



Enhanced Operations at the Water Treatment Plant

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Fontus Blue

OTCO Annual Class III & IV Workshop

July 31, 2019



fontusblue Presentation Overview

- Discuss two groups of key metrics to monitor and enhance operations:
 1. Key metrics from existing data and no additional software or lab equipment required
 2. Key metrics requiring additional software and/or lab equipment
- Key Metric Discussion Format
 - What the metric is
 - Why the metric is valuable
 - How the metric is measured
 - Case studies with data from Ohio-based water treatment plants

OhioEPA		Surface Water Treatment Plant Monthly Operating Report (MOR)												
Division of Drinking and Ground Waters		Version: 2.0.4												
PWSID: 04740014		Last Updated: December 13, 2011												
STU ID: 745000		NOTE: Begin entering data in row 18												
Reporting Lab Certification Number: 625		Generate XML												
Reporting Month/Year (M/YYYY): 8/2018		Indicators Required: Fast												
Distribution Disinfectant Reporting		Cleanwell Information												
Number of Samples Analyzed: 21		Calculation Type: Simple												
Number Below Required Residual: 0		Disinfectant Monitored Continuously?: Y												
% Meeting Disinfectant Requirement: 100.0		Filtration Type: Conventional												
Prev. Month % Meeting Min. Disinfectant Requirement: 100.0		Required Log Inactivation: 0.5												
Date	Lowest Residual Distribution at Entrance to Distribution System	Duration Residual Disinfectant Free	Peak Hourly Treatment Flow (gpm)	Highest pH	Lowest Temp (°C)	Lowest Cleanwell Operating Depth (feet)	Lowest Disinfectant Conc. (mg/L)	Effective Disinfectant Contact Time (min)	Minimum Actual (mg/L)	Required CT (min x mg/L)	Interpolation? (Y/N)	Raw Alkalinity (mg/L)	Raw TOC (mg/L)	Finished TOC (mg/L)
8/1/2018	2.00	0.30	0.0	7.50	8.00	23.0	13.00	2.00	369.7	691.5	14.0	Y		
8/2/2018	1.90	0.30	0.0	1.54	8.00	23.0	14.10	2.00	315.9	631.8	12.0	Y		
8/3/2018	1.80	0.30	0.0	1.71	8.00	21.0	14.10	2.00	307.4	654.8	14.0	Y		

Real UV254 Meter

P SERIES





fontusblue Key Metric: Lab Measured Stability

- What?
 - aka Marble Test
 - Direct measure of water tendency to deposit/dissolve calcium carbonate scales
 - Recorded on MOR as Stability
- Why?
 - Provides information about whether water is corrosive or excessively scale forming
- How?
 - Lab test to determine saturated vs. unsaturated alkalinity and pH





fontusblue Lab Measured Stability Results (Monthly)

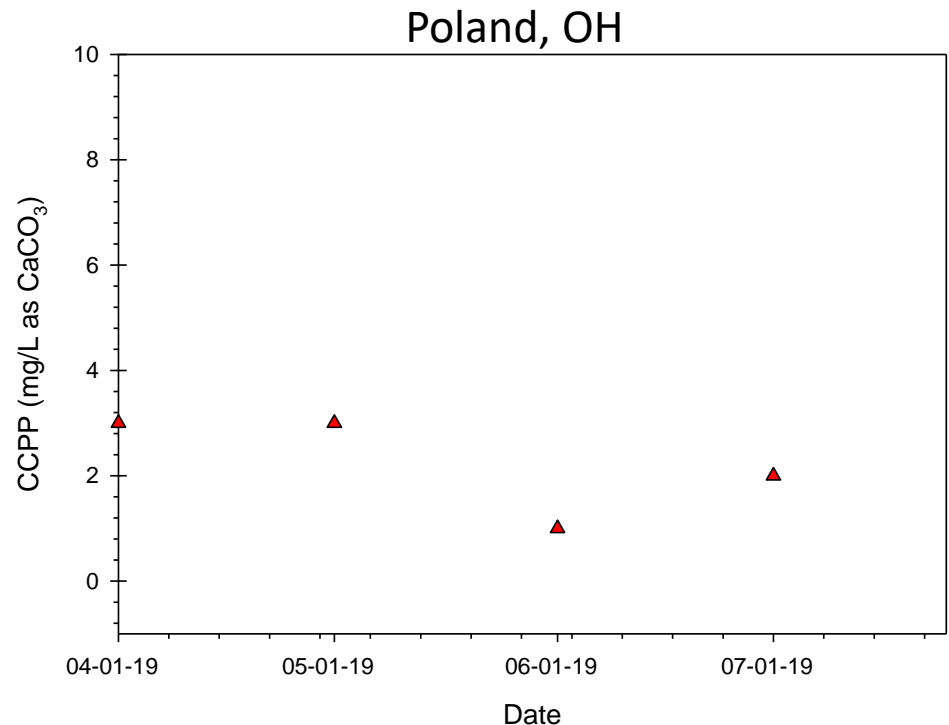
Calculation

CCPP = unsat. alk. – sat. alk.

