New England's Largest Continuously Backwashing Sand Filter Helps the Meriden WCPF Achieve Low Effluent Phosphorus

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Outline

- Background
- Tertiary Upgrade Project Development
- Tertiary System Components
- Construction
- System Performance
- Thanks and Q&A

Background

Background

Meriden, CT

- ~ 61,000 resident (2020 census)
- The “Silver City”

Water Pollution Control Division

- Responsible for 210 Miles Sewer
- 3 RWW Pump Stations
- Water Pollution Control Facility

WPCP

- 11.6 mgd Average Daily Flow
- 48.0 mgd Peak Flow
- Advanced Treatment
  - Nitrogen Removal
  - Biological P Removal

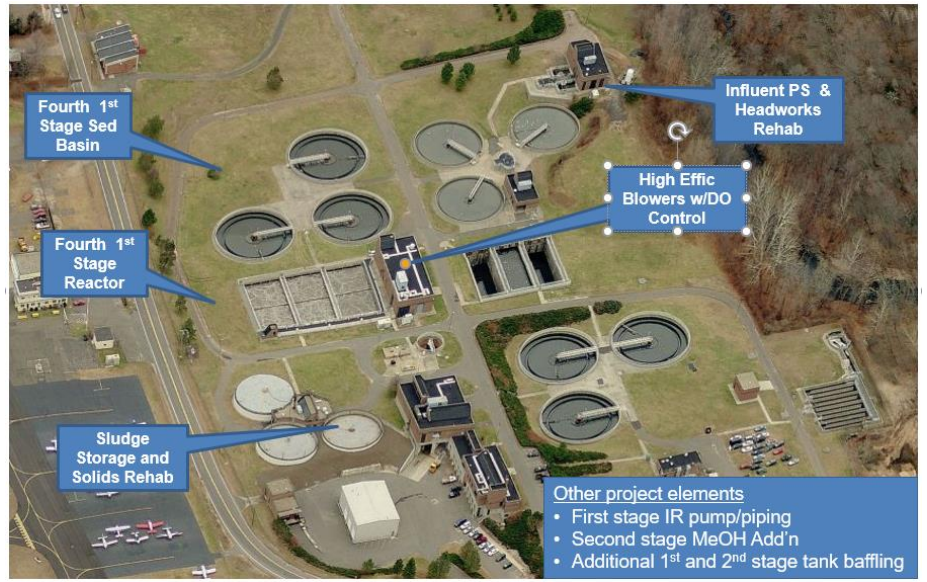
Meriden WPCF Phosphorus Limits and Treatment History

Facility Upgrade 2007-2010

Nitrogen Removal and Systems Upgrade Project

2008 (<u>one year into construction</u>)

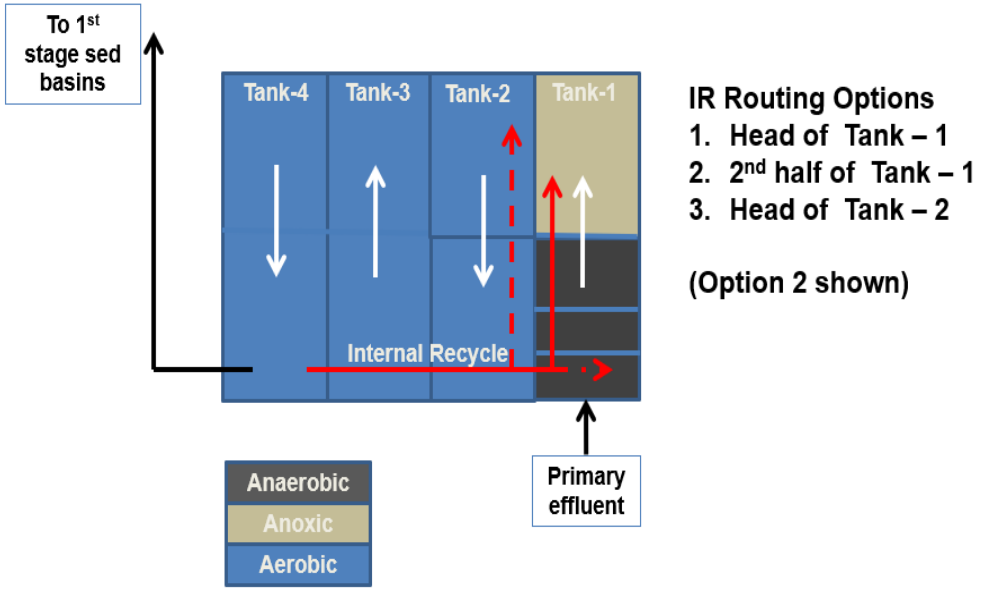
- DEEP requests Meriden implement full-scale demonstration
- Implement system(s) to achieve TP = 0.7 mg/l
- Bio-P Retrofit Added to Construction Contract



