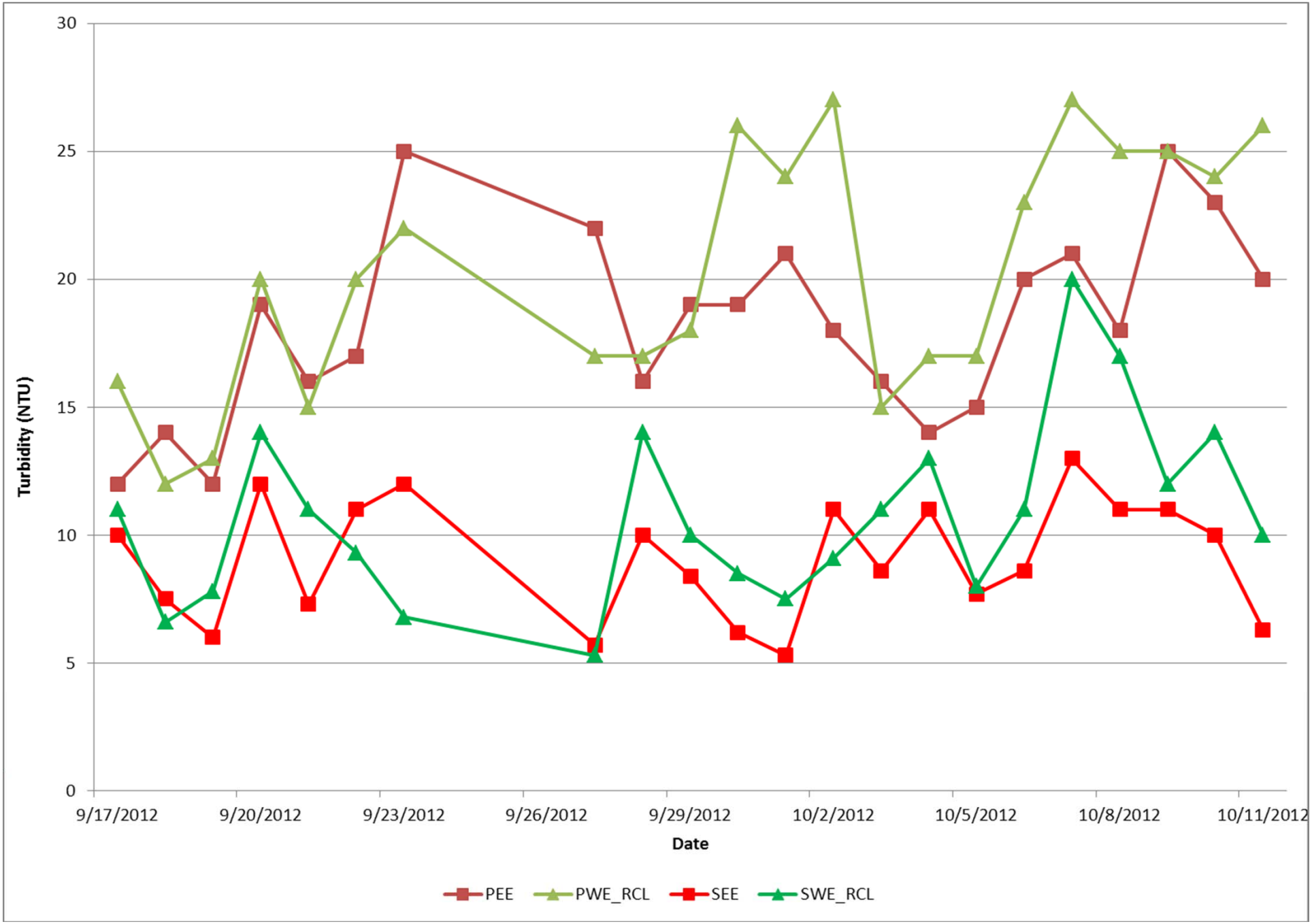
Study 3 Hardness



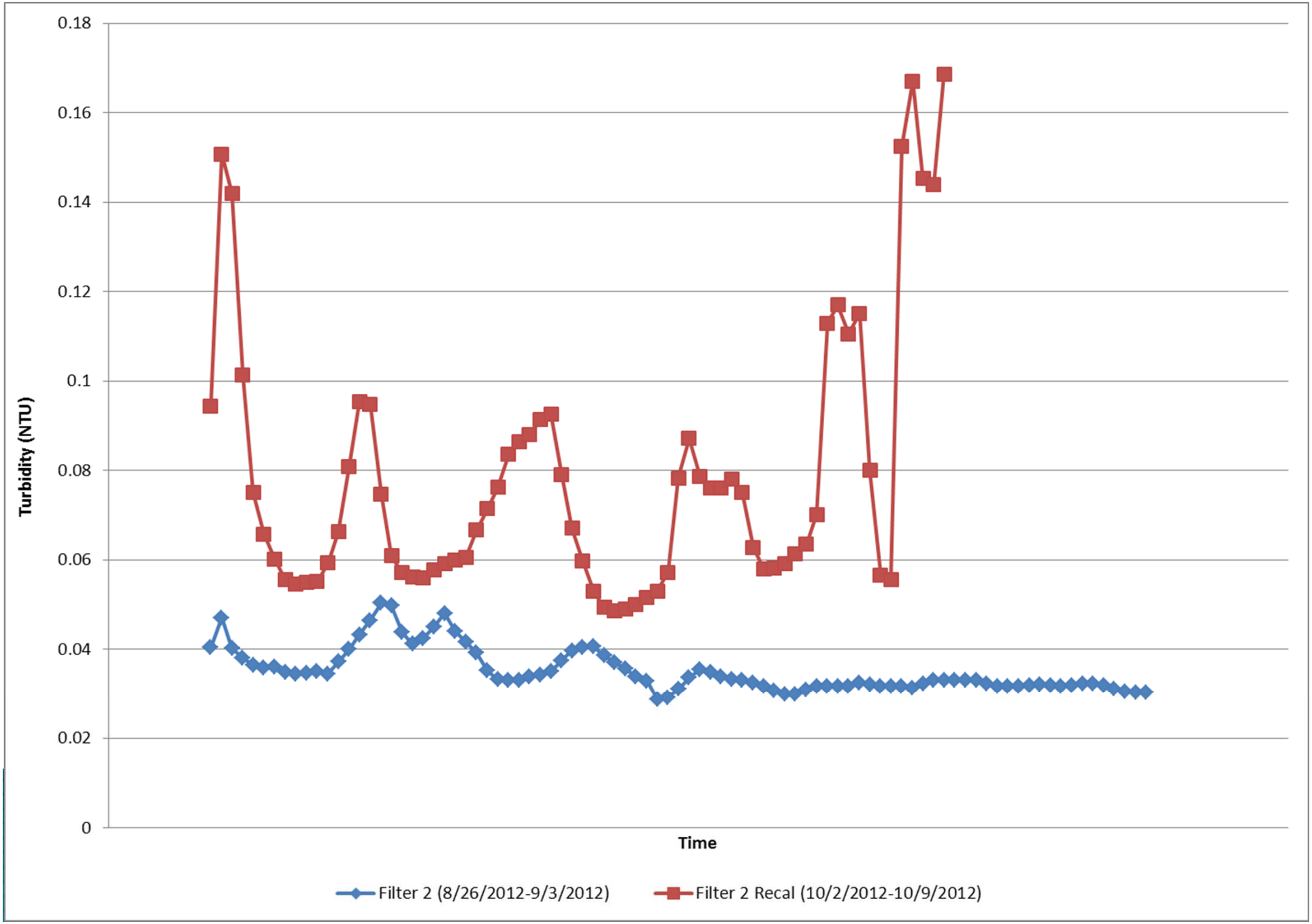
Background Hardness



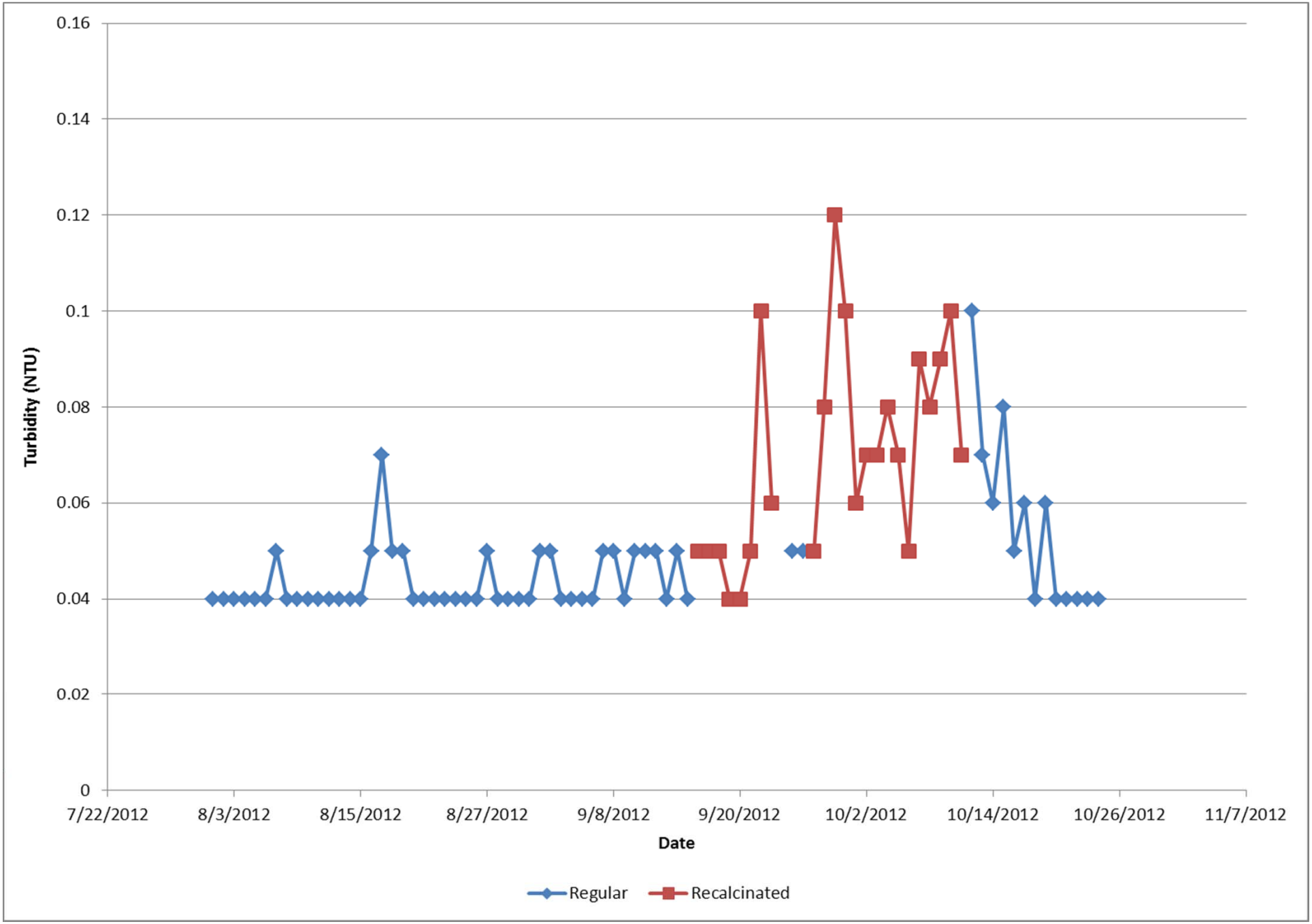