- >0 stable or scale forming
- < 0 corrosive

Observations

- Monthly results could miss changes in stability caused by operational changes

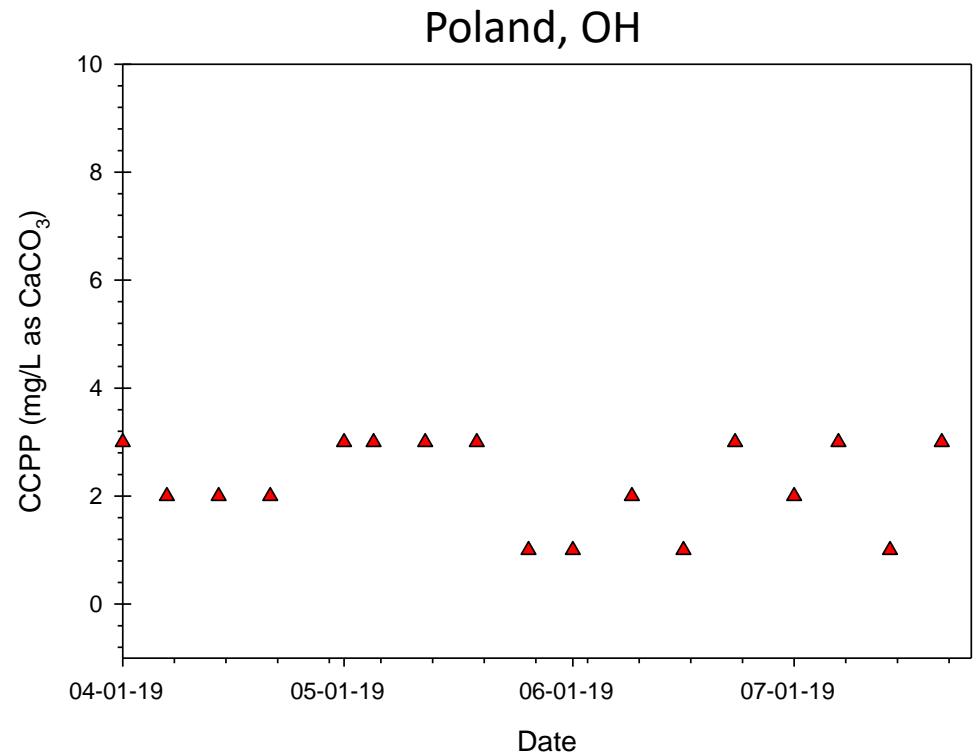




Lab Measured Stability Results (Weekly)

Observations

- Weekly results show trends and could catch operational changes

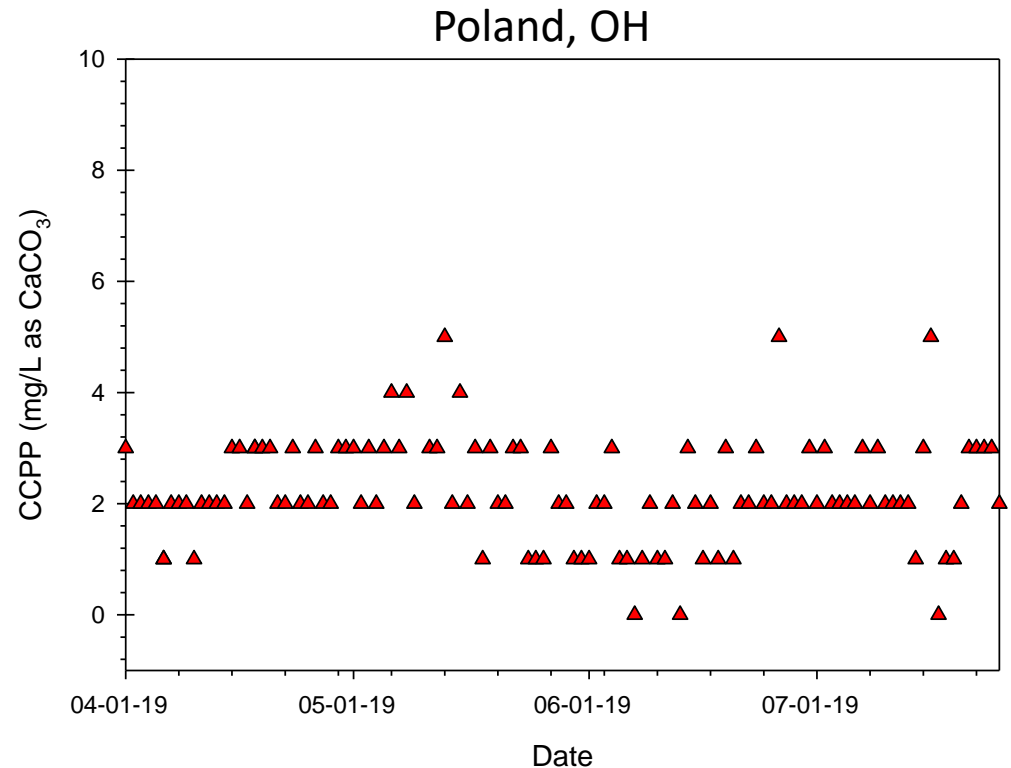




Lab Measured Stability Results (Daily)

Observations

- Daily measures identify operational extremes
- Additional uses for daily values?





fontusblue Key Metric: TOC

- What?
 - A measure of the total organic carbon
- Why?
 - Monitor variation in source water
 - If SW, must meet required removal percentages
 - Estimate chlorine demand from Tap
 - Associated with DBPs
- How?
 - Data required for MOR
 - Usually sent out to a lab for analysis

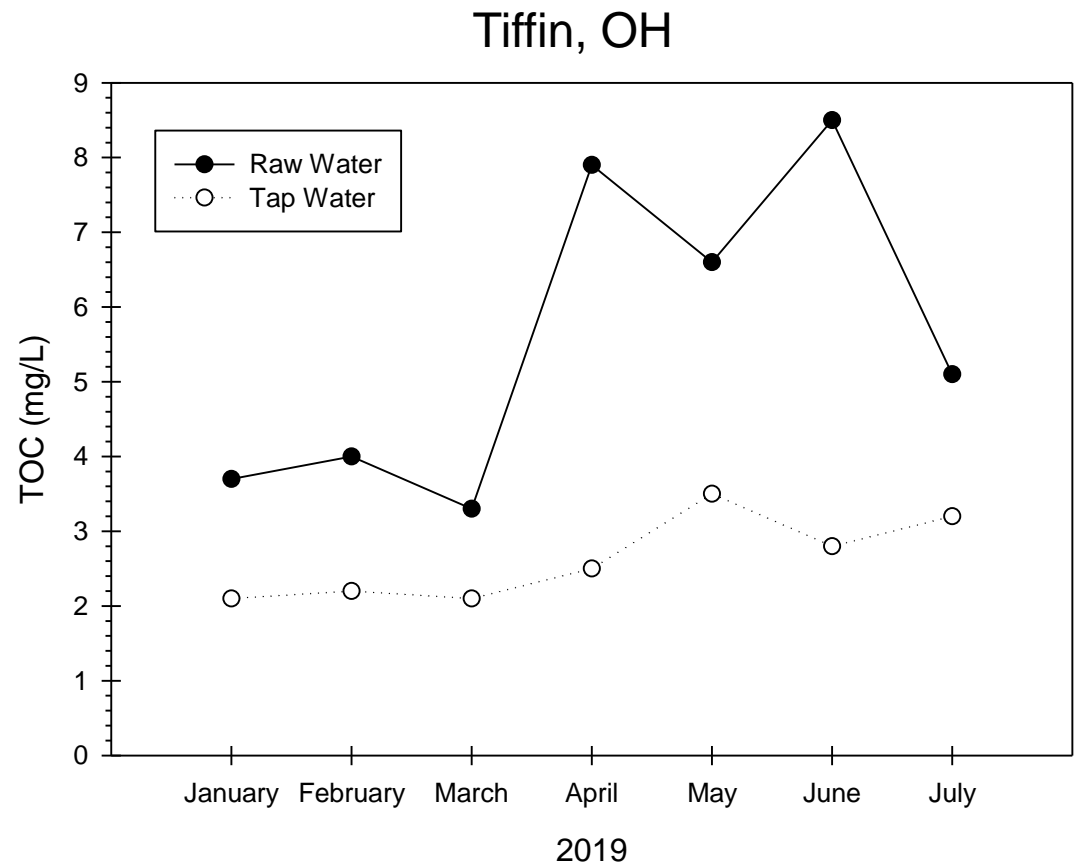
Required TOC Removal			
Source water TOC, mg/L	Source water alkalinity, mg/L as CaCO ₃		
	0-60	>60-120	>120
>2.0 to 4.0	35%	25%	15%
>4.0 to 8.0	45%	35%	25%
>8.0	50%	40%	30%

