



Startup & Initial Operation of the New Peirce Island WWTF

NEWEA Annual Conference – January 25, 2022

Erik Meserve – AECOM Project Manager
Terry Desmarais – City of Portsmouth City Engineer
Peter Conroy – City of Portsmouth Chief Plant Operator
Jon Pearson – AECOM Project Director
Jeff Reade – AECOM Technical Lead
Glen Wilson – City of Portsmouth Wastewater Operations Manager

Agenda

- Background
- BAF Process
- Startup Timeline
- Startup Challenges
- Lessons Learned
- Performance Testing
- Operational Performance
- Conclusions



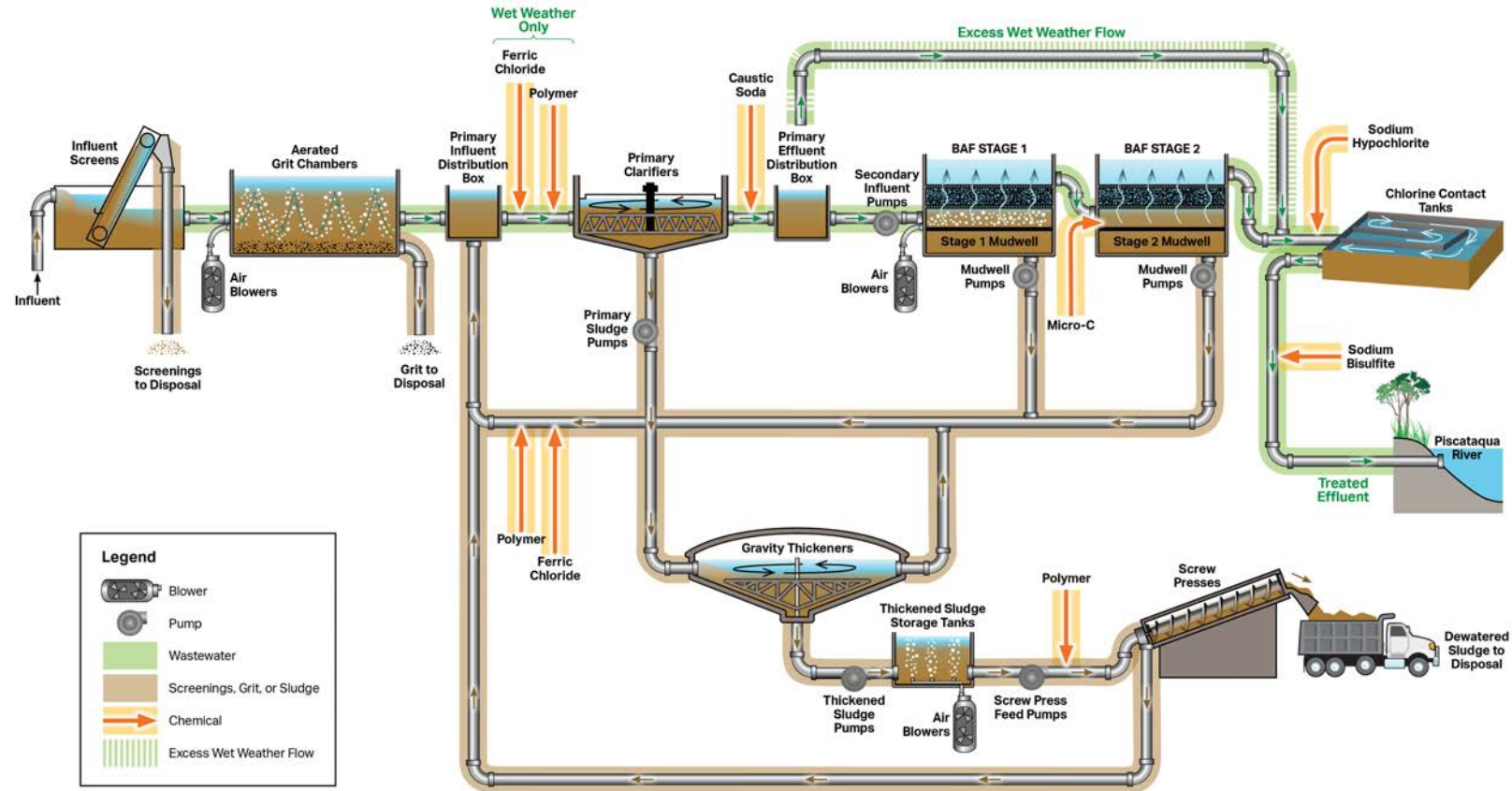
Background: Pre-Upgrade WWTF

- Design Average Flow 4.8 MGD
- Peak Flow 22 MGD
- Aerated Grit Removal
- Chemically Enhanced Primary Treatment
- Sodium Hypochlorite / Bisulfite Disinfection
- Gravity Thickener & Belt Filter Press
- 3.7 Acres



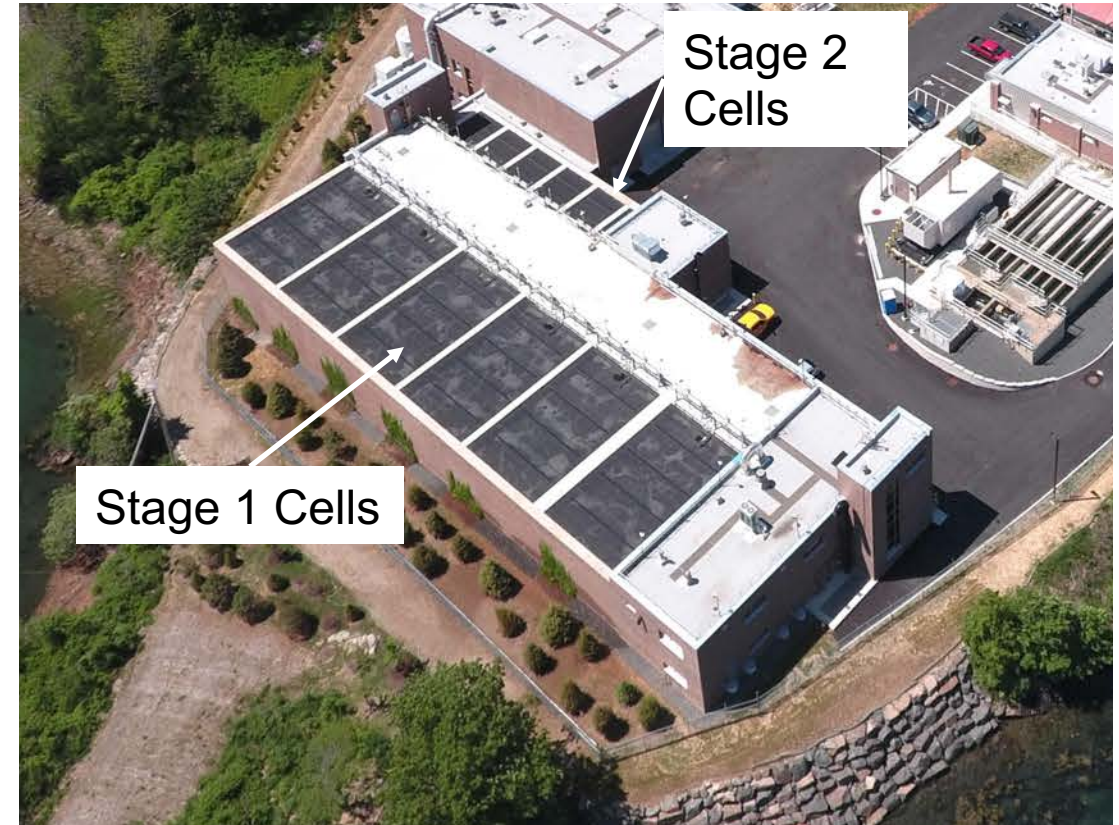
Background: Upgrade Design

- Design Average Flow 6.1 MGD
- Peak Flow 22 MGD
- Screening
- Upgraded Aerated Grit Removal
- Upgraded Primary Treatment
- Two-Stage Biological Aerated Filter (BAF)
- Sodium Hypochlorite / Bisulfite Disinfection
- Wet Weather Flow Management
- Additional Gravity Thickener
- Sludge Storage
- Screw Presses



