

PORTLAND WATER BUREAU
Bull Run Treatment Program

Findings from the Bull Run Treatment Pilot

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Pilot Team

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Outline

- Project Introduction
- Pilot Results
 - Oxidation
 - Filter Design
 - Finished Water
 - Turbidity Spiking
- Plan Moving Forward
- Questions





What is a
“pilot”?



**PORTLAND
PILOTS**

Project Introduction

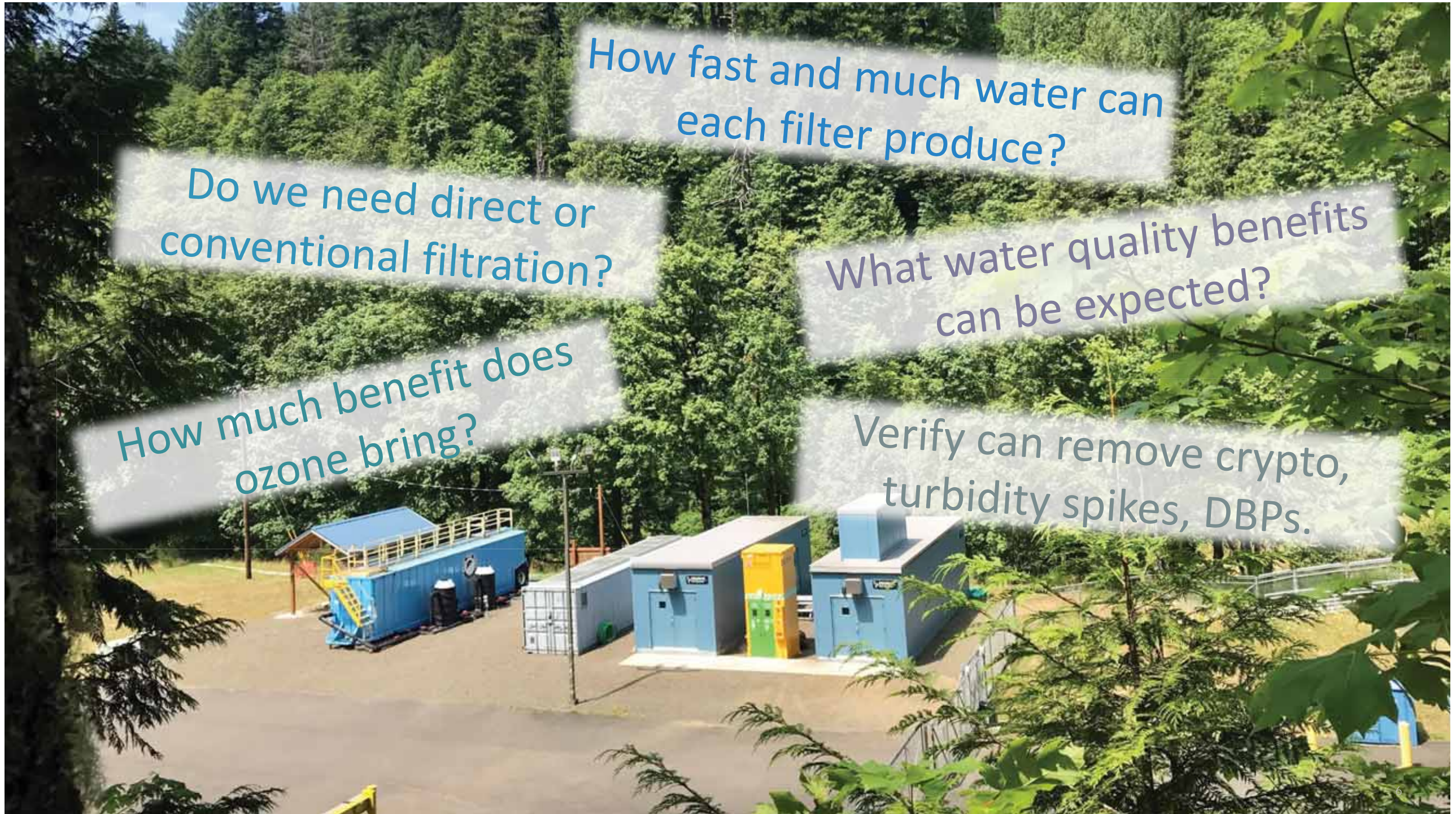
How fast and much water can
each filter produce?

Do we need direct or
conventional filtration?

What water quality benefits
can be expected?

How much benefit does
ozone bring?

Verify can remove crypto,
turbidity spikes, DBPs.



Video: Welcome to the pilot

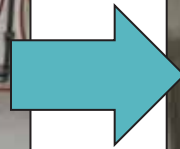


Tom Krause & Melanie Roy
Video produced by Reed Buterbaugh

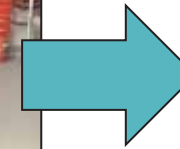
What the pilot includes



Oxidation



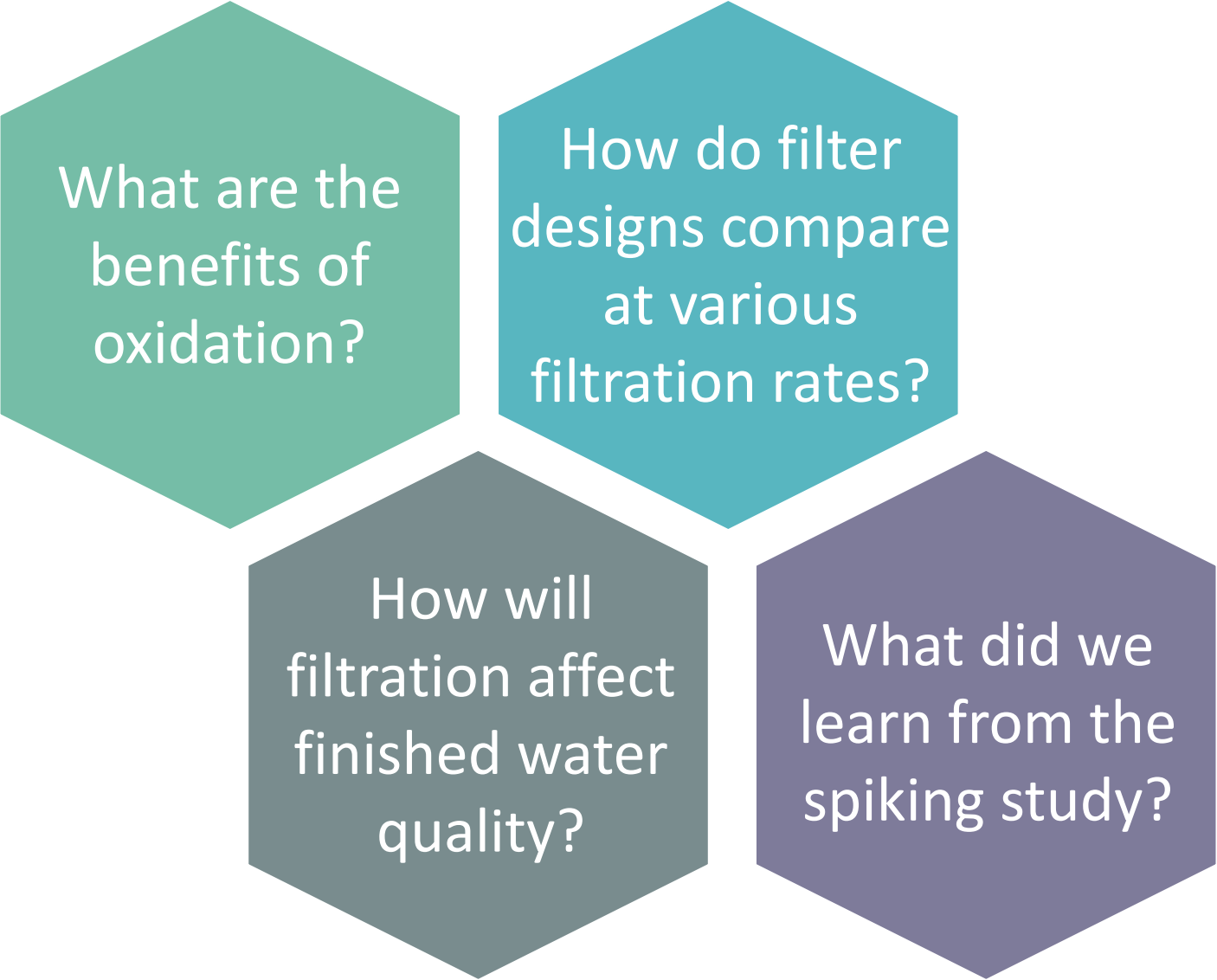
Flocculation/
Sedimentation



Filtration

Results



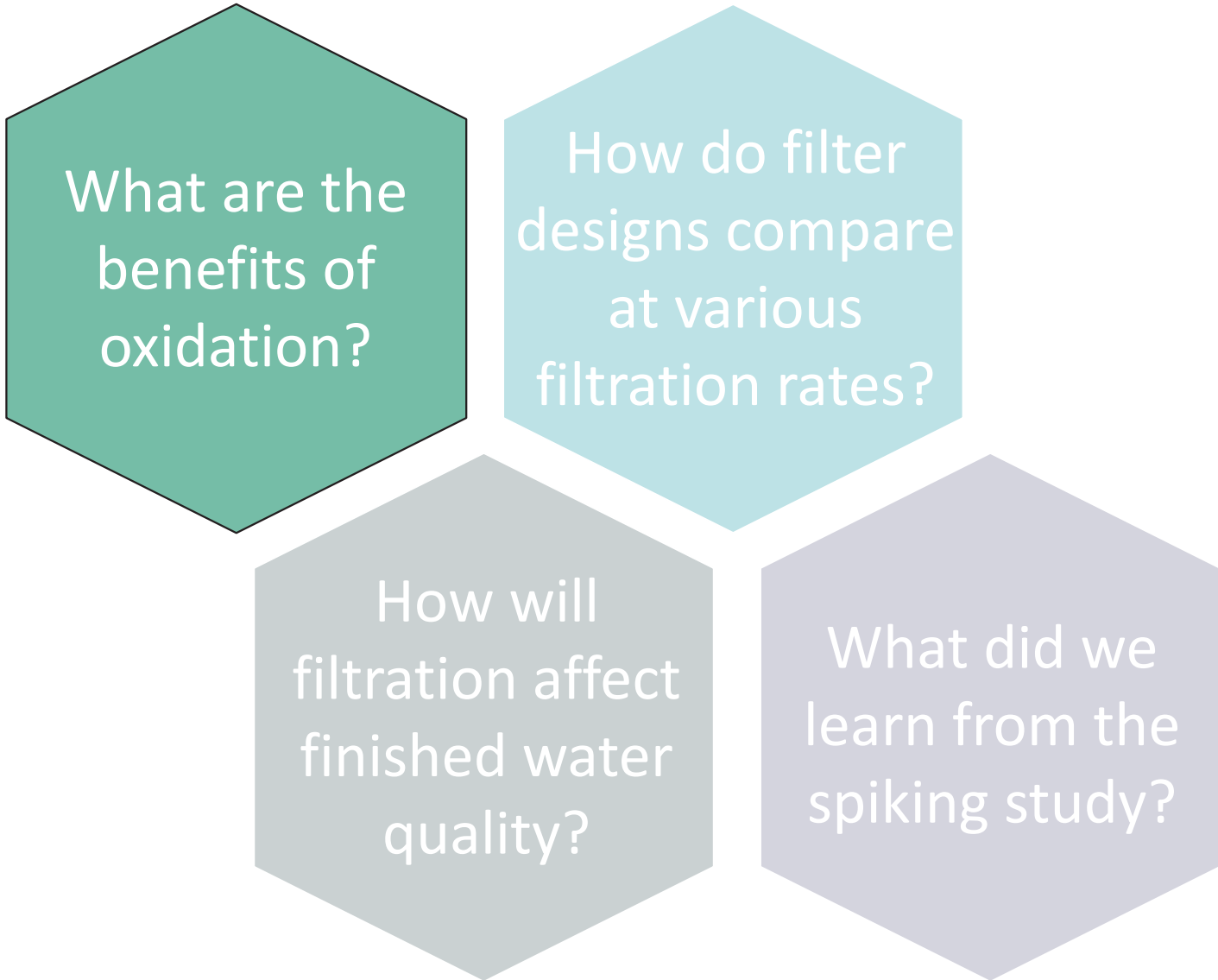


What are the
benefits of
oxidation?

