

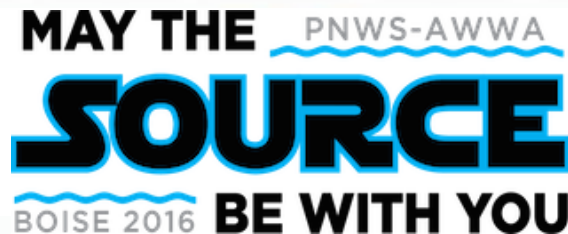
Using Zeta Potential To Optimize Coagulation For Direct Filtration & Conventional Treatment:

The Green River Filtration Facility Experience

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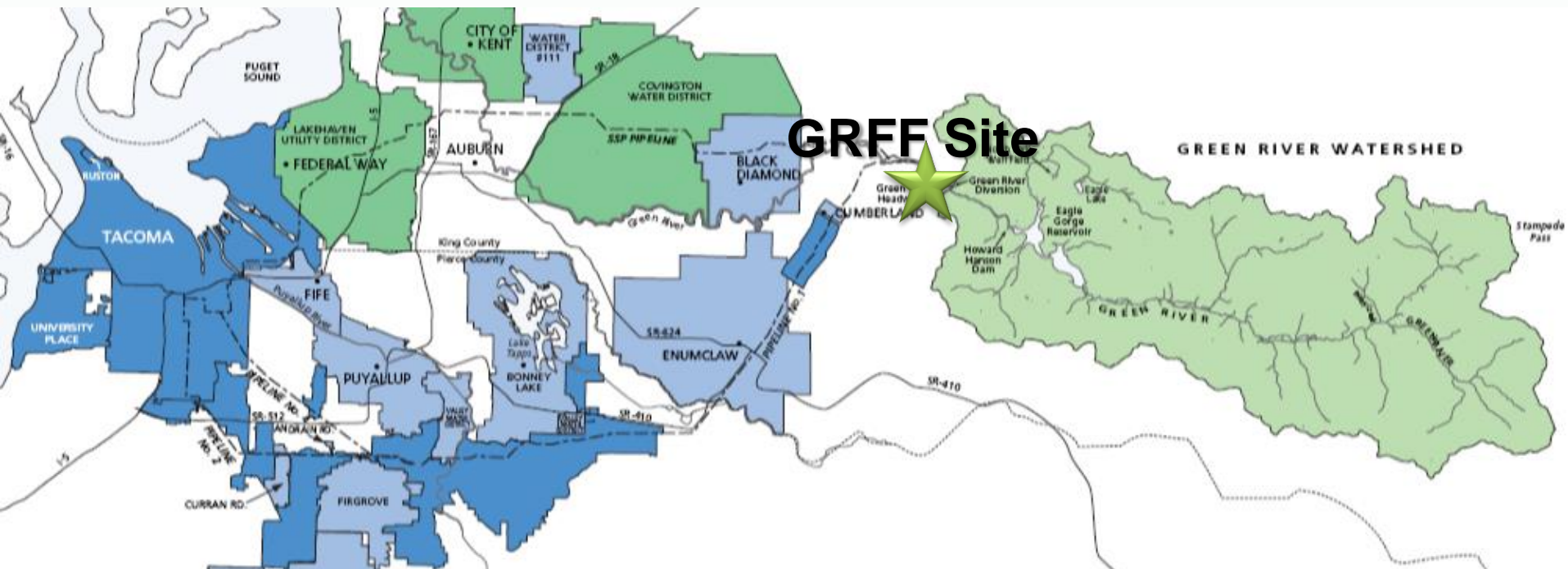


AGENDA

- GRFF Background
- Water Quality Changes and Treatment Variability
- Options for Coagulation Control
- Why Zeta Potential?
- GRFF Results
- Acknowledgements and Questions