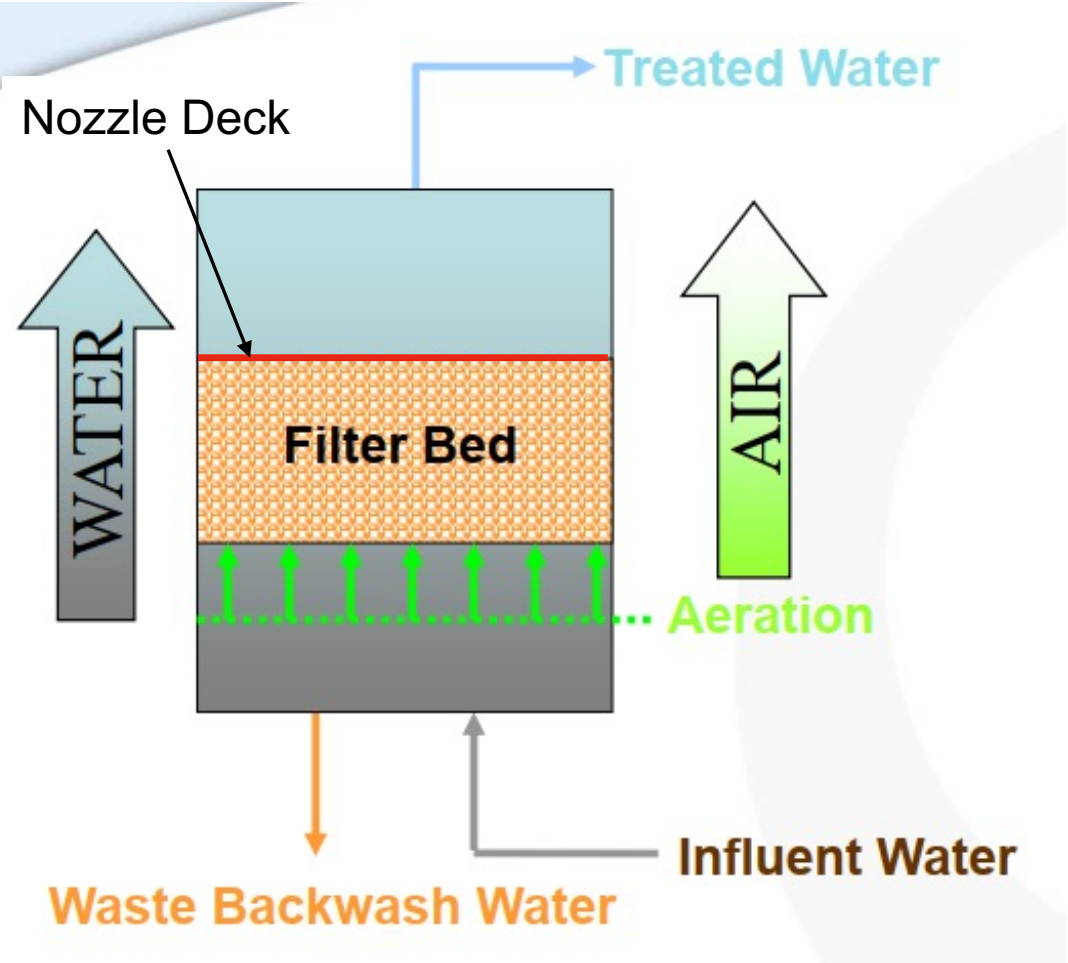
BAF Process

- Veolia BIORSTYR BAF Selected After Extensive Pilot Testing
- **B**iological **A**erated **F**ilter
- Biological Treatment & Solids Separation in Same Reactor Results in Small Footprint
- High Level of Automation
- First Stage for Carbon Removal and Nitrification
- Second Stage for Denitrification

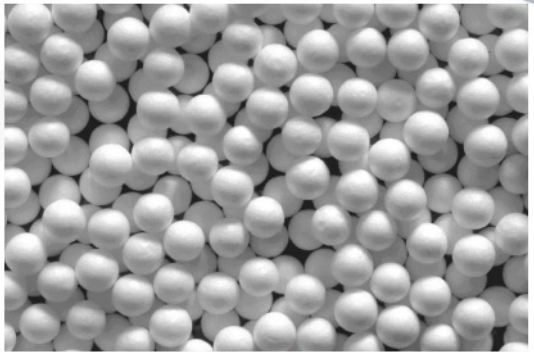


BAF Process

- Floating Media
- Upflow Filtration
- Counter-Current (Downflow) Backwash
- No Air & Carbon Addition for Denitrification