How do filter
designs compare
at various
filtration rates?

How will
filtration affect
finished water
quality?

What did we
learn from the
spiking study?



What are the
benefits of
oxidation?

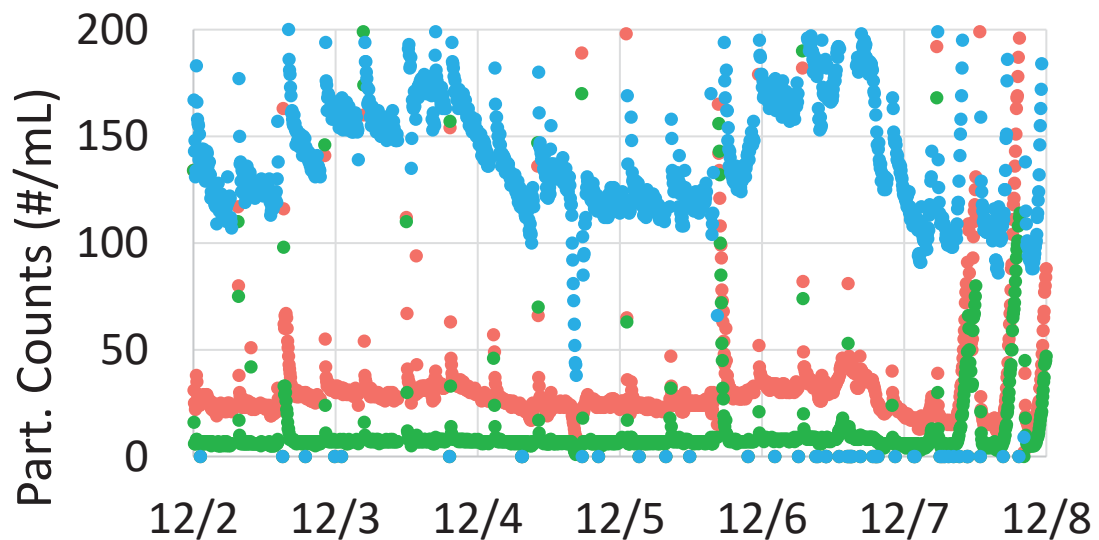
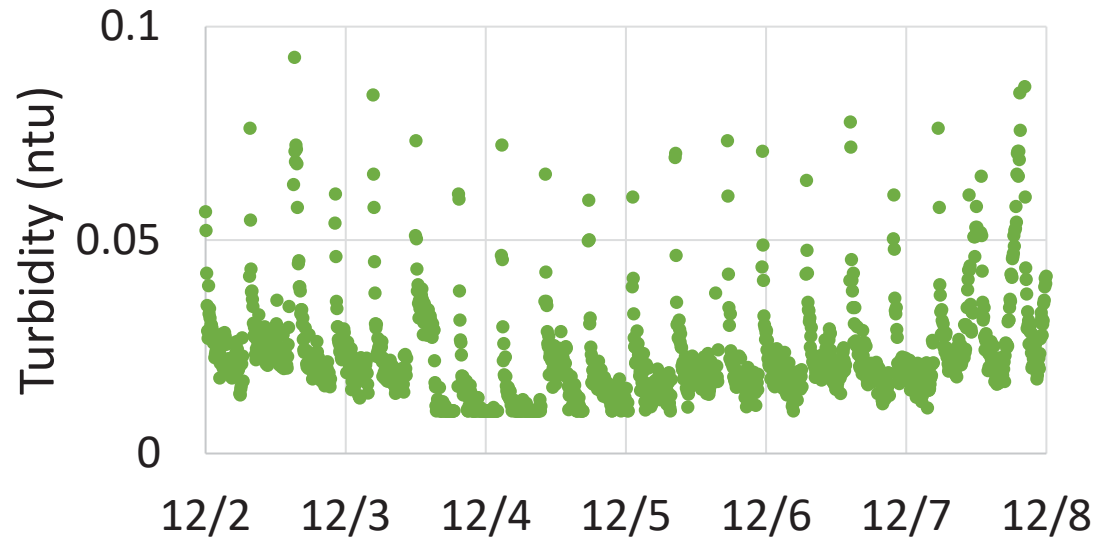
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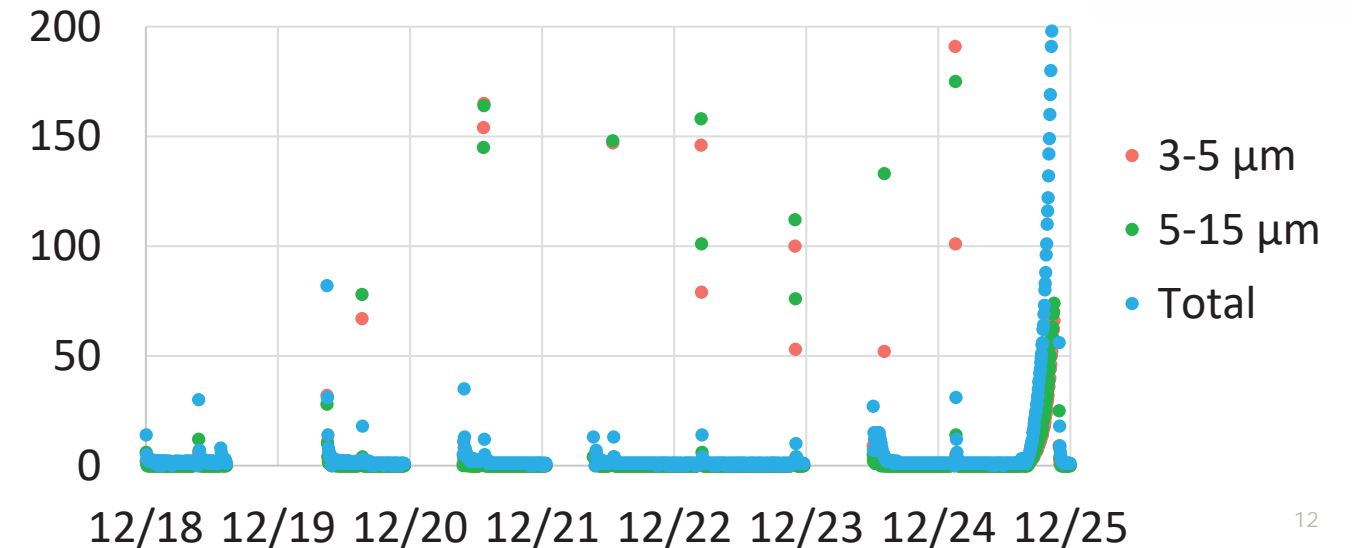
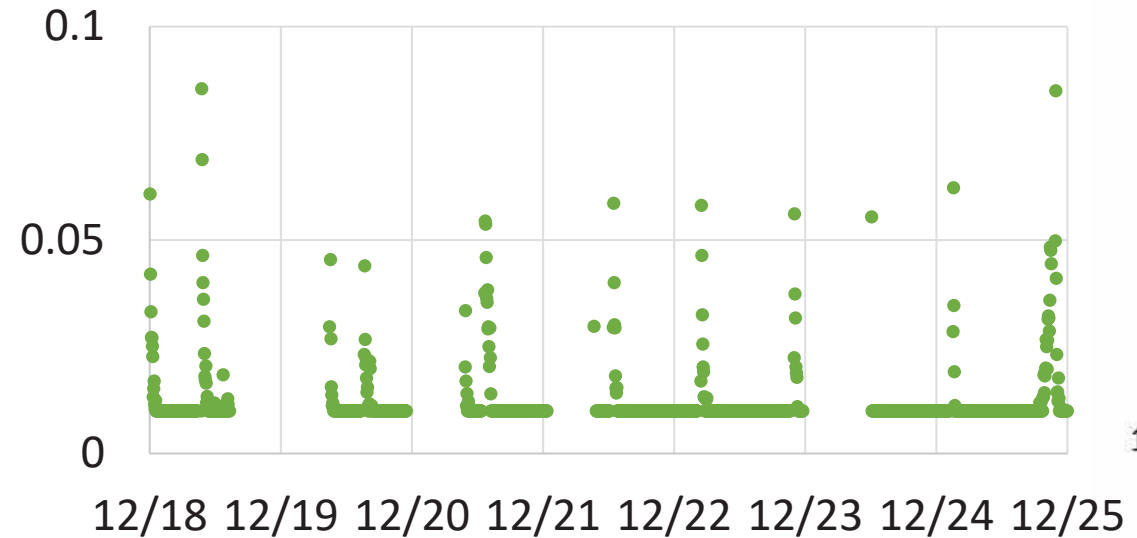
What did we
learn from the
spiking study?