Meriden 2013 NPDES Permit Renewal

New TP Effluent Limits

- Ave Month < 0.14 mg/l
- Max Daily < 0.31 mg/l
- Seasonal cap of 8.71 lbs/d = 0.09 mg/l at 11.6 mdg (average flow)
- Compliance schedule of April 1, 2022



New Limits Required Tertiary Treatment

Tertiary Upgrade Project Development

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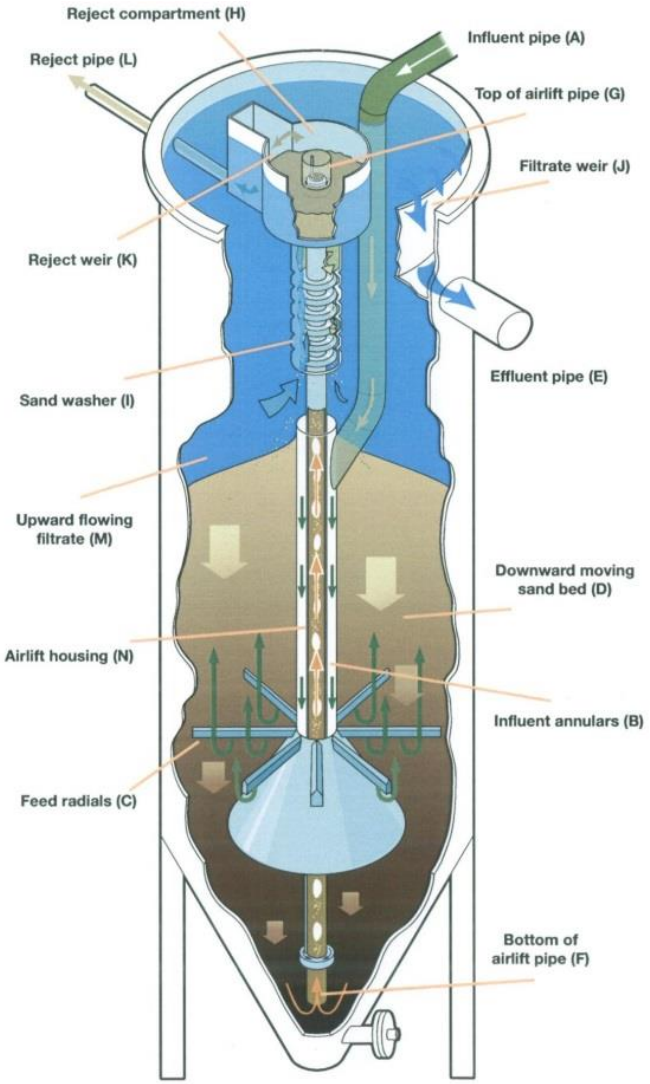
Meriden WPCF Tertiary Upgrade Project