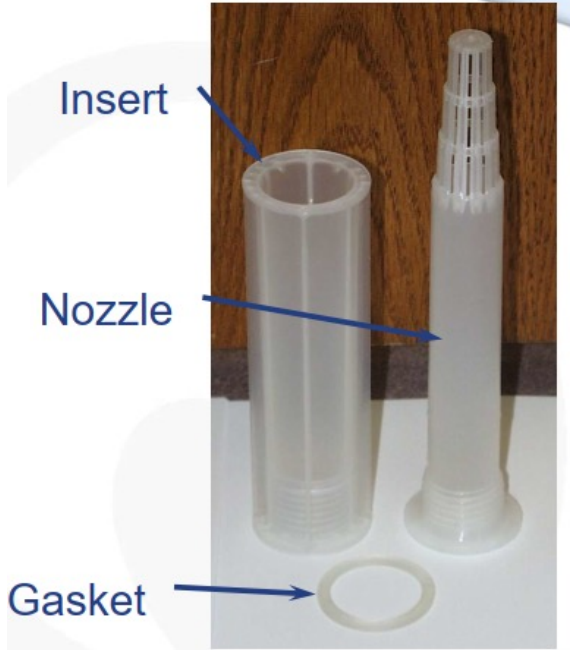


BAF Schematic - Courtesy of Veolia



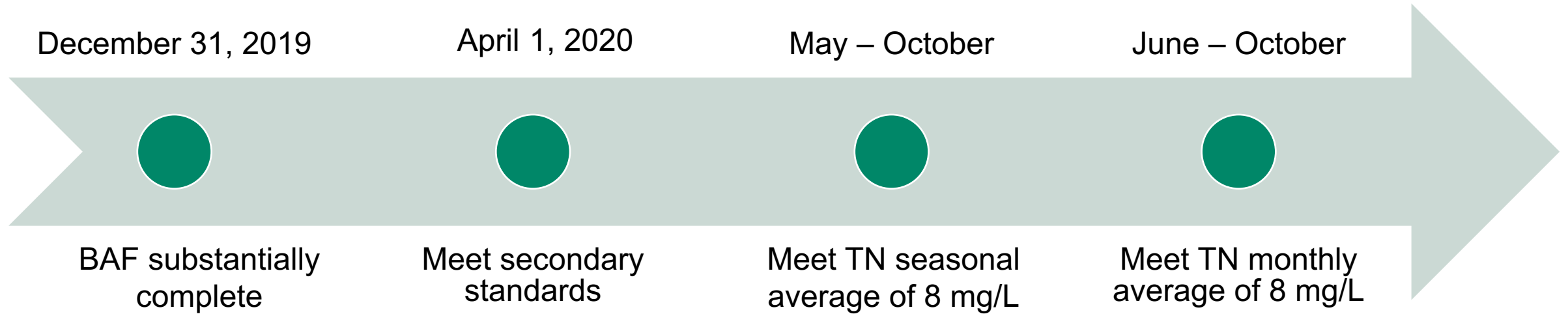
4.0 or 4.5 mm

BAF Media - Courtesy of Veolia



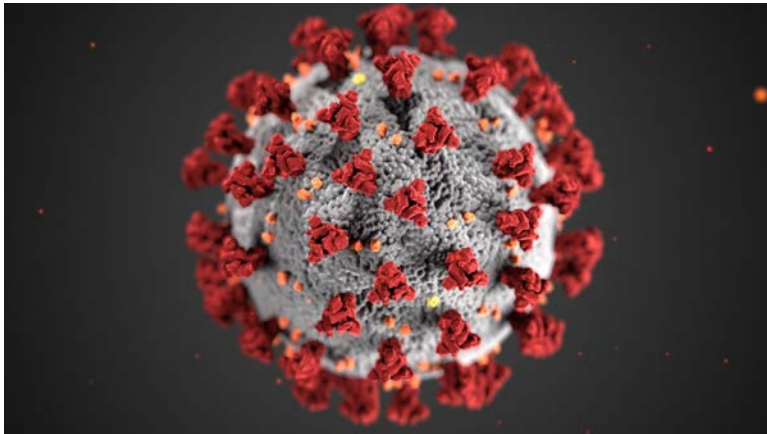
BAF Nozzles - Courtesy of Veolia

Startup Timeline Mandated by Consent Decree

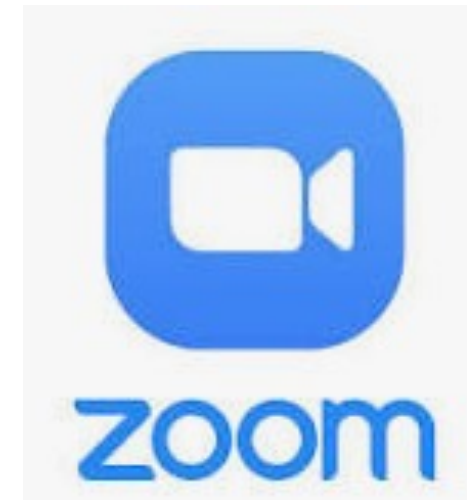


Startup Challenges

- COVID-19!
 - Challenge: Key vendors unable to travel to site during startup of BAF process
 - Result: Delayed startup, troubleshooting & training
 - Solution: Weekly process startup conference calls
 - Solution: Training by Zoom
 - Solution: Troubleshooting with remote vendor providing direction to City staff



US FDA

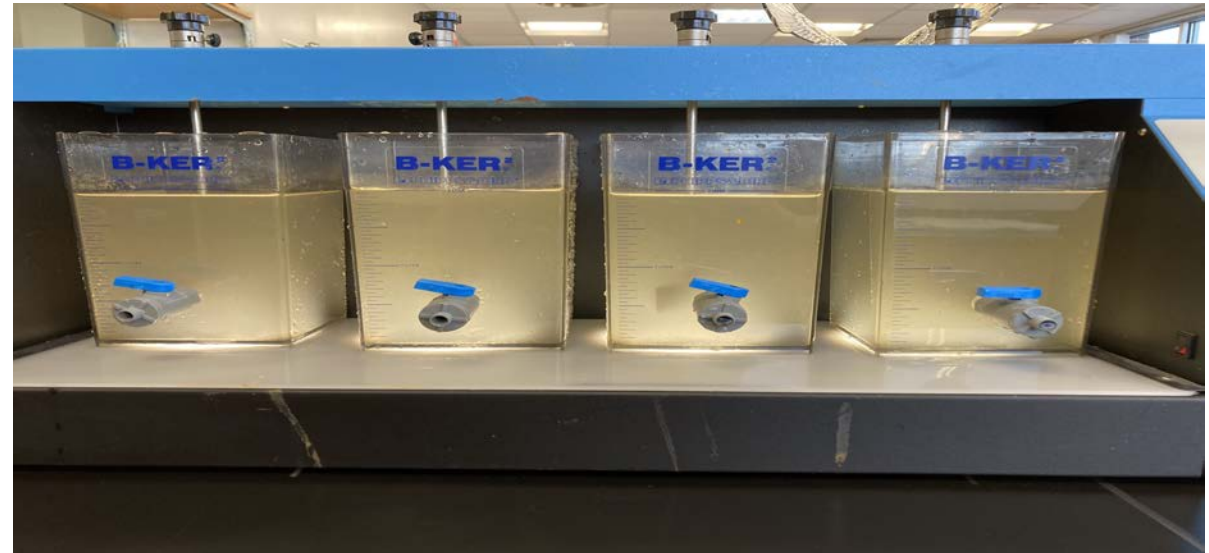


Startup Challenges

- Foaming
 - Developing biofilm resulted in foaming
 - Typical during BAF startup because it is not common to seed a BAF
 - Solution: Added defoamer for several weeks until foaming subsided



- Co-Settling Optimization
 - BAF backwash dosed with coagulant prior to co-settling in primary clarifiers
 - Limited pilot scale data to base optimal coagulant dose on
 - Solution: Backwash from CN and DN mudwells was jar tested to determine optimal dosing.
 - Optimal dose less than design value. Current dose is approximately 25 mg/L Ferric Chloride and around .1 mg/L of polymer versus design value of 40 mg/L and 1 mg/L