Calculation

- Plot over time

Observation

- Source water varies from ~3-8 mg/L (>150%)
- How much does it vary between monthly samples?



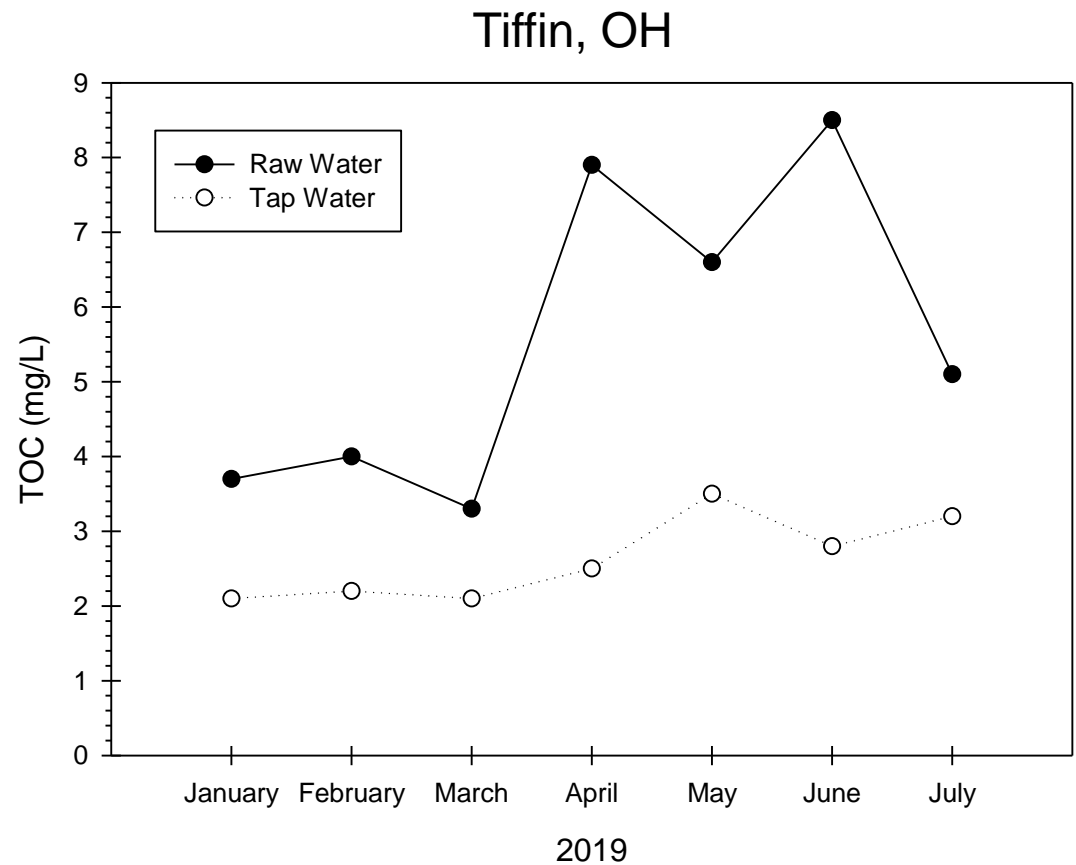
TOC Results – Tap Water Variation

Calculation

- Plot over time

Observation

- Tap water varies from ~2-3 mg/L (50%)
- How much does it vary between monthly samples?
- Impact on disinfection demand?