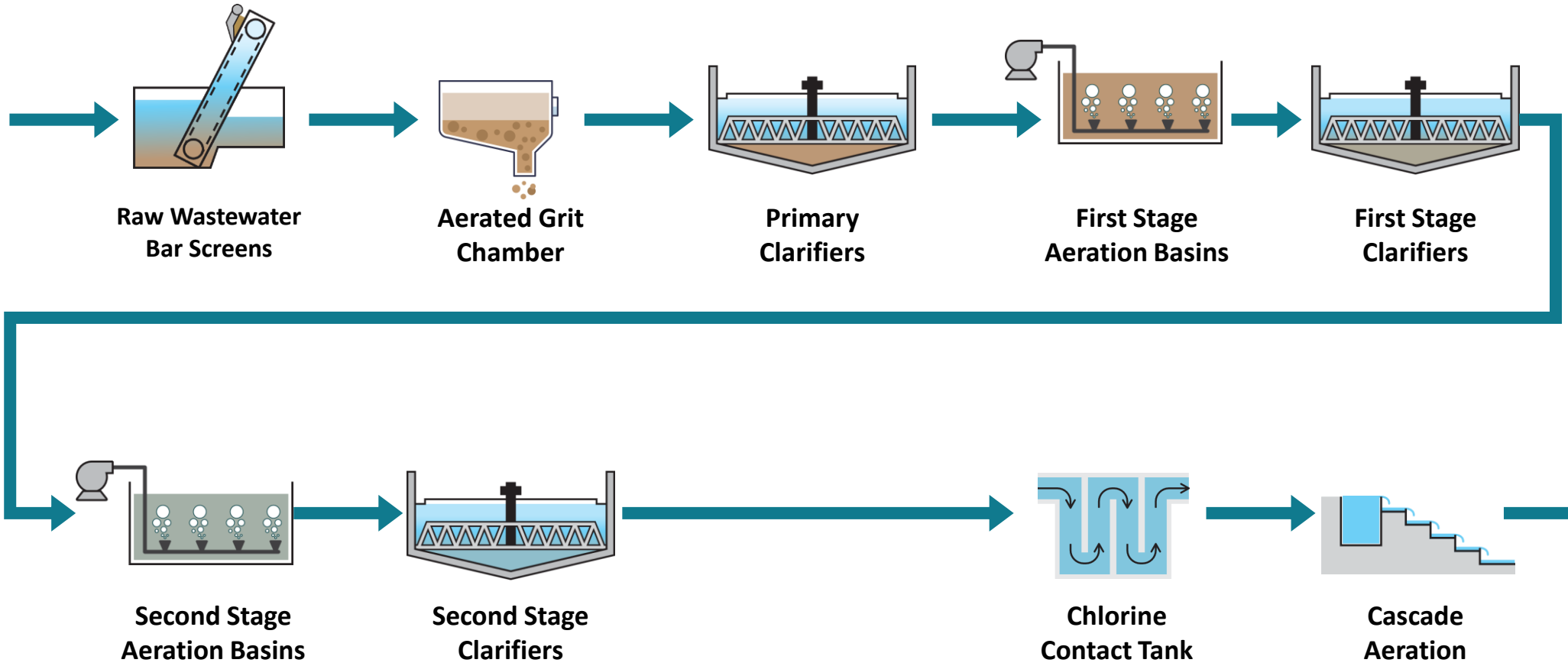
- Several technology choices at/near performance capabilities
- Technology Screening Workshop - March 2015
  - Cloth Disk Filter (Aqua Aerobics AquaDisk)
  - Ballasted Flocculation (Kruger Actiflo)
  - Continuous Backwashing Sand Filtration (Parkson Dynasand)
- Piloting - August 2015
  - All technologies demonstrated ability to get to 0.09 mg/l
  - Some operational differences
  - Continuous Backwashig Sand Filtration technology of choice
- Design Started – March 2017
- Equipment Preselection Bids Solicited – December 2017
  - Parkson Selected – March 2018
- Construction Started – June 2019

Continuously Backwashing Sand Filter

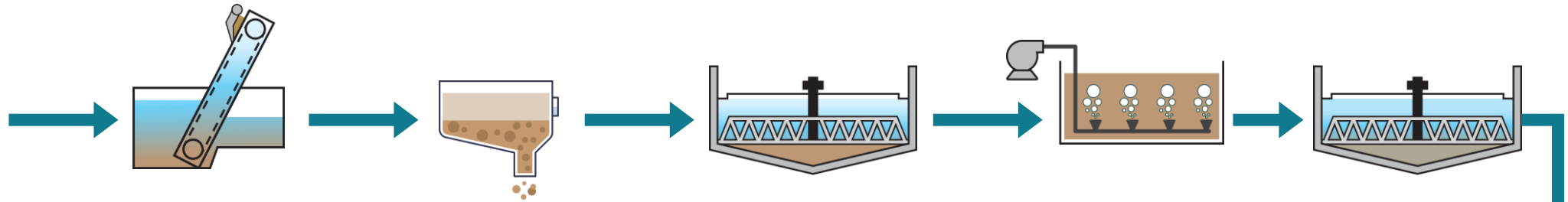
- Chemical Addition Followed by Deep Bed Filtration
- Advantages:
  - Simple operation
  - Modular design
  - Cells easily taken on and offline
  - No polymer needed
  - Physical barrier treatment
- Disadvantages:
  - Large footprint
  - Higher headloss