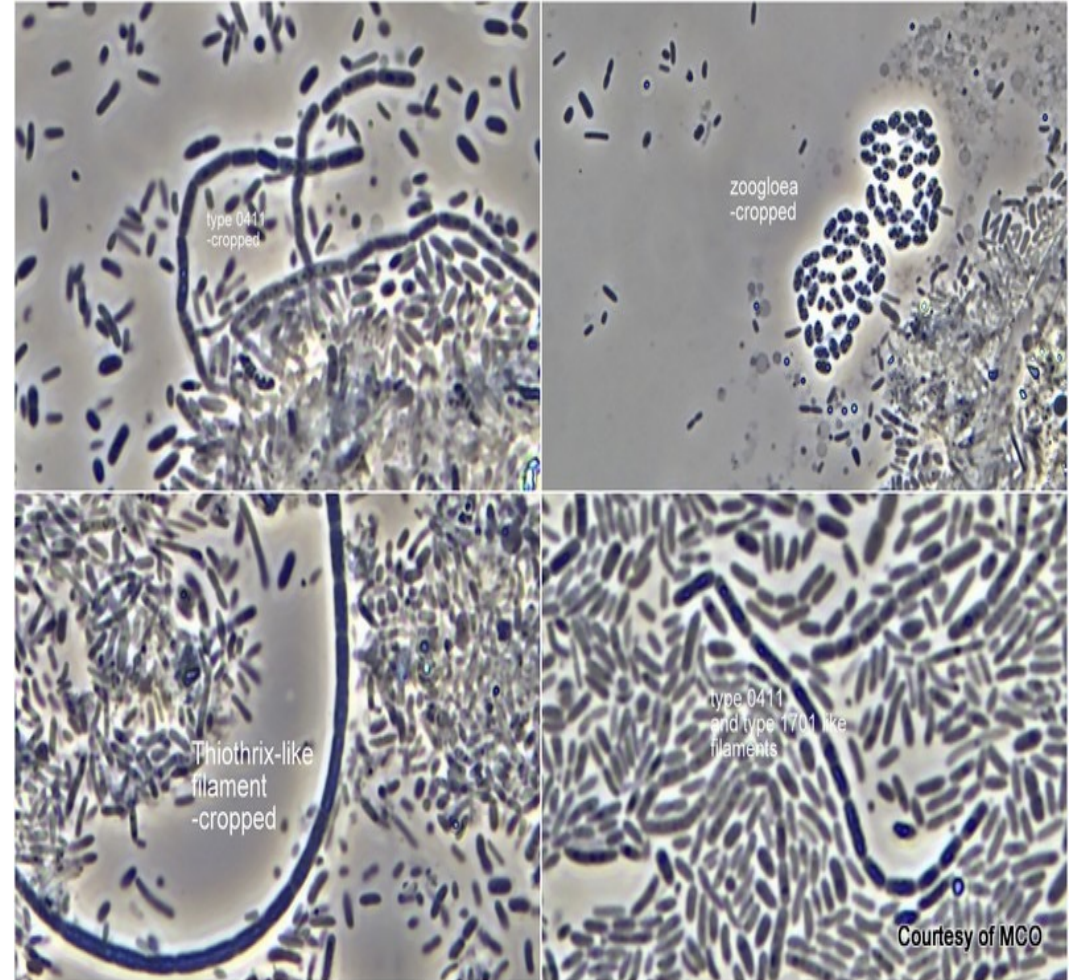


Lessons Learned

- Carbon Source Dose Optimization
 - Micro-C used as carbon source in lieu of methanol
 - Dose controlled by Stage 1 effluent nitrate, Stage 1 effluent DO, and Stage 2 effluent nitrate
 - Too High – Undesirable bacteria / foaming
 - Too Low – Nitrite formation & increased chlorine demand
 - Low alkalinity across Stage 1 added to formation of undesirable bacteria
 - Solution: Increase backwash duration to compensate for Micro-C's higher yield



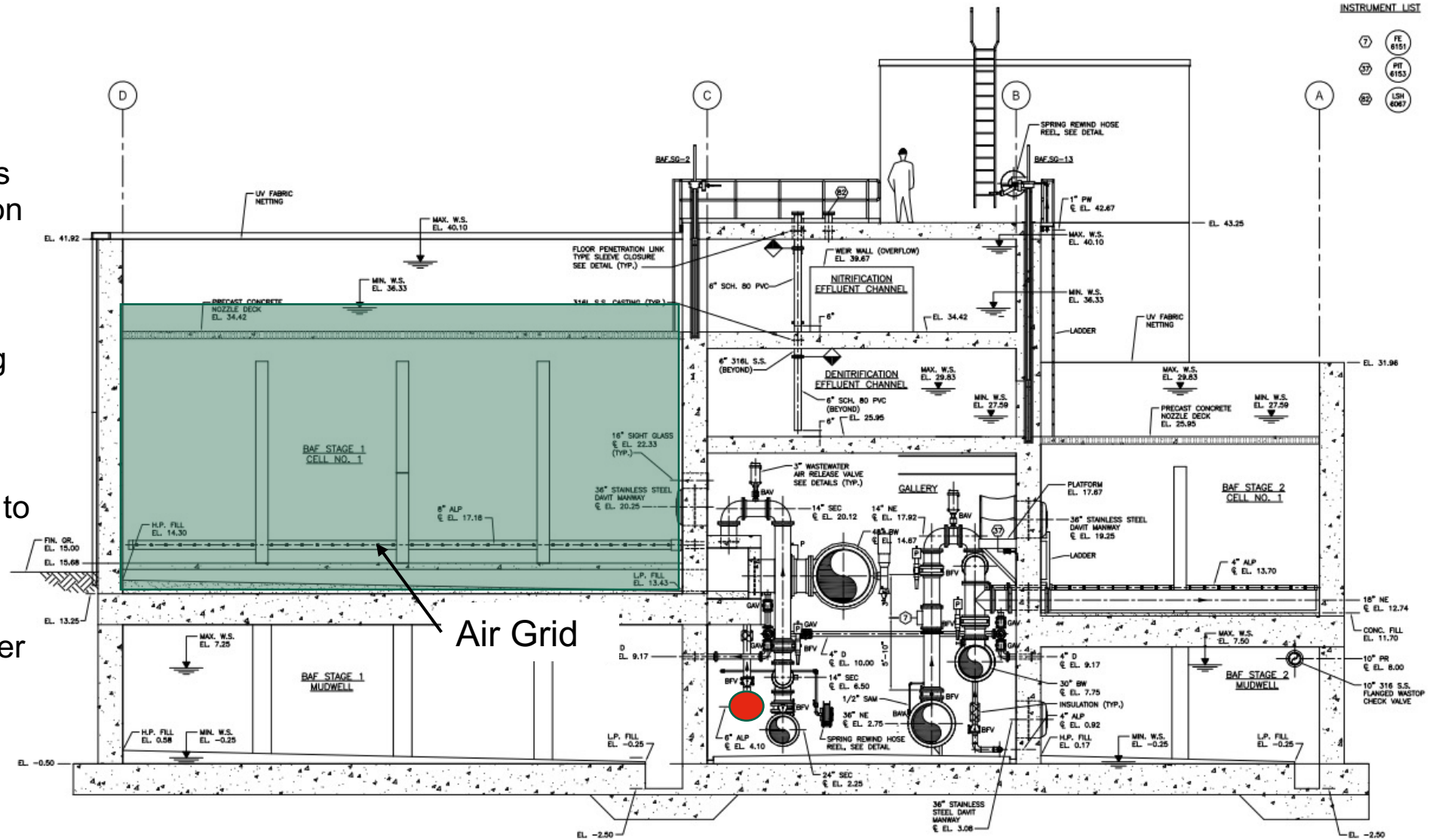
Zoogloea Formation in the Sample Sink



Microscopic View of Several Undesirable Bacteria

Lessons Learned

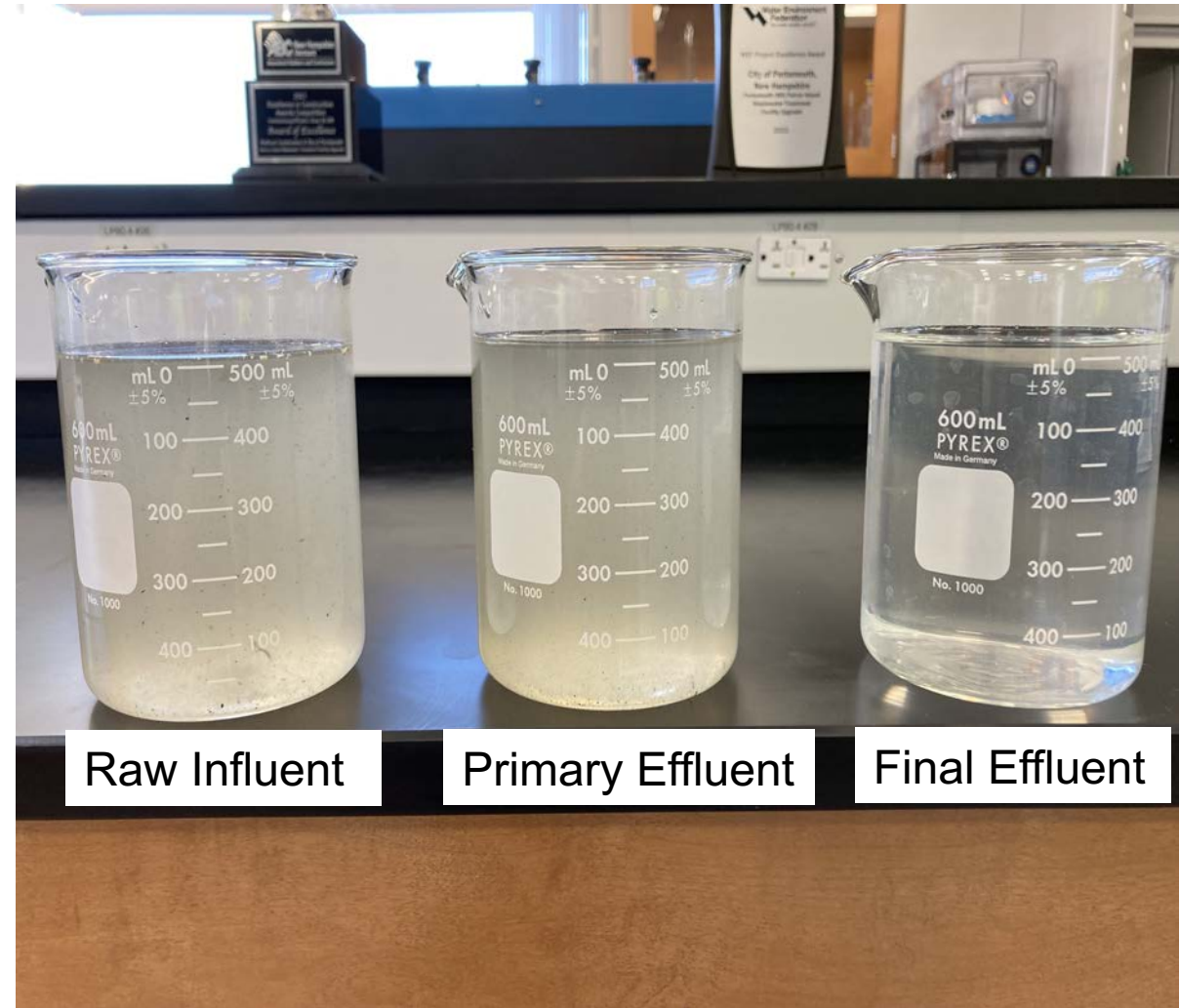
- Aeration Header
 - Design height restrictions limited location of aeration header within gallery
 - Air header positioned below cell water level resulted in water flooding header during initial operation and complete shutdown of BAF
 - Solution: Slight increase to air header pressure set point and changes to startup / shutdown procedures to purge water from piping