GRFF BACKGROUND

- Tacoma Water has been diverting from the Green River since 1913
- Filtration was selected for Tacoma Water to comply with LT2ESWTR in 2010
- Project cost was \$185M; construction (\$144M) from 2012-2015
- GRFF hybrid design capacity is:
 - 90 mgd conventional (winter)
 - 150 mgd direct (summer)
 - 168 mgd ultimate



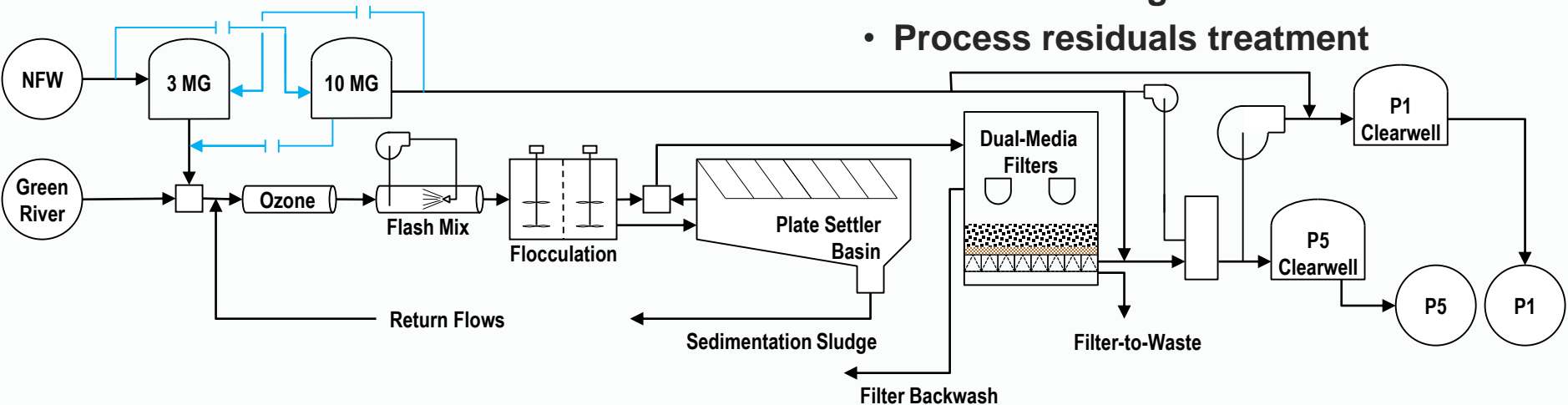
GRFF ONLINE DECEMBER 2014

ORIGINAL GREEN RIVER SYSTEM

- Blending with NFW
- Pre-ozonation
- CT in transmission pipelines
- Gravity flow through plant (mostly)

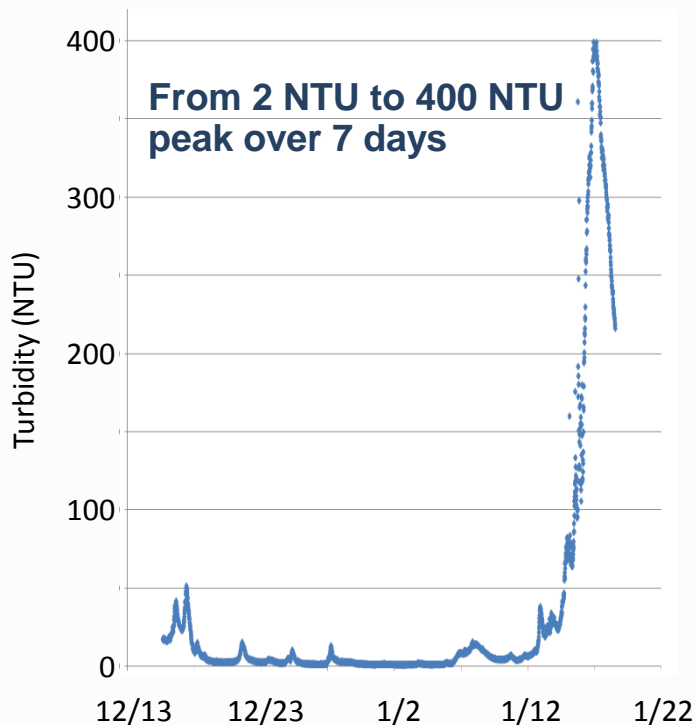
NEW FACILITIES ADDED

- Coagulation (alum & ACH)
- Flocculation
- Plate settlers
- High-rate dual-media filtration
- Clearwell storage
- Process residuals treatment