Study 1 Turbidity



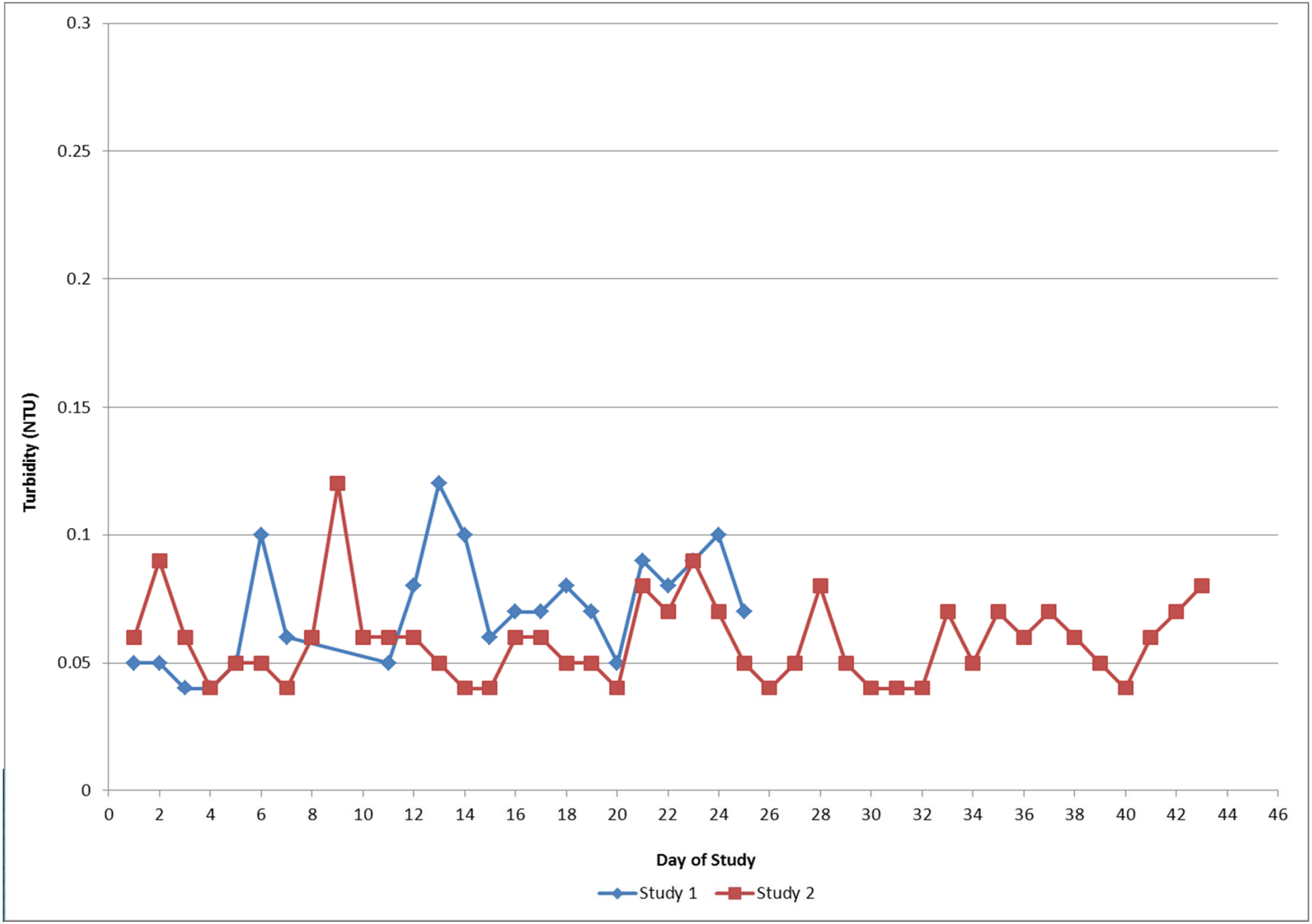
Study 1 Filter Turbidity



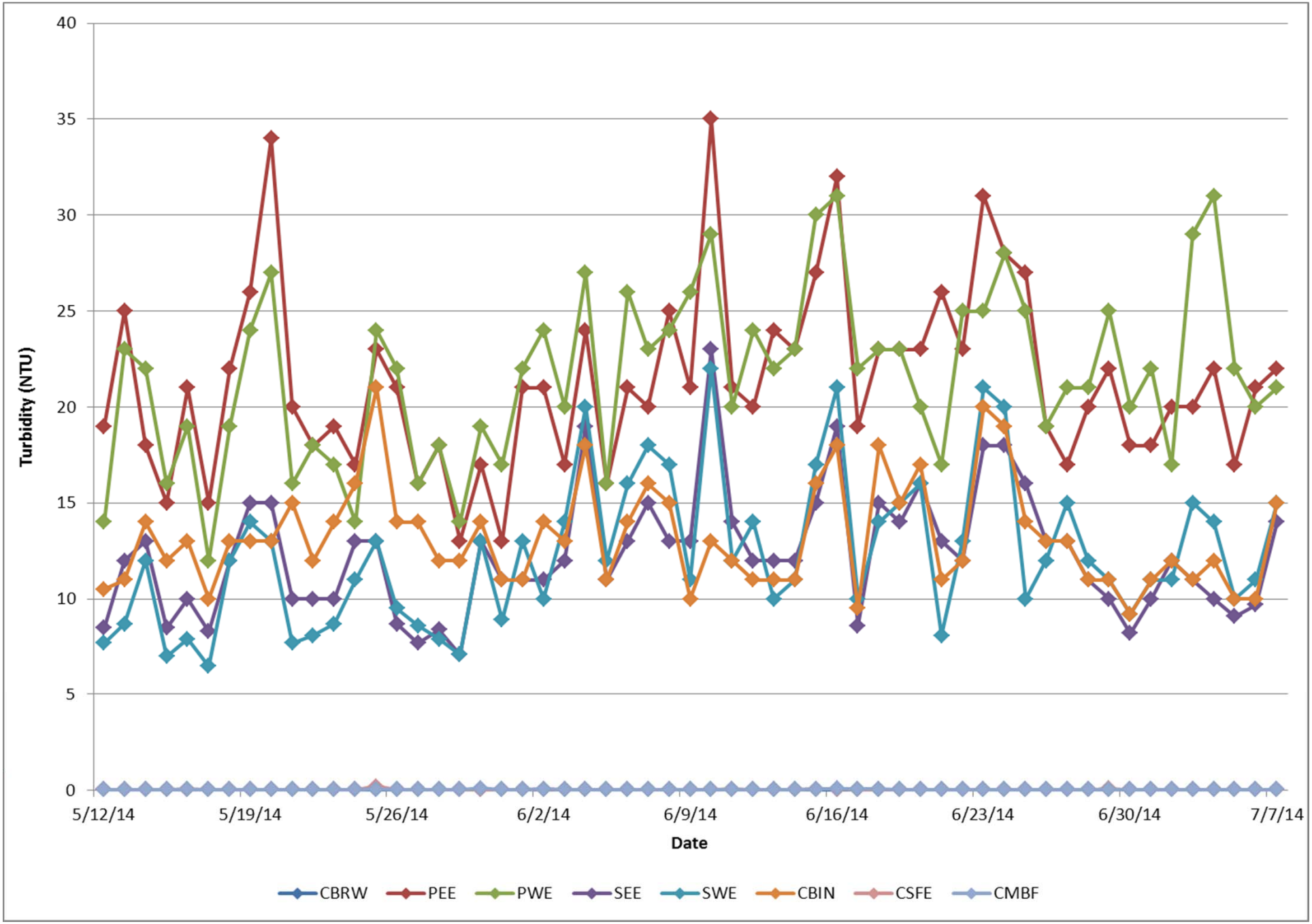
Study 1 Turbidity



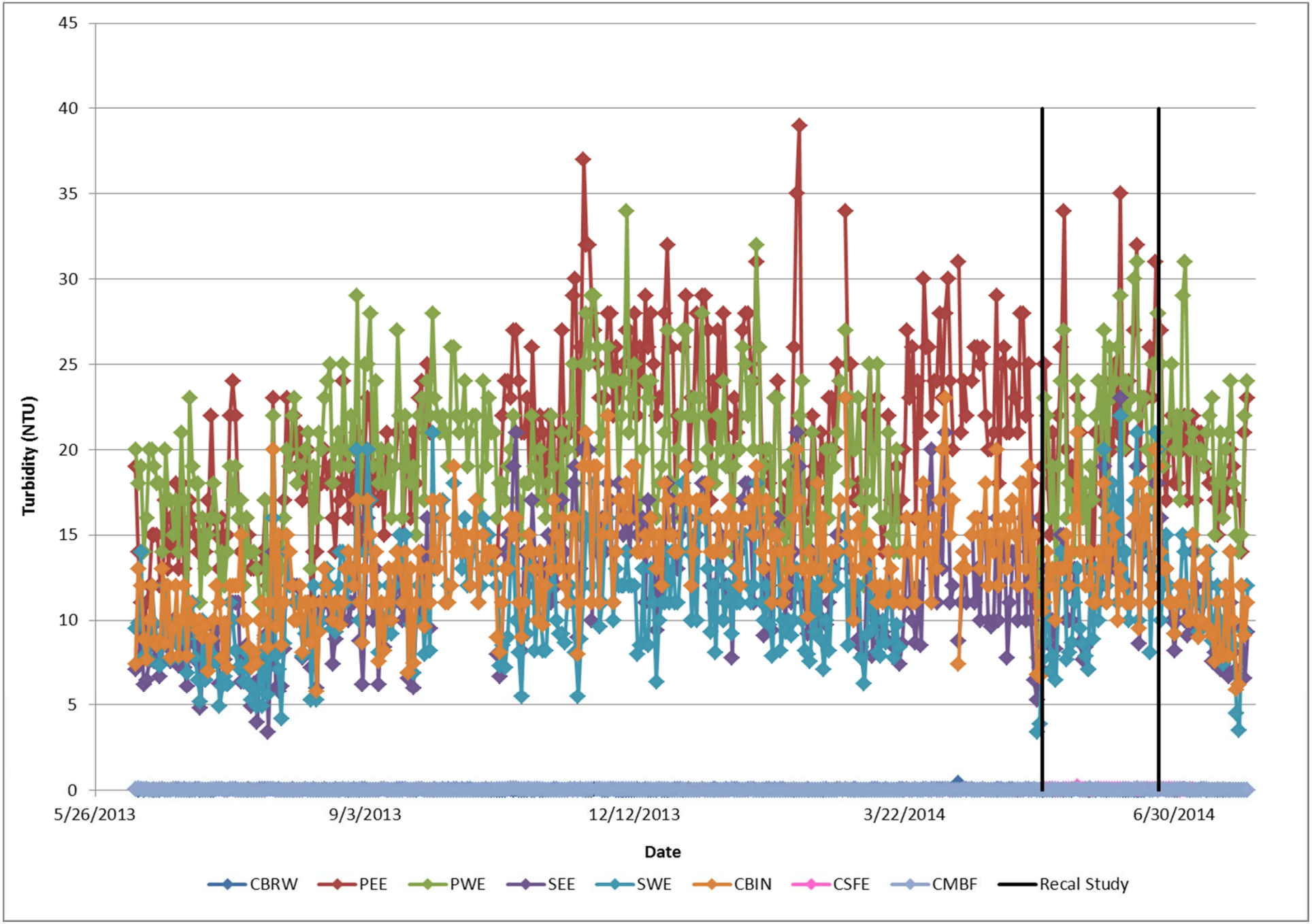