Ozone improves turbidity and particle control

Without Pre-Oxidation



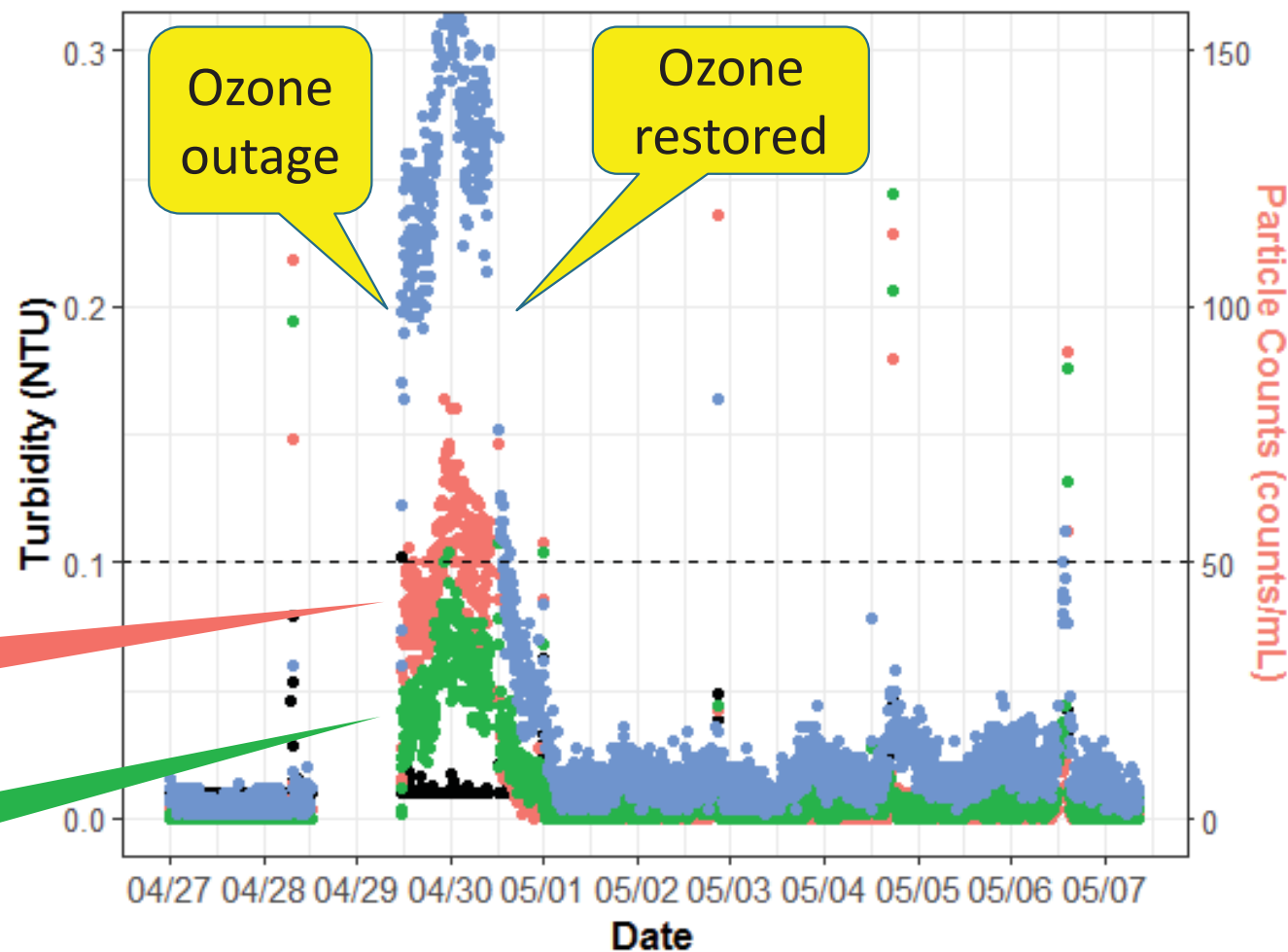
With Pre-Ozone



Particle counts jump up in all filters when lost ozone.

F6-Anth-60 8 gpm/sf

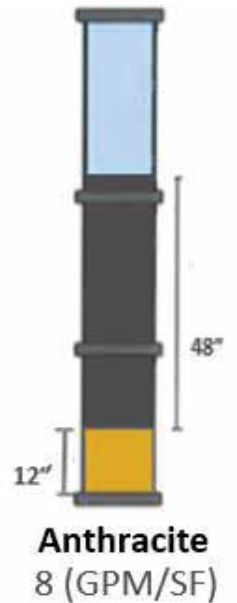
• 3 to 5 μm • 5 to 15 μm • 2 to 100 μm



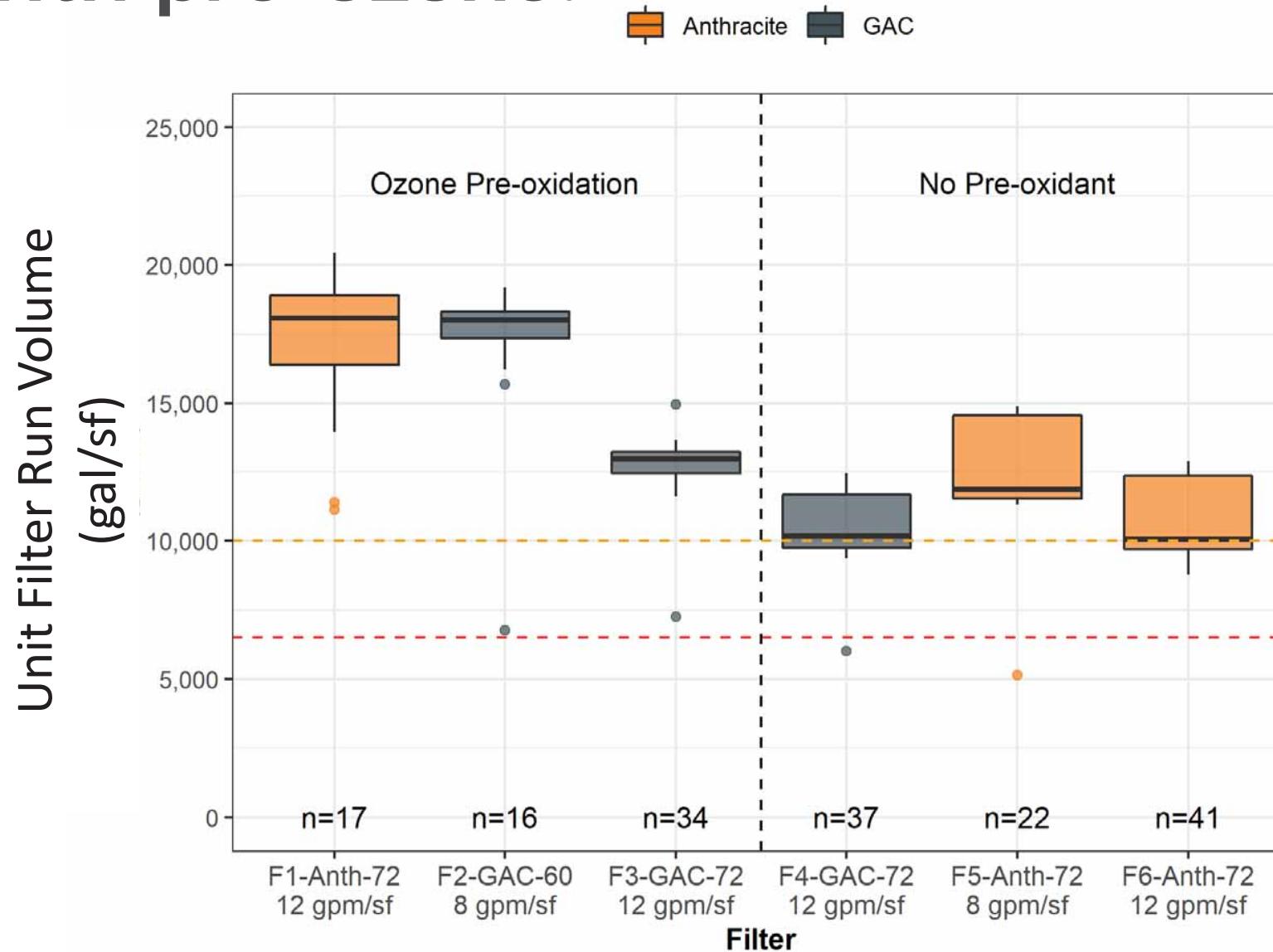
Crypto-sized particles

Giardia-sized particles

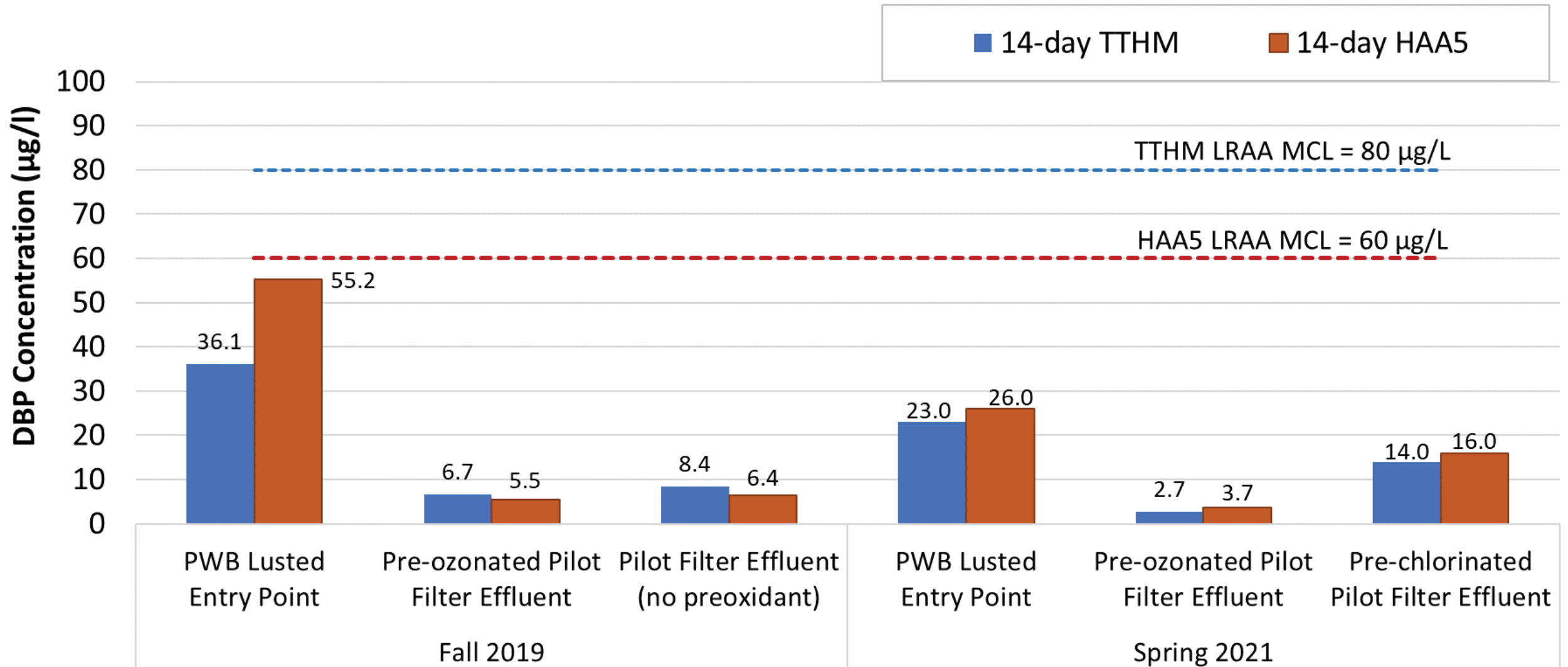
Column 6



Average productivity was 1.5 times greater in filters with pre-ozone.