GRFF TREATMENT CHALLENGES

- Summer water quality very consistent with low turbidity
- Winter water quality highly variable with rapid changes due to storm events or upstream flood control reservoir operation



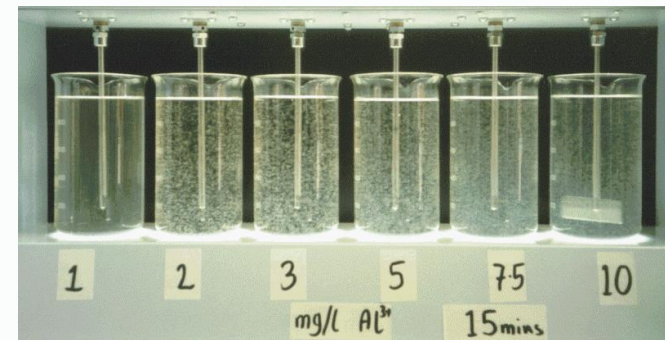
- Temperature fluctuates seasonally from near 0 to 20°C
- Relatively low alkalinity (15-25 mg/L)
- Coagulation with ACH effective during low-turbidity periods; alum used during high-turbidity periods
- pH and alkalinity adjustment (NaOH & CO₂) used for optimum alum coagulation

SEASONAL WQ CHANGES IMPACT COAGULATION CONDITIONS

- GRFF changes coagulants seasonally
- Operation:
 - **Direct filtration May-September**
 - ACH @ 1-2.5 mg/L; average ~85 mgd
 - **Conventional October-April**
 - Alum @ 4-25 mg/L; average ~55 mgd
 - Coagulation pH target of ~7.4
 - **PEC (cationic polymer) fed year round (0.2-0.3 mg/L)**
- Coagulation control is especially important for DF mode, and during semi-annual transition periods
- Approximate annual coagulation chemical cost = \$520k

OPTIONS FOR COAGULATION CONTROL

- **Jar Testing** – tried and true; takes time, not ideal for rapidly changing water quality conditions or direct filtration operation.



- **Pilot Filters** – installed in a lot of older WTPs; provides ‘early warning’ system for coagulant dosing



- **Streaming Current Detector/ Streaming Current Monitor** – commonly used in many WTPs and can be accurate with consistent WQ; does not measure charge on all particles, not as sensitive to low particle water



- **Zeta Potential** – Electrophoretic and measures charge on all particles, can zero at any time; higher capital investment than SCM

WHY ZETA POTENTIAL AT GRFF?

- Pilot testing conducted by TW for 2+ years showed potential benefits of ZP
- Other WTPs that TW contacted had positive results:
 - Everett, WA
 - Seymour-Capilano, Vancouver, BC
 - Lynden, WA
 - Aurora, CO
- Protecting TW's \$185M investment in GRFF, especially with no previous filtration experience
- \$70k initial investment didn't seem like too much for new facility
- Tacoma Water decided to also install an SCM as well as a ZP

BUSINESS CASE STUDY FOR ZETA POTENTIAL – AURORA, CO

- Enables unattended operation, automation of dosing control and man power optimization – future proofing
- Improving plant stability, preventing breakthroughs and extending filter operating times
- Potential for significant savings in chemicals and less sludge
- Wemlinger WPF (80 mgd) demonstrated approximately 20% cost savings by switching to ZP.