Section through BAF Building

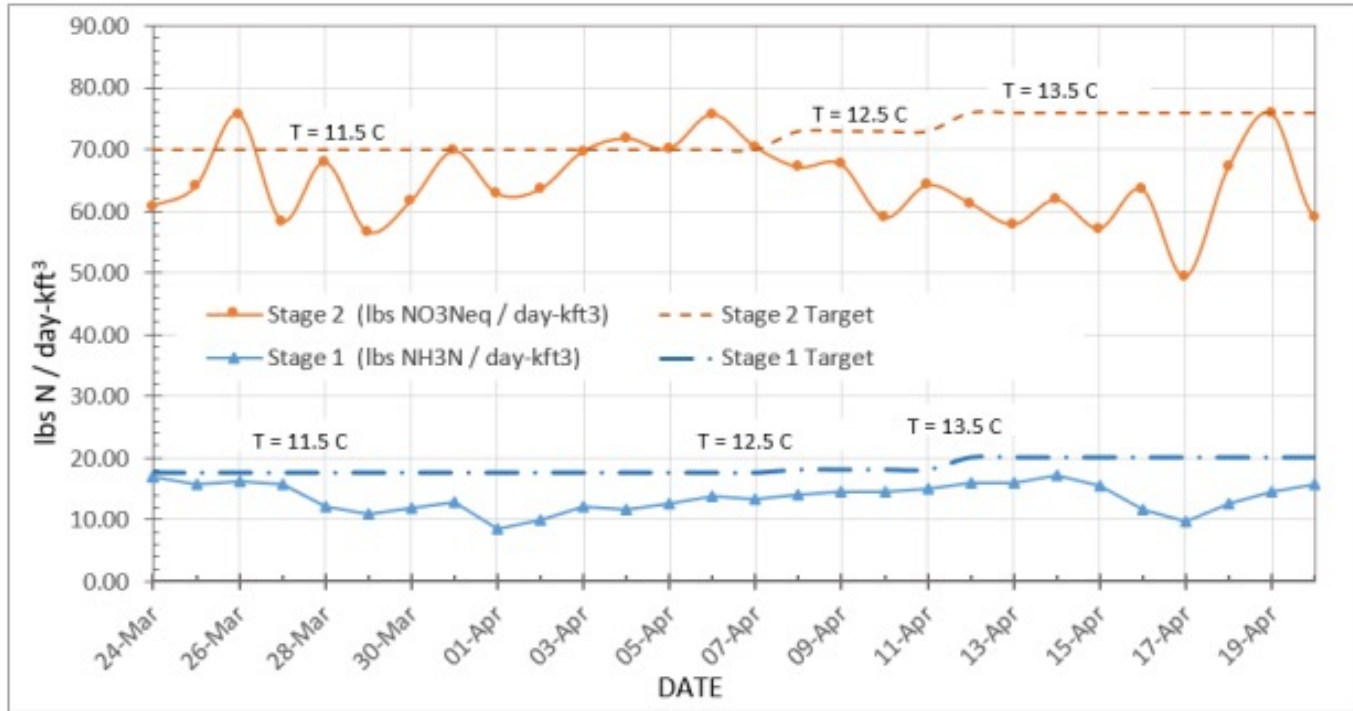
Lessons Learned

- Loading Rate Optimization
 - Volumetric loading vs. hydraulic loading
 - Too Low – “Tunneling” through the media results in poor effluent performance
 - Too High – Cells offline for long periods of time resulted in continued cell respiration and buildup of carbon dioxide within cell that decreased alkalinity and pH when the cell was rotated into service.
 - Solution: Aerate offline cells at low rate to minimize buildup of carbon dioxide



Performance Testing

- Performance testing designed to simulate BAF operation at design loading rates at minimum temperature
- Large operational and lab burden
- Challenges operating at design loading rates



Design Loading Rates Adjusted for Wastewater Temperatures During Test.
 Number of Cells in Operation Adjusted to Try and Match Adjusted Loading Rates.

Parameter	Sample Type	Sample Frequency	Minimum Total Sample Results
Primary Effluent Flow	Insitu Monitoring	Totalized Daily	30
Final Effluent Flow	Insitu Monitoring	Totalized Daily	30
Temperature	Insitu Monitoring	Daily average	30
NH ₃ -N	24-hour composite	Min 5/week	20
Total TKN	24-hour composite	Min 5/week	20
Soluble TKN	24-hour composite	Min 5/week	20
NO _x -N	24-hour		
CBOD ₅	24-hour		
TSS	24-hour		