Existing Meriden WPCF



Meriden WPCF Tertiary Upgrade



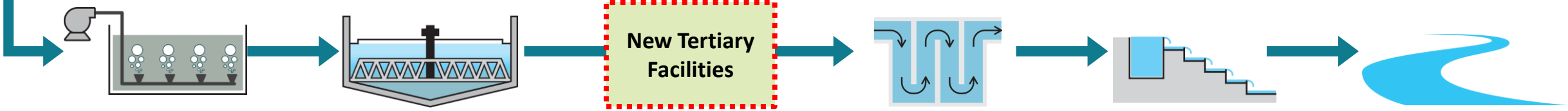
Raw Wastewater Bar Screens

Aerated Grit Chamber

Primary Clarifiers

First Stage Aeration Basins

First Stage Clarifiers



Second Stage Aeration Basins

Second Stage Clarifiers

New Tertiary Facilities

Chlorine Contact Tank

Cascade Aeration

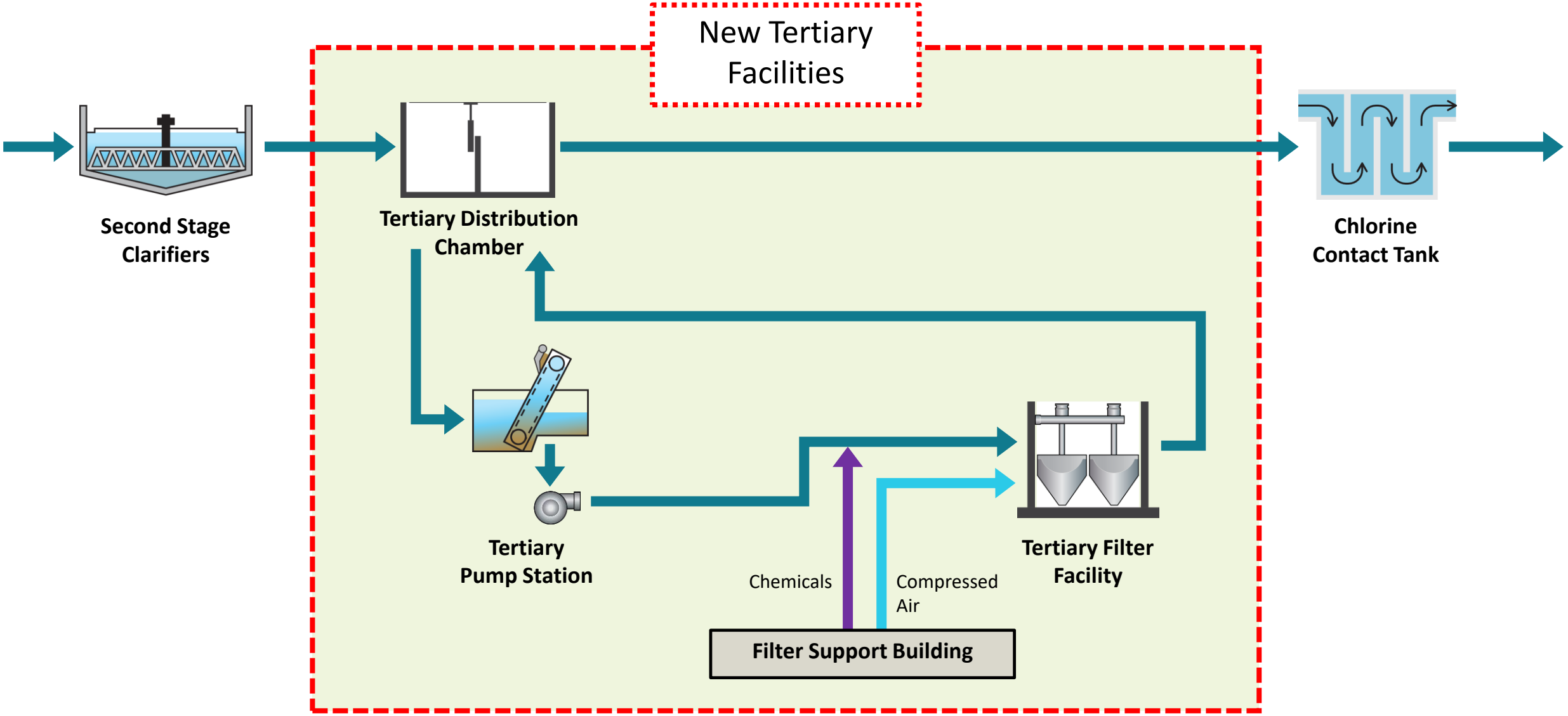
Quinnipiac River

Tertiary System Components

Tertiary System Components

- Tertiary Diversion Chamber
- Pumping Station (51 mgd)
- DynaSand Process/Filter Structure
- Filter Support Building
  - Chemical Storage and Feed
  - Air Compressors
  - System PLC
- Multi-Point Chemical Feed Systems
- Instrumentation
- Yard Piping