Wemlinger WPF

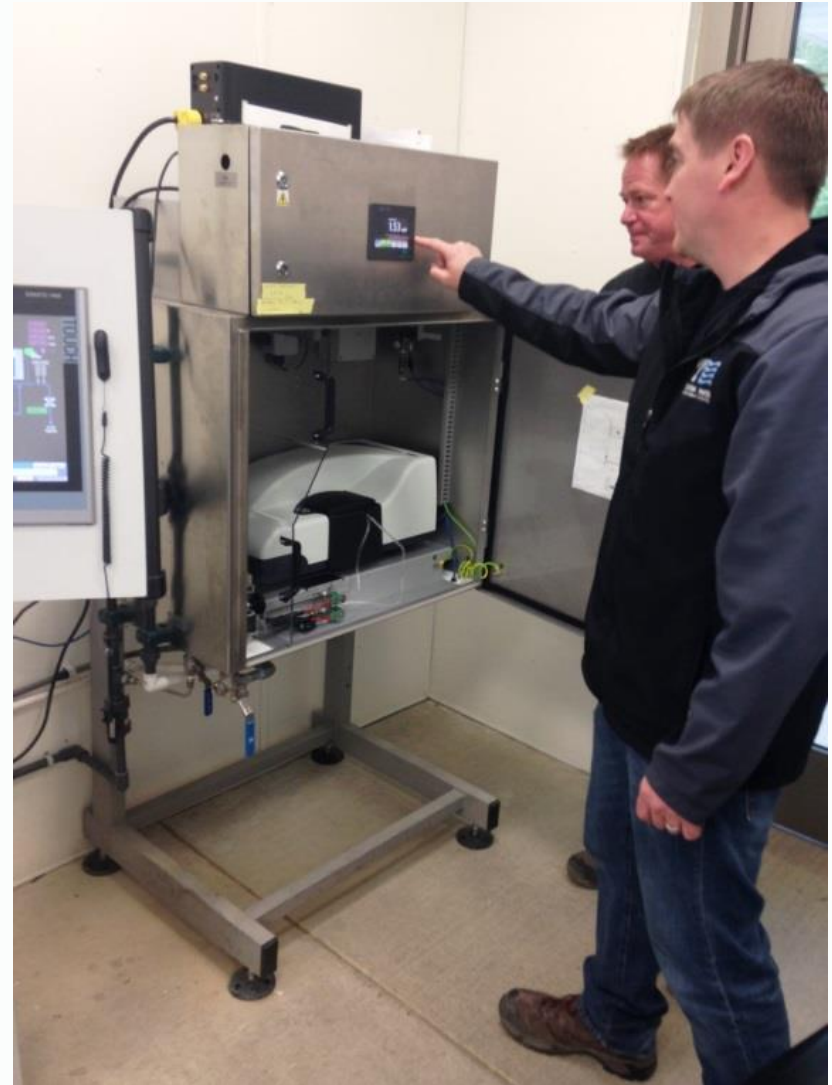
	2010	2011	2012	2013
Alum Costs	\$ 69,576.64	\$55,870.98	\$56,879.70	\$34,466.31
PEC Cost	\$ 214,912.09	\$72,709.90	\$68,071.11	\$56,685.22
Coag. Summary	\$ 284,488.73	\$128,580.88	\$124,950.81	\$91,151.53
Cost per Million	\$32.55	\$22.81	\$18.43	\$20.70*
MG Delivered	8739.44	5636.47	6780.99	4402.88