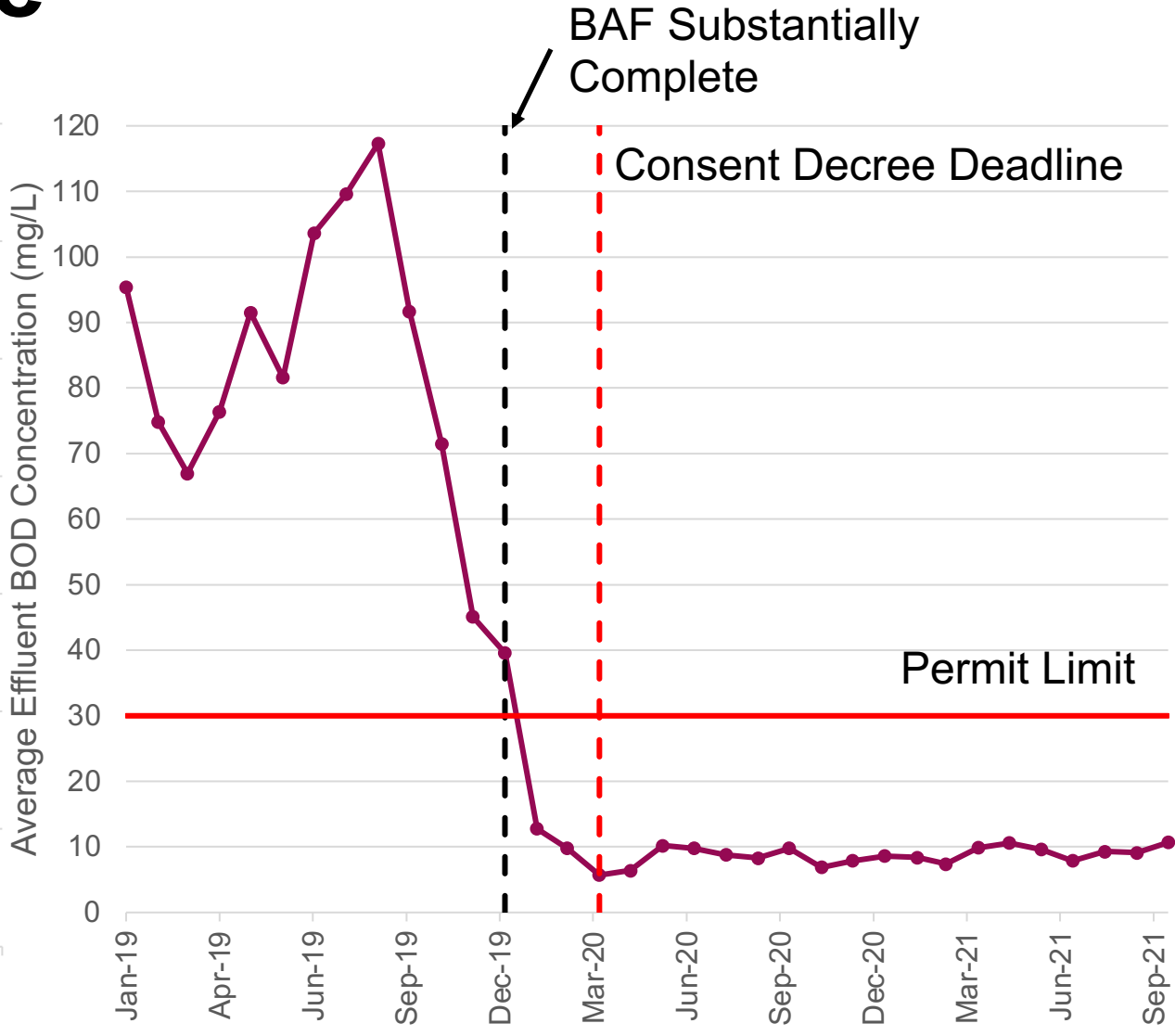
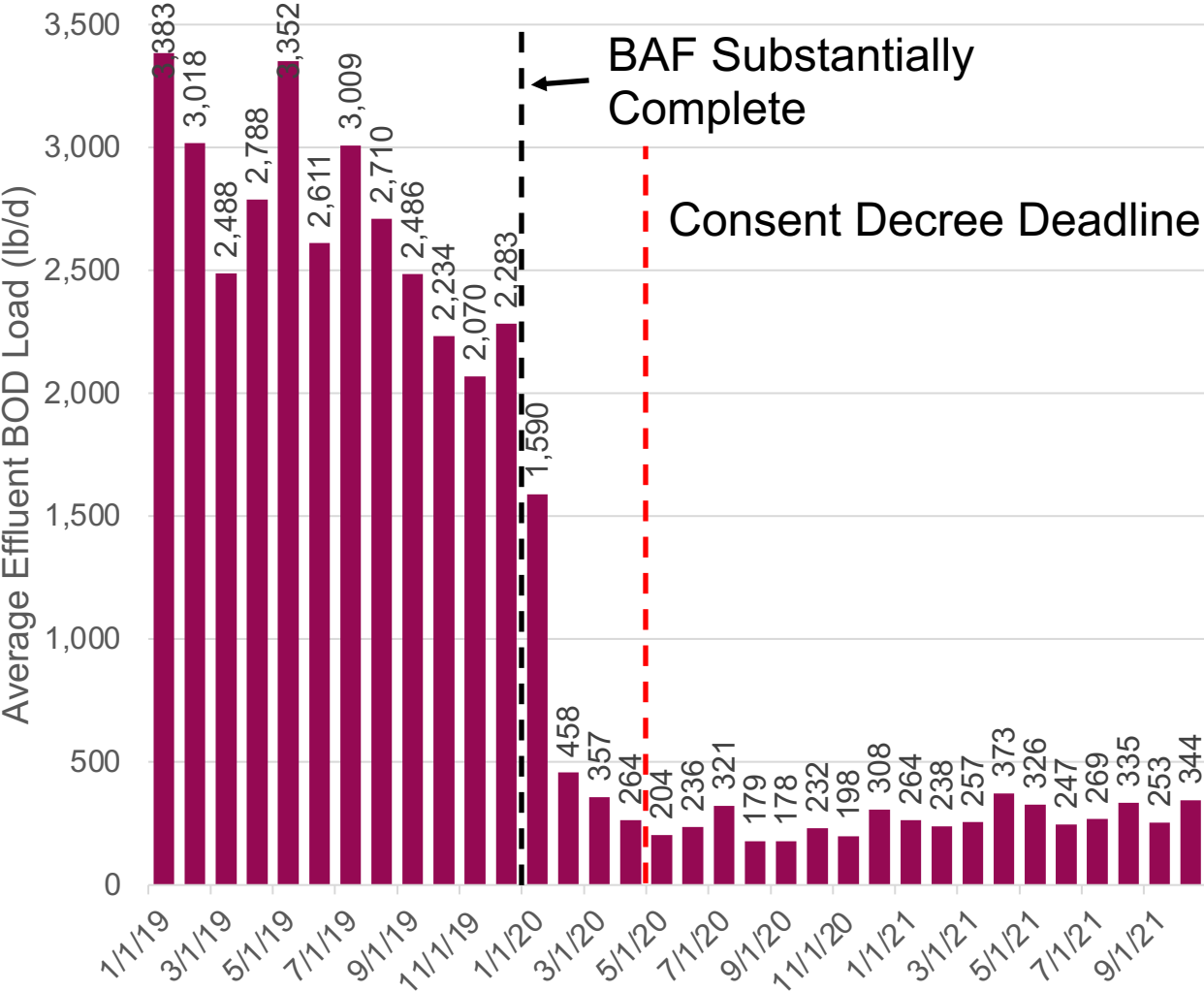
Parameter	CN Effluent Sample Sink	DN Effluent Sample Sink
PO ₄ -P	Min 3/week	Min 3/week
NH ₃ -N	Min 6/week ¹	Min 6/week ¹
NO ₂ -N	Min 6/week ¹	Min 6/week ¹
NO ₃ -N	Min 6/week ¹	Min 6/week ¹
pH	Min 6/week ¹	Min 6/week ¹
DO	Min 6/week ¹	Min 6/week ¹
Soluble COD	Min 3/week	Min 3/week
Alkalinity	Min 3/week	None