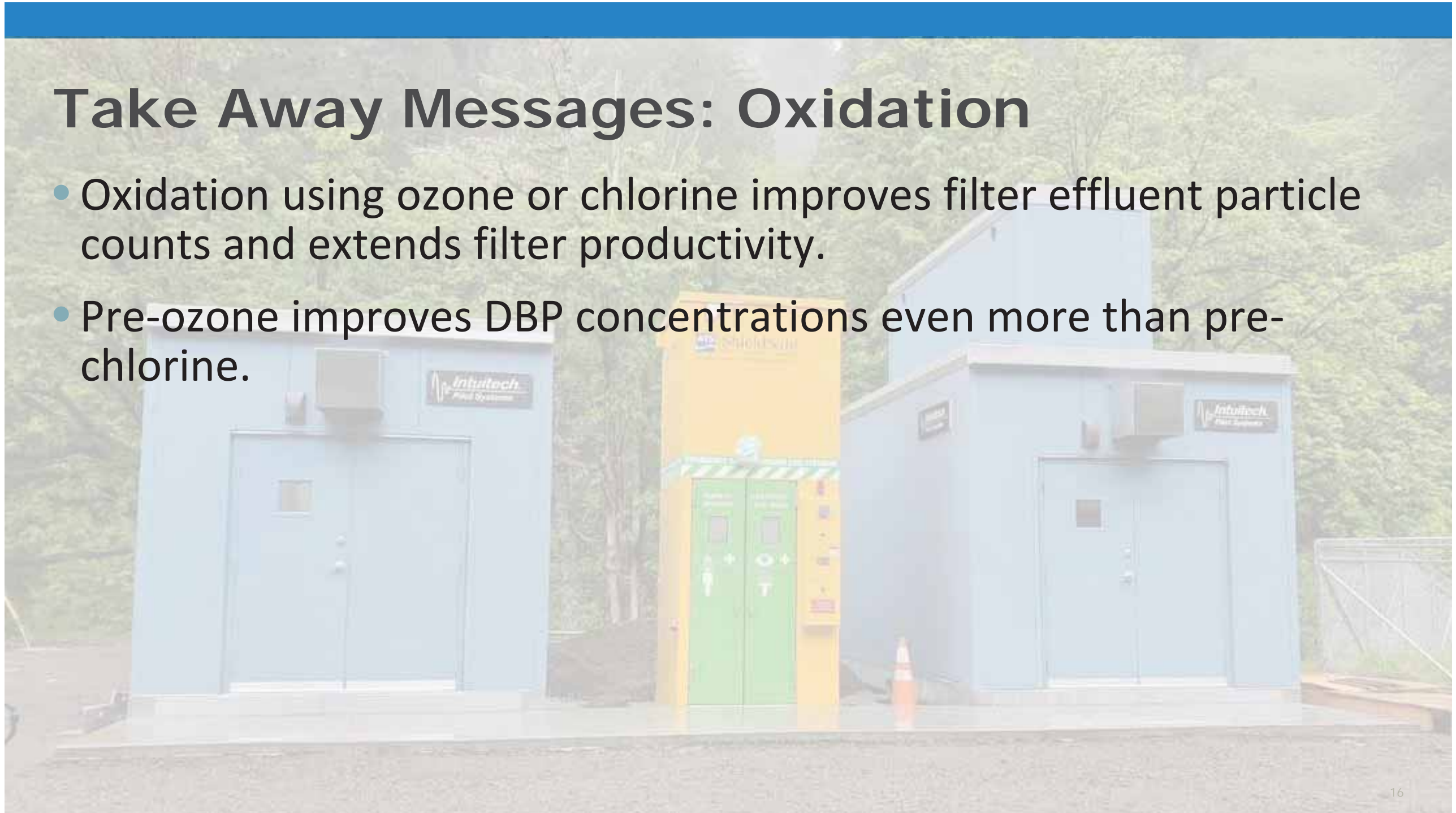


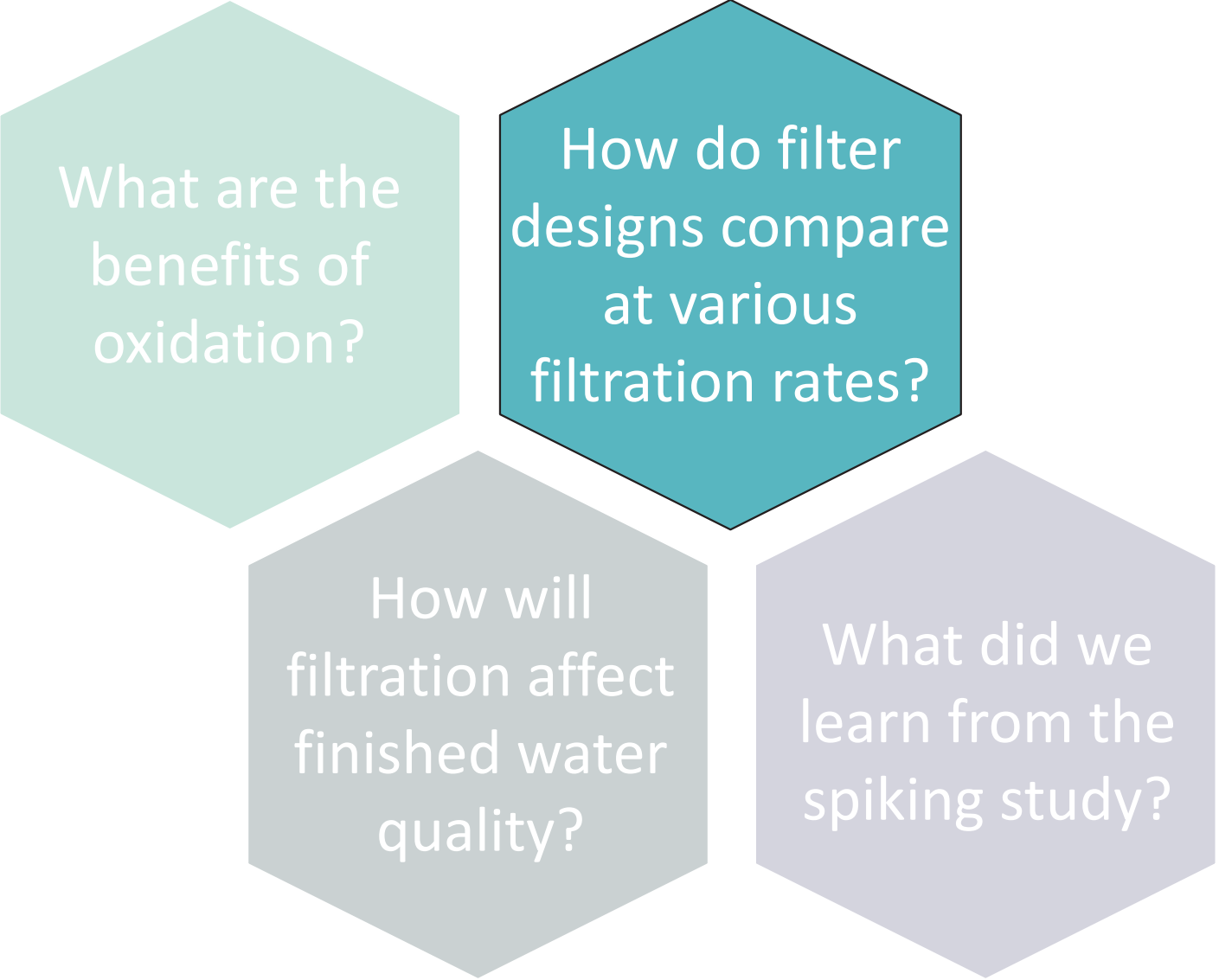
Filtration significantly reduces DBPs, with additional reductions when using pre-ozone.



Take Away Messages: Oxidation

- Oxidation using ozone or chlorine improves filter effluent particle counts and extends filter productivity.
- Pre-ozone improves DBP concentrations even more than pre-chlorine.





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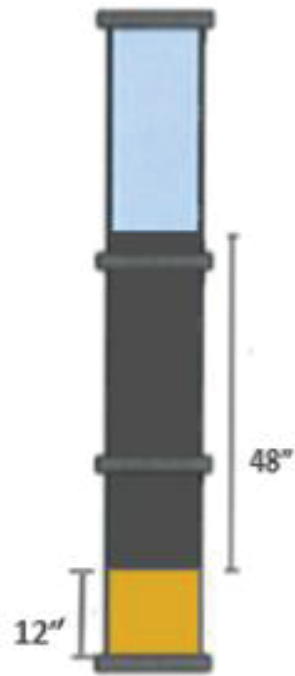
Video: Tour of Pilot Skids



Mojtaba Azadiaghdam & Humberto Piedra-Ruiz
Video produced by Reed Buterbaugh

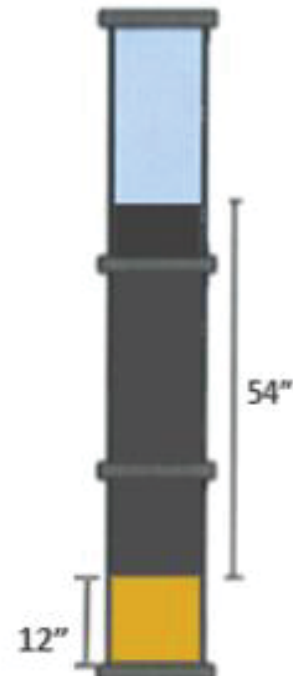
Filter Configuration

ANTH-60
Filters 1/6



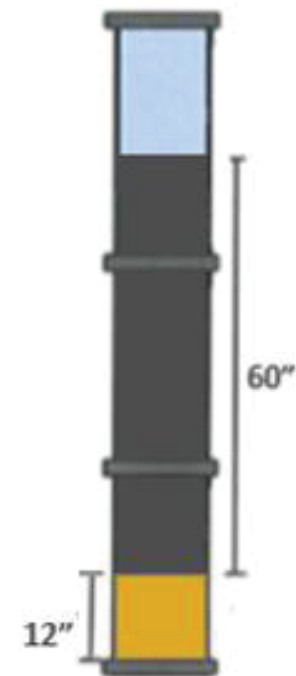
1.1 mm Anthracite
0.55 mm Sand
8 gpm/sf

ANTH-66
Filters 2/5



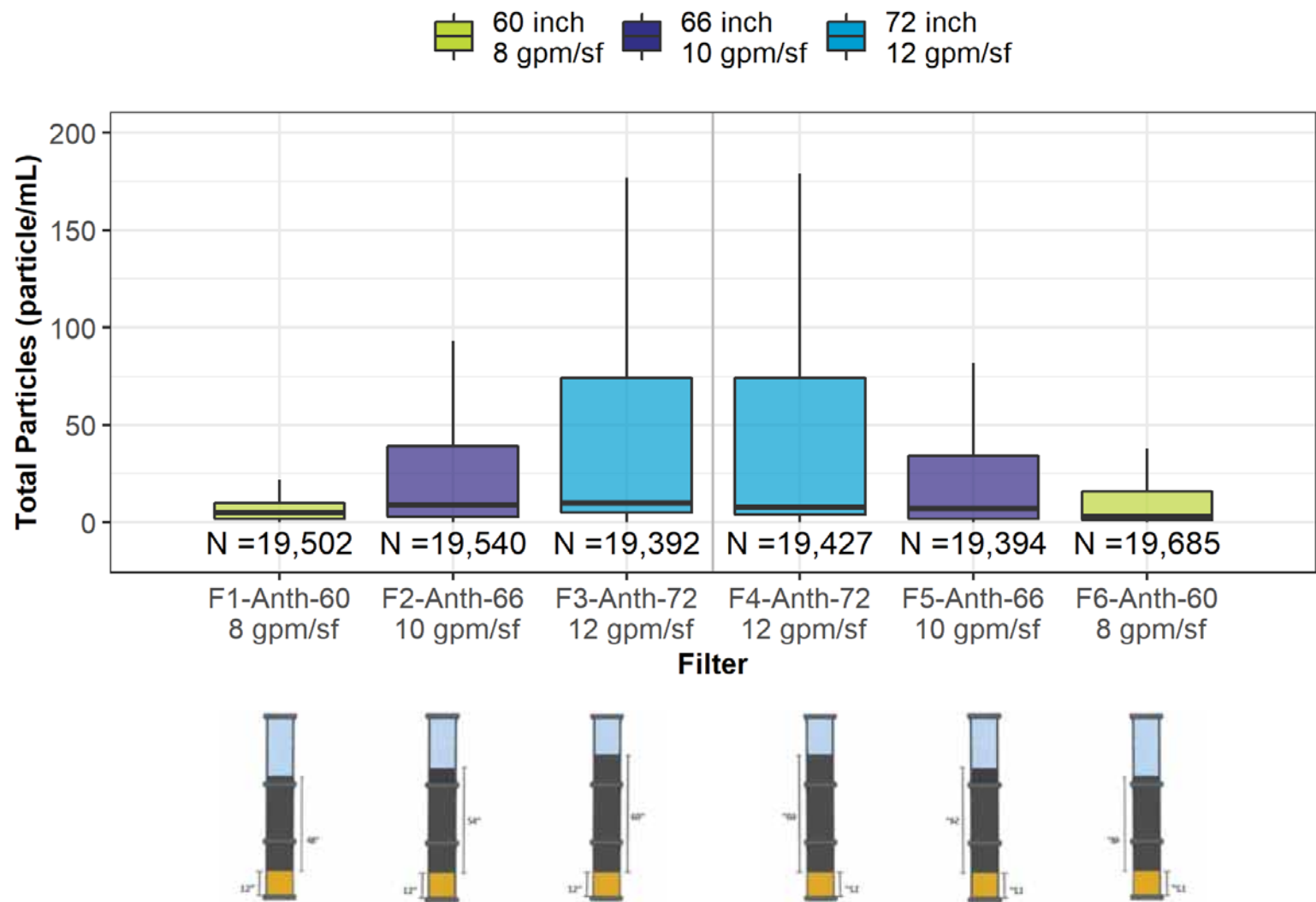
1.2 mm Anthracite
0.60 mm Sand
10 gpm/sf