*2013 numbers impacted by flooding

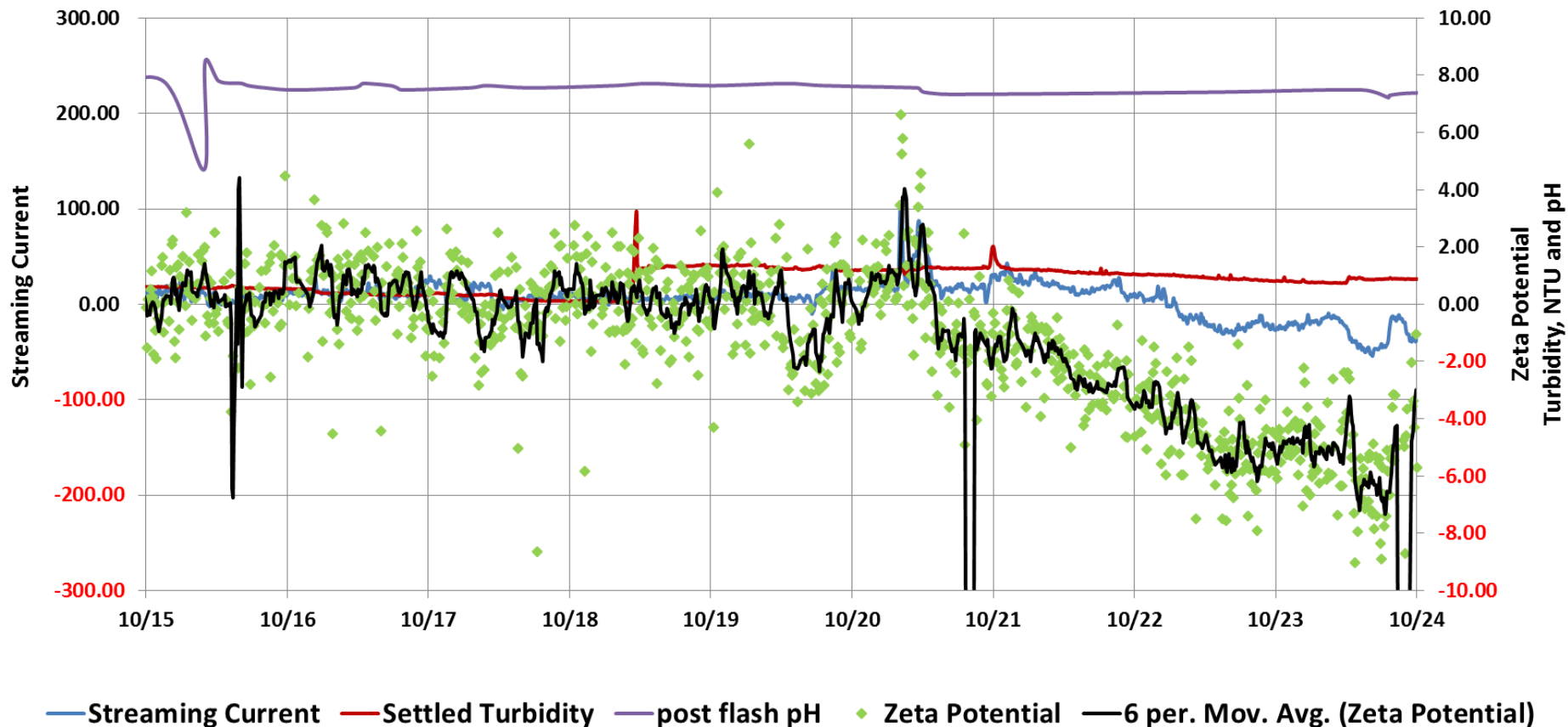
Estimated payback period of 1-2 years

PROCUREMENT OF ZETA POTENTIAL METER

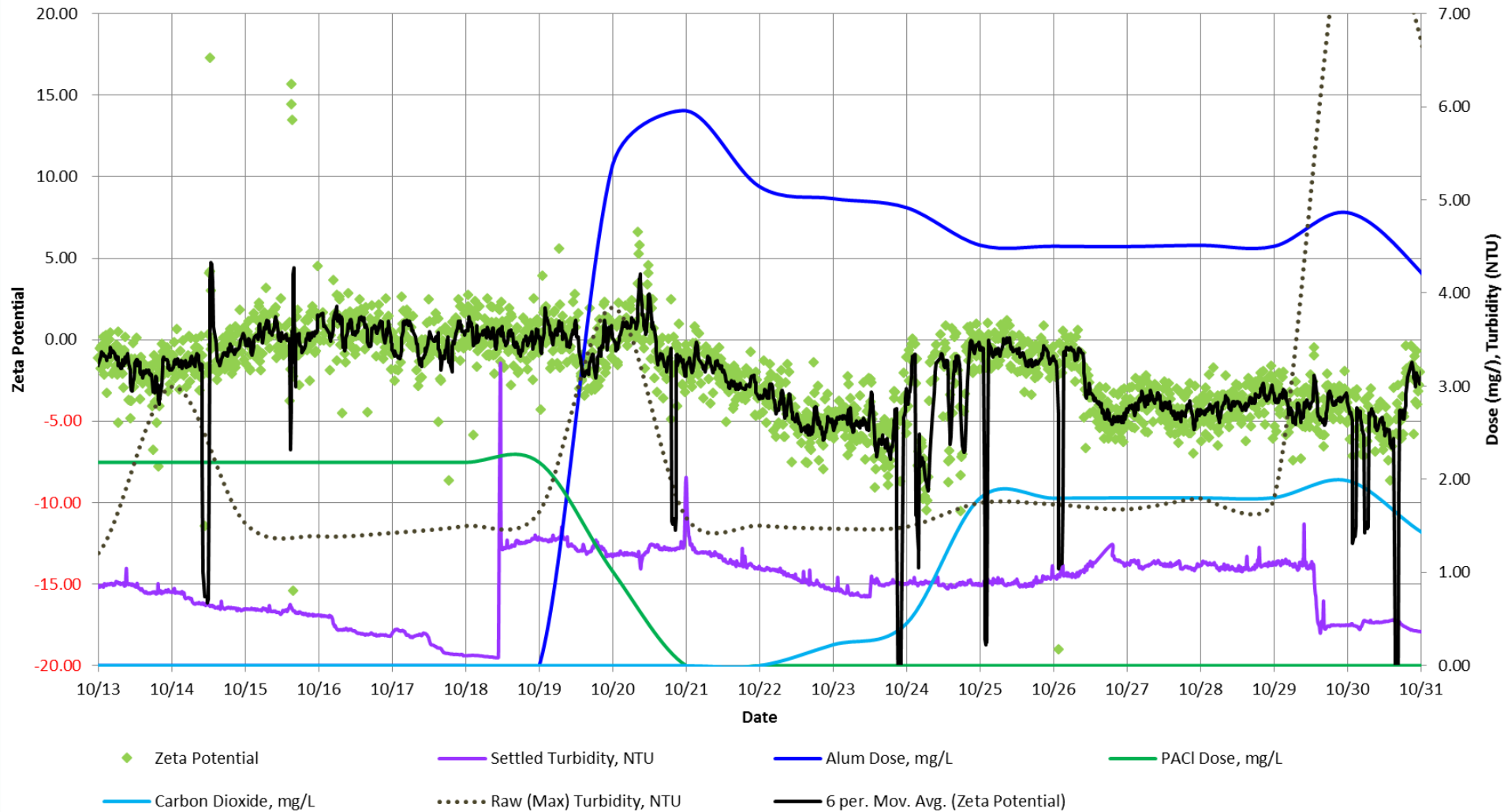
- Online vs. batch
- GC/CM impacts
- Alternative vendors, emerging technology for drinking water



GRFF RESULTS – ZP VS. SCM



GRFF RESULTS – ACH TO ALUM SWITCH



LESSONS LEARNED AND CLOSING THOUGHTS

- Zeta potential a very critical parameter we monitor – updated every 3 minutes?
- It tells you that a floc is formed – know you are really right
- Minimal routine maintenance-cell replacement monthly, standards used for validation
- Experimenting with supernatant on solids dewatering to determine good floc formation
- Next step is to optimize treatment in summer low dose season – reduce chemical costs
- Value added to being online via SCADA and automated-eliminates human error

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- Alon Vaisman – Malvern (Zetasizer WT)
- GRFF and Tacoma Water Staff
- Mark Graham & Andrew Nishihara (MWH)

QUESTIONS?

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