Extensive Sampling Required During Performance Test

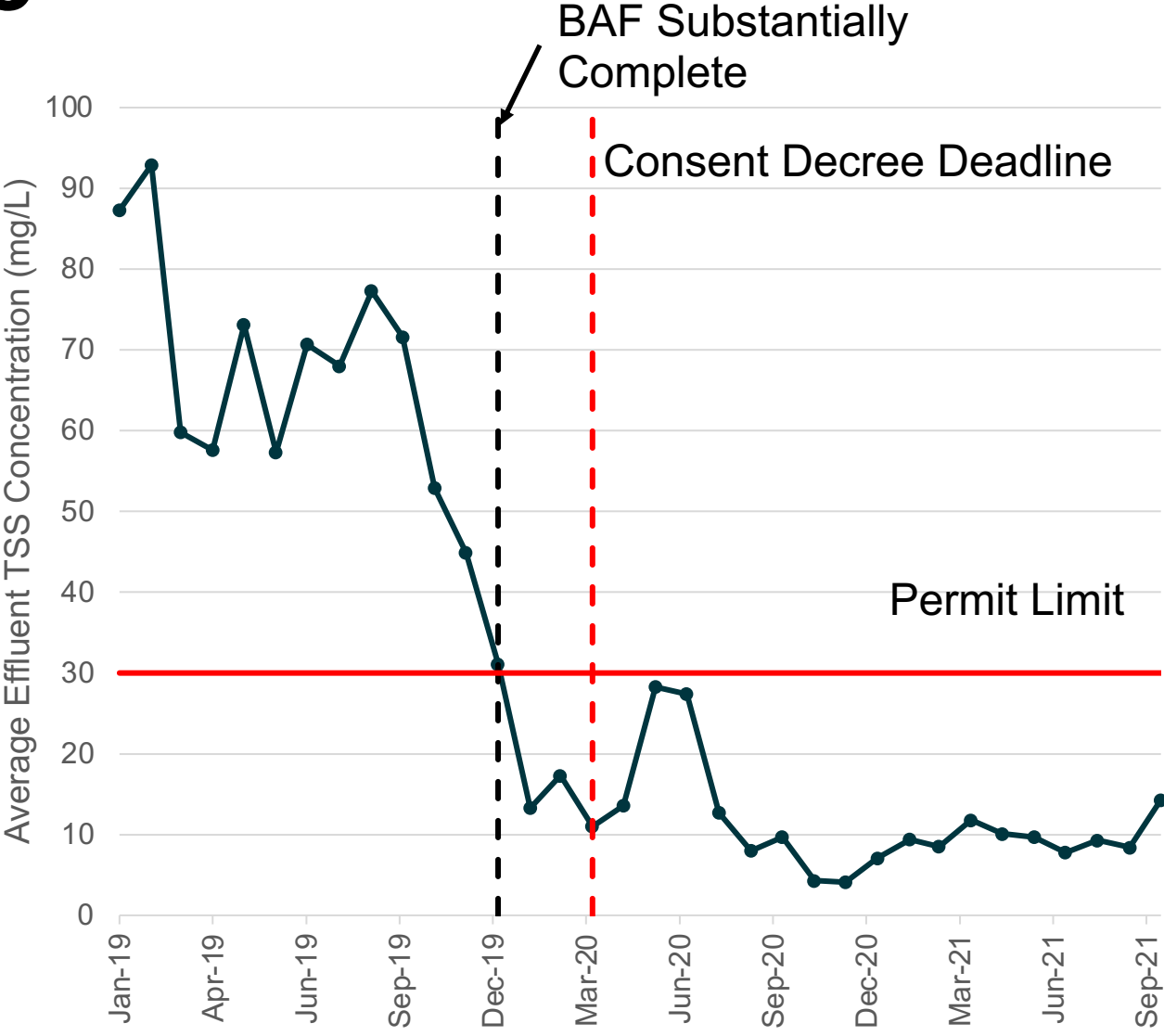
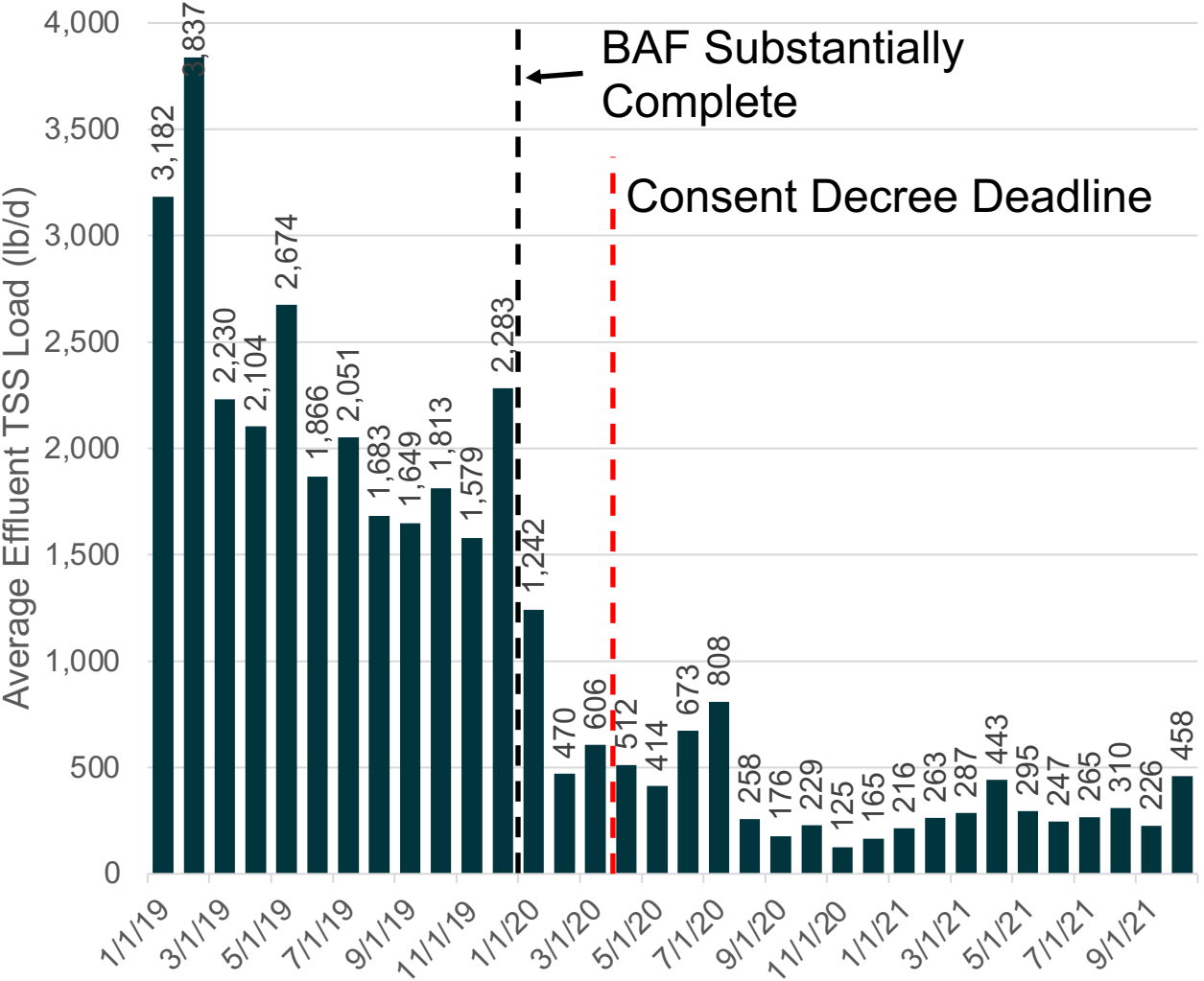
Parameter	Effluent Requirement	Effluent
CBOD (mg/L)	≤ 30	9
TSS (mg/L)	≤ 30	11
TN (mg/L)	≤ 3	2.8

Results Met Performance Requirements

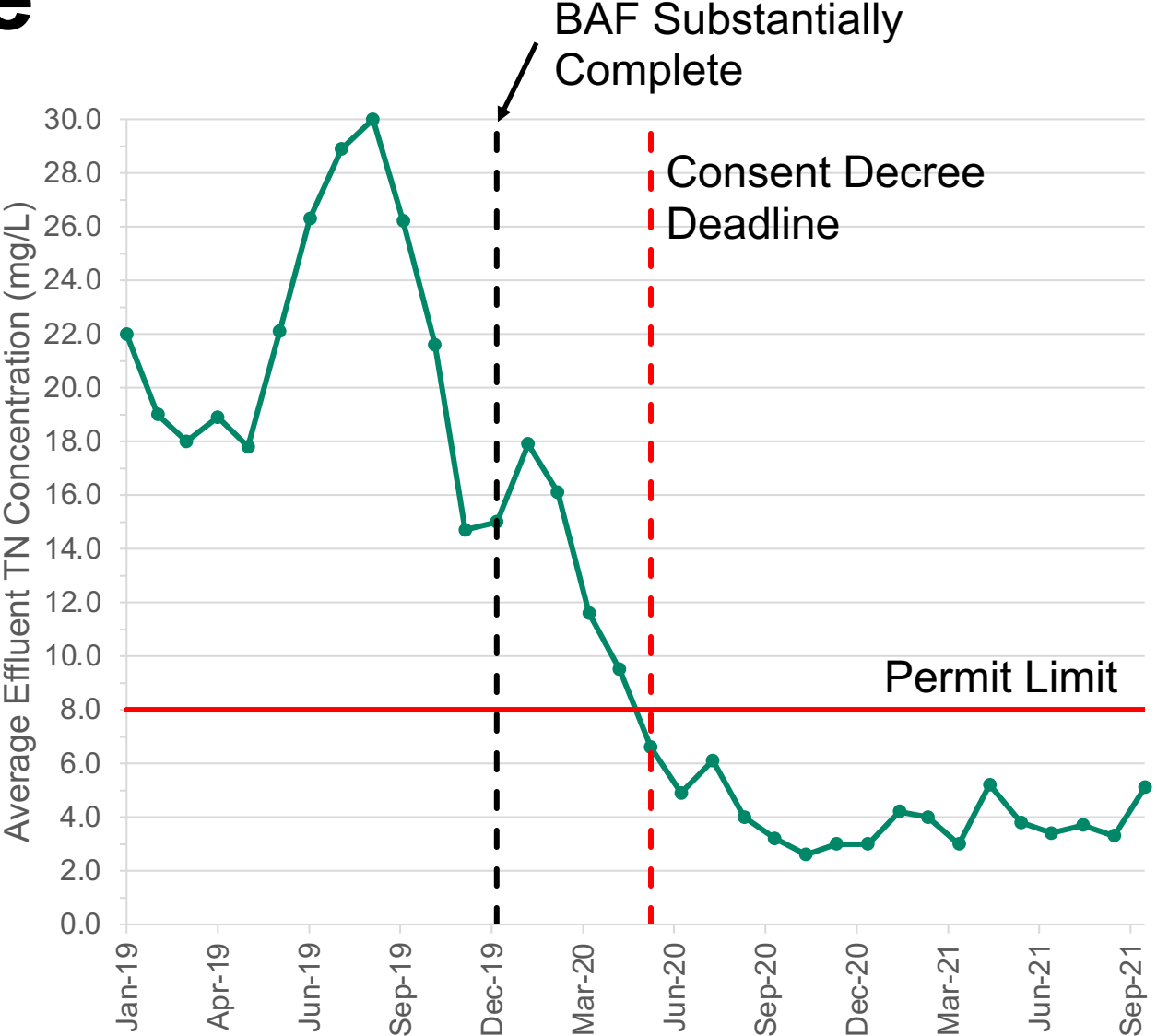
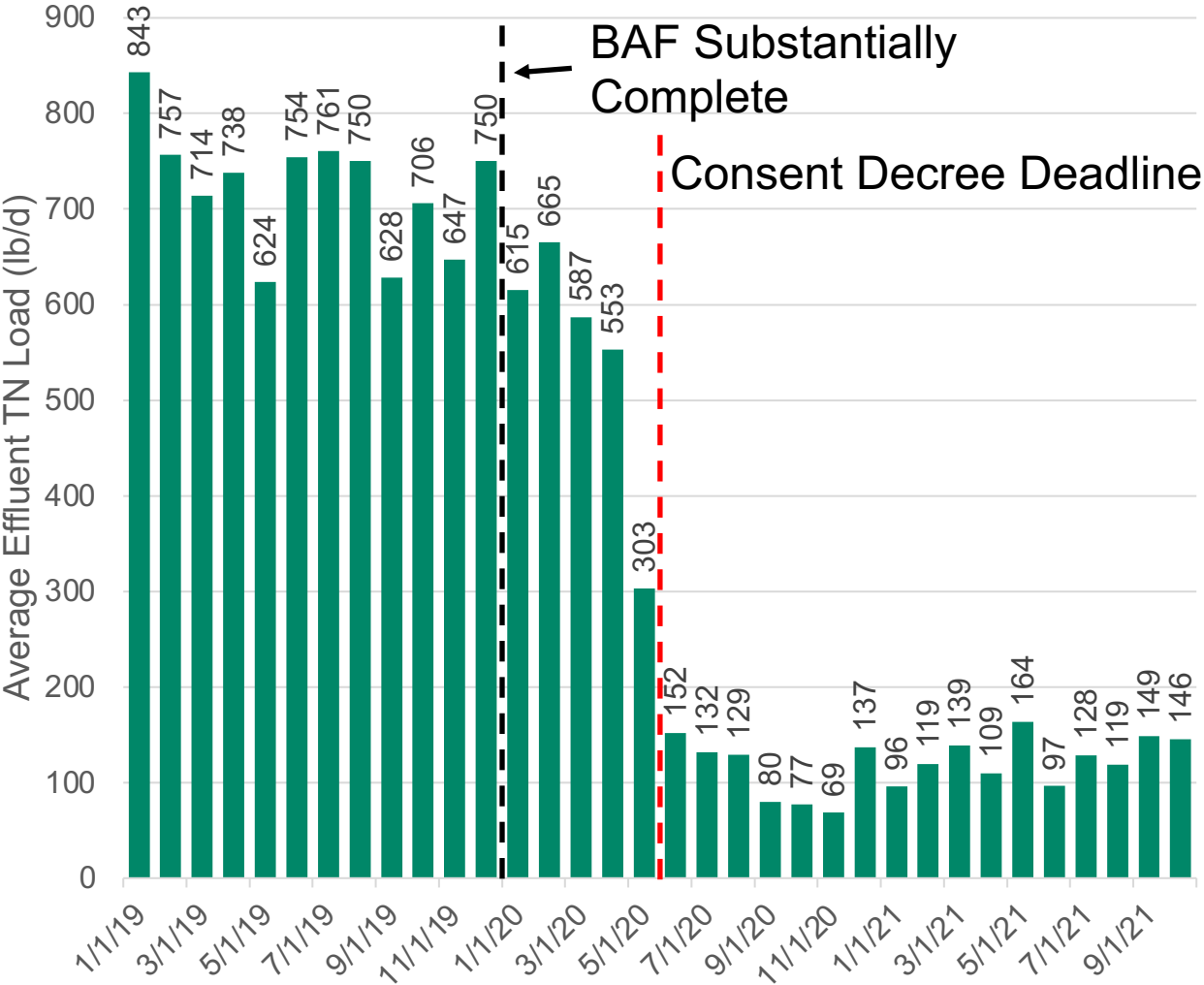
Operational Performance



Operational Performance



Operational Performance



Conclusions

- Peirce Island BAF performing as advertised
- Adaptive management is key. Project team and plan had to adapt constantly to the unforeseen
- Good communication between stakeholders was a must
- Good lab support is a must, especially for strict performance test requirements
- Provisions for remote access to process equipment/controls should not be overlooked
- Patience





Thank you. Questions?

erik.meserve@aecom.com
paconroy@cityofportsmouth.com