ANTH-72
Filters 3/4

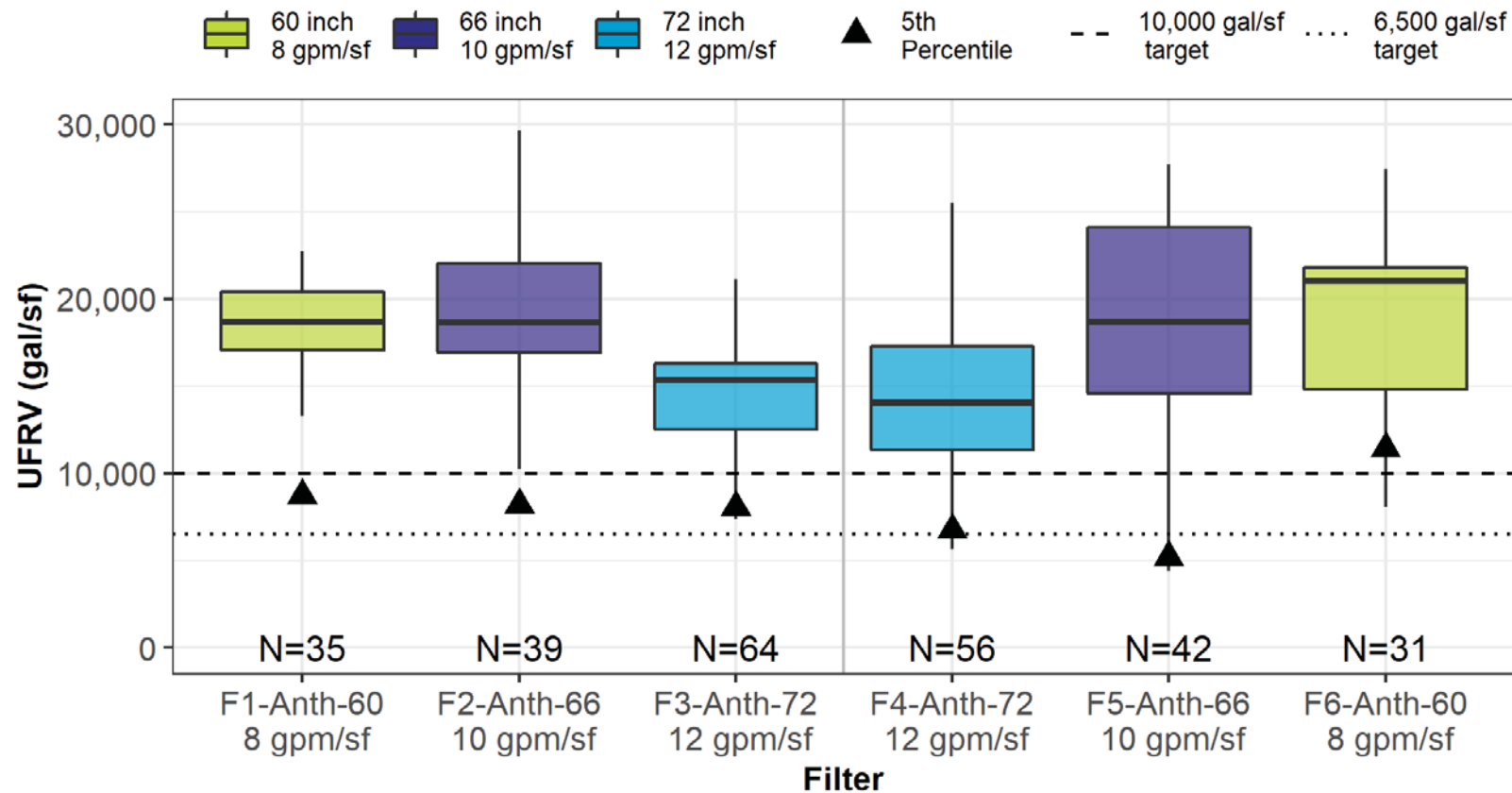


1.3 mm Anthracite
0.65 mm Sand
12 gpm/sf

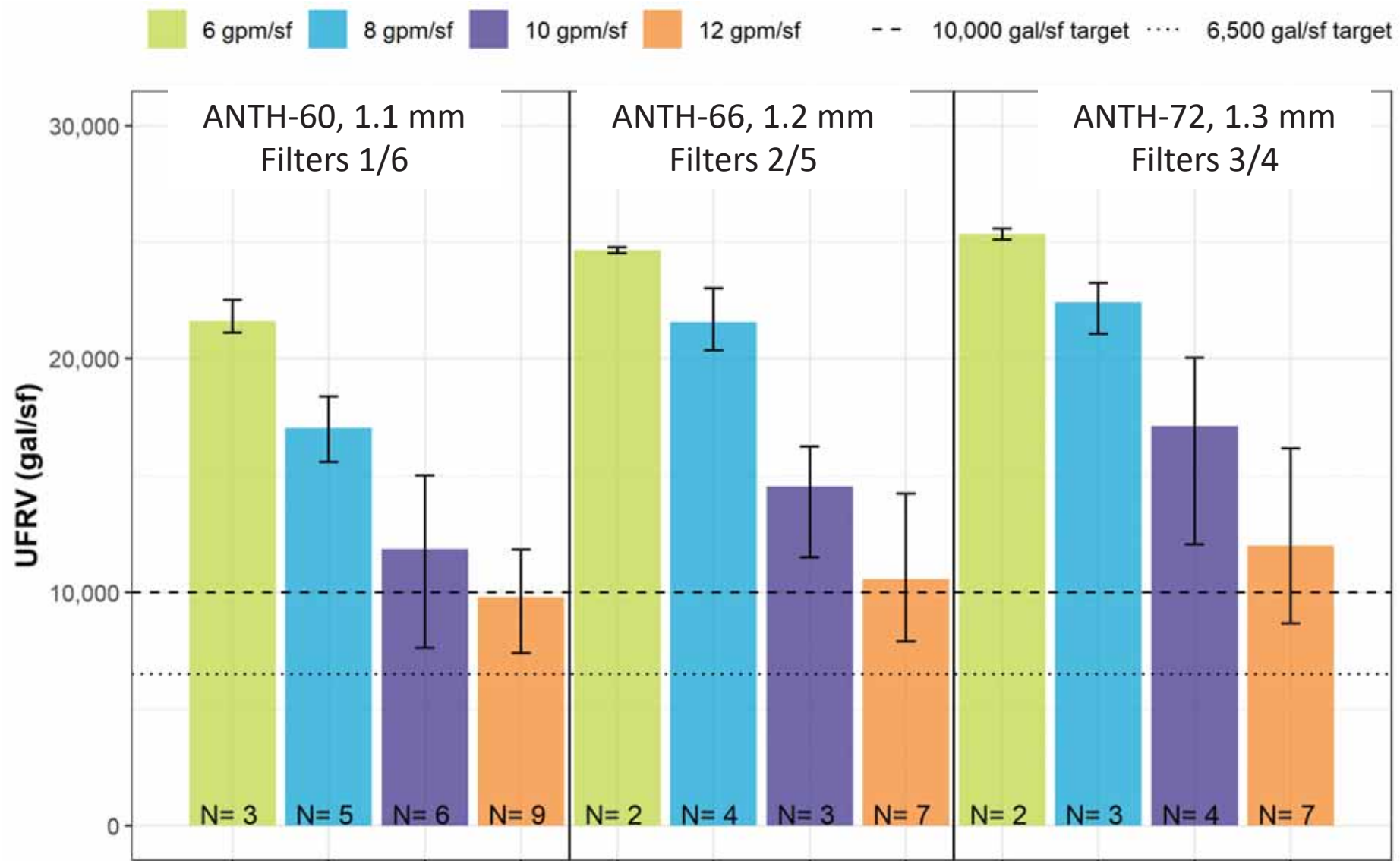
All filters met turbidity and particle count goals, but lower filtration rates had lowest particle counts



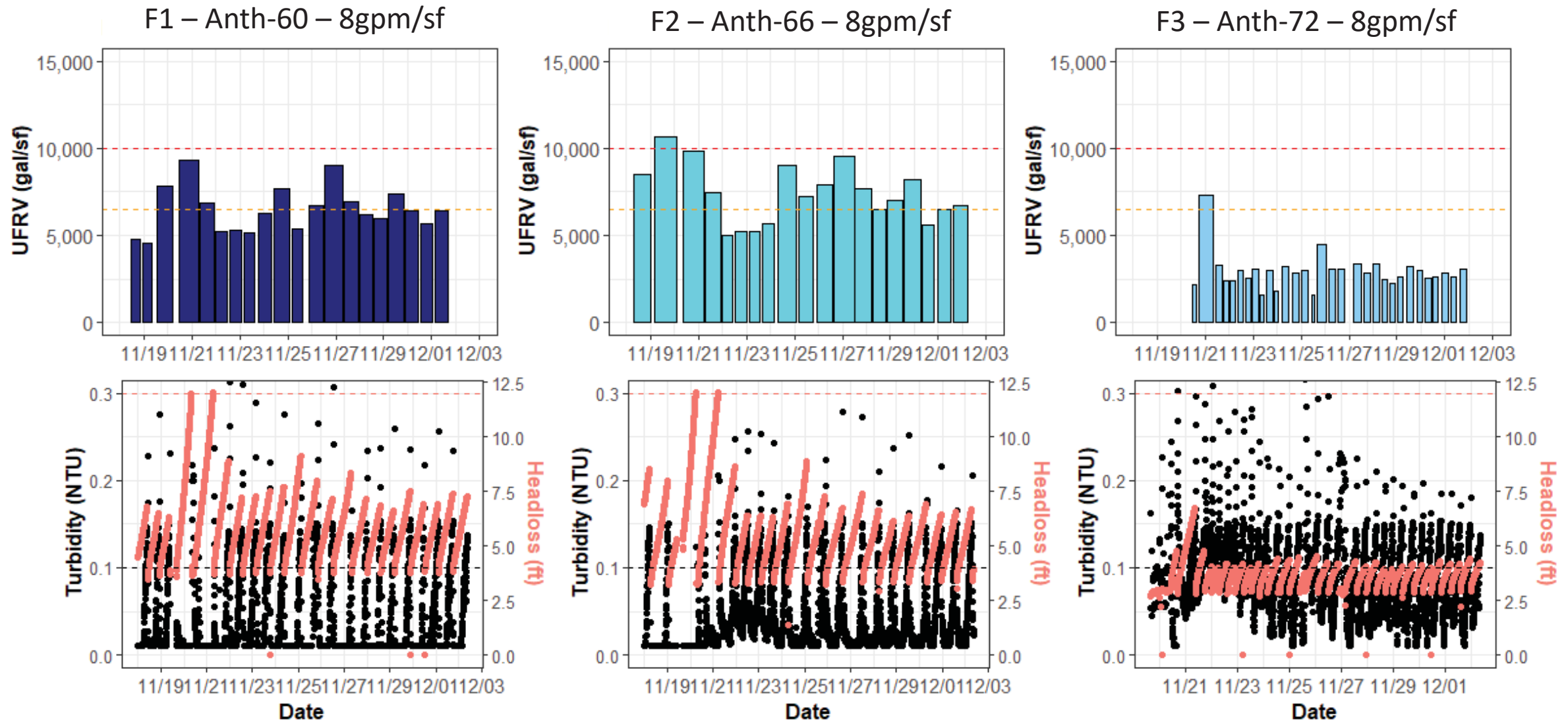
All filtration rates met productivity goals, but highest rates showed lowest productivity



For given loading rate, filters with deeper beds & larger diameter media have higher productivity.