Turbidity Comparison



Study 3 Turbidity



Background Turbidity



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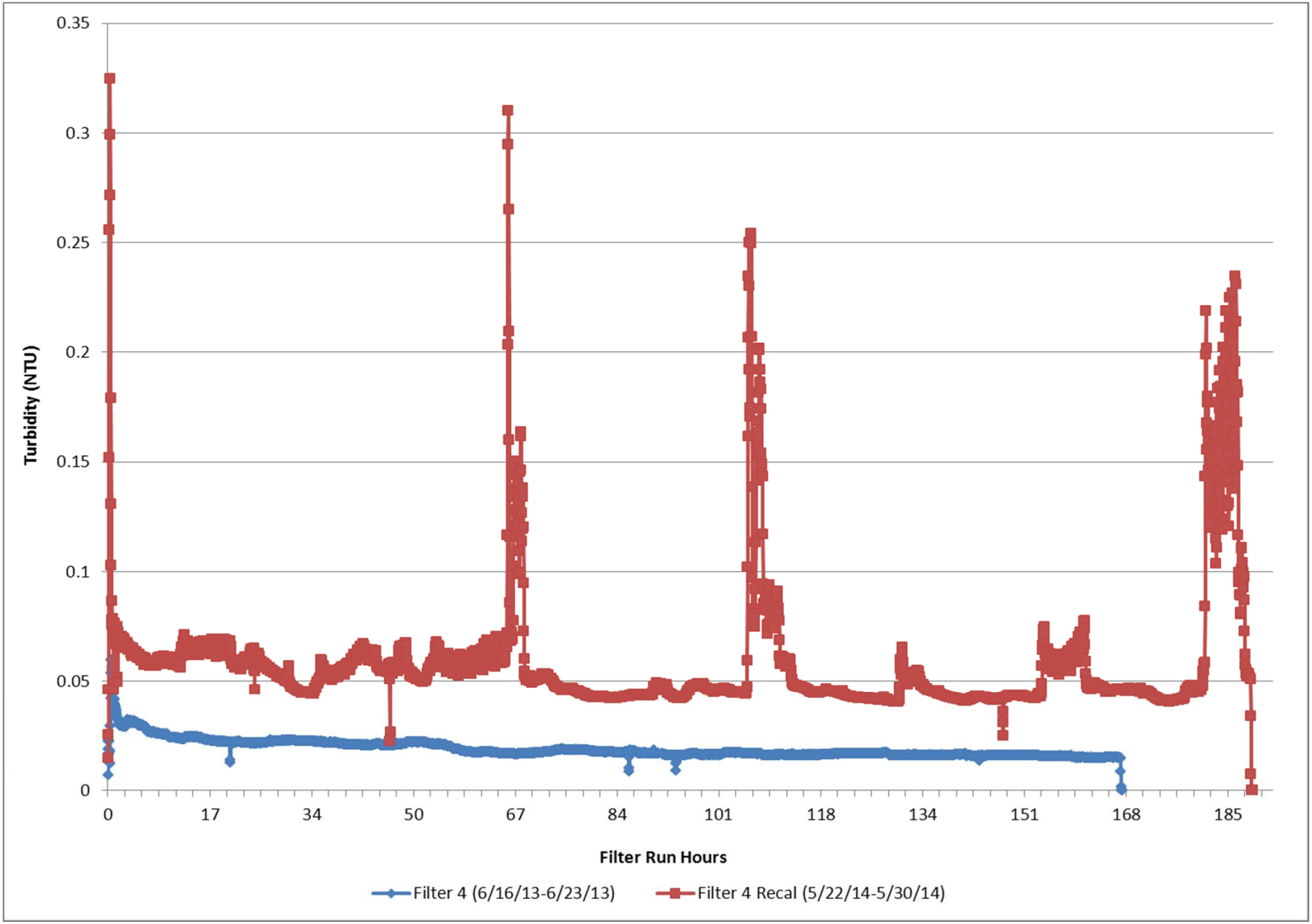

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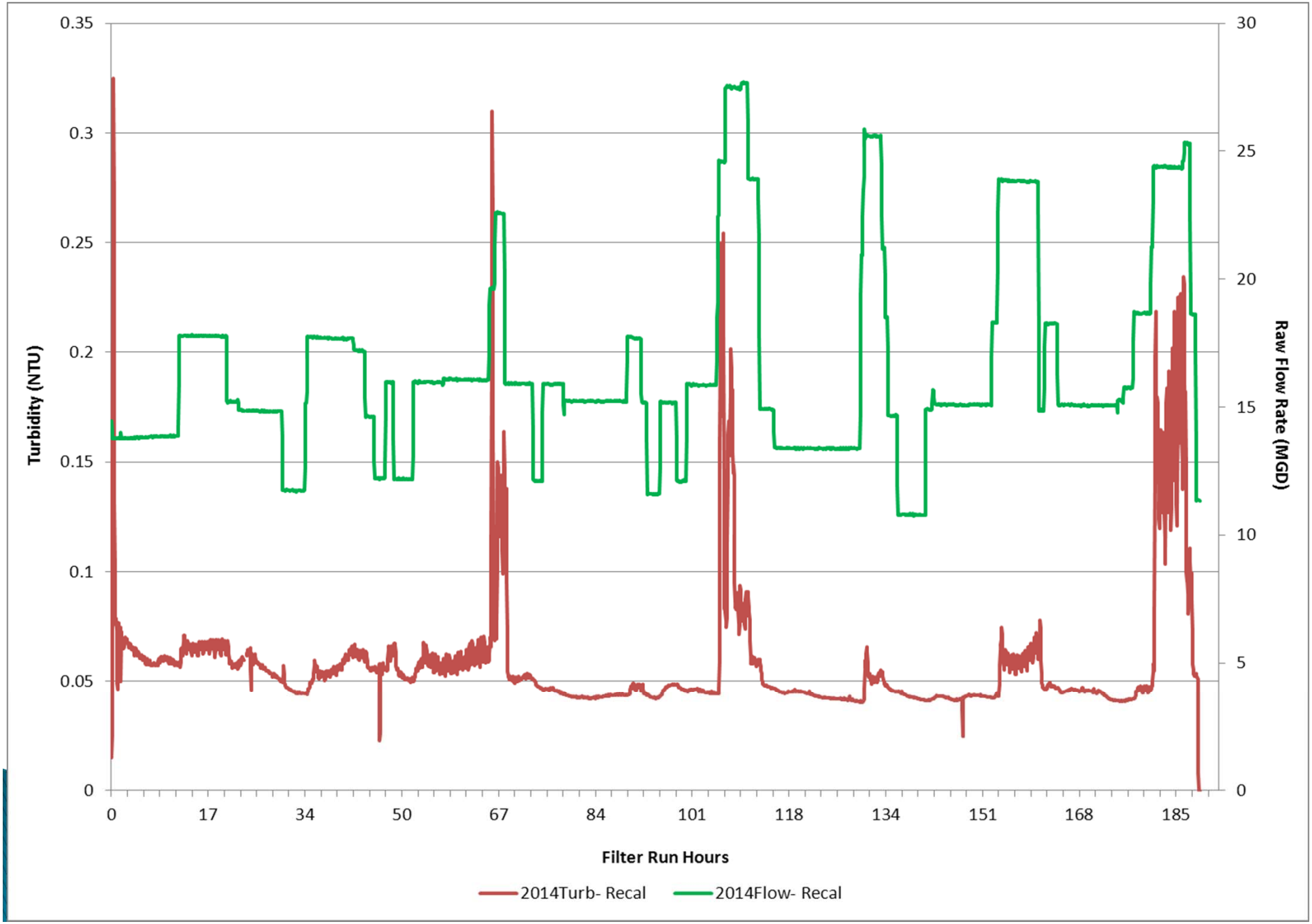
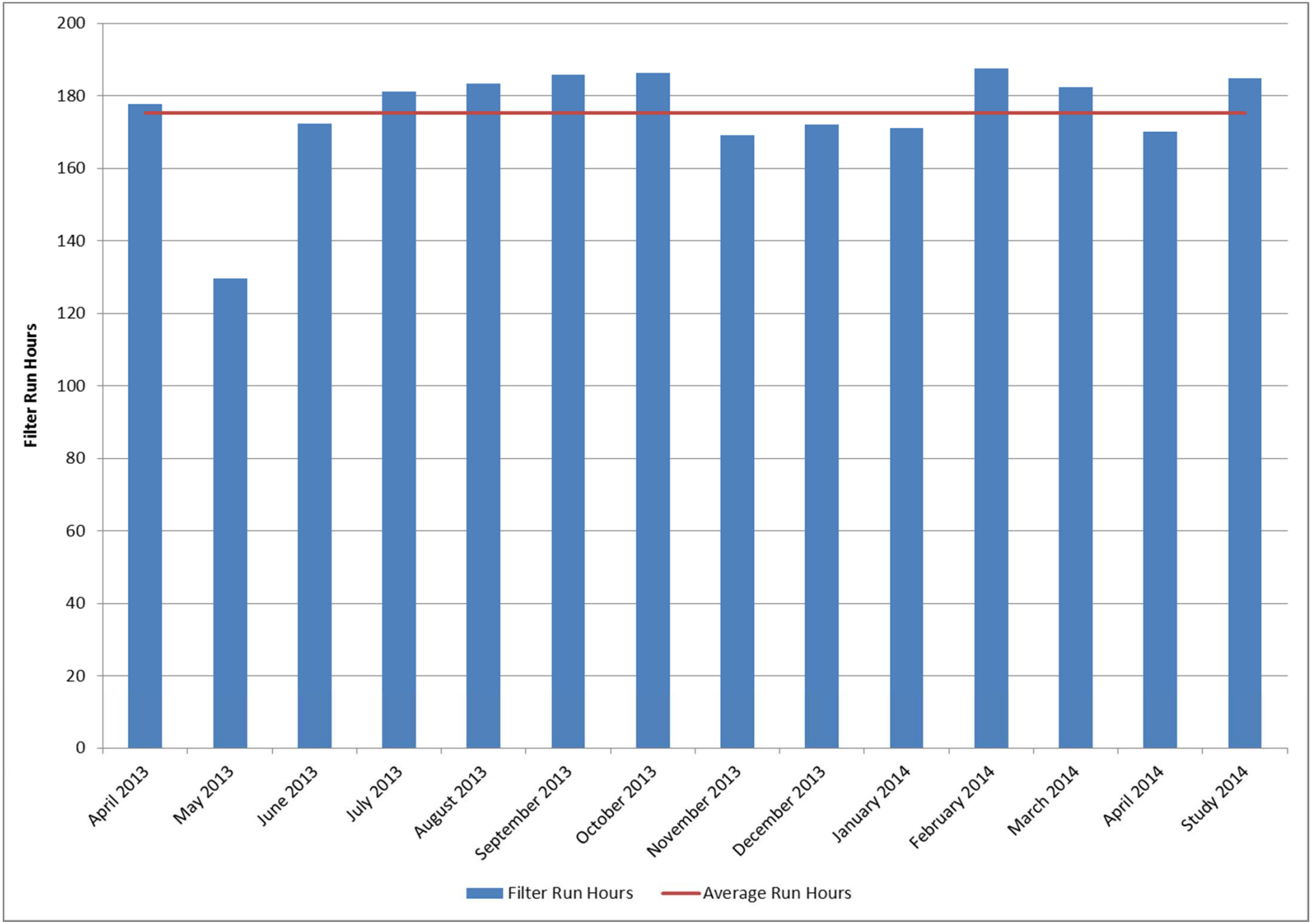
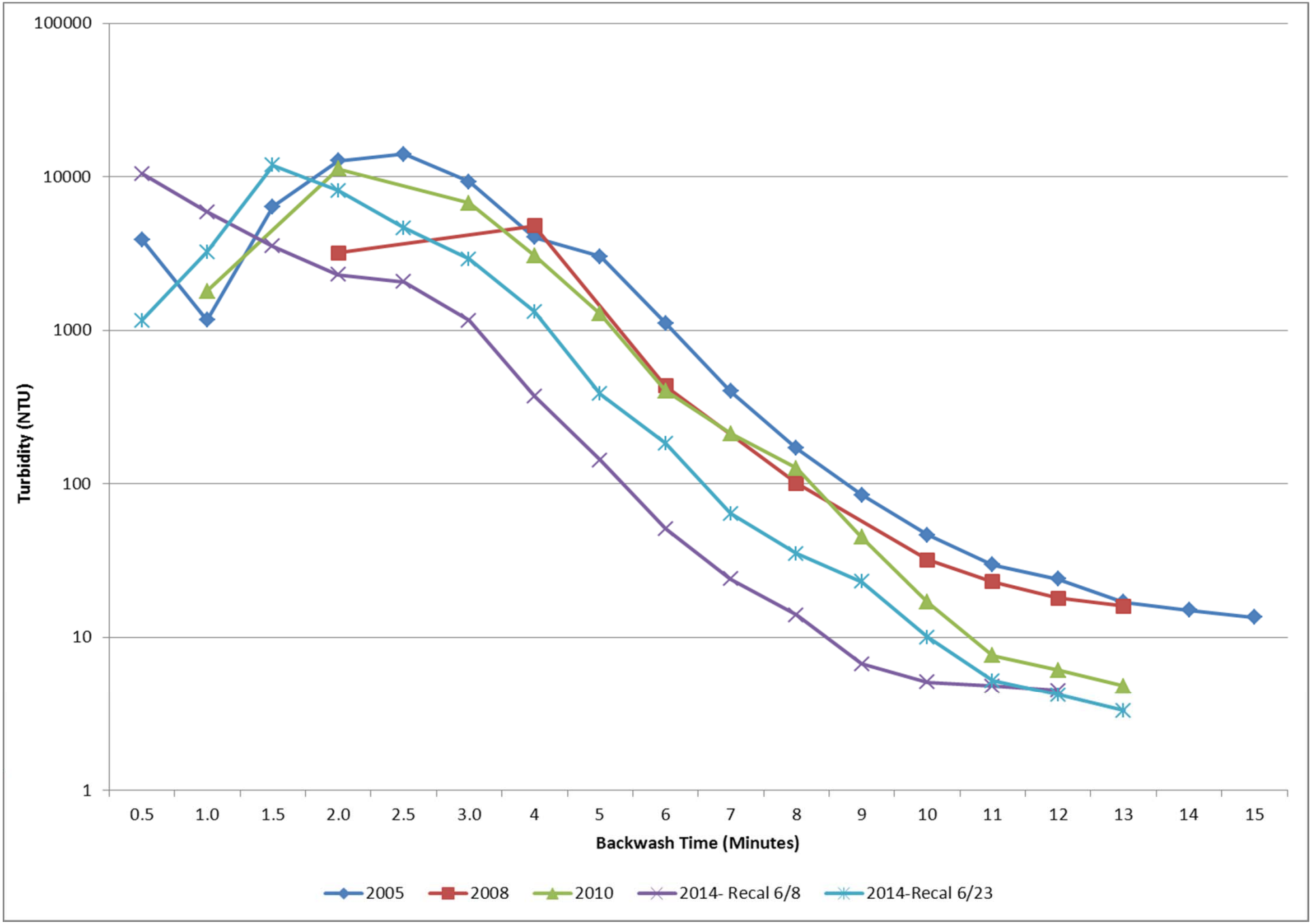


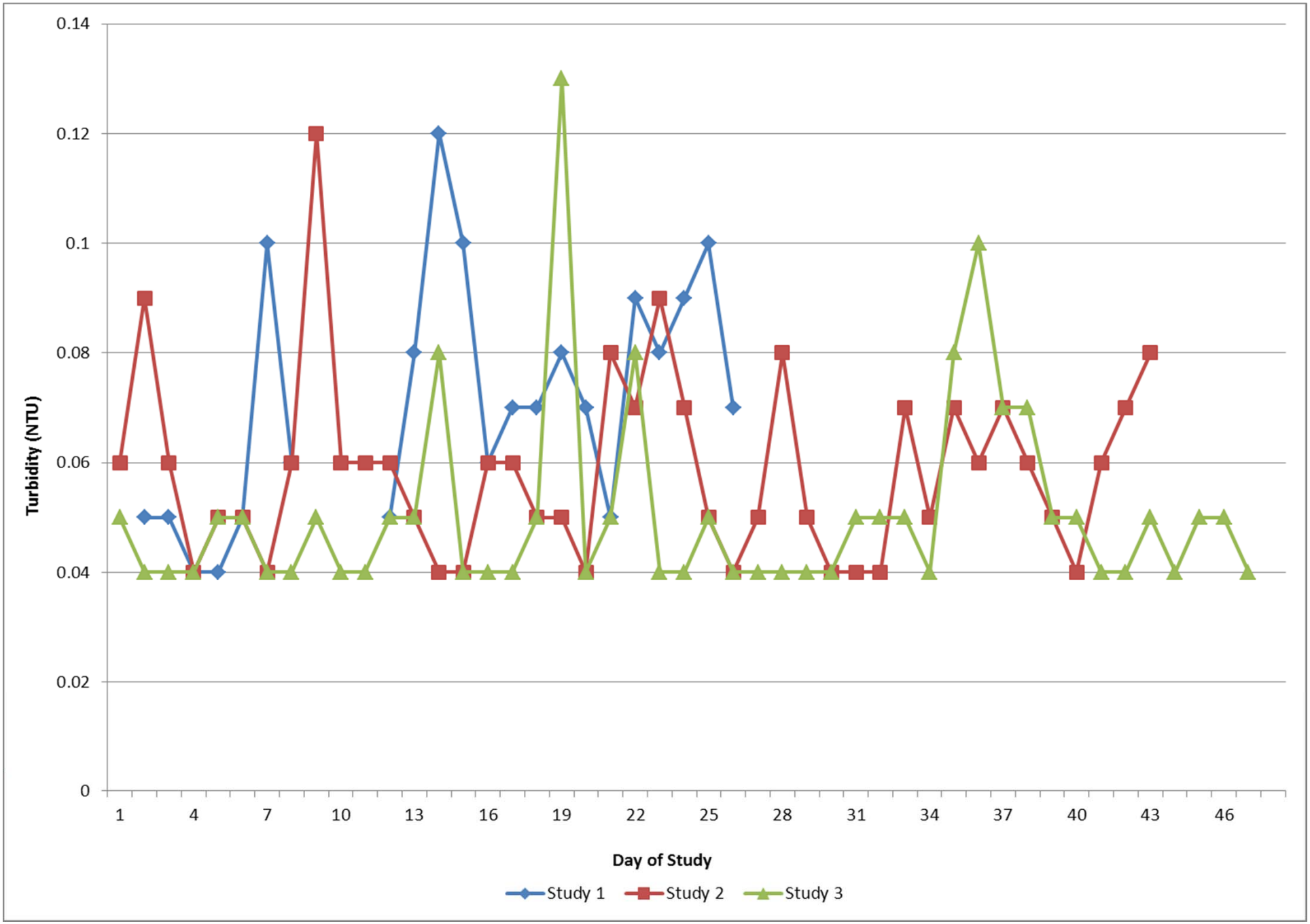
Filter Run Hour Comparison



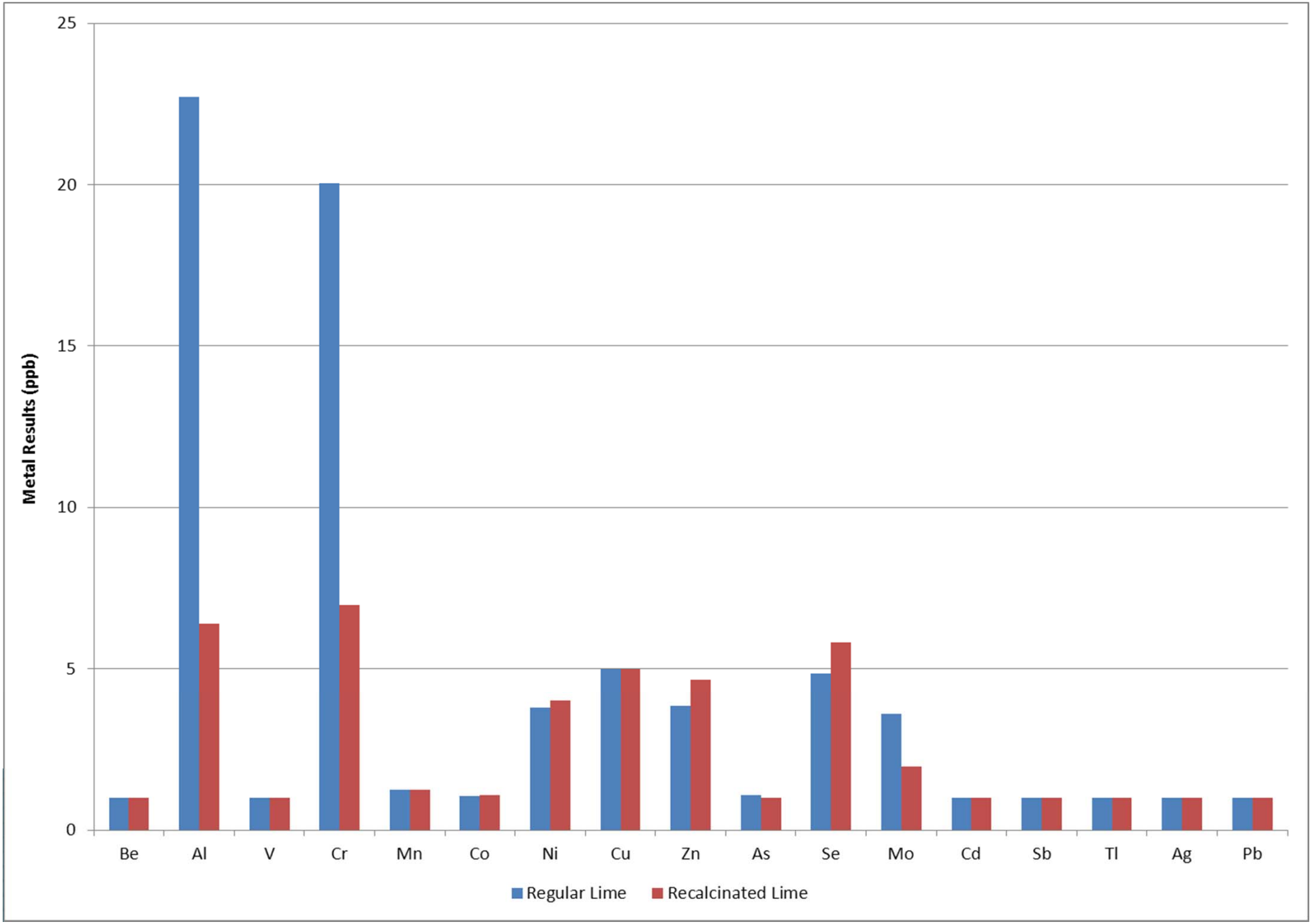
Filter Backwash Profile Comparison



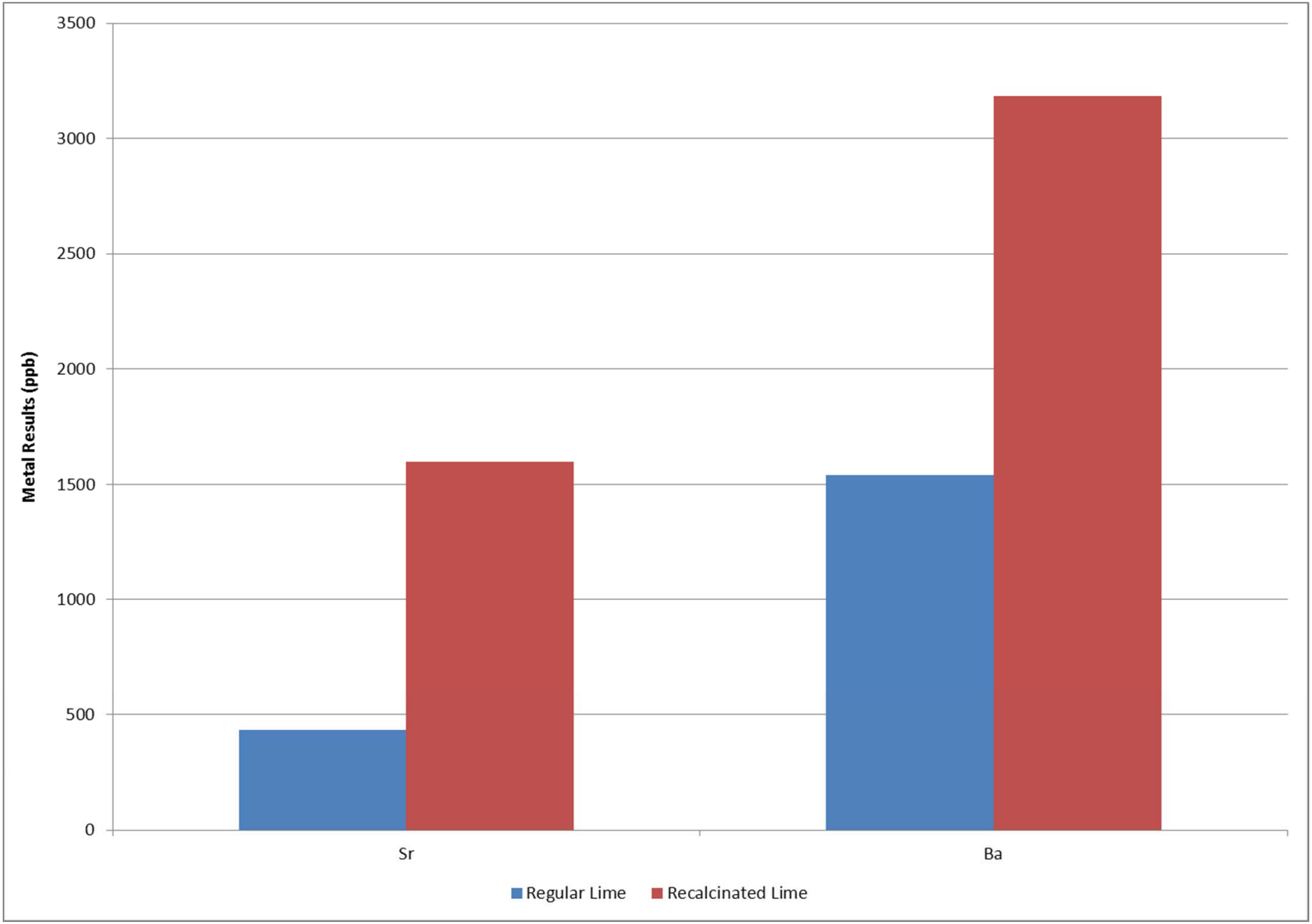
Turbidity Comparison



Metals in Lime Comparison



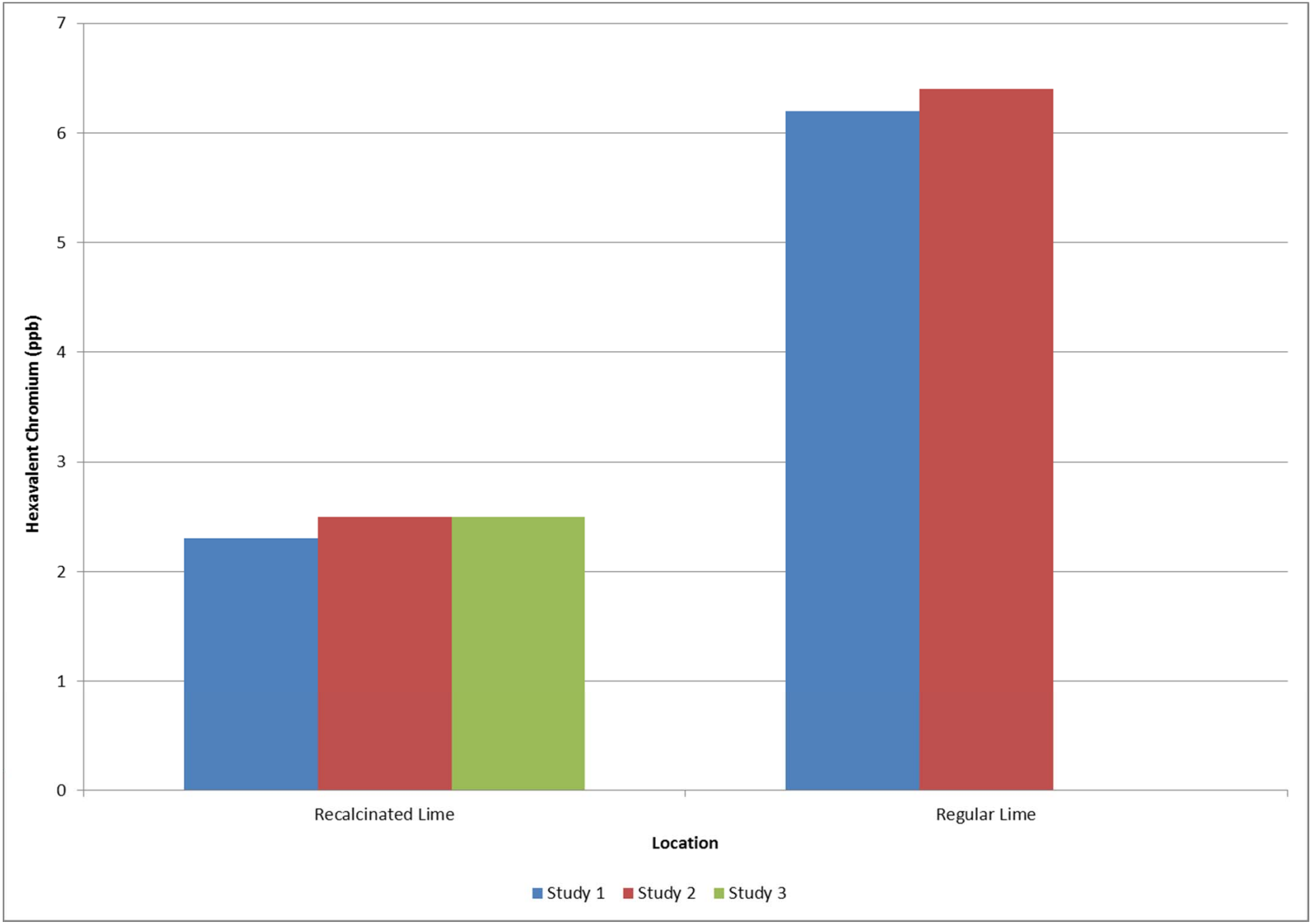
Metals in Lime Comparison



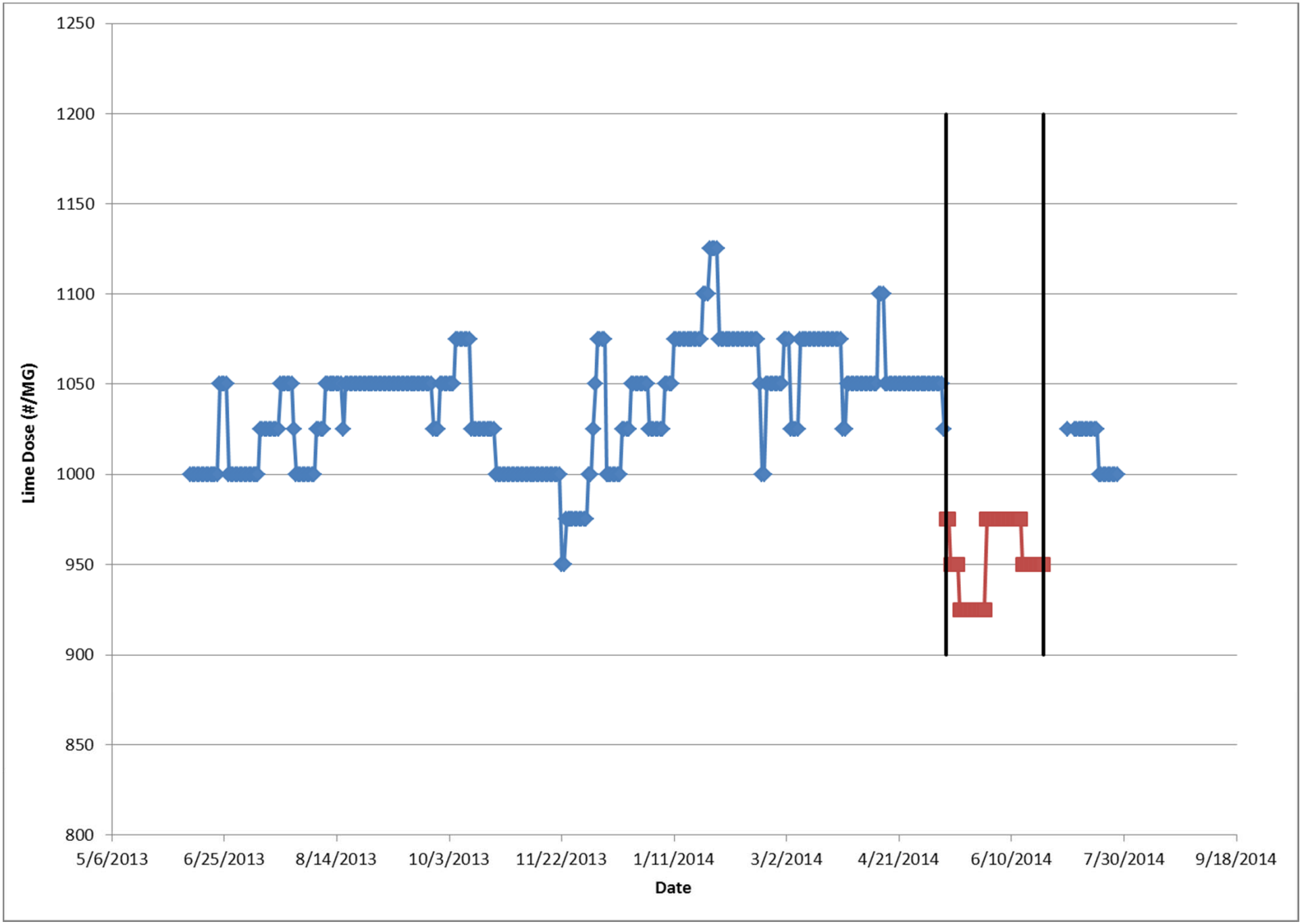
Metals in Plant Samples

	Regular Lime	Recalcinated Lime	CBRW	PEE	PWE	CSFE	Standard (ppb)	Type of Standard
Be	1	1	1	1	1	1	4	MCL
Al	22.72	6.41	1.31	10.28	27.33	9.23	600	PHG
V	1	1	1	1	1	1		
Cr	20.03	6.99	1	1	1	1	100	MCL
Mn	1.24	1.24	111.37	17.02	18.11	1		
Co	1.06	1.09	1	1	1	1		
Ni	3.79	3.99	1.52	1	1.08	1.10		
Cu	5	5	5.79	5	5	5	1300	AL
Zn	3.85	4.67	1.55	1.73	5.76	1.17	5000	SMCL
As	1.07	1	1	1	1	1	10	MCL
Se	4.86	5.83	1	1	1	1.86	50	MCL
Mo	3.58	1.96	3.09	3.12	3.99	3.53	40	LHA
Cd	1	1	1	1	1	1	5	MCL
Sb	1	1	1	1	1	1	6	MCL
Tl	1	1	1	1	1	1	2	
Ag	1	1	1	1	1	1	100	SMCL
Pb	1	1	1	1	1	1	15	AL
Sr	432.89	1598.41	4.16	4.09	3.49	2.76	4000	LHA
Ba	1541.49	3182.18	78.48	42.21	37.54	24.18	2000	MCL

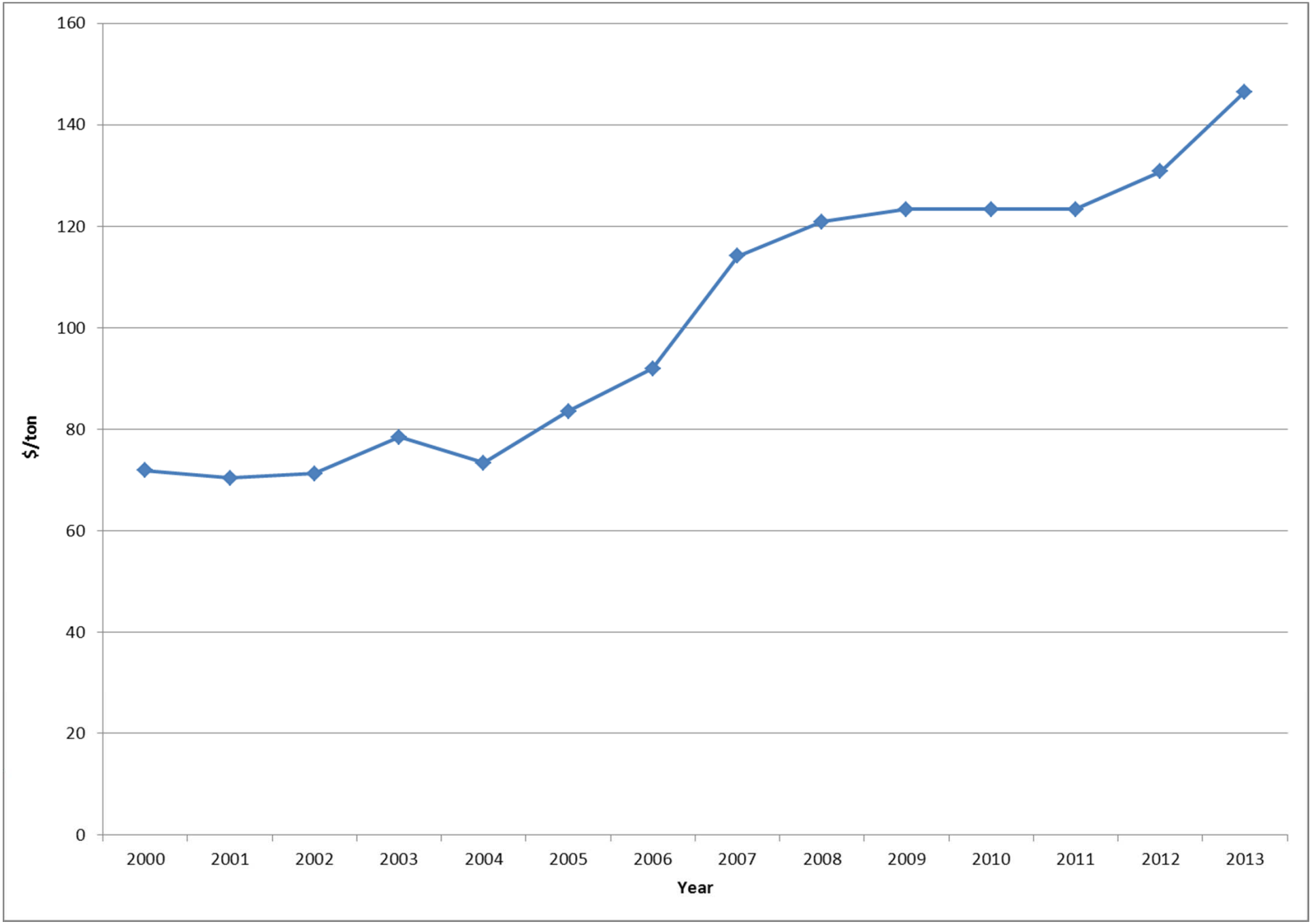
Hexavalent Chromium Comparison



Lime Dose Comparison



Lime Costs per Ton



Maintenance

Conclusions

- Recalcinated Lime is a good alternative to regular quicklime for softening.
- Although turbidity did increase, it was still within our target range.
  - Sludge blanket operation in the future?

Benefits

- Using recalcinated lime completes the lime cycle
- Less grit is produced during the slaking process
- Decrease in transportation costs
- Keeping business in the Region

Next Steps

- Use Recalcinated lime as Dayton has inventory
- Evaluate operating with a sludge blanket
- Continue to evaluate lime disposal alternatives

BIG THANKS TO…

- City of Dayton
  - Shannon Zell
  - Phil Van Atta
  - Linda Odom

- GCWW
  - Helen Prack
  - Kim Curry
  - Dominic Murphy
  - Tracy Kump
  - Vicky Stapleton
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