OPTIMIZING CAPACITY AT A HYBRID ROTATING BIOLOGICAL CONTACTOR PLANT

WHERE DO WE STAND AND WHERE DO WE INVEST NEXT TO GET THE CAPACITY WE NEED?

NEWEA Annual Conference, January 28, 2020

Frederick Mueller, PE, Tighe & Bond
Cynthia Castellon, PE, Tighe & Bond
Peter Boria, Town of Charlton

Tighe&Bond

OUTLINE

- Plant Overview
- Events that Led to Study
- Study Goals
- Study Recommendations
- Plant Changes Since Study

PLANT OVERVIEW

- **Service Area**
  - Charlton (600 Households)
  - Mass Pike Charlton Rest Stops
    - High Strength (BOD/Grease) @ 0.06 MGD
  - Various Commercial
- **Upgrade History**
  - 1995 Plant Constructed (2 RBCs)
  - 2000 Plant Upgrade (2+6= 8 RBCs)
  - 2008 Plant Upgrade (8+2= 10 RBCs)
    - Low Level Phosphorus <0.11 mg/l (Comag)
- **2017 New Customer**
    - Destination Brewery

PLANT OVERVIEW

- **NPDES Discharge to Cady Brook (Quinebaug)**
  - TSS/BOD5 14 mg/l Summer, 21 mg/l Winter
  - Ammonia 1.42 mg/l Summer
  - Aluminum Limit 0.093 mg/l
  - Phosphorus 0.11 mg/l Summer

  (Weekly Sample –Collected Tuesday 7 AM)
- **How?**
  - EQ Tanks
  - RBCs
  - Clarifiers
  - CoMag – Phosphorus Removal
    - Add Ferric Chloride - Multipoint
  - Add Sodium Bicarbonate
  - Final pH Adjust – Sodium Hydroxide