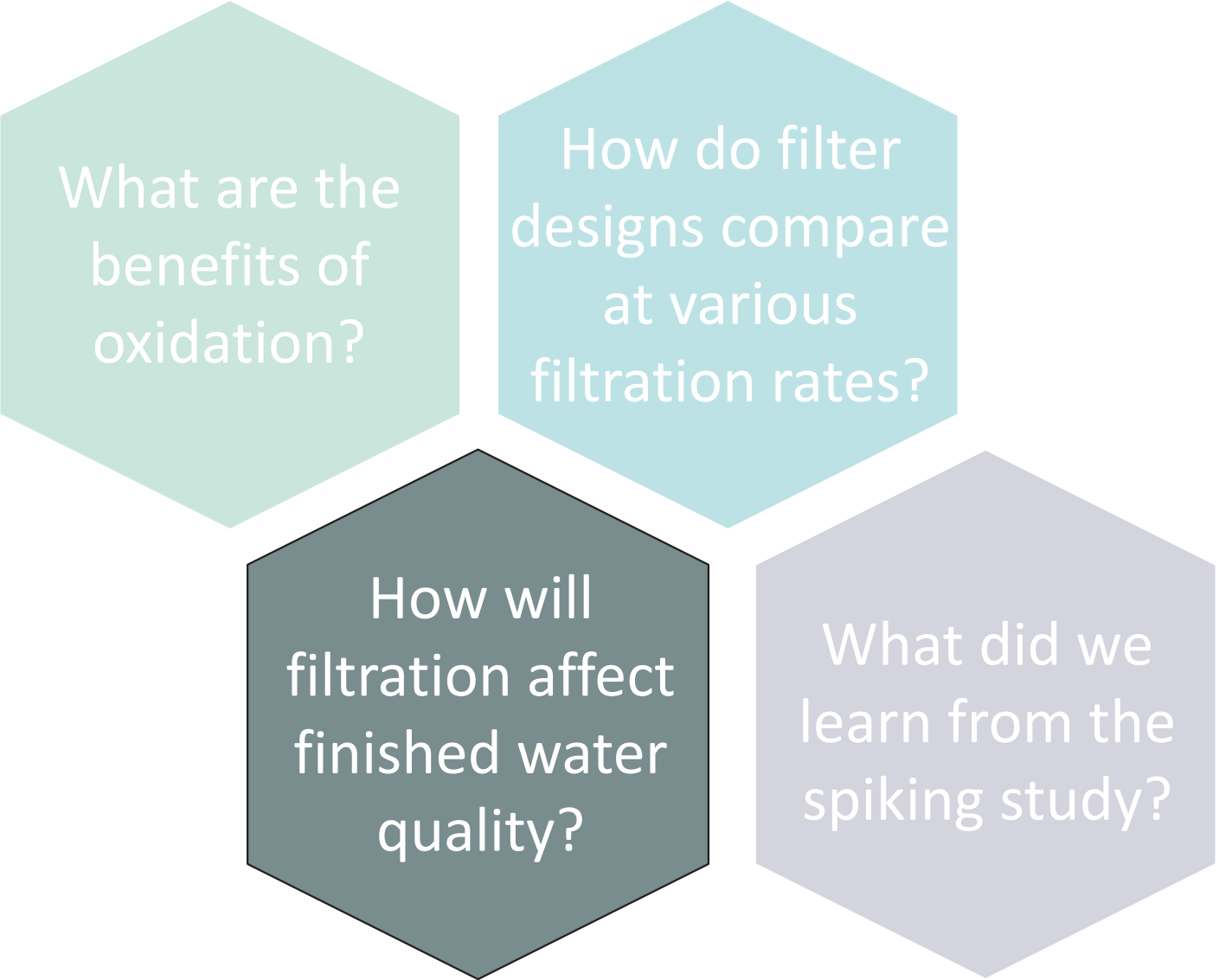


Filters with tighter media more resilient when pretreatment chemistry is inadequate



Take Away Messages: Filter Design

- Higher filtration loading rates had turbidity and particle breakthrough sooner.
 - Media configurations with short beds & tight media hydraulically limited at the highest loading rates.
- Comparing filter designs for a given filtration rate
 - filter configurations with deeper beds & larger media have higher productivity,
 - but configurations with shorter beds & tighter media were more resilient to process upsets.



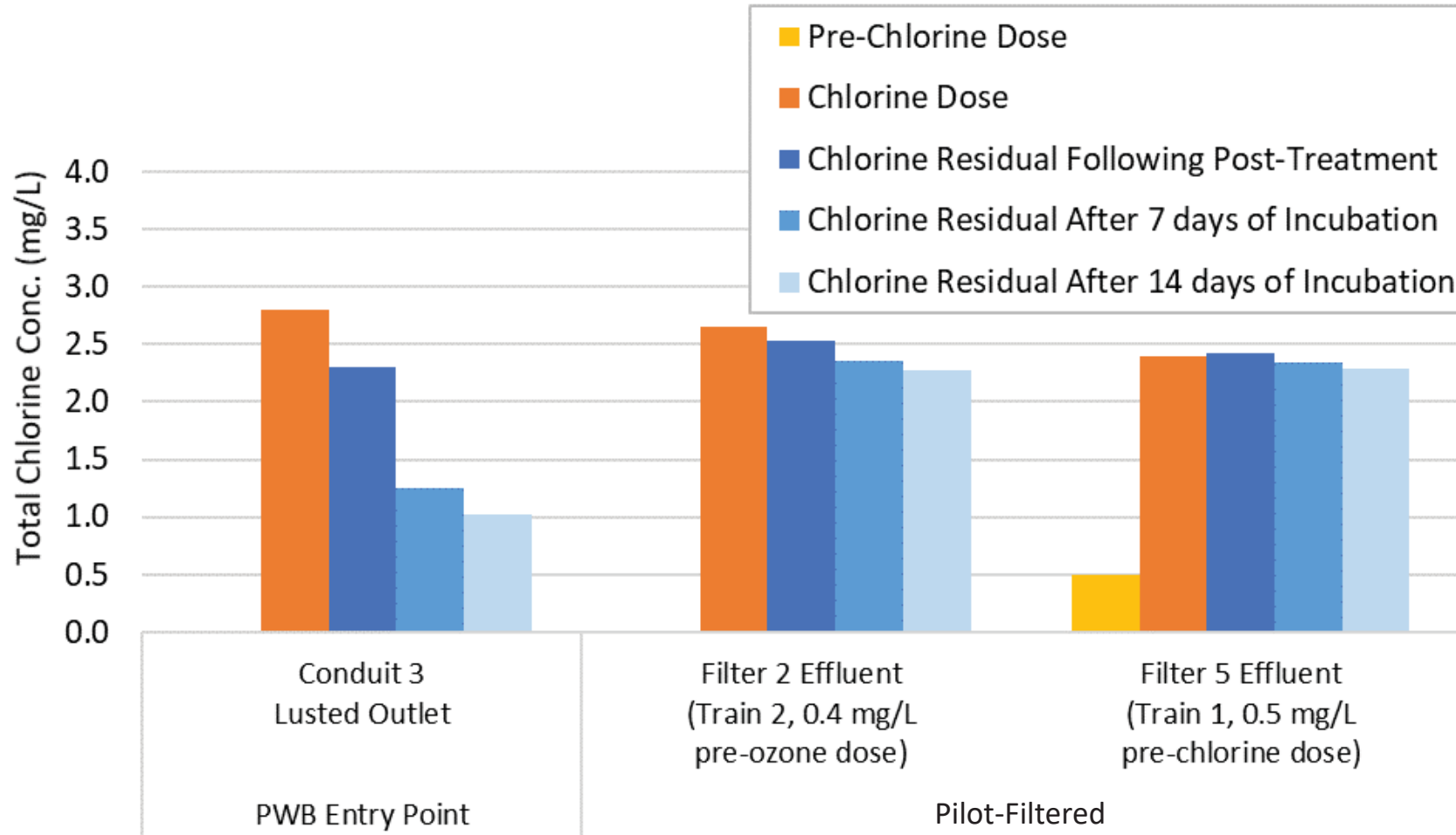
What are the
benefits of
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How do filter
designs compare
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filtration rates?

How will
filtration affect
finished water
quality?

What did we
learn from the
spiking study?

Filtered water reduces disinfectant demand and improves secondary chlorine stability

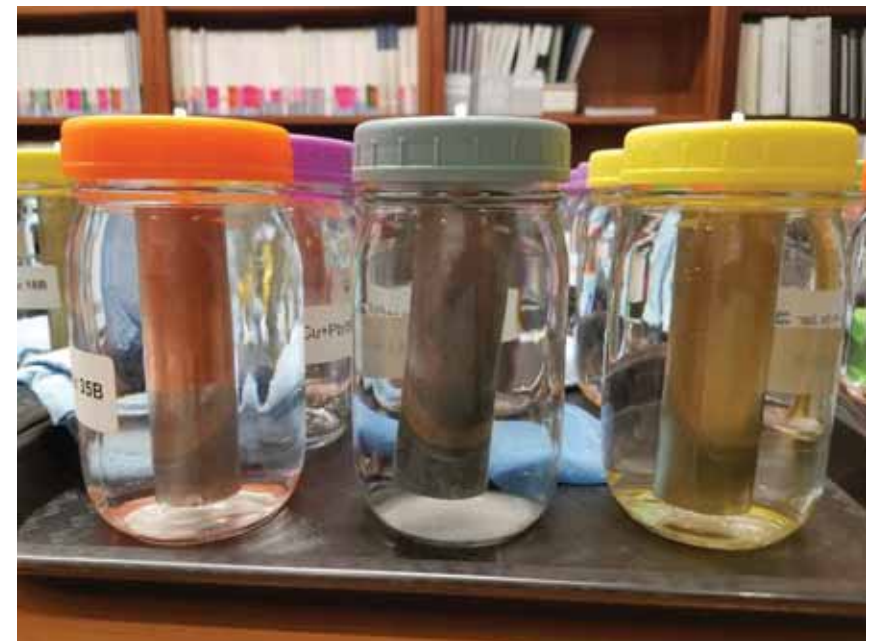


Taste & odor is expected to continue to be excellent after filtration

Sample	Flavor Profile Analysis 0 (best) – 12 (worst)			Flavor Rating Assessment 1 (best) – 9 (worst)
Raw Water	Odor	earthy	0.8	4.3
	Taste	earthy, muddy, dirt	0.8	
Current Finished Water at Entry Point	Odor	-	0.0	1.0
	Taste	chlorine, chalky	0.5	
Pilot Filtered Water (Pre-ozonated)	Odor	-	0.0	1.0
	Taste	chlorine	0.5	
Pilot Filtered Water (No pre-oxidant)	Odor	-	0.0	1.0
	Taste	bitter	0.5	