Meriden WPCF Tertiary Facilities



Overview of Major System Components

New Tertiary Facility

- Tertiary Distribution Chamber (“TDC”)
  - Used to direct, some, all or none of 2nd stage effluent flow through tertiary system.
  - Motorized weir gate used to direct flow to tertiary system.
- Tertiary Pump Station (51 MGD)
  - Two 6 mm 25 mgd screens (1 duty, 1 assist). To prevent debris from clogging filters.
  - Dual chamber wetwell with connecting sluice gate
  - Five (2 @ 5.8 mgd, 3 @ 19.4 mgd) pumps for pumping screened secondary effluent to filter influent channel
- Filter Facility
  - Sixteen cells of 8 modules/each (128 total)
- Tertiary Ferric Feed
  - Three (2 duty, 1 standby) metering pumps
  - Dosed at Tertiary pump discharge header or filter influent channel
  - Mixer in filter influent channel

Overview of Major System Components

Upstream Dosing Systems

- Primary Ferric Dosing System
  - Roughing, biggest “bang for buck” in terms of ferric use.
  - Important not to overdose. Biology needs about 0.3 to 0.5 mg/l OP residual for growth.
  - Dosing point at primary splitter box, 2 new metering pumps, new mixer.
  - Controlled by OP analyzer in First Stage Influent Channel (pH monitored).
  - Use is optional, if using, recommended target OP of 1.0 to 1.5 mg/l.
- Secondary (Second Stage) Ferric Dosing System
  - Intermediate polishing, reduces solids load to Filter system.
  - Been in operation since 2011, demonstrated ability to get to TP < 0.7 m/g.
  - Dosing point at 2nd stage mixed liquor channel.
    - New induction mixer to improve performance.
  - Overdose results in high ISS in second stage, recommended target OP of 0.3 to 0.5 mg/l.

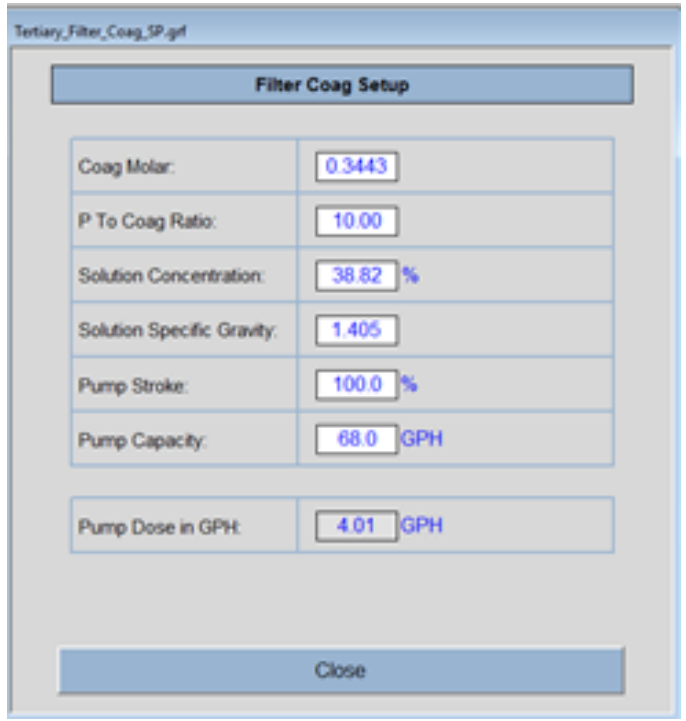
Overview of Major System Components

Ancillary Systems

- Caustic Addition System
  - Ferric lowers pH, effluent limit is pH 6-9 S.U.
  - Two (1 duty, 1 standby) metering pumps
  - Include pH monitoring
- Air Compressors
  - Three (2 duty, 1 standby) 270 CFM, 60 HP Each
- Plant Water System
  - Four (3 duty, 1 standby) pumps.
  - Provides screen wash water, carrying water for chem add'n, etc.
- Flow Metering/Phosphate Analyzer
  - FM Located on Tertiary pump header
  - Phosphate Analyzer (filter influent and Effluent) used in ferric dose algorithm

Tertiary Ferric Dosing Stratgey

- When in AUTO, driven by Parkson PLC. Two modes of operation
  - PPM (concentration) Mode
  - Substrate Mode
- PPM Mode
  - Operator sets desired Ferric dose, PLC uses Tertiary Flow (FE-1260) to determine desired flow output to Tertiary Ferric Chloride Pump(s).
- Substrate Mode
  - Operator sets desired Coagulant to P ratio (molar basis)
  - Uses Flow (FE-1260) and Secondary Effluent OP (AE-1260) to determine desired flow output to Tertiary Ferric Chloride Pump(s).
  - Based on concentration and flow, determines mass of OP coming into filters. Calculates mass of ferric needed based on Fe:P ratio