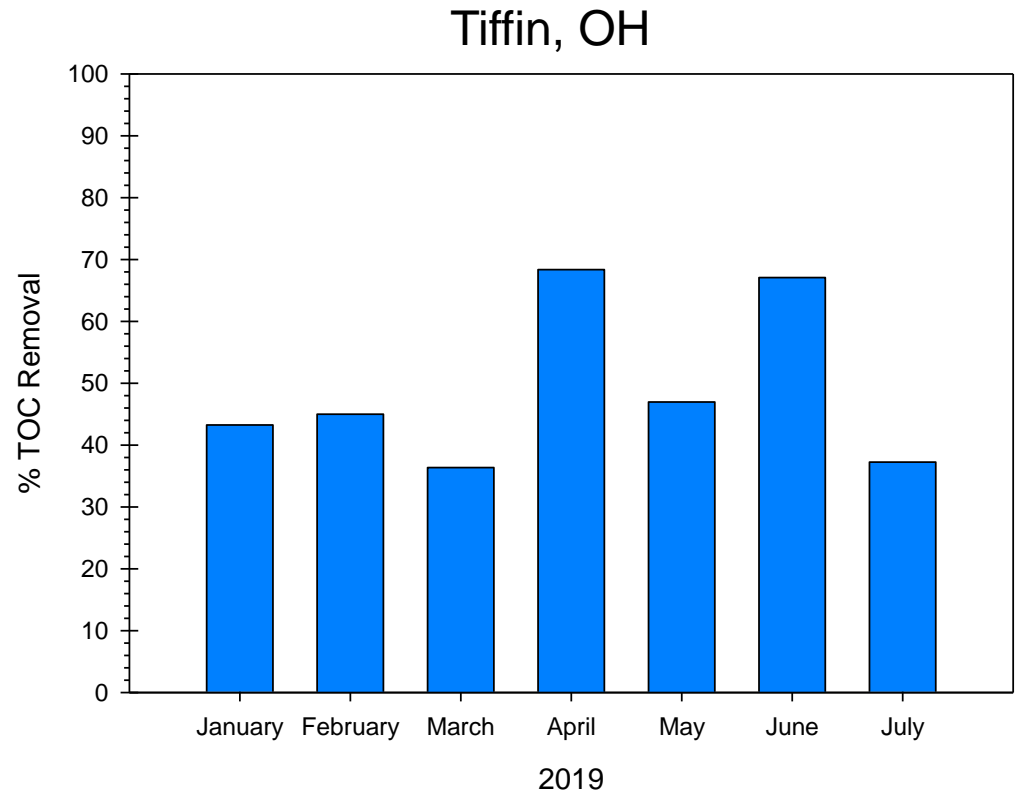
TOC Results - % Removal

Calculation

- Simple removal calculation

Observation

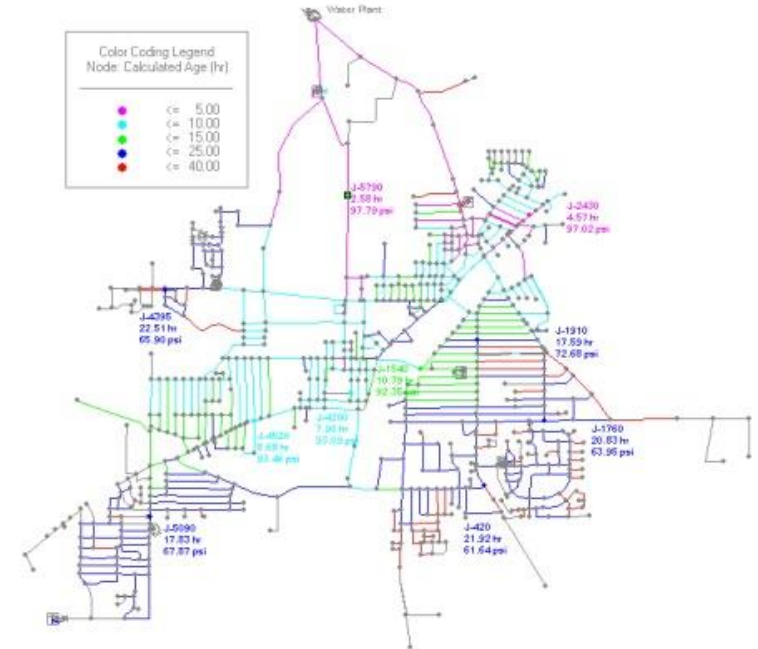
- Removal varies ~30-70% from month to month
- How much does it vary between monthly samples?





fontusblue Key Metric: Max. Chlorine Demand

- What?
 - Maximum measured chlorine demand in the distribution system
- Why?
 - Provides information about seasonal demand
 - Potential to reduce disinfectant dose if DBP concerns
- How?
 - Required data available on MOR



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Exceptional Water for Everyone, Every Day



Max. Chlorine Demand Results

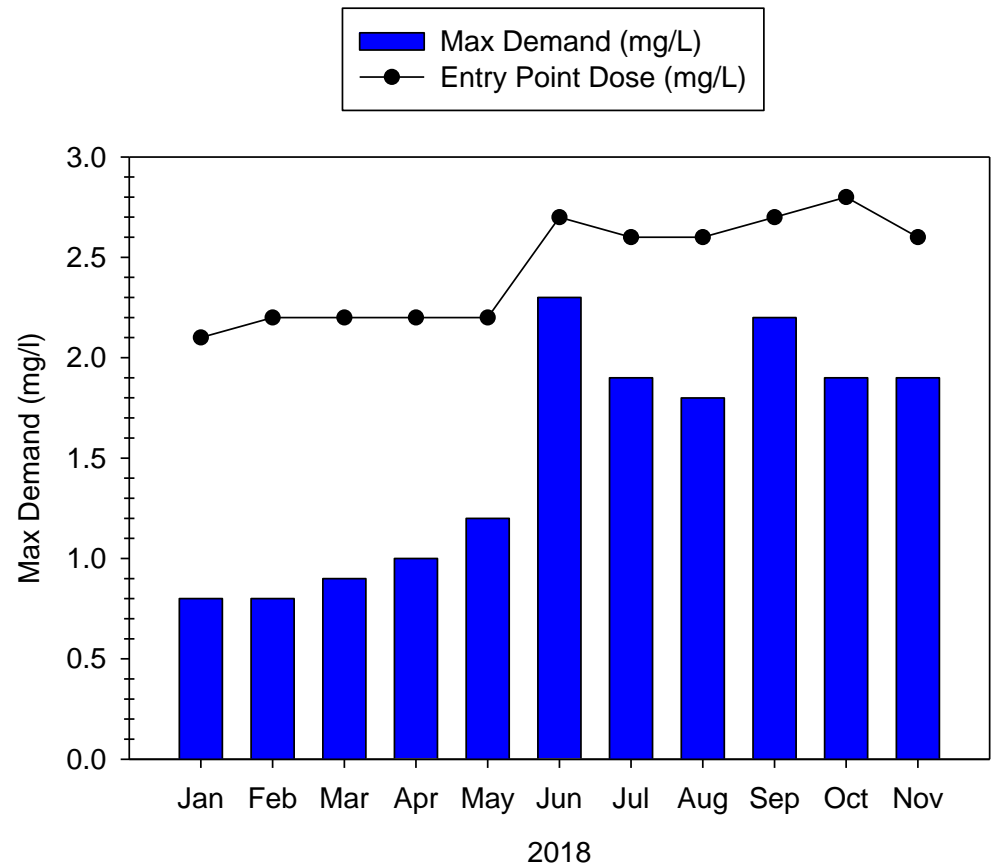
Calculation

Max Demand (in given month) = Entry Point Total – Dist. System **Lowest** Total

Observations

- Seasonal variation as expected and more frequent insight than TOC results
- Demand more than doubles in the summer and fall (tap TOC and temperature)
- Opportunity to lower dose in January-May?