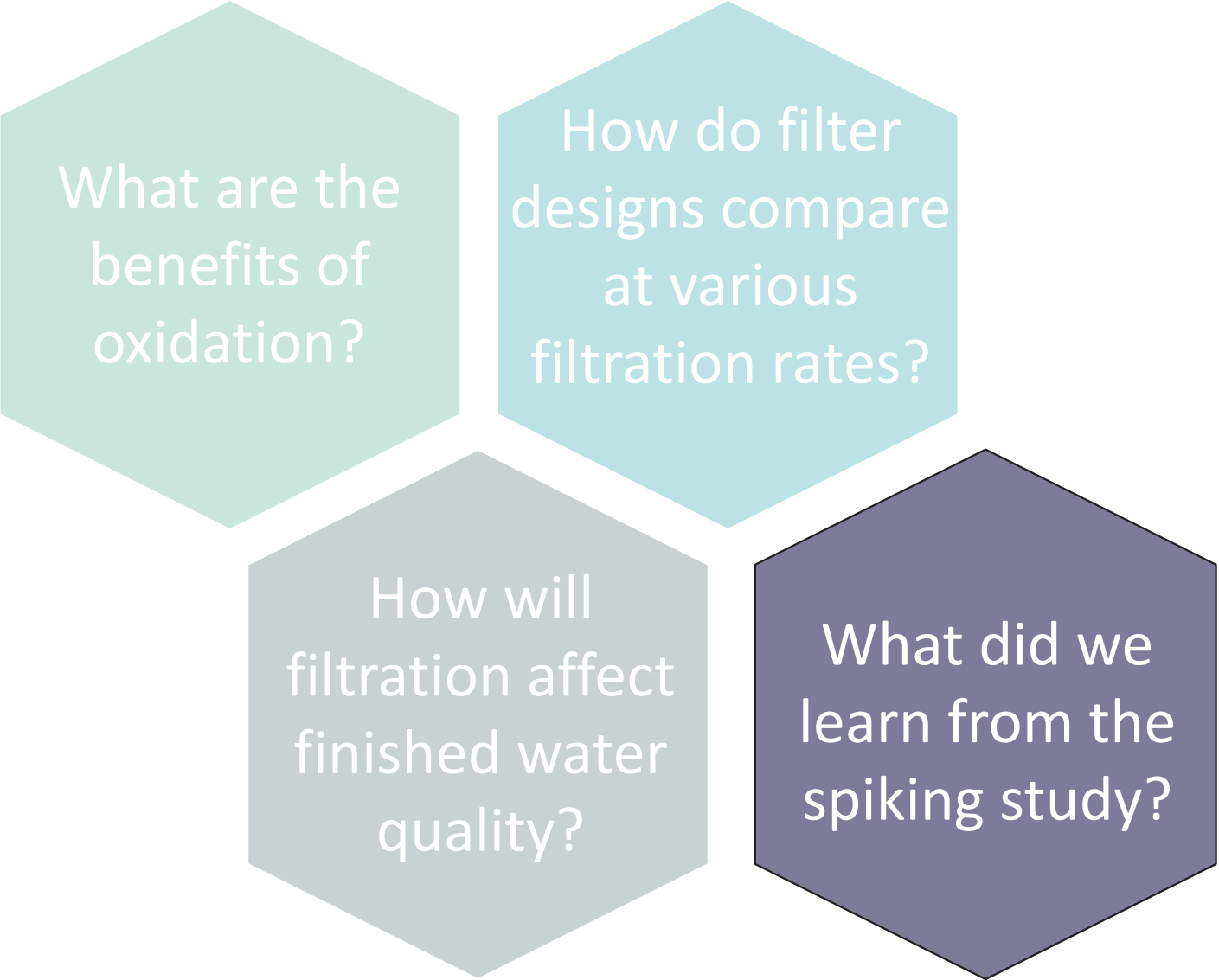
Currently studying effects of filtration on corrosion control

- Jars with copper/lead, lead, or brass coupons
- Filtered, disinfected water with different coagulants
- Explore effect of pH/alkalinity setpoints and orthophosphate on lead and copper solubility in filtered water
- Coupon jars and bench scale testing plan prepared by Confluence Engineering Group



Take Away Messages: Finished Water

- Filtration treatment reduces primary disinfectant demand, and increases expected secondary disinfection residuals.
- It is not expected that filtration treatment will significantly change the taste and odor of the finished water.
- Effects on corrosion are being studied.



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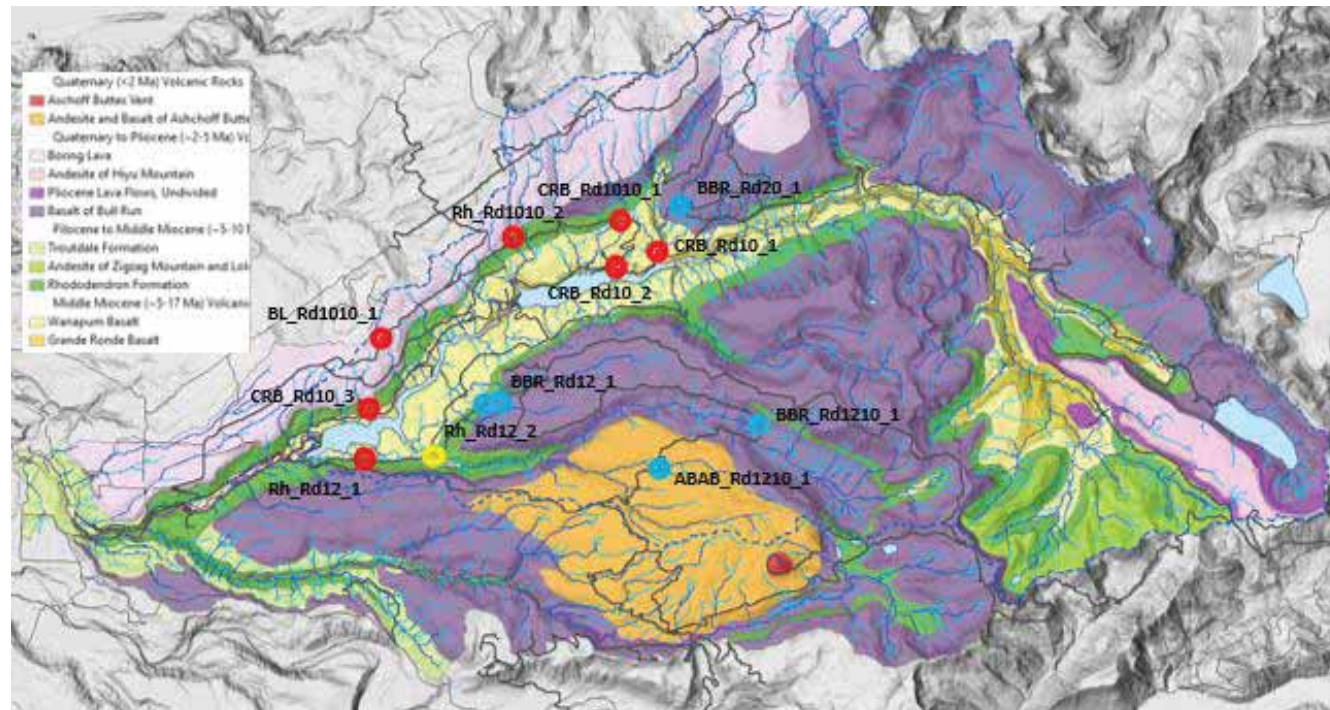
How will
filtration affect
finished water
quality?

What did we
learn from the
spiking study?

Spiking Study Targets

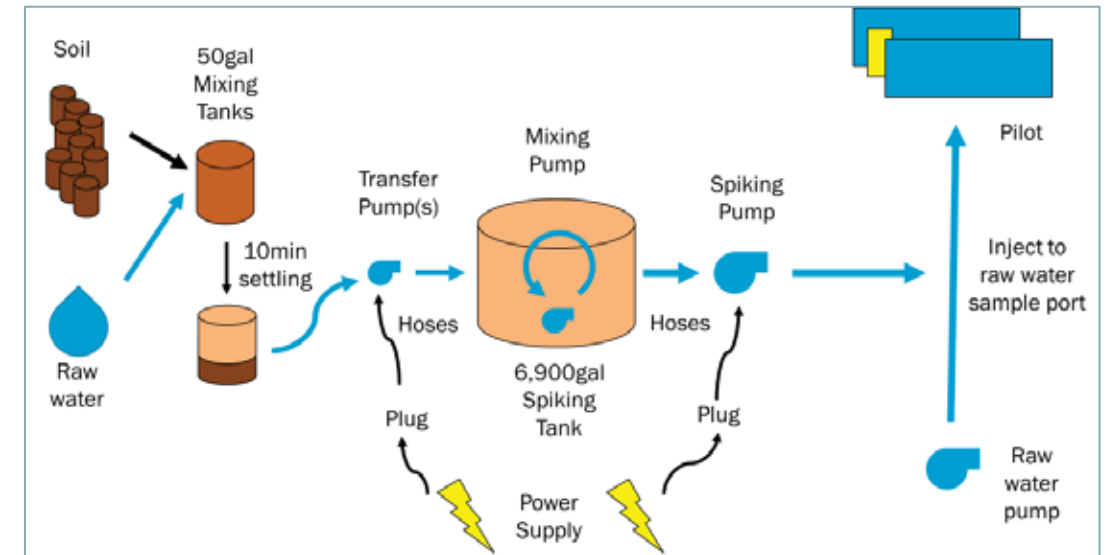
- Increase influent particle counts so can demonstrate log removal
- Target 20 ntu pilot influent for 30 hours
- Storm event, not catastrophic (earthquake, landslide, or forest fire)
- Increased turbidity (0.3 to 20 ntu) and particle counts (2,500 to 32,000)
- Increased apparent color, TOC, and unfiltered UV254
- No increases in true color, DOC, and filtered UV254

Collect soil
that
represents
the
watershed



Slurry Preparation

- Important to pre-settle the slurry.
- Settled for 10 min to remove floating and easily settled material before filling the spiking tank.



Spiking Study



Raw



Floc Basin 3



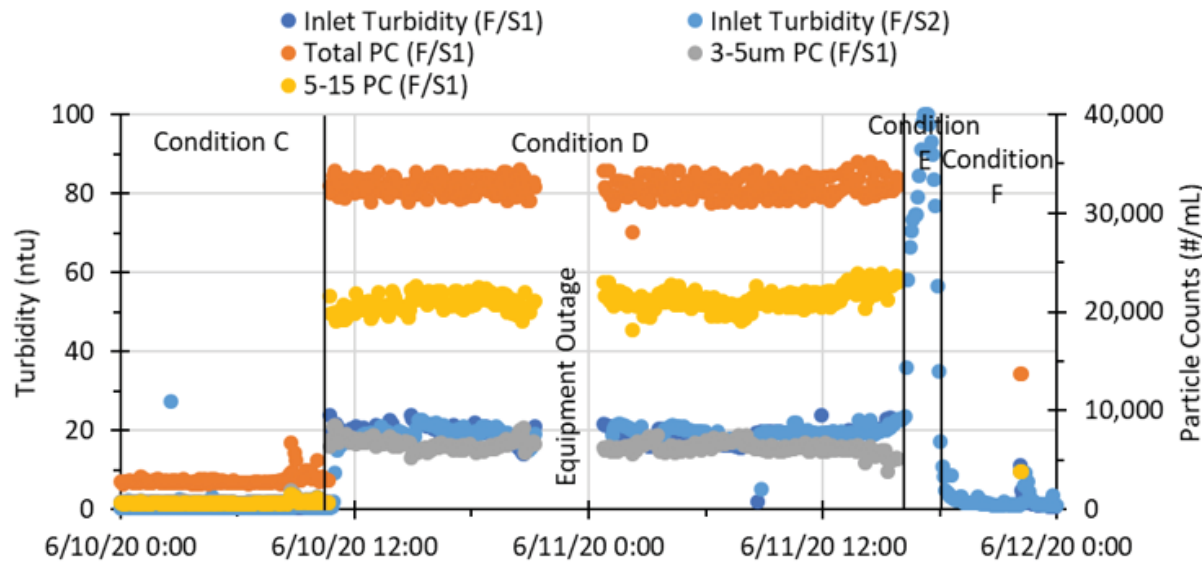
settled



Filtered

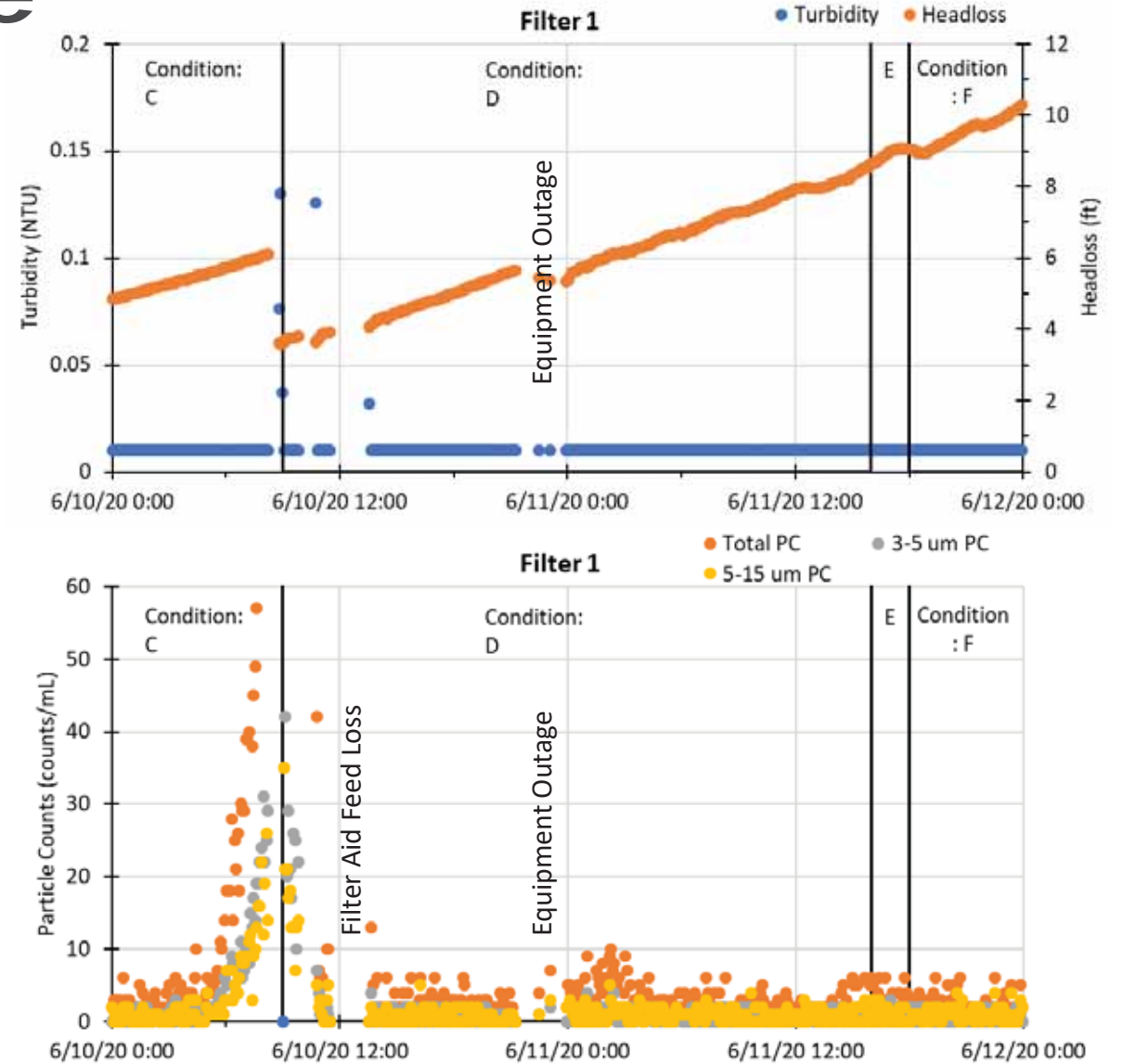
Treatment Performance

Pilot Influent

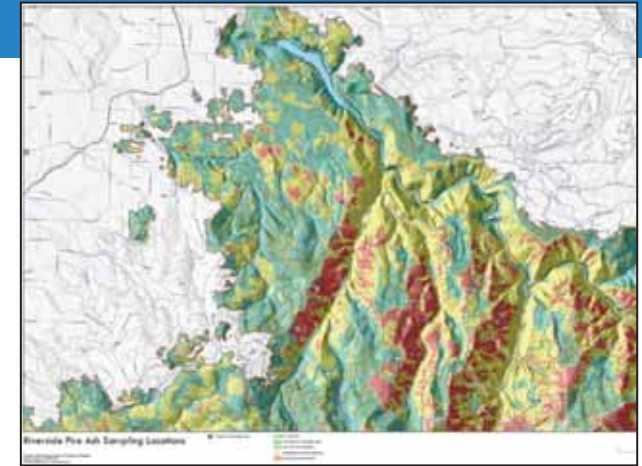


- Met settled water and filter effluent turbidity goals
- Demonstrated 3.5-log removal of particles

Filter 1 (Anth-60, 8gpm/sf) Effluent



Wildfire Ash Spiking



Take Away Messages: Spiking Study

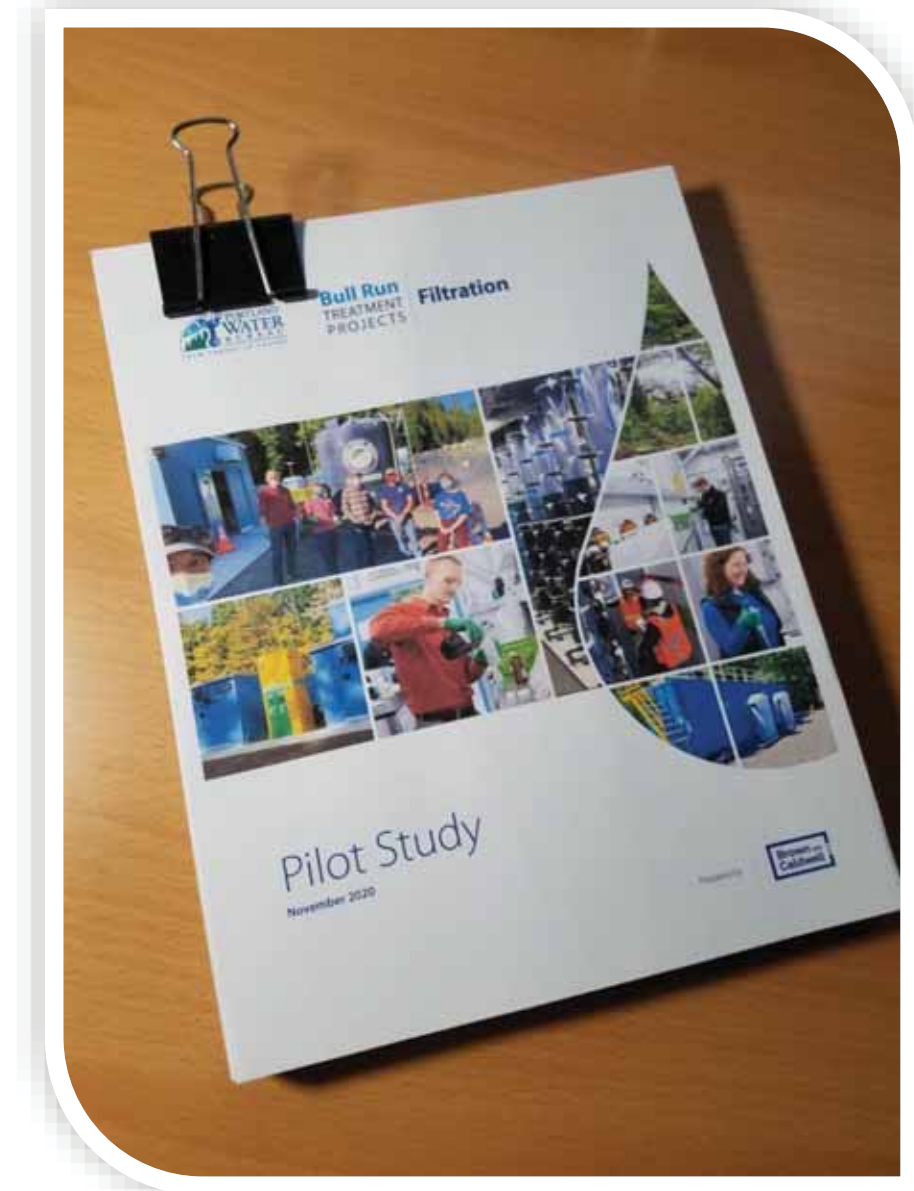
- Conventional filtration provides risk mitigation for future catastrophic events
- Can continually meet treatment goals through challenges like:
 - Turbidity increasing from 0.3 to 20 to 100 ntu.
 - Reduced ozone dose below demand on pre-ozone train.
- Lost ability to meet treatment goals through challenges like:
 - Coagulant dosing significantly out of charge neutralization.
 - Loss or underdosing of non-ionic filter aid.
 - Loss of supplemental alkalinity (bicarbonate) while dosing with alum for sweep floc.

Wrap Up



Regulatory Report Approved

- Submitted November 2020
- Met first compliance deadline for Bilateral Compliance Agreement
- Get your free copy at:
Bull Run Treatment blog post April 30
<https://www.portland.gov/water/bullrun-treatment/news/2021/4/30/science-helping-shape-future-bull-run-water>
- Approved May 2021



2022, and beyond!

- Inform detailed design
- Explore seasonality
- Explore process resiliency
- Train operations staff
- Define operational approaches and startup conditions
- Support operational refinements
- Collaborate with regional water treatment providers
- Participate in industry research



Take Away Messages

- Piloting is a tool to inform process selection, operational decisions, and detailed design.
- Able to meet water quality goals using variety of treatment approaches.
- Conventional filtration provides everyday benefits for drinking water quality, like
 - Avoiding discolored water and sediment loading to distribution system,
 - Improved handling of turbidity disruptions,
 - Improving public health by reducing pathogens, increasing chlorine stability, and reducing disinfection byproducts.

Questions?

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Some of the Q&A...

- Was chlorine demand study done on the filter effluent with pre- oxidation and no oxidation?
- Think we touched on this live, but we expect filtration with either oxidant to significantly reduce primary disinfectant demand.
- Did you monitor and notice any impact of pre-oxidation on nitrogenous DBPs?
- We have measured NDMA and other N-DBPs. Thankfully there are no precursors in the source water, so we can evaluate oxidants on other criteria.
- Is crypto a concern before the plant goes online?
- Yone and the WQ team are doing a great job monitoring crypto and communicating with the public in the meantime, but send us an email if you'd like to know more.
- What target CL2 levels are you trying to maintain in the distribution system?
- We currently target 1.0 mg/L through the DS, and expect that it will be much easier to achieve after filtration.