Parkson Dosing Guidelines

Iron Ratios	
Effluent P [mg/l]	Ratio
0.030	40.000
0.050	30.000
0.075	20.000
0.100	10.000
0.250	2.000
0.500	1.500
1.000	1.000

- Coag Molar, proportion by weight of metal in salt
  - FeCl3 is 34.43% Fe by weight
- P to Coag ratio is a typo, it's really Coag to P ratio. The higher the ratio, the higher the dose
- Conc'n and S.G. set point (manufacturer based inputs)

Construction

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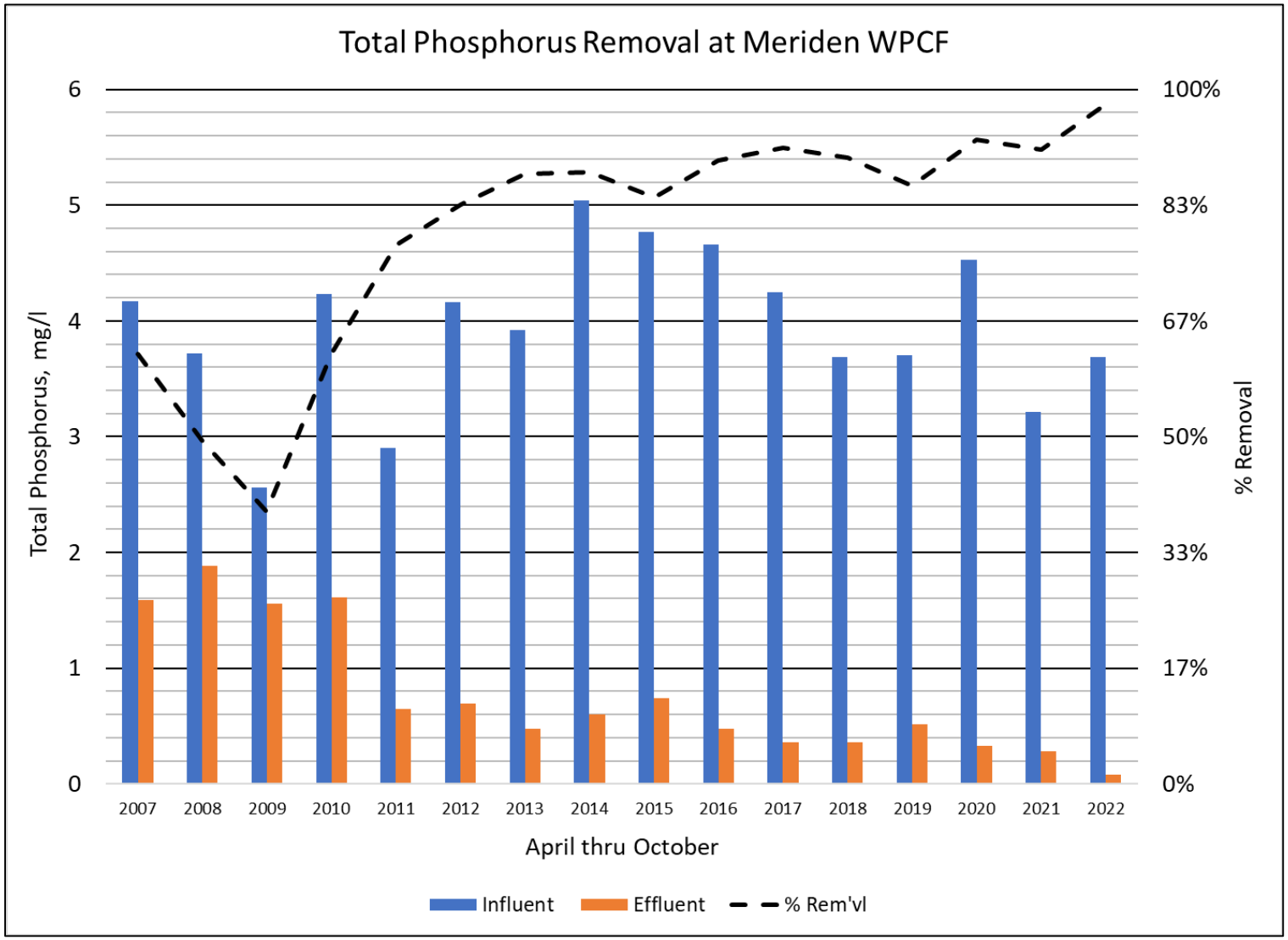
Meriden, CT WPCF – May 2020