Mentor, OH



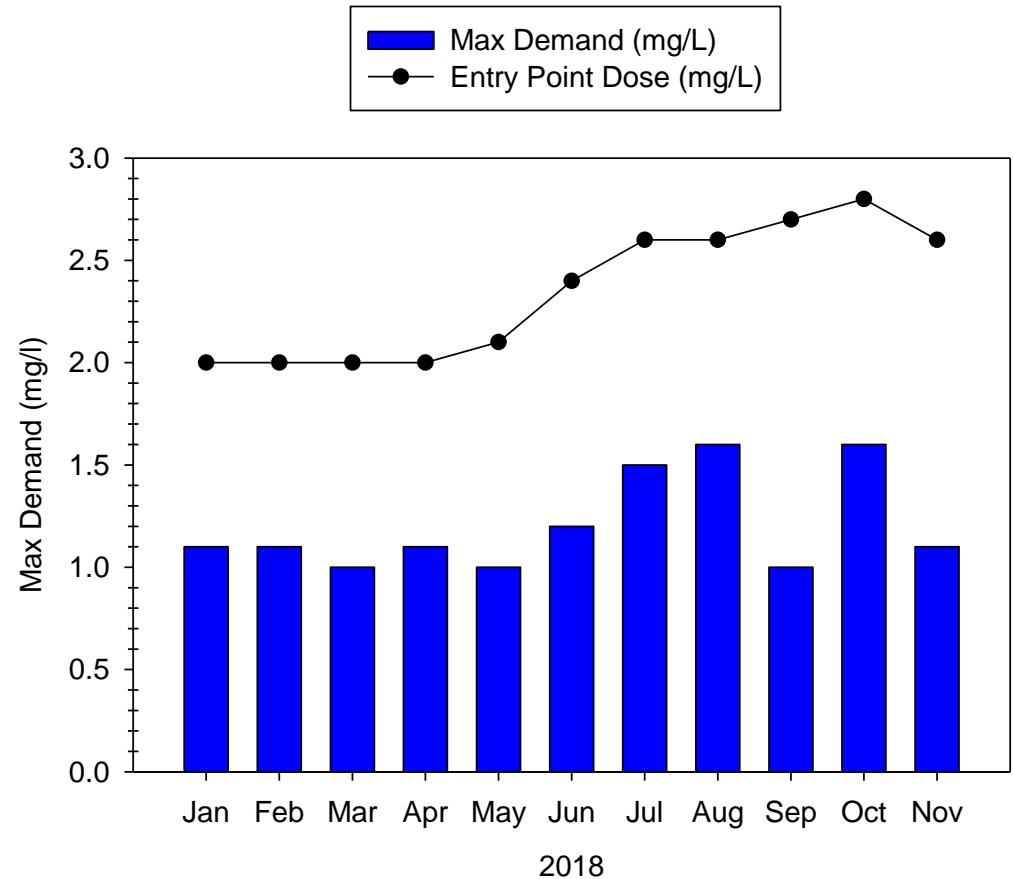


Max. Chlorine Demand Results cont.

Observations

- Seasonal variation as expected
- Demand increases by 50% in the summer (tap TOC and temperature)
- Opportunity to lower dose throughout the year?

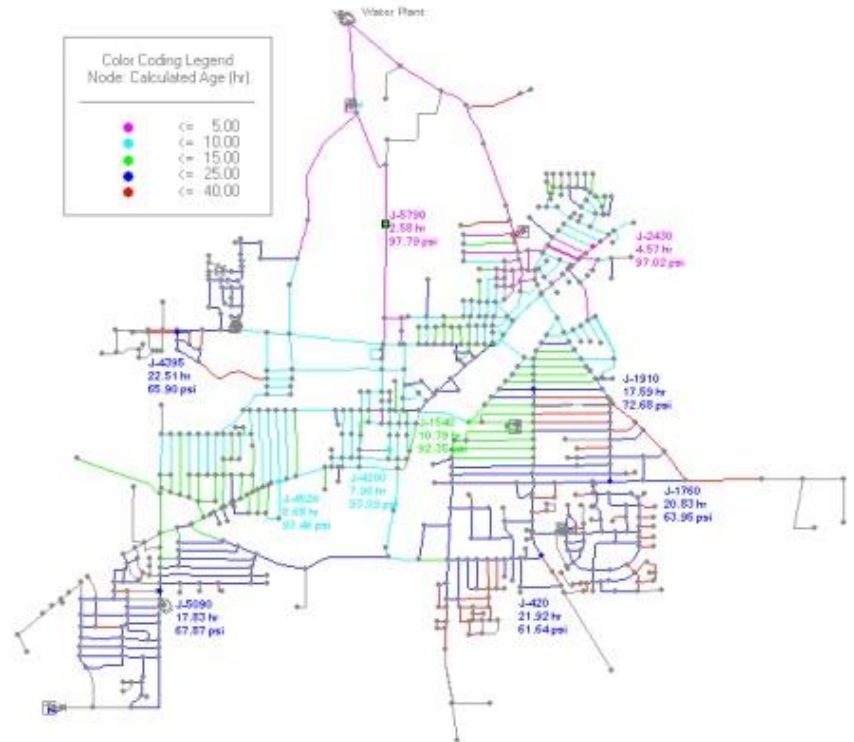
Tiffin, OH





fontusblue Key Metric: Distribution System DBPs

- What?
 - Disinfection byproduct compliance results
- Why?
 - Provides information about treatment performance and disinfection practices and distribution system issues
- How?
 - Basic calculations (LRAA etc.)





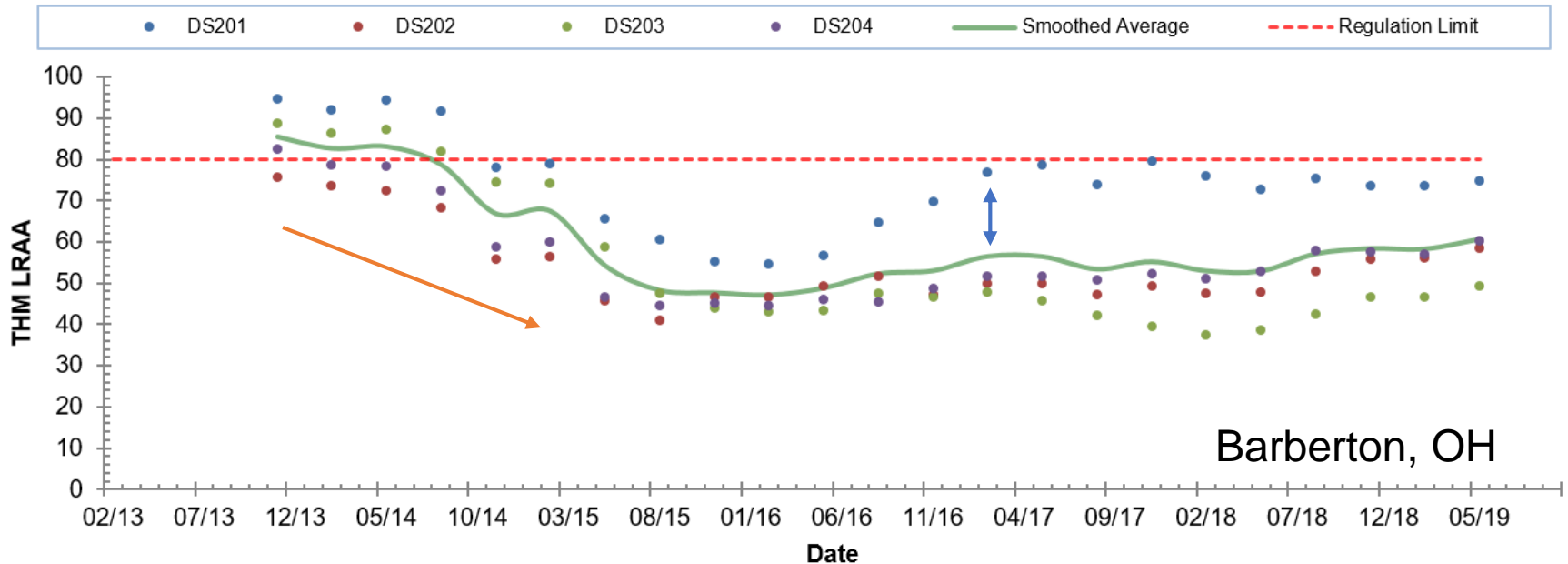
fontusblue Distribution System DBP Results - LRAAs

Calculation

LRAA (Locational Running Average) for each site

Observations

- LRAA's general trend can be visualized
- Sites moving in unison indicates treatment and disinfection practices
- “Rogue” sites indicate distribution system location-specific issues



Barberton, OH



fontusblue Additional Support for Some Key Metrics

- Additional items required to support some key metrics:

1. UV254 Meter-Spectrophotometer
2. Simulation Software



Real UV254 Meter

P SERIES ~ \$2,300



Excel-based program

decisionblue

Cloud-based program

Instrument	Adapter
DR 6000	LZV902.99.00020 (1-cm, 5-cm sample cells)
	LZV902.99.00002 (1-cm carousel)
	LZV887 (10-cm sample cell)
DR 5000	A23618 (1-cm, 5-cm sample cells)
	LZY421 (10-cm sample cell)



fontusblue Key Metric: UV254

- What?
 - Surrogate measure of organics in water
- Why?
 - Monitor variation in source water
 - If SW, estimate required TOC removal
 - Estimate chlorine demand and DBPs from tap
 - Can be measured more frequent than TOC
- How?
 - UV meter/spec, easy and fast (<1 min/sample)

Real UV254
Meter

P SERIES

~ \$2,300



Instrument	Adapter
DR 6000	LZV902.99.00020 (1-cm, 5-cm sample cells)
	LZV902.99.00002 (1-cm carousel)
	LZV887 (10-cm sample cell)
DR 5000	A23618 (1-cm, 5-cm sample cells)
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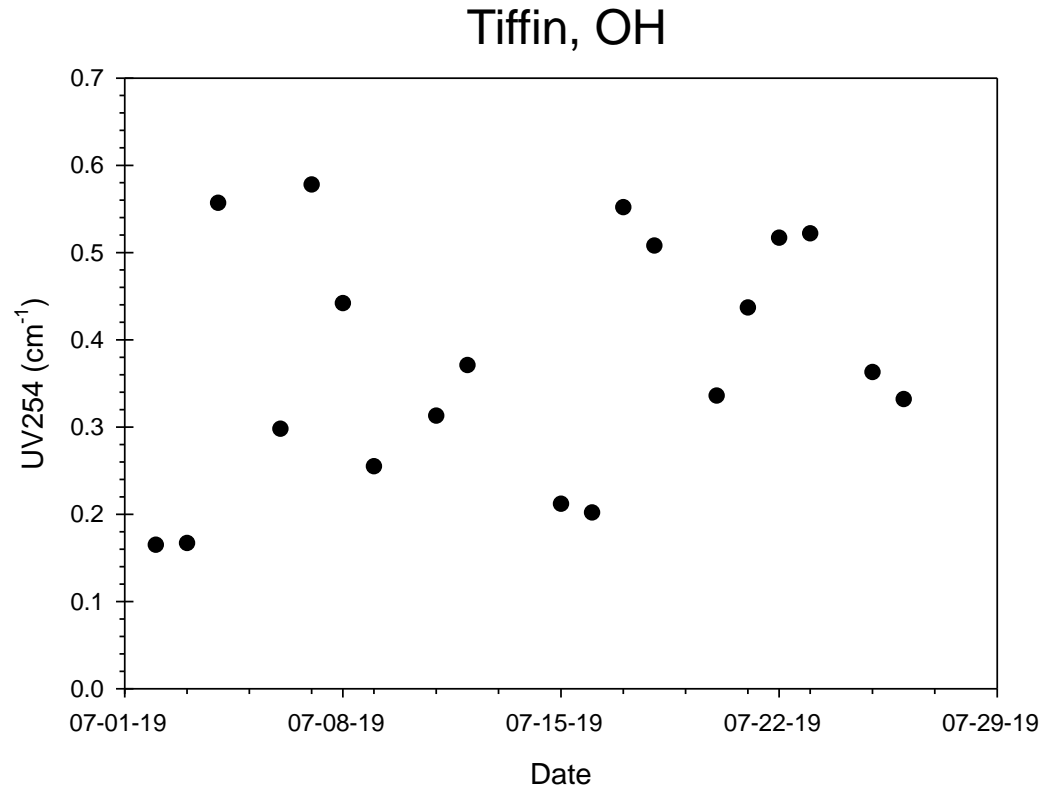
fontusblue UV254 Results – Source Water Variation

Calculation

- Plot over time

Observation

- Source water varies from ~ 0.15 - 0.6 cm^{-1} (400%)
- Considerable variation within a month (not captured in monthly TOC)





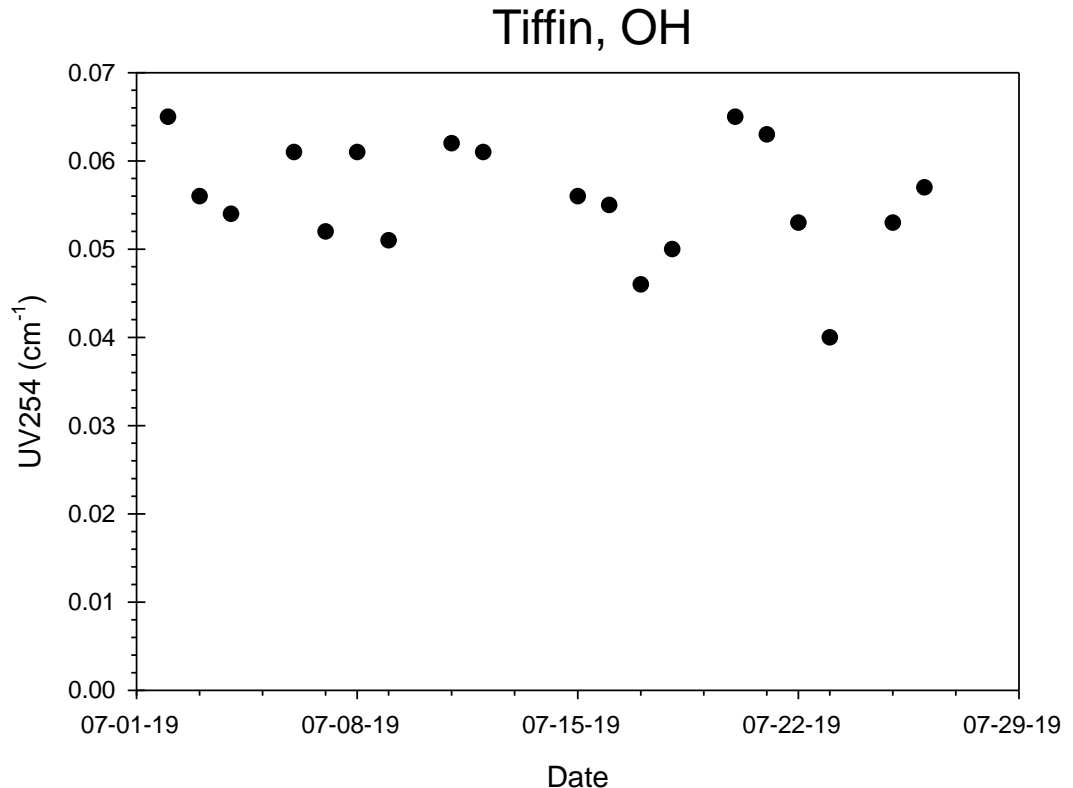
UV254 Results – Treated Water Variation

Calculation

- Plot over time

Observation

- Treated water varies from ~0.04-0.065 mg/L (>50%)
- More variation than captured by monthly TOC





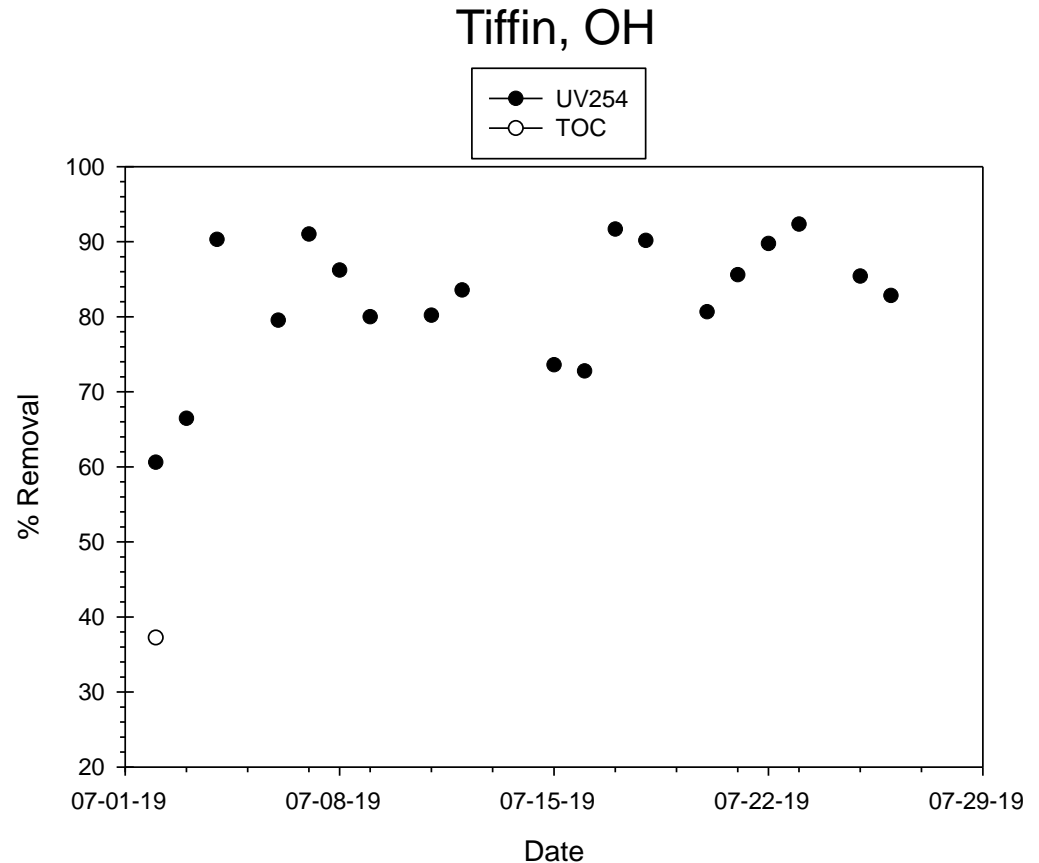
fontusblue UV254 Results - % Removal

Calculation

- Simple removal calculation for UV254
- Predicted TOC is 40-70% of UV254 removal

Observation

- July TOC at 60% of UV254 removal
- UV254 removal varied from ~60-90% over month
- Going into August, can expect removal to be 41-50%.





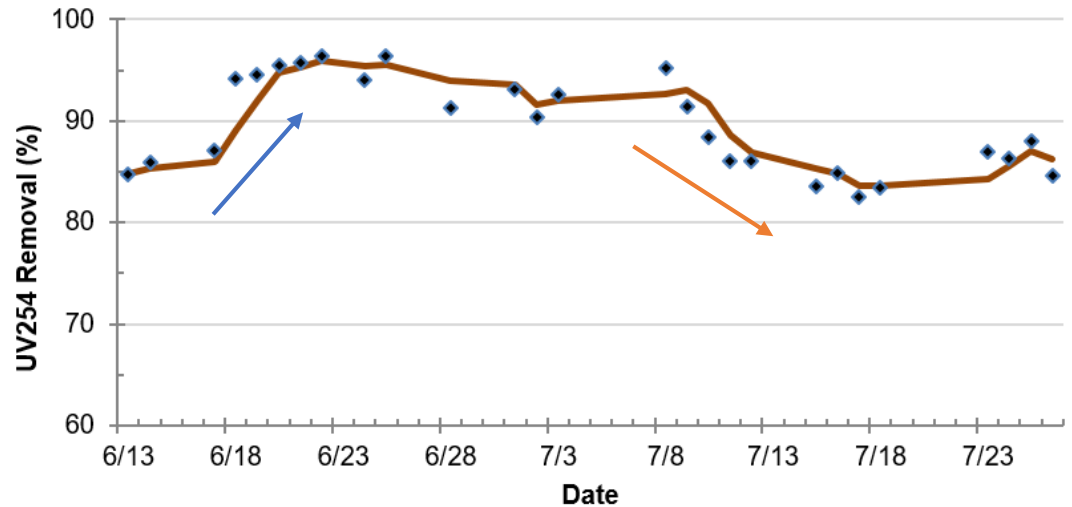
fontusblue UV254 Results – PAC Dosing

Calculation

- Simple removal calculation

Observation

- Removal increases with increasing PAC
- Removal decreases with decreasing PAC
- Can be used to approximate when dose is “right” – immediate response





fontusblue Key Metric: Simulated CCPP

- What?
 - Simulated value of the mass of CaCO_3 to deposit or dissolve based on equilibrium chemistry
- Why?
 - Provides stability estimate how corrosive or scale forming water is
- How?
 - Uses values already recorded on bench sheet **plus calcium hardness**
 - Calculation is complex





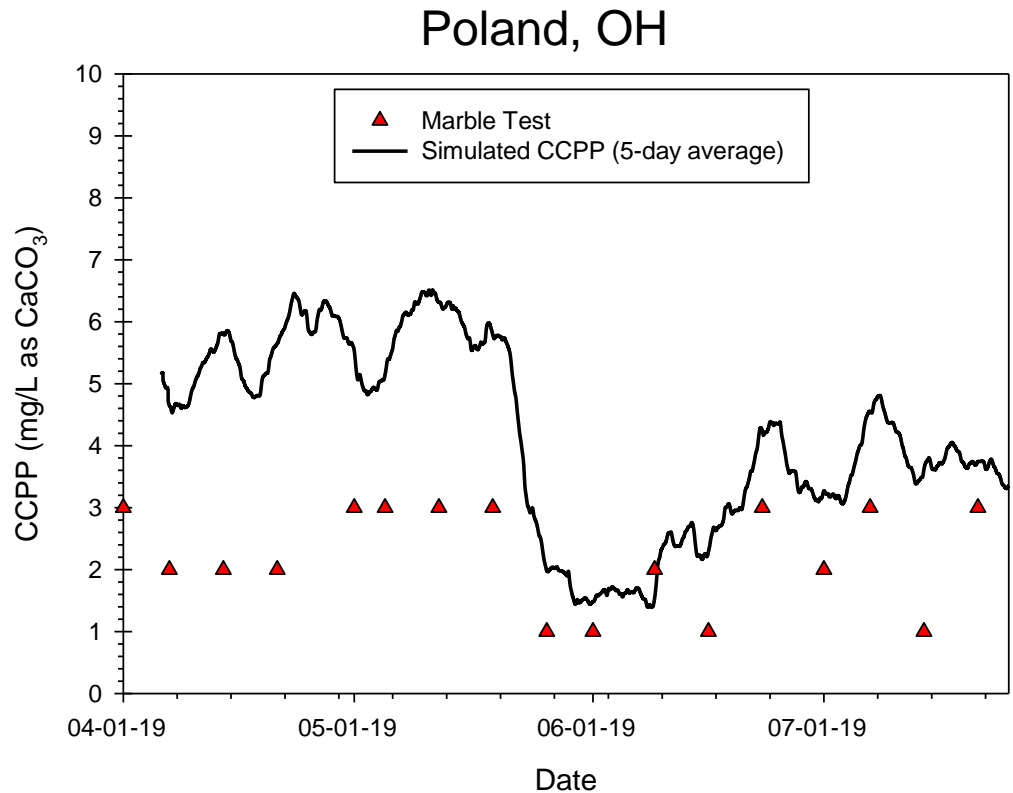
fontusblue Key Metric: Simulated CCPP

Calculation

- Calculation is complex
- CCPP:
 - >0 stable or scale forming
 - < 0 corrosive

Observation

- Simulated CCPP is different than measured CCPP
- Simulated CCPP changes are much more visible than measured



Thanks for your attention.

E. Ashley Bair

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