SURFACE WATER TREATMENT PLANT OPTIMIZATION

September 2018

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SUEZ

NYSAWWA Tifft Symposium

OVERVIEW

TYPICAL ISSUES/OPPORTUNITIES FACING SWTPs:

- THM OEL, LRAA Exceedances
- TOC Compliance: TOC Removal, Effluent TOC Requirements
- CT: Maintain Compliance, Reduce Chlorine Dosage to Meet DBPs
- Reducing Backwash Water Volume
- Beneficial Reuse of WTP Residuals
- Corrosion Control
- Alternatives to Gaseous Chlorine

CASE STUDIES ILLUSTRATING APPROACHES:

- Mohawk Valley Water Authority (MVWA), Utica, NY
- Blue Lake WTP, SWNY, Orange County, NY
- Lake Deforest WTP, SWNY, Rockland County, NY
- Pawtucket WTP, Pawtucket, RI
- Lambertville WTP, Lambertville, NJ
- Carthage WTP, Carthage, NC

SUMMARY

MVWA - UTICA, NY

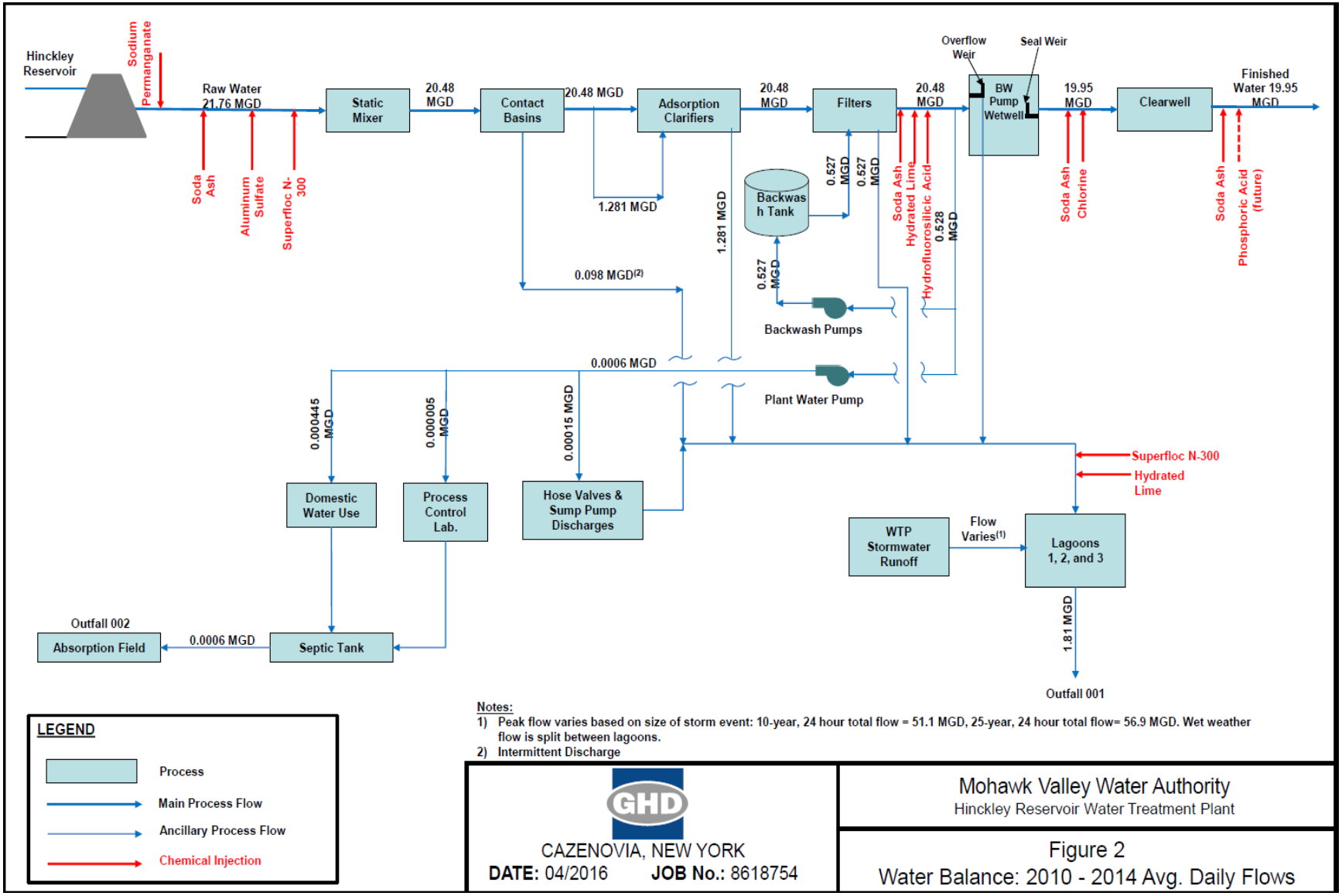
DESCRIPTION – HINCKLEY WTP:

- Soda ash, alum, contact tanks, upflow clarifiers, GAC, clearwells, soda ash, lime

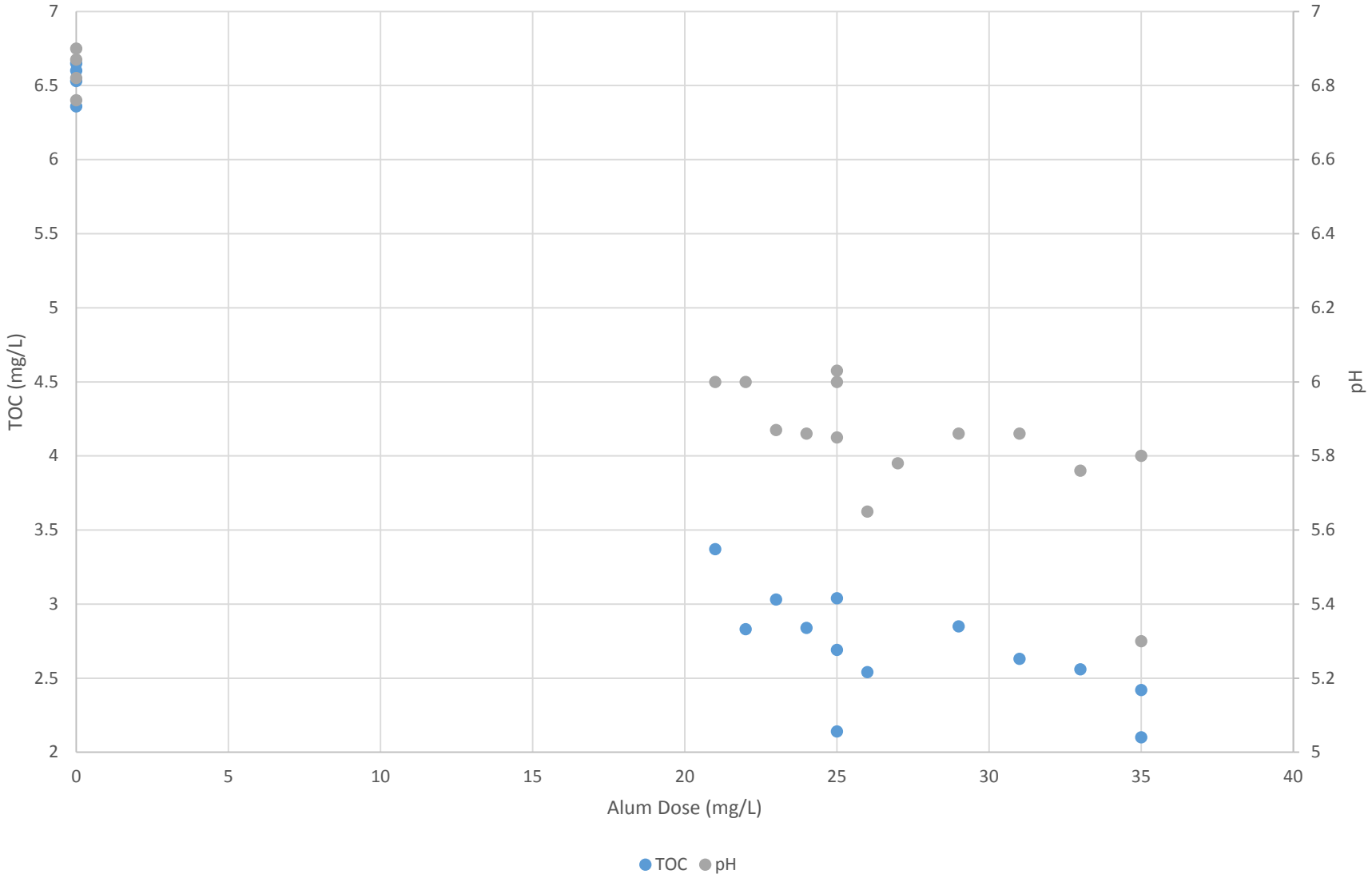
ISSUES/EVALUATIONS:

- DBPs: reduce TOC before GAC – extend GAC life?
  - Jar tests evaluating alum dosages and lower pH
  - Jar tests comparing alum to a variety of PACls
  - Change GAC once/year in July to lower DBPs ~ $ 1M/year
  - Pilot testing to evaluate custom regenerated vs virgin GAC
  - Large quantities of post-soda ash raises finished water pH to 9.5
- Backwash Evaluation: improve backwashing, reduce backwash flow
- Beneficial Reuse of Residuals: reduce costs, environmental sustainability

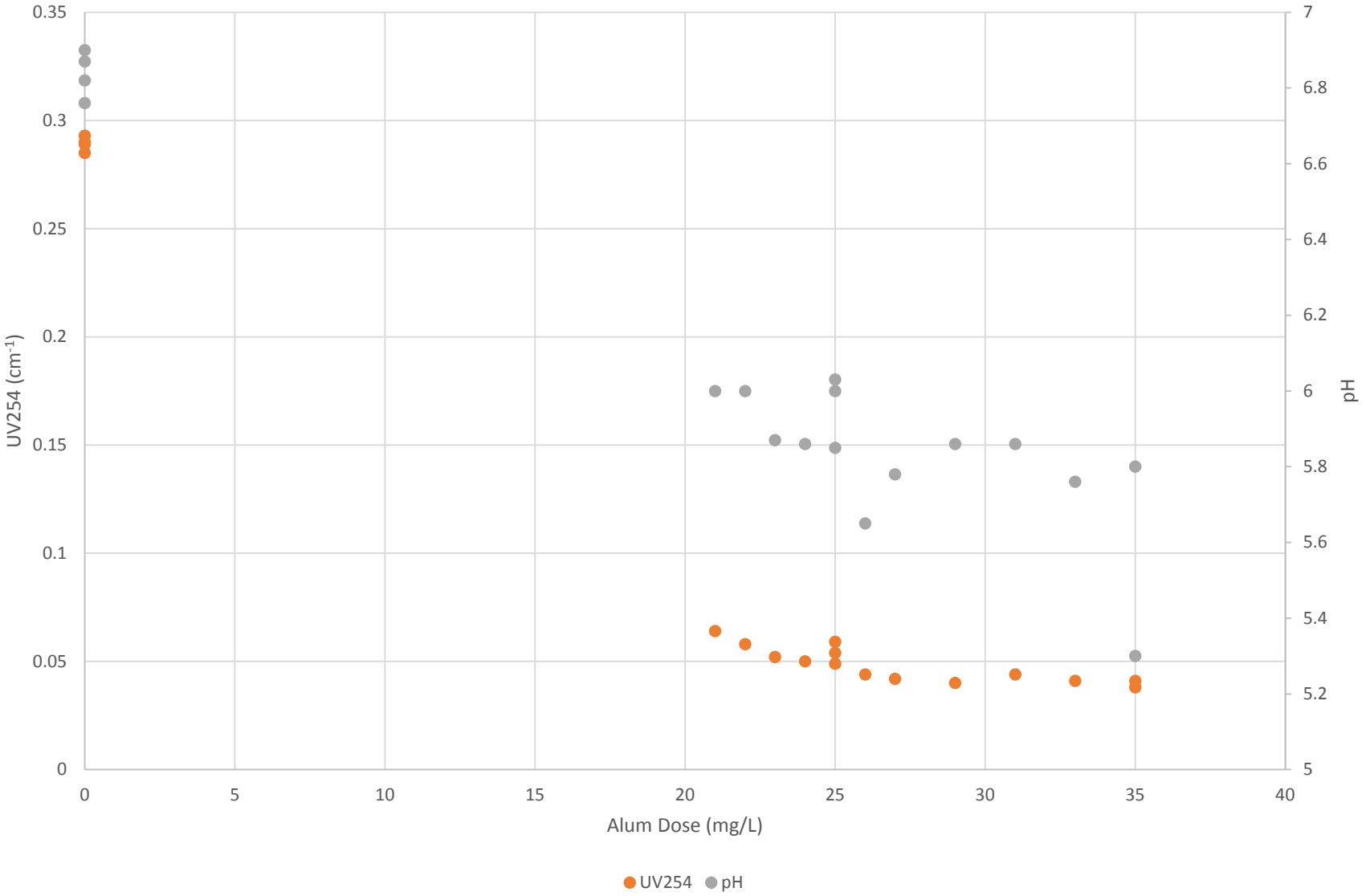
HINCKLEY WTP PROCESS SCHEMATIC



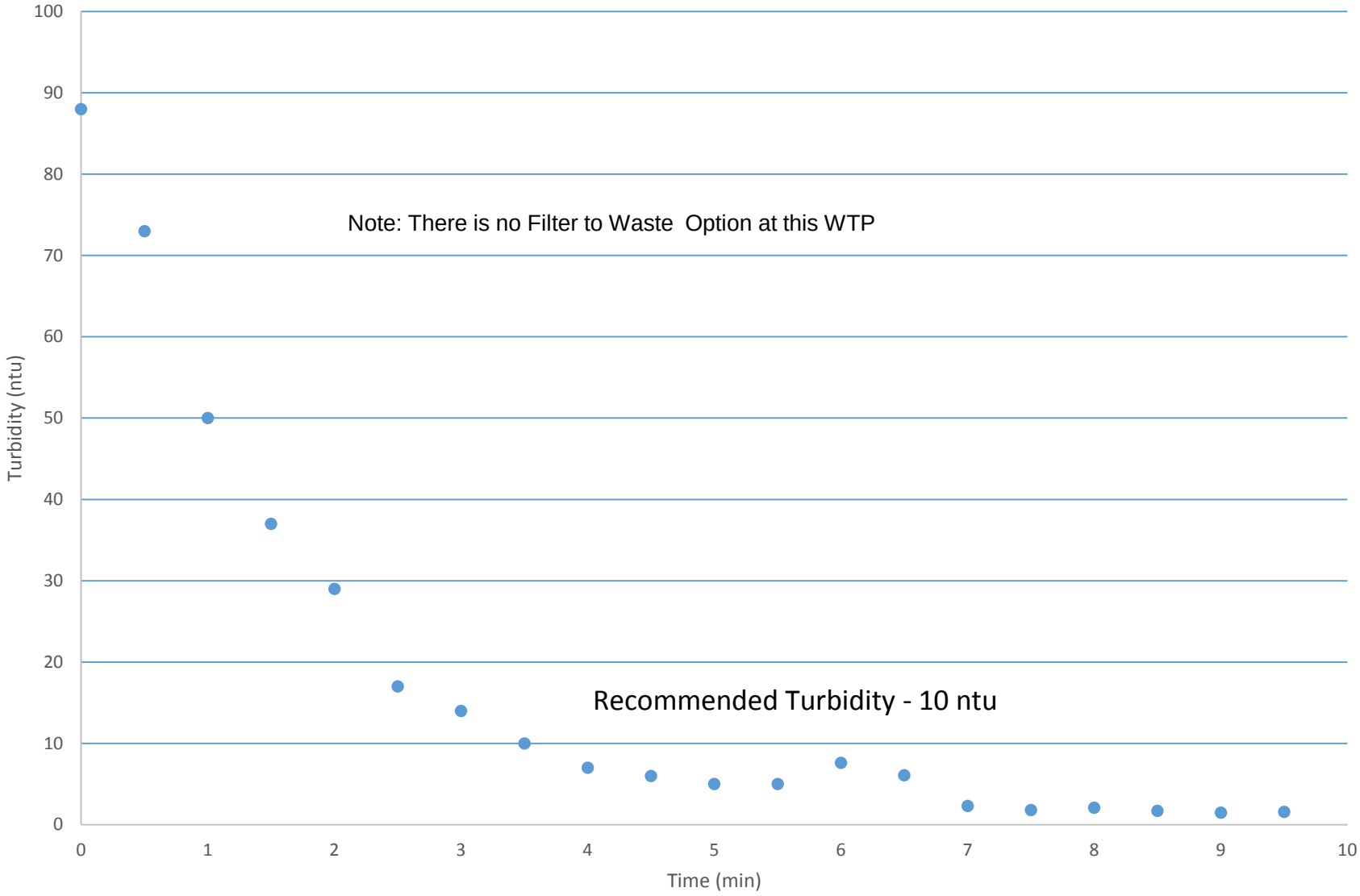
MVWA – JAR TESTs – TOC vs ALUM DOSAGE, pH



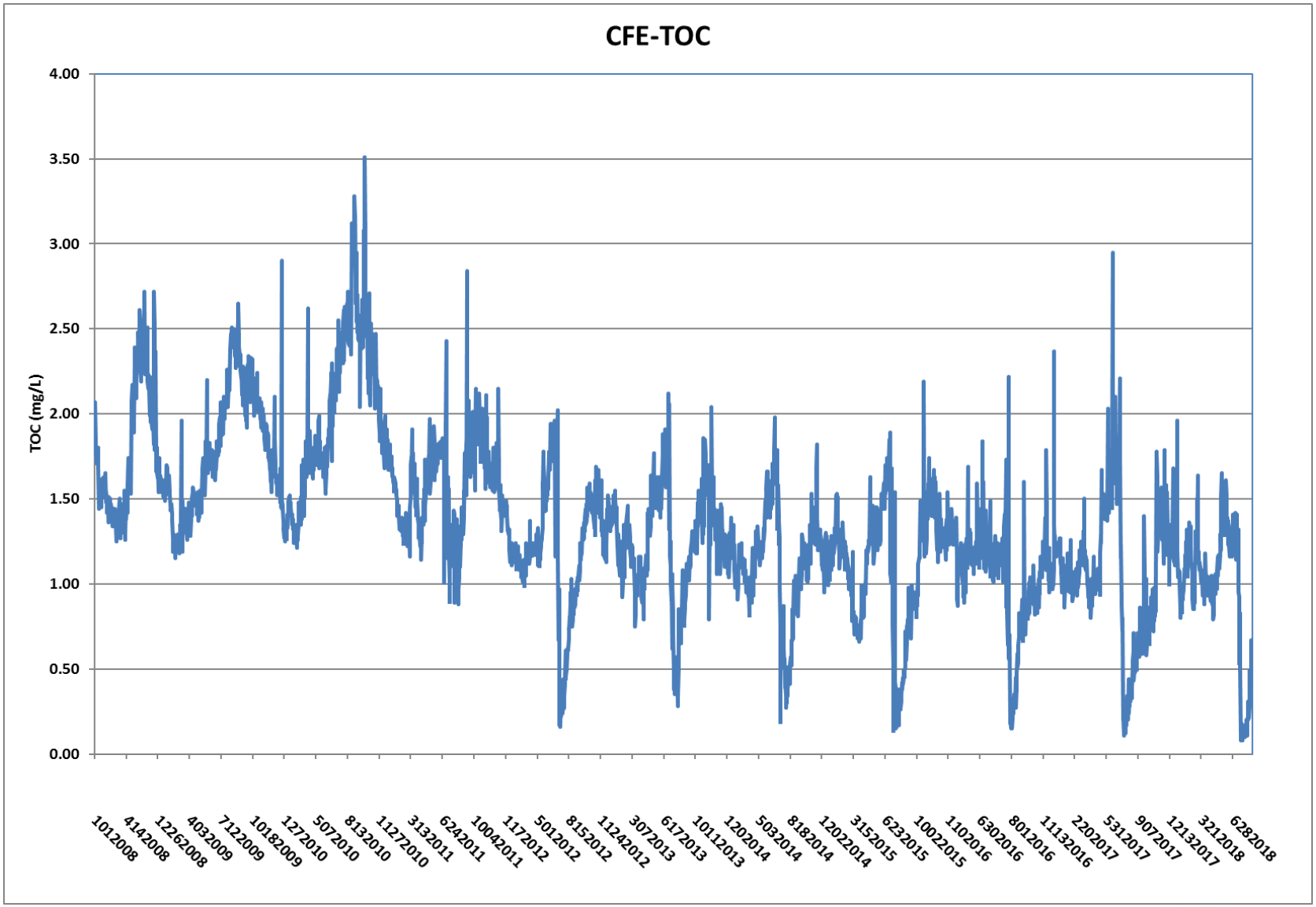
MVWA JAR TEST RESULTS – UV vs ALUM DOSAGE, pH



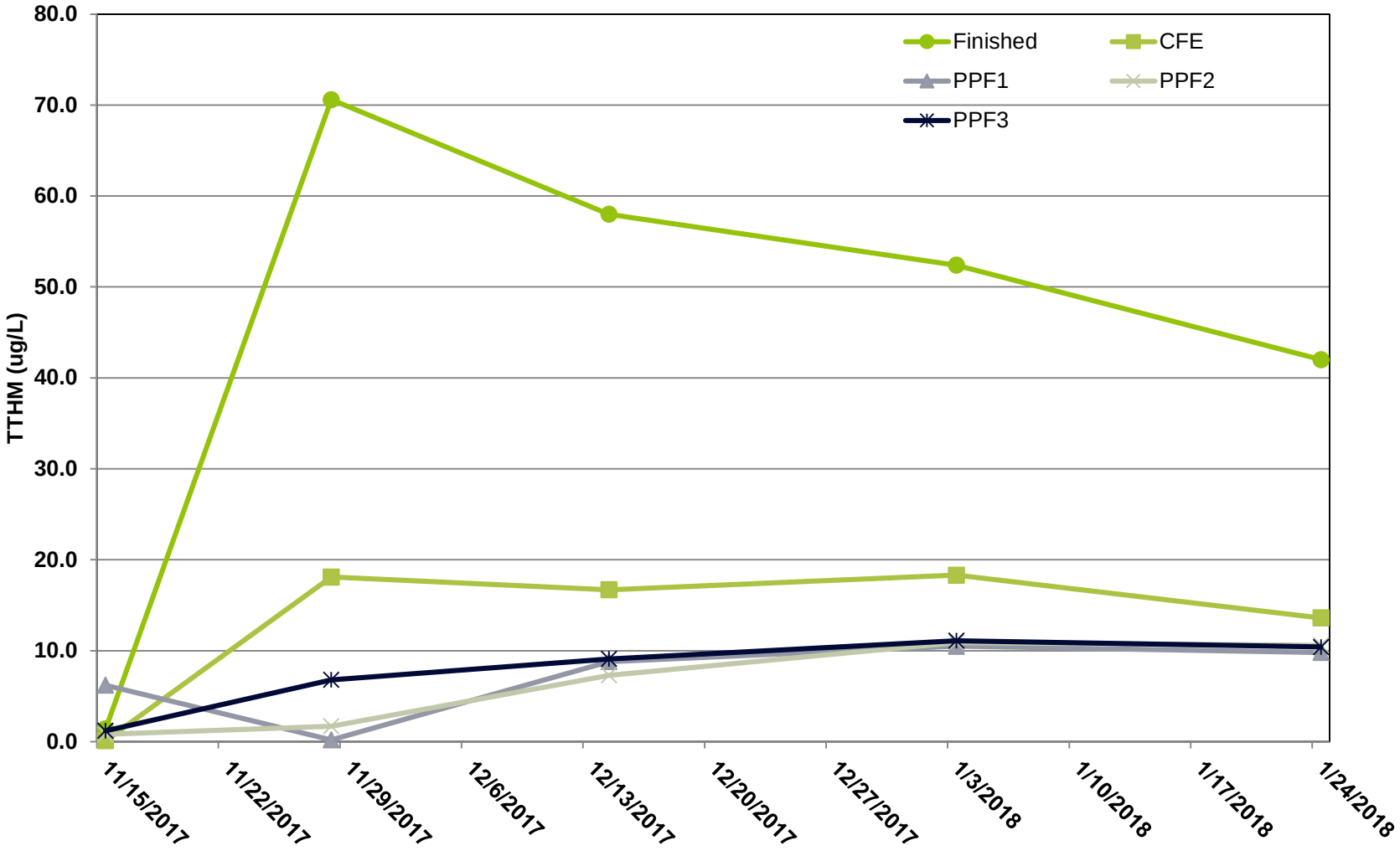
FILTER BACKWASH TURBIDITY PROFILE



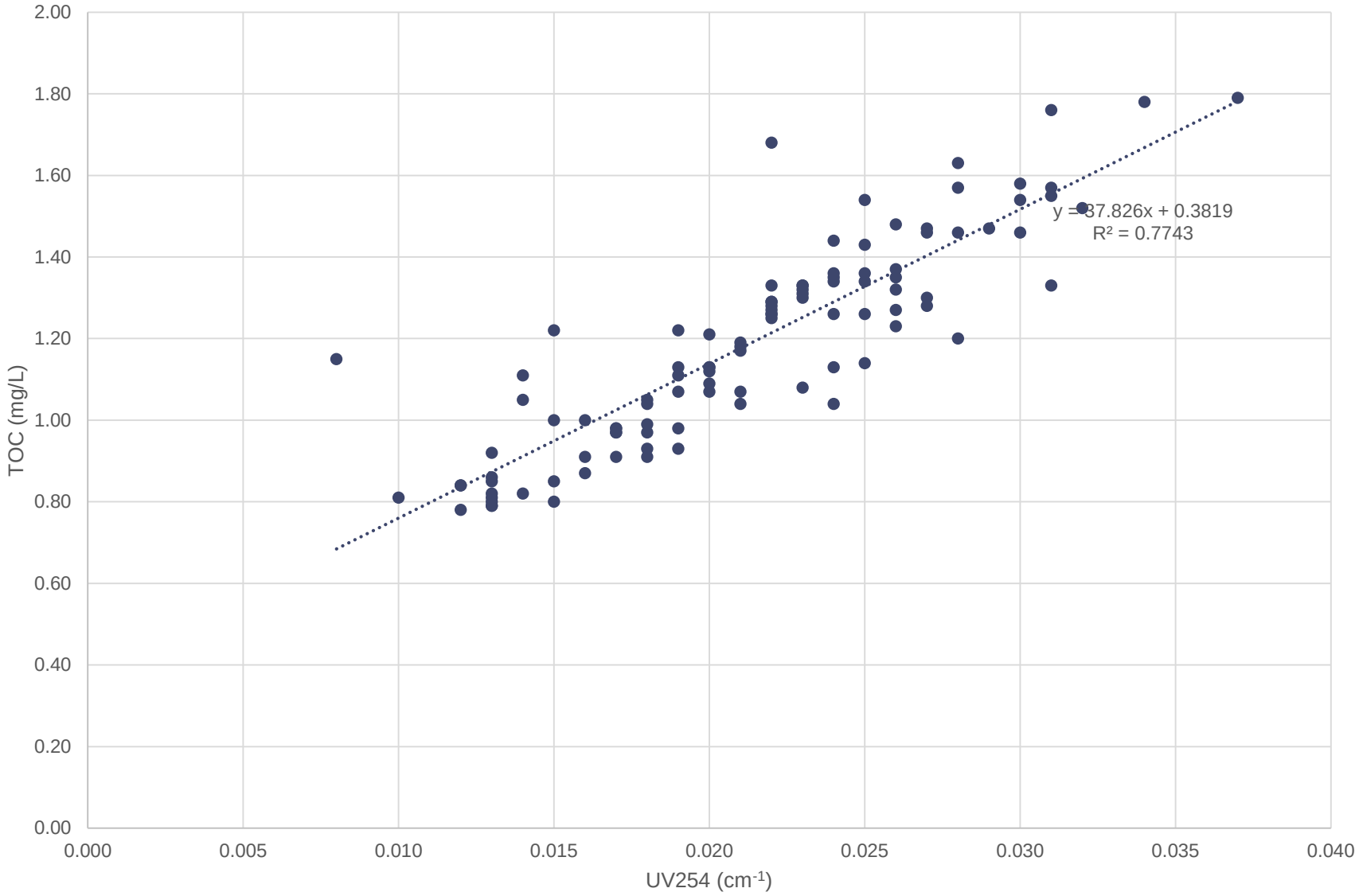
MVWA CFE (GAC) TOC 2008 - 2018



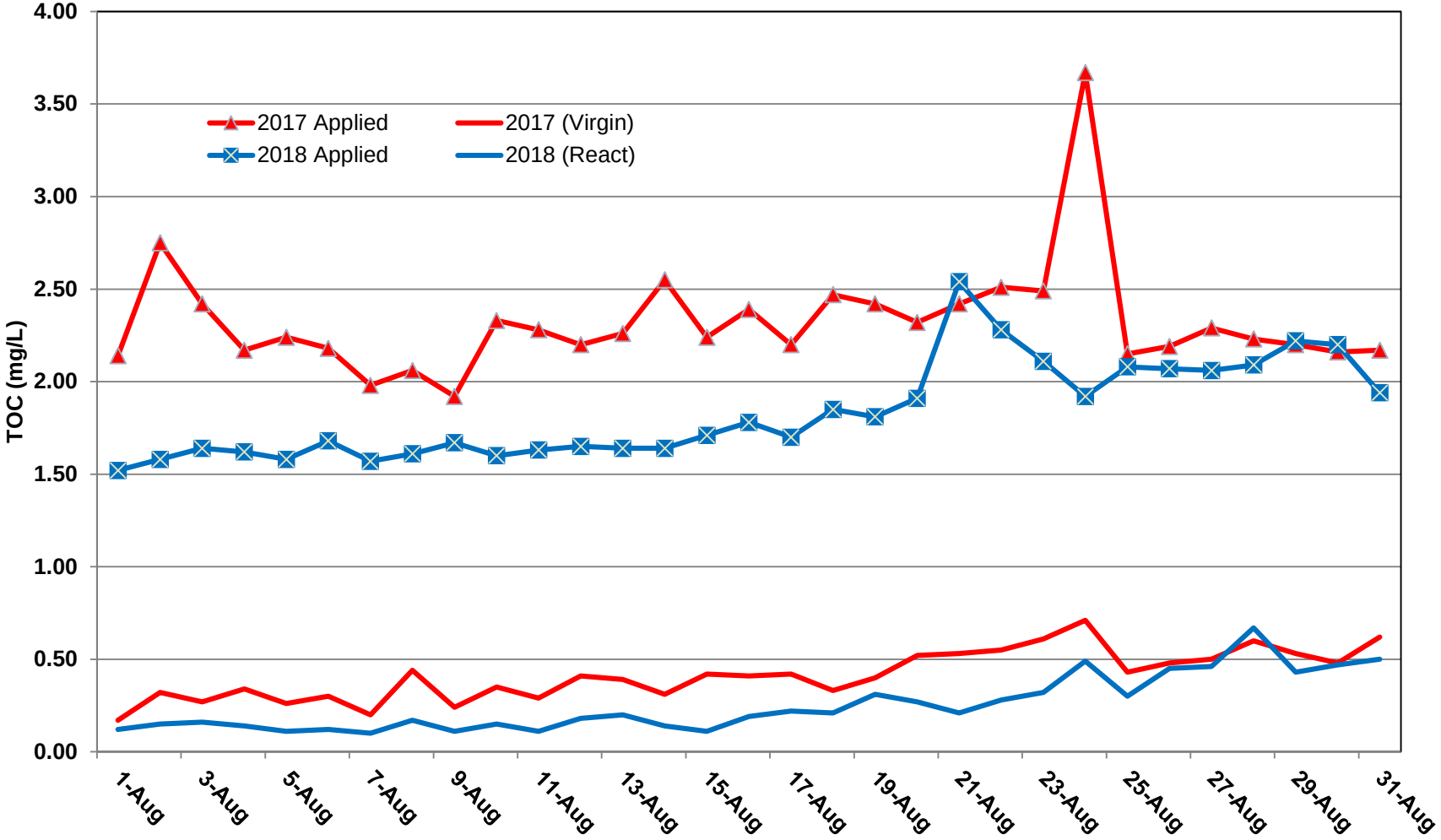
MVWA REGENERATION PILOT 7-DAY SDSTHM



MVWA CFE (GAC) TOC vs UV254



MVWA FULL SCALE TOC COMPARISON REGENERATED VS VIRGIN GAC



BENEFICIAL REUSE DETERMINATION (BUD)

APPROACH:

- Identify beneficial reuse alternatives and recipients of WTP residuals
- Uses include: topsoil production, roadbed application, remediation site cover, others
- Characterize residuals as per NYSDEC requirements
- Submit BUD application to NYSDEC, obtain approval
- Ongoing residuals characterization, preparation of annual reports

MVWA BUD STATUS:

- Identified recipient – nearby topsoil manufacturer who will also haul residuals, all at no cost to MVWA
- Characterized residuals – significantly below NYSDEC requirements
- Prepared and submitted BUD application to NYSDEC
- Received minor comments from NYSDEC
- Addressing comments, then wait for NYSDEC approval

MVWA – FINDINGS, RECOMMENDATIONS

FINDINGS:

- Plant is near optimum alum dosage (25 mg/L)
- Alum outperformed all PACLs
- Filter Backwash can be reduced by 100,000 gal/day
- GAC greatly reduces TOC (and THMs) in the summer
- All pilot plant filters (regenerated, virgin GAC) performed similarly (SDSTHM, TOC, UV, Turbidity, UFRV)
- Switched to regenerated GAC in July 2018; equivalent performance, $250,000/yr cost savings
- UV254 may be useful as a surrogate for TOC and possibly THMs
- Beneficial Reuse Determination (BUD) submitted to NYSDEC; awaiting approval; estimated cost savings $125,000/yr

RECOMMENDATIONS/FUTURE WORK:

- Track raw, clarifier effluent, CFE, finished water for TOC/UV254 to optimize plant performance, assess UV254 as TOC surrogate
- Evaluate use of corrosion inhibitors in order to lower finished water pH – lower THMs, reduce soda ash costs, possibly extend GAC life; potential cost savings $500,000/yr
- Evaluate alternatives to replace gaseous chlorine: hypo, onsite hypo generation, MIOX

SWNY WTP PLANTS: BLUE LAKE, LAKE DEFOREST

DESCRIPTION:

- Blue Lake: coagulation (PACL)/flocculation/sedimentation/filtration, hypo, clearwell
- Lake Deforest: coagulation (alum)/flocculation, CO2, DAF, hypo, filtration, hypo, clearwell

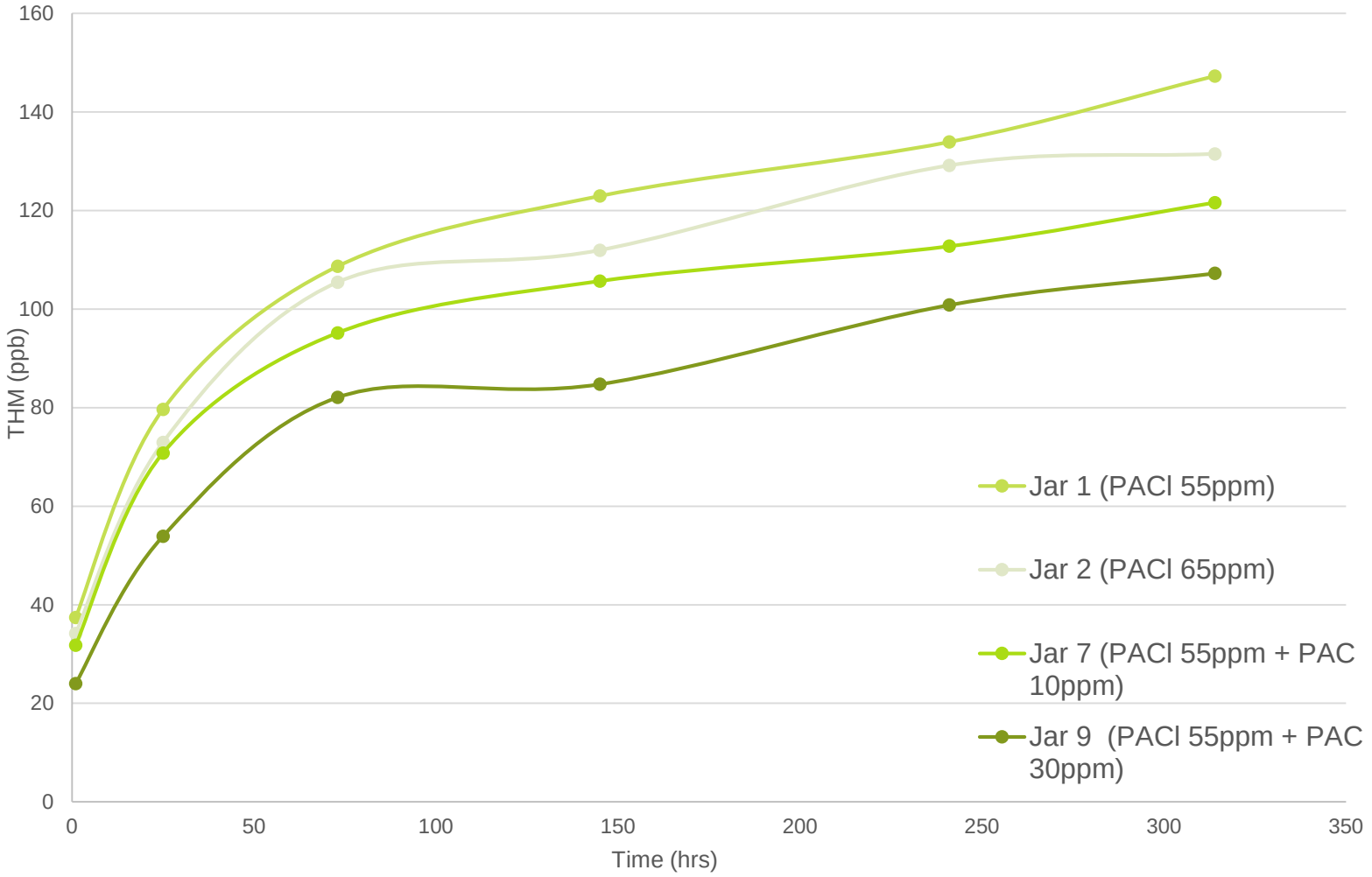
ISSUES/EVALUATIONS:

- Blue Lake – THMs
  - Jar Tests: Evaluate PACl dosage, PAC addition
- Lake Deforest – THMs, TOC
  - Evaluate lower filter effluent chlorine residual

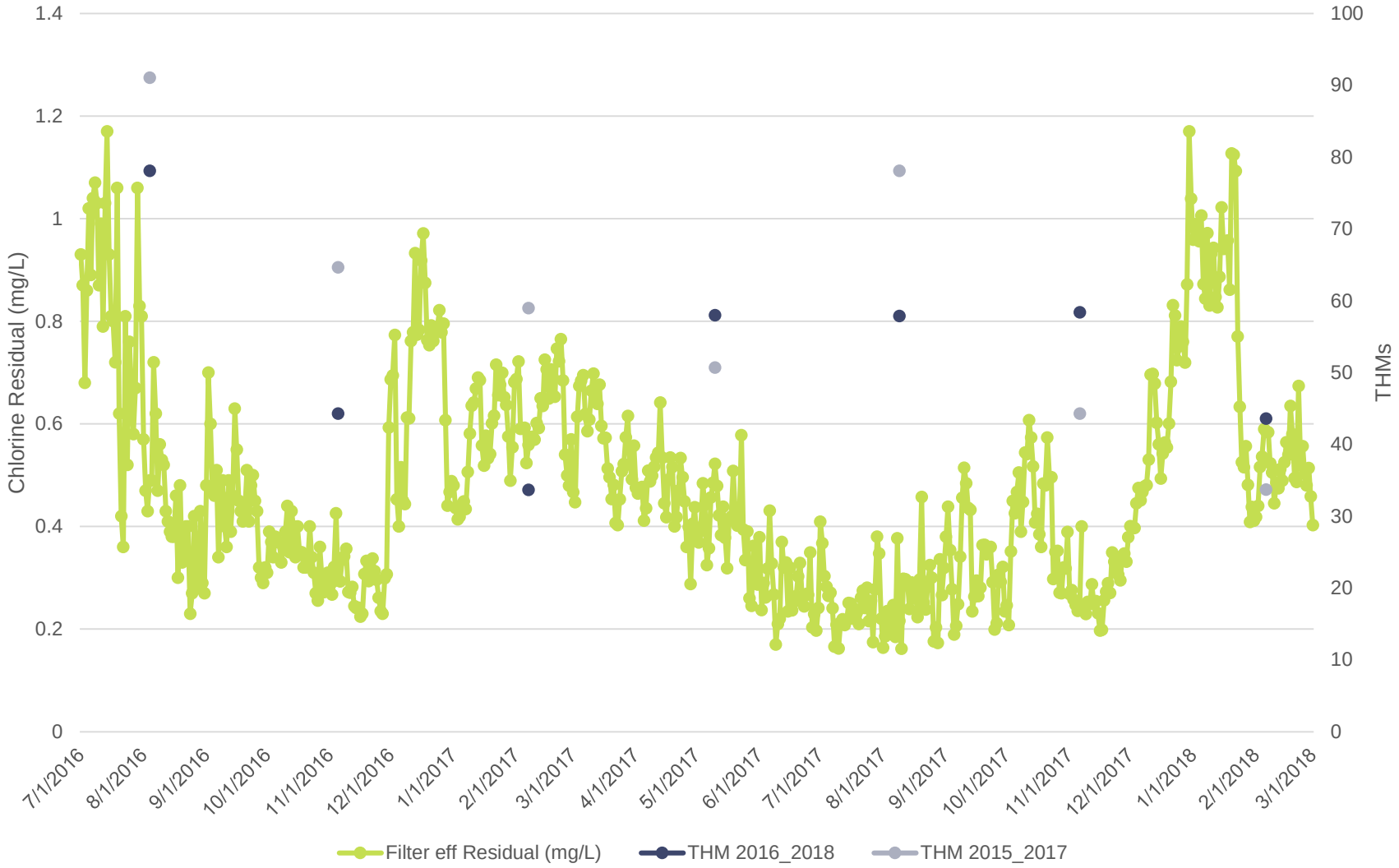
FINDINGS/RECOMMENDATIONS:

- Blue Lake: Increasing PACl dosage not as effective as PAC
  - Implement larger PAC system (dosage 10-30 mg/L)
- Lake Deforest: Reducing filter effluent chlorine residual reduces THMs
  - Reduce filter effluent chlorine (0.2-0.3 mg/L in warmer weather); need higher residual in winter for CT
  - Coagulate at pH 6.3-6.5 (lower THMs, better TOC removal)
  - Conducted pilot test in 2017; ozone/PAC selected as best TOC and THM control

BLUE LAKE WTP JAR TESTS – IMPACT of PACL DOSAGE and PAC



LDF FILTER EFFLUENT CHLORINE IMPACT ON THMs 2016-2018



PAWTUCKET, RI

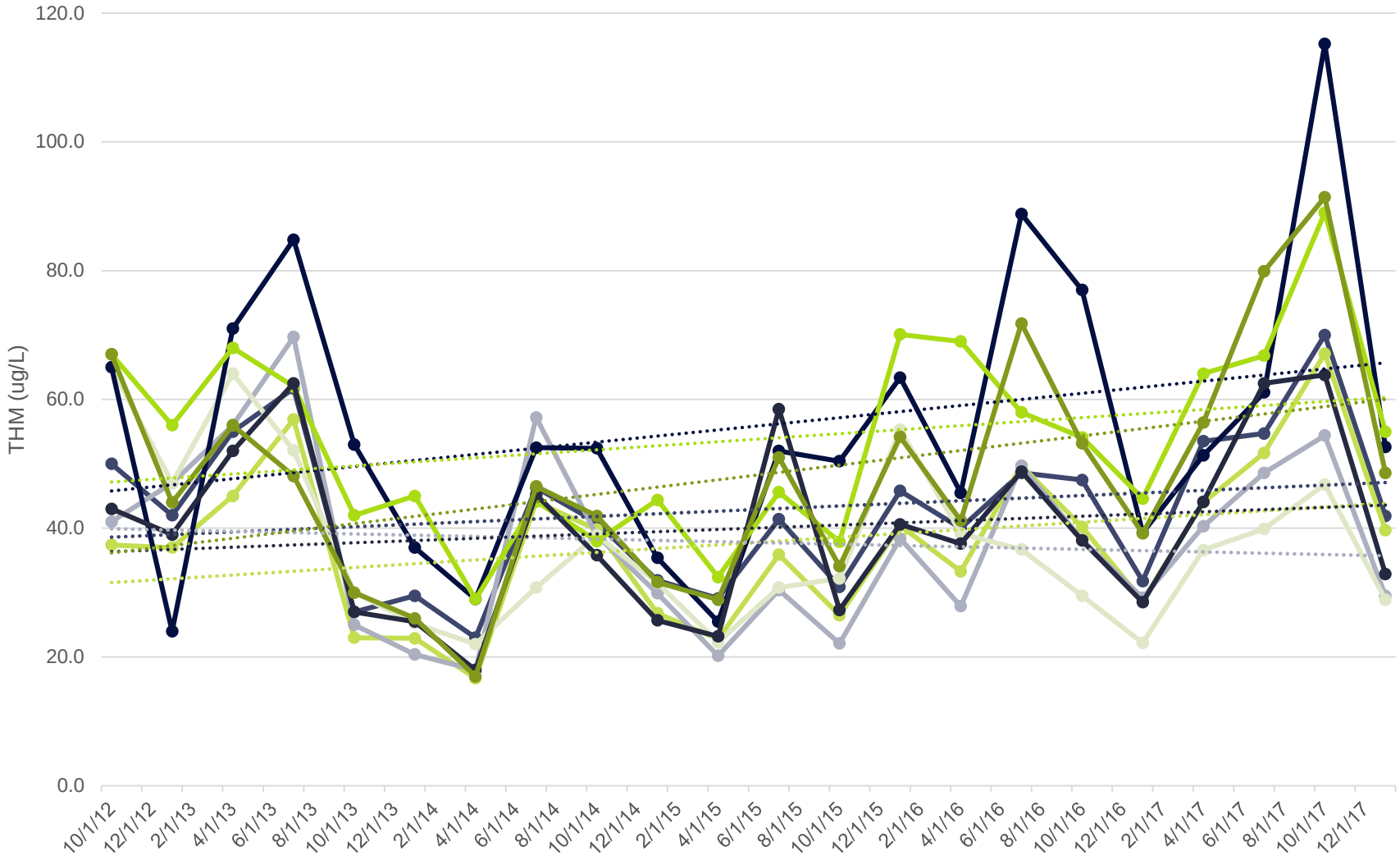
DESCRIPTION:

- Seasonal PAC, coagulation (PACl), upflow clarification, filtration (GAC), hypo, clearwell, 5MG onsite storage

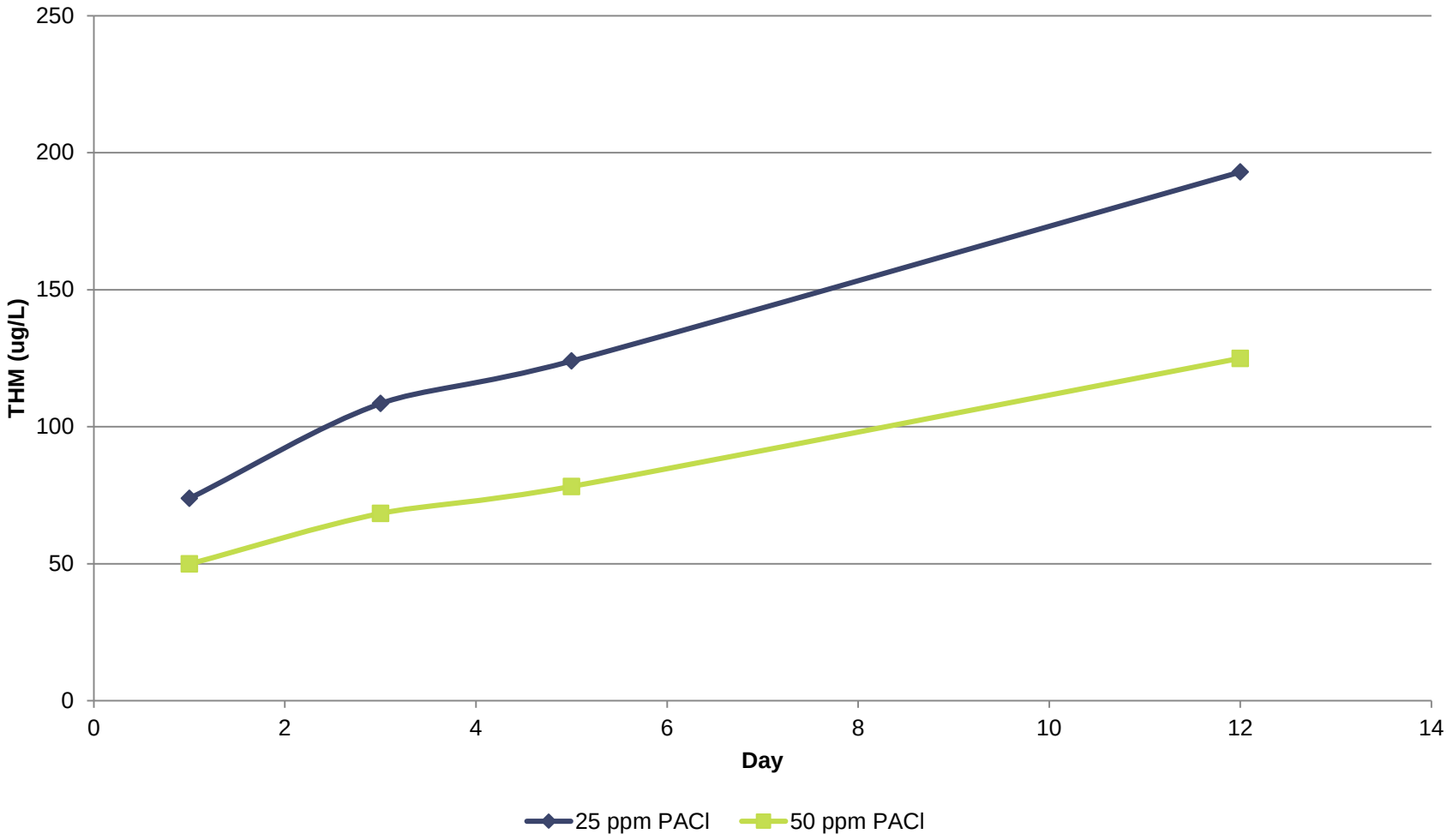
ISSUES/EVALUATIONS:

- THM OEL Exceedance – October, 2017
  - Evaluate THMs over time and consider parameters that may impact (pH, temperature, coagulant dosage, effluent TOC, UV254)
  - Review source water quality
  - Review distribution system operations and water quality
  - Conduct jar tests to evaluate increasing PACl dosage
  - Collect THM samples in plant and out into the distribution system
- Finished water TOC < 1.6 mg/L
  - Review raw/finished TOC over time
  - Review impact of PAC dosage on TOC

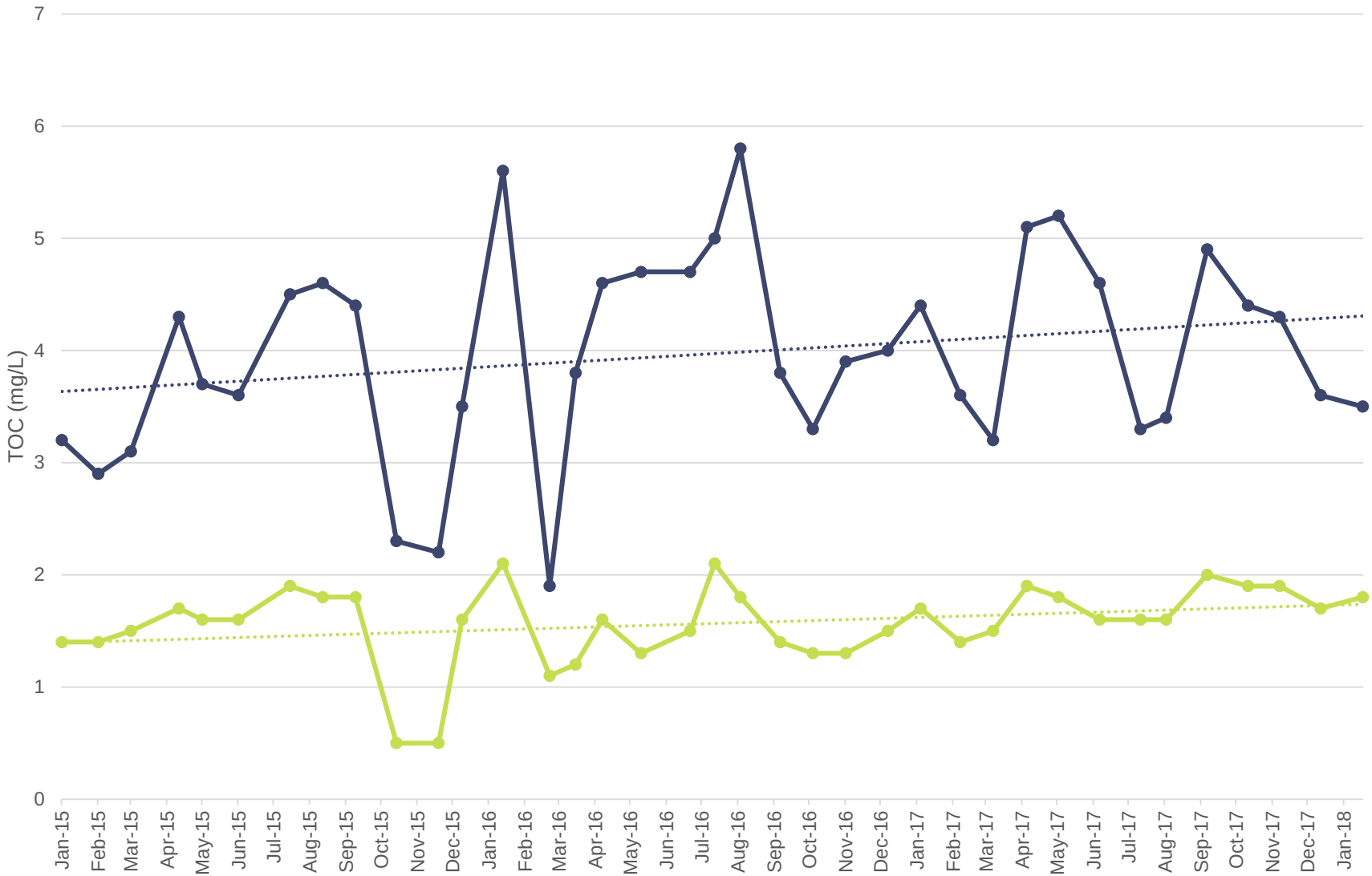
PAWTUCKET THMS 10/2012 – 1/2018



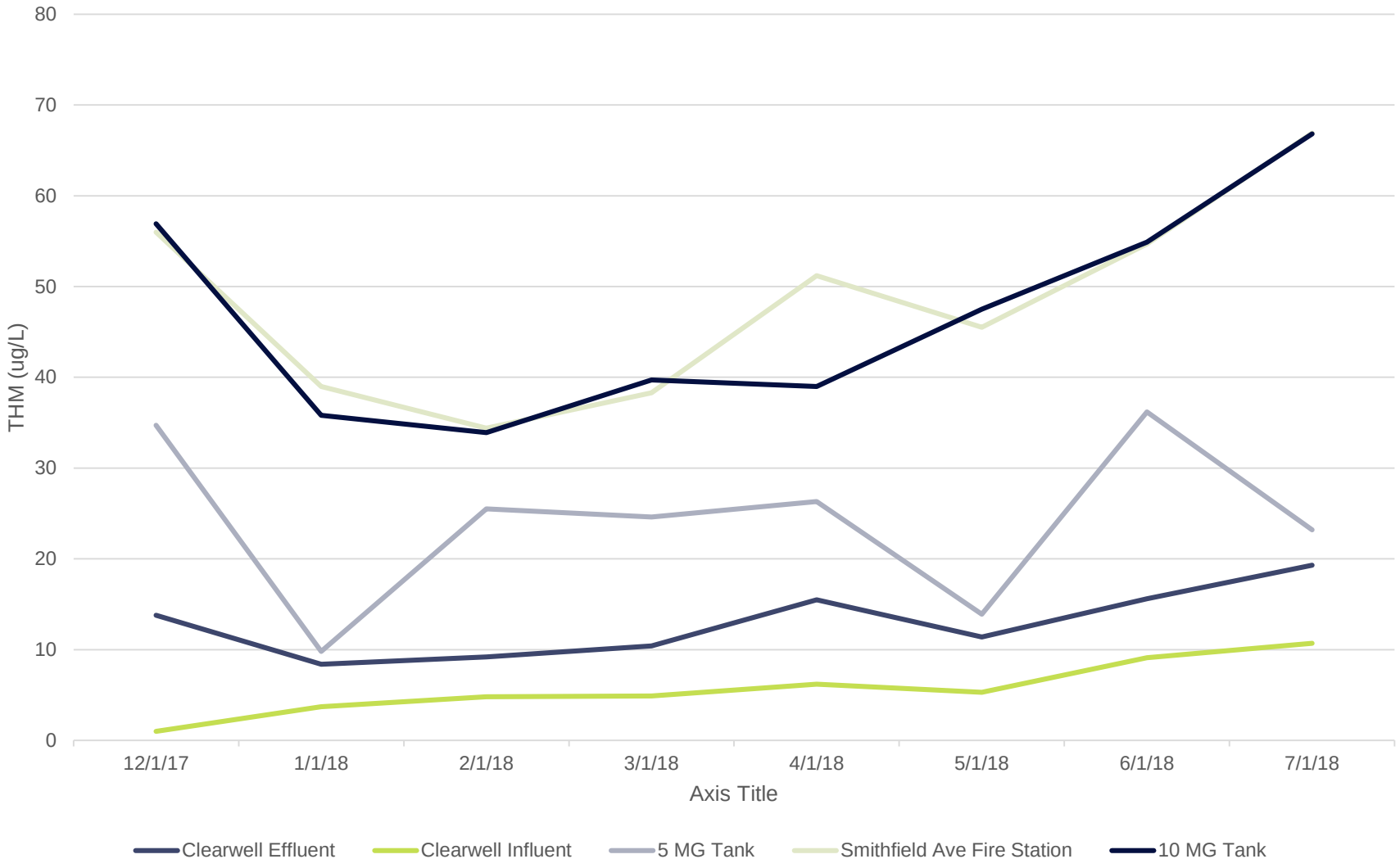
PAWTUCKET SDSTHMs – COMPARISON of TWO PACL DOSAGES



PAWTUCKET TOC - RAW, FINISHED 2015 - 2018



PAWTUCKET PLANT, DISTRIBUTION SYSTEM SAMPLING



PAWTUCKET – THM OEL FINDINGS and RECOMMENDATIONS

FINDINGS:

- Increase in THMs over time, but October 2017 spike very unusual
- Jar tests indicated increasing PACl dosage improved SDSTHM
- Distribution system pH increased over time – fully cement lined distribution system – Ca leaching?
- 10 MG tank in system – detention time
- 5 MG onsite tank drained a few days before DBP sampling – most likely cause of spike and OEL
- THM sampling from plant into the distribution system showed plant THMs very low

RECOMMENDATIONS:

- Continue monitoring THMs through the plant and into the distribution system
- Video inspection of clearwell, 5 and 10 MG tanks and cleaning if needed
- Develop unidirectional flushing program
- Adjust finished water chlorine residual if possible
- Evaluate THM reduction equipment in 5 and 10 MG storage tanks
- Evaluate pH in distribution system

PAWTUCKET – TOC < 1.6 mg/L FINDINGS and RECOMMENDATIONS

FINDINGS:

- Raw and effluent TOC increasing slightly over time
- TOC % removals excellent (40 – 75%), removal ratio > 1.5
- GAC likely spent; does not appear to be removing TOC
- PAC dosage (3 mg/L) not enough for TOC removal

RECOMMENDATIONS:

- Collect data through plant for TOC/DOC, UV254
- Collect CFE TOC and UV254 to try to develop a correlation
- Conduct jar tests to evaluate increasing PACl dosage and alternate PACls
- Conduct jar tests to evaluate PAC for TOC removal (10 – 30 mg/L PAC)
- Design larger PAC system for higher PAC dosages
- Consider peroxide addition prior to GAC to remove EPS and possibly improve TOC removal

LAMBERTVILLE NJ

DESCRIPTION:

- Cl02,pre-soda ash, coagulation (PACl), seasonal PAC, sedimentation, filtration, post-soda ash, hypo, clearwell
- Two sources of supply: reservoir and D&R Canal

ISSUES/EVALUATIONS:

- THMs, TOC, Algae, T&O
- Jar Testing: compare sources of supply and different PACls

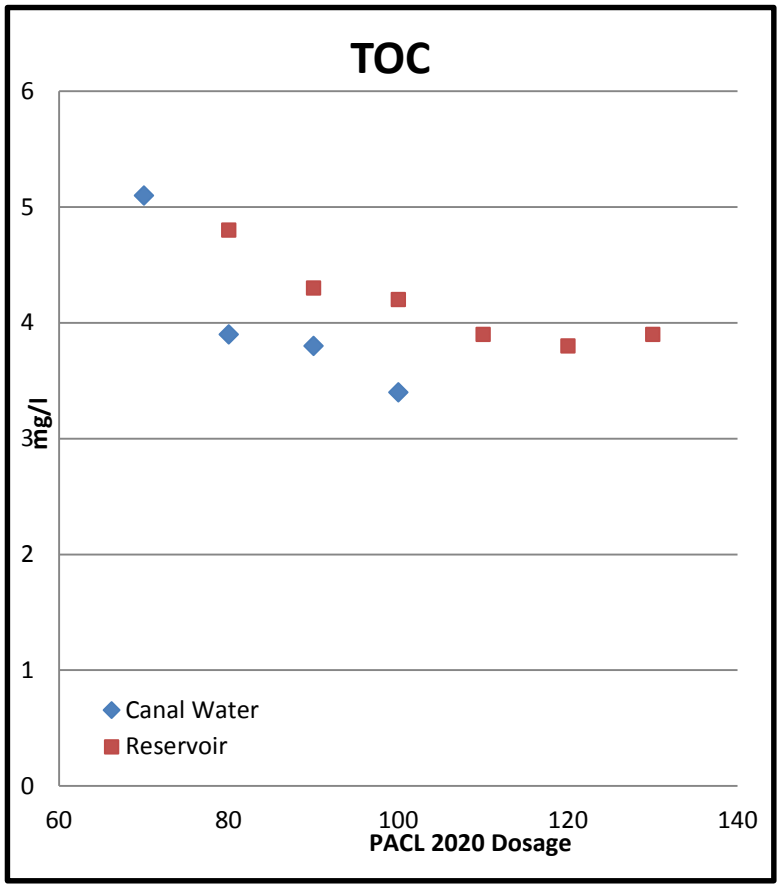
FINDINGS:

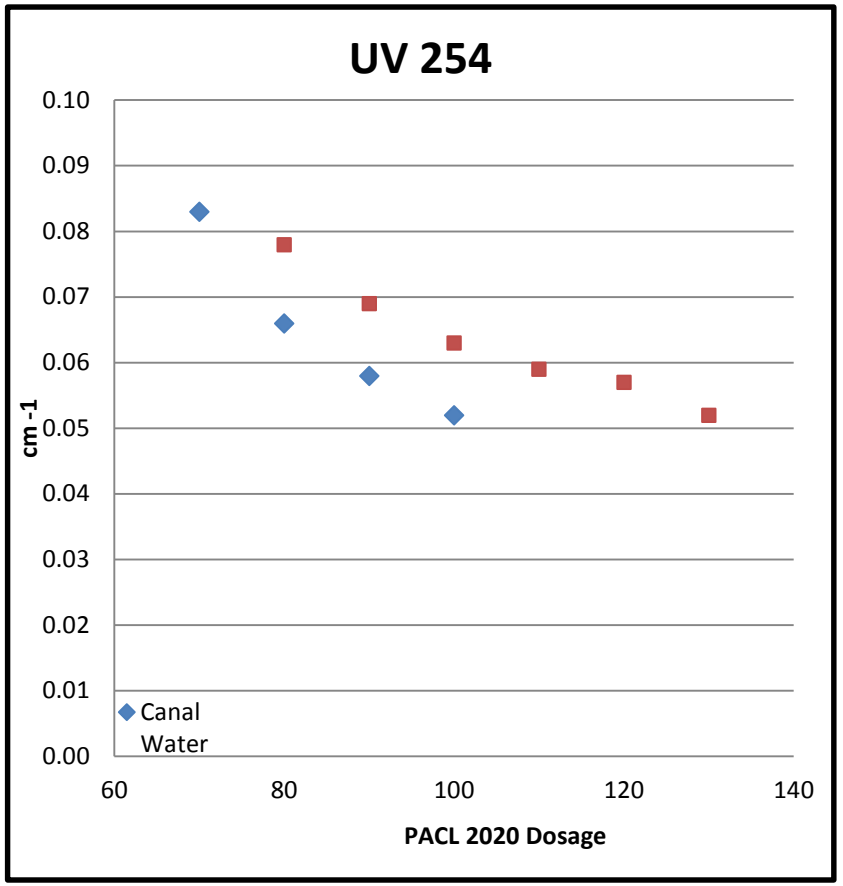
- Canal water better water quality than reservoir (TOC, UV254, Algae, T&O)
- Higher aluminum PACl improves TOC, UV254 removal

RECOMMENDATIONS:

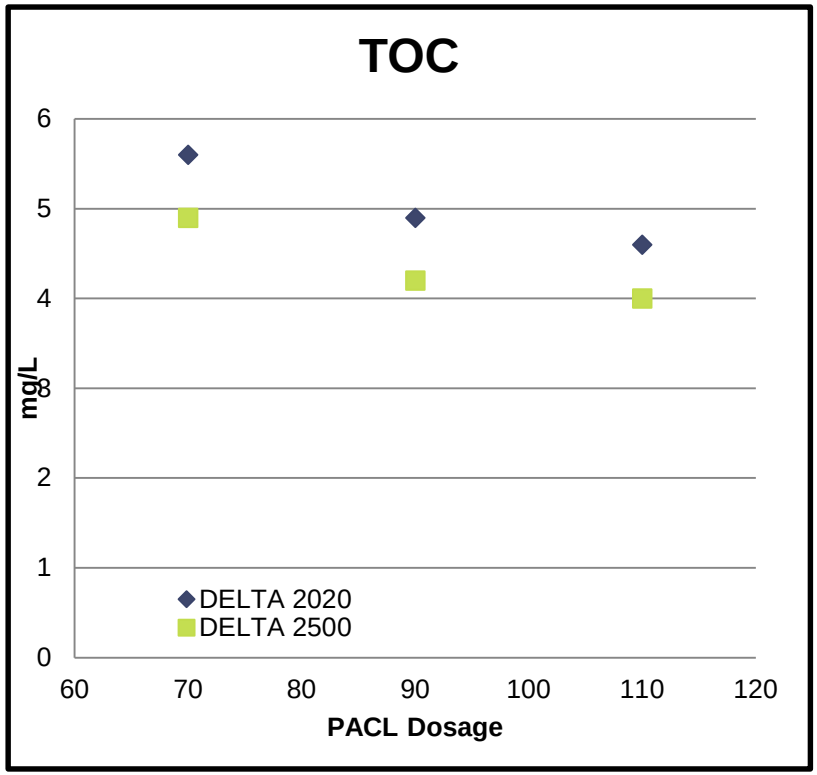
- Use Canal water when reservoir quality is poor (T&O, high TOC, UV254)
- Switch to higher aluminum PACl
- Reduce/eliminate pre-soda ash to lower coagulation pH

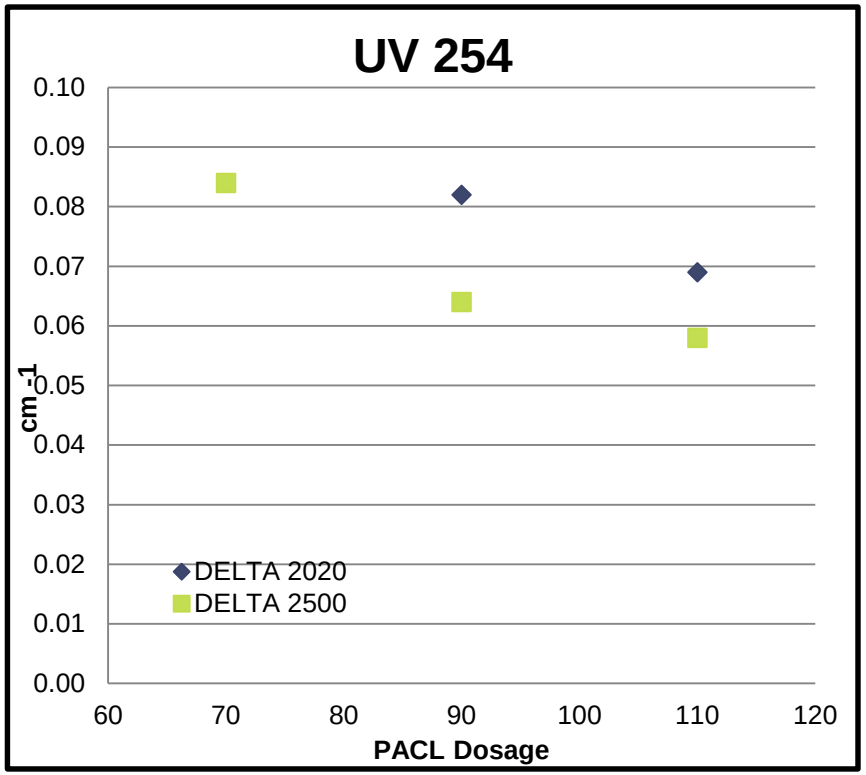
LAMBERTVILLE – COMPARISON of SOURCES of SUPPLY





LAMBERTVILLE – COMPARISON of TWO PACLs





CARTHAGE NC

DESCRIPTION:

- Coagulation (PACl), flocculation, DAF, membranes, hypo, CT contact tank, chloramination, lime, corrosion inhibitor

ISSUES/EVALUATIONS:

- THMs
- Jar tests comparing alum and PACl
- Plant profiling (TOC, UV254, pH)
- CT Tracer Testing

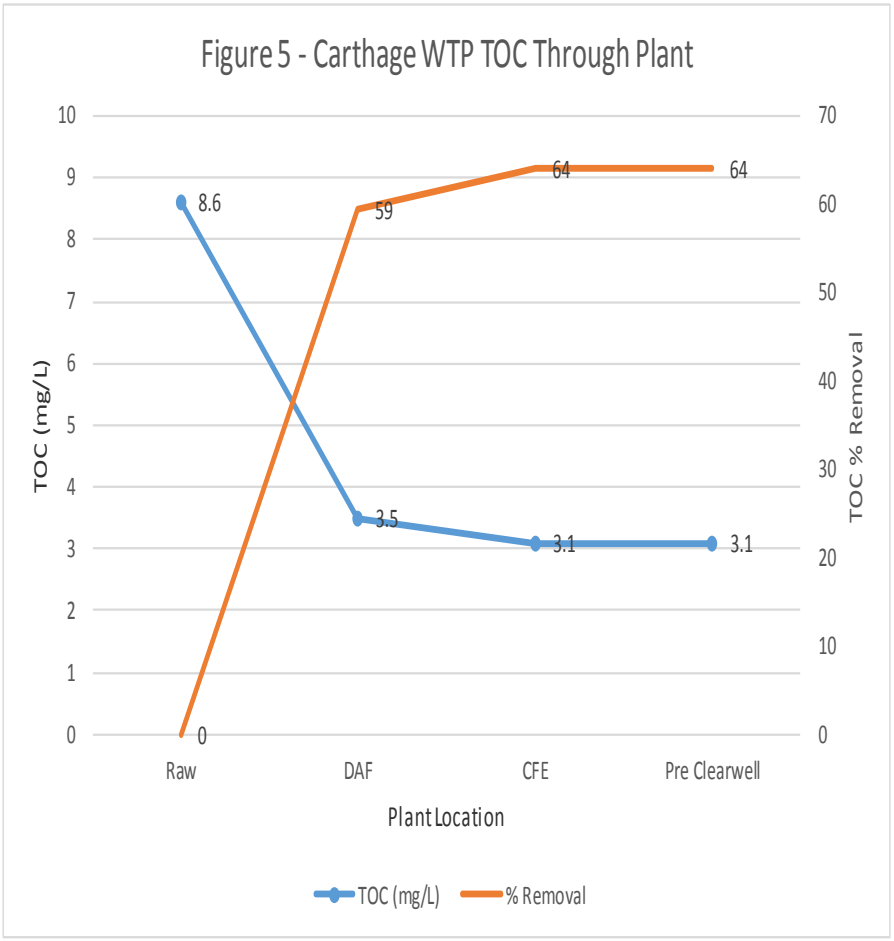
FINDINGS:

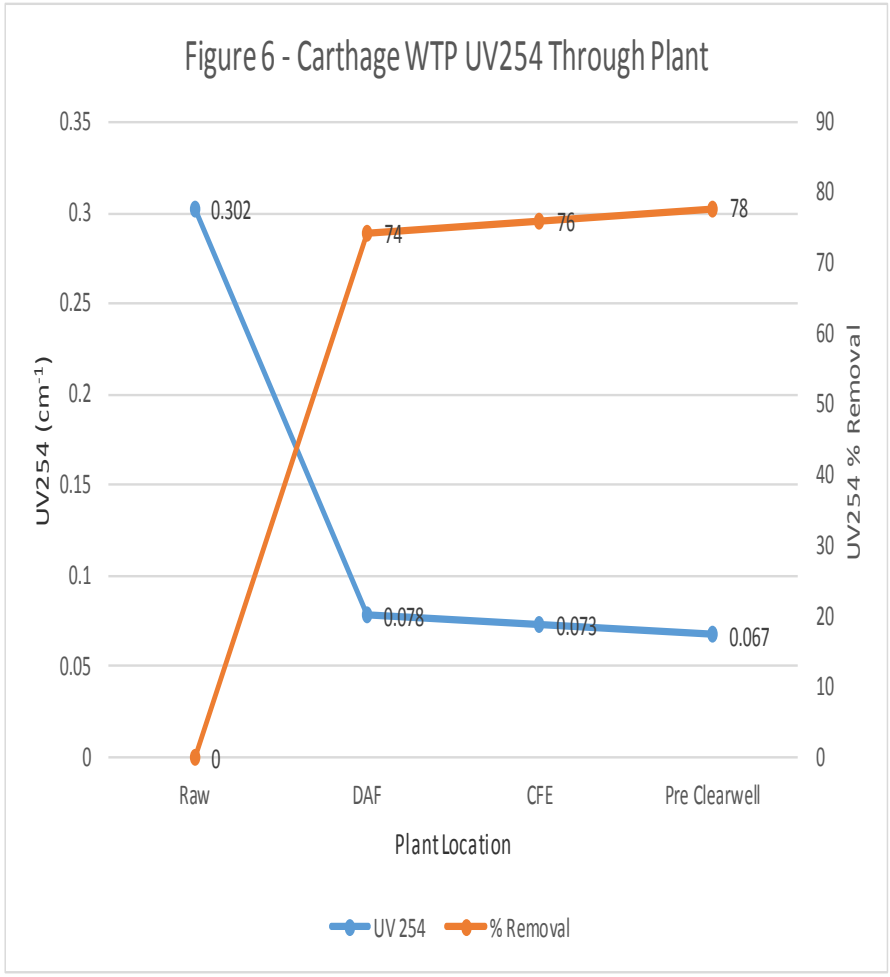
- Alum outperformed PACl
- Most of TOC, UV254 removal done by DAF; pH leaving the plant is high (8.3)
- High chlorine residual through CT tank; tracer test indicated could lower the residual in warm weather

RECOMMENDATIONS:

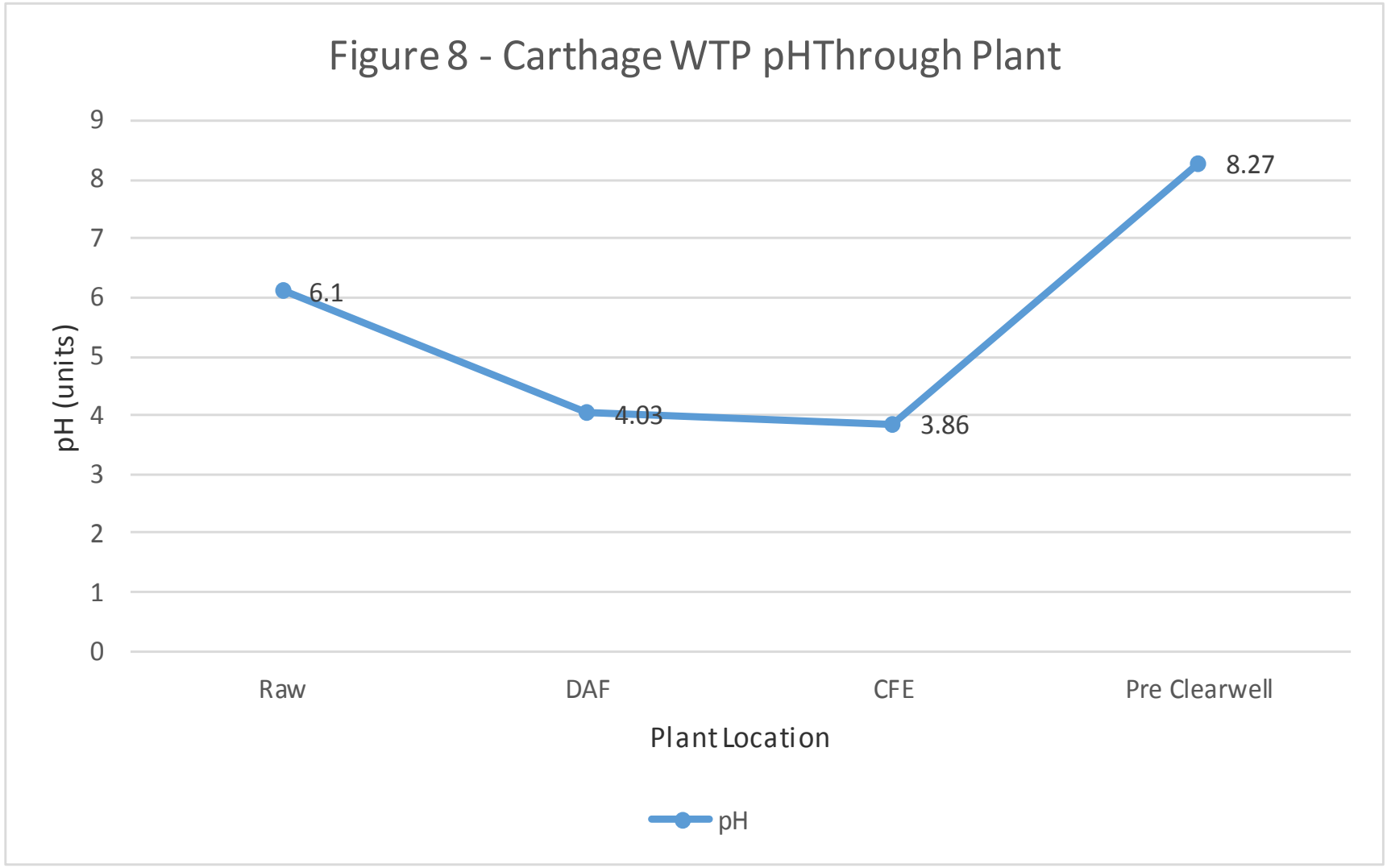
- Increase alum
- Lower pH leaving the plant
- Reduce chlorine residual through CT tank; use downstream chlorination point to finish chloramination

CARTHAGE TOC and UV254 REMOVAL THROUGH PLANT





CARTHAGE WTP – pH THROUGH PLANT



SUMMARY

STRATEGIES FOR REDUCING DBPs:

- Review source water quality for changes over time; if have multiple sources use best source especially in warmer water
- Evaluate TOC,UV254 (raw/CFE), distribution THMs over time and consider parameters that may impact THMs (pH, temperature, coagulant dosage)
- Perform plant profiling of TOC, UV254 and possibly DBPs
- Develop correlations between TOC, UV254, DBPs (if possible)
- Review distribution system operations and water quality
- Consider tank cleaning and use of THM removal equipment in tanks
- Use jar tests to evaluate: coagulant dosages, different coagulants, pH, PAC - compare TOC, UV254, SDSTHM
- Optimize coagulant dosage and pH (generally as low as possible)
- Reduce finished water pH
- Lower the CFE chlorine residual in warmer water and still maintain CT

SUMMARY CONT'D

STRATEGIES FOR PLANT OPTIMIZATION:

- Perform backwash turbidity profiles to improve backwashing and reduce BW waste volumes
- Evaluate beneficial reuse of WTP residuals; reduce costs
- Evaluate disinfection alternatives; safety, cost, performance
- Evaluate corrosion inhibitors, especially to lower finished water pH; reduce costs, improve DBP control

Thank You !

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