Meriden Dynasand Filters – December 2020

Meriden, CT WPCF – June 2021

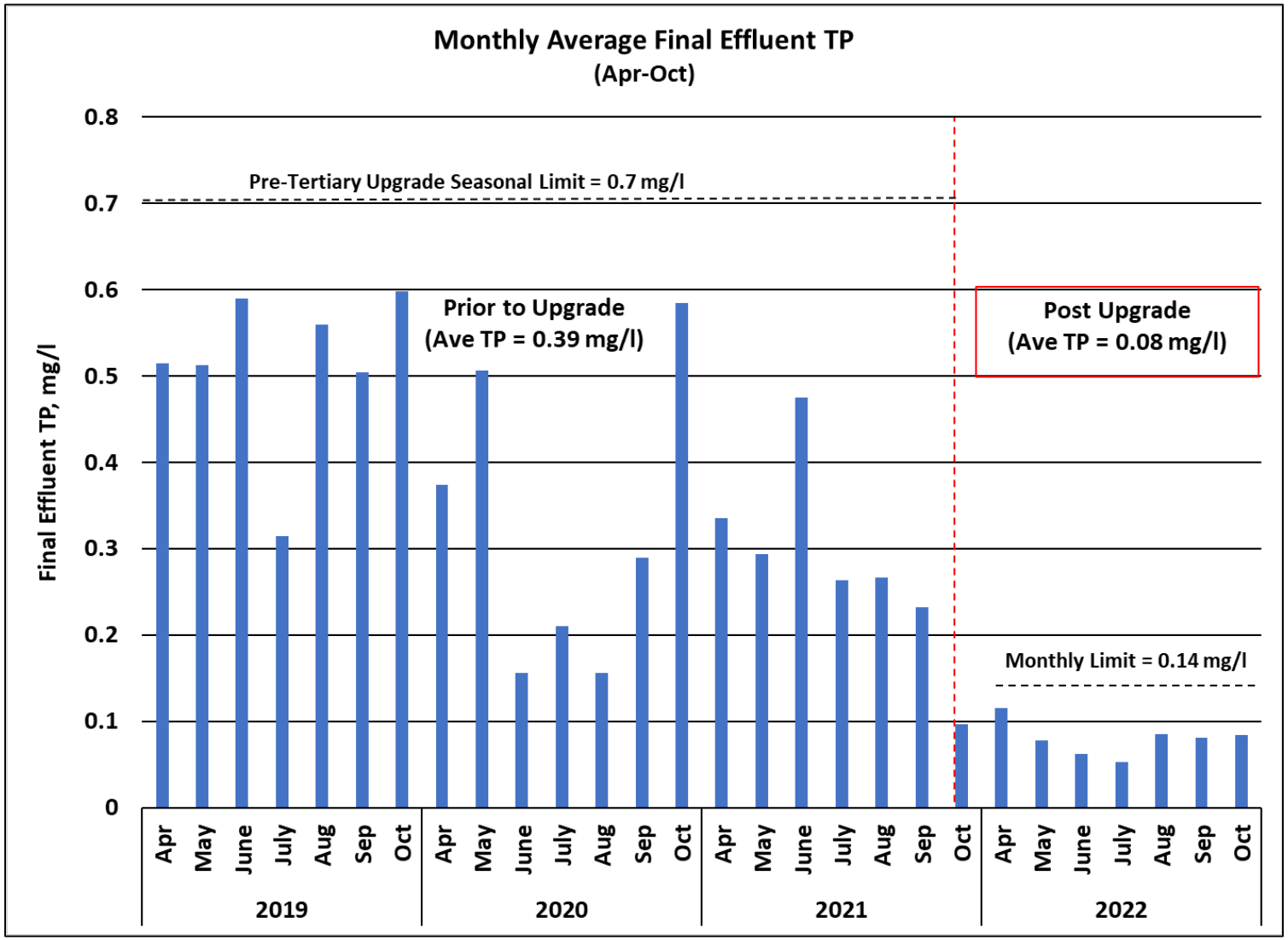
System Performance

Phosphorus Treatment – Since 2007



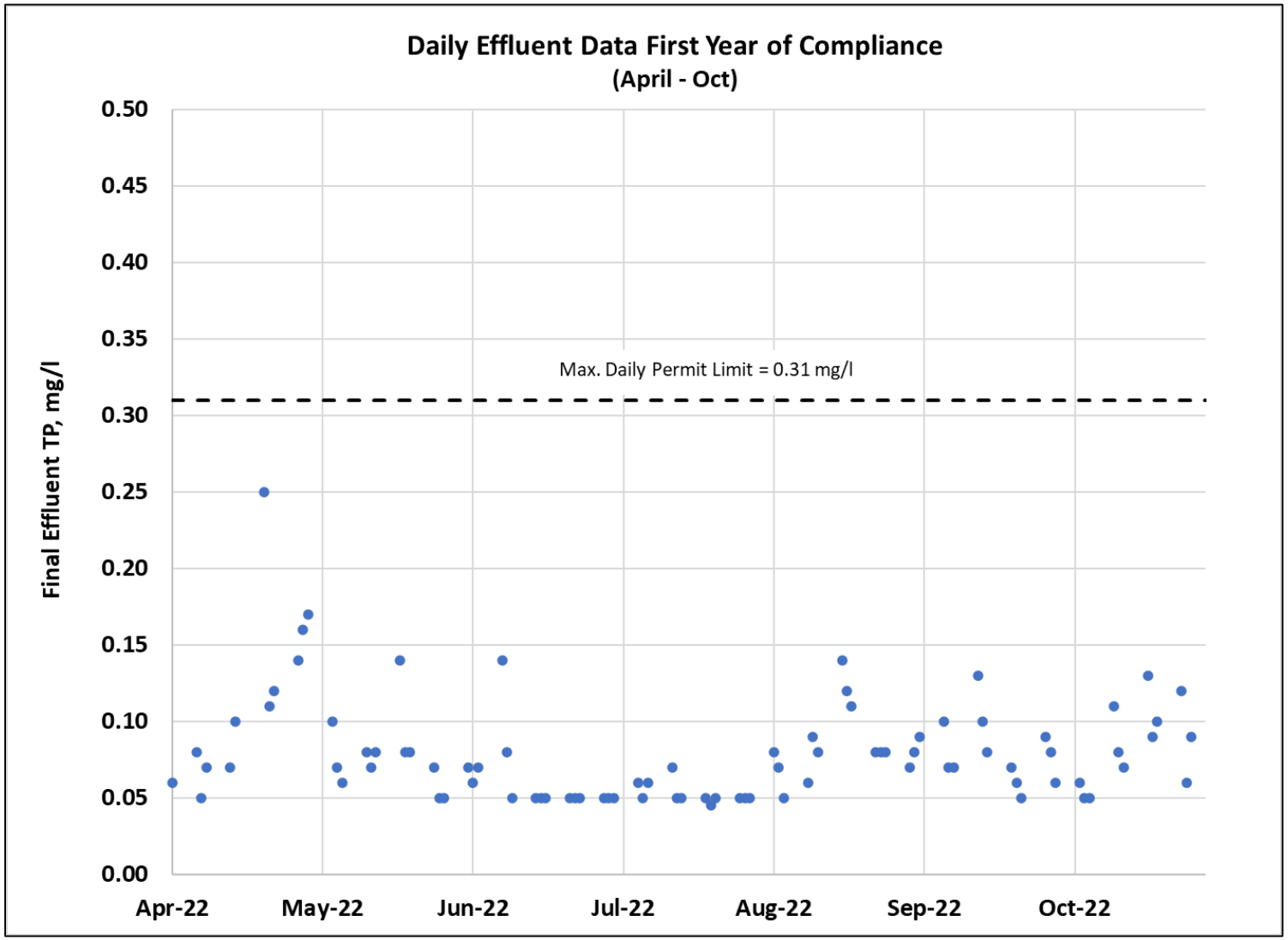
- Influent TP has remained relatively constant
- 2010 Upgrade Effluent TP
  - Before ~ 1.6 mg/l
  - After ~ 0.6 mg/l
- TP Removal Across Plant (thru 2021)
  - Before ~ 50%
  - After ~ 85%

Phosphorus Treatment – Since 2019-2022



- Start Up October 2021
- Tertiary Upgrade Effluent TP
  - Before ~ 0.39 mg/l
  - After ~ 0.08 mg/l
- Tertiary Upgrade TP Removal Across Plant
  - Before ~ 85%
  - After ~ 98%

Phosphorus Treatment – 2022 Season



- Good Seasonal Performance
  - Approx. 1/3rd of samples at Detection Limit
- Learning Curve Items/Performance Reduction Events
  - Initial High Flow Operations (April)
  - Higher Solids/Backwash Impacts (August)
  - Ferric Feed Pump Issue (October)
- Nitrogen Removal Benefit
  - Pre-Tertiary Upgrade ~ 1.9 mg/l TN
  - Post-Tertiary Upgrade ~ 0.9 mg/l TN

Thanks to:

- CH Nickerson Construction Co.
- CT DEEP
- Meriden WPCP Staff
- City of Meriden Staff
- Parkson Corporation

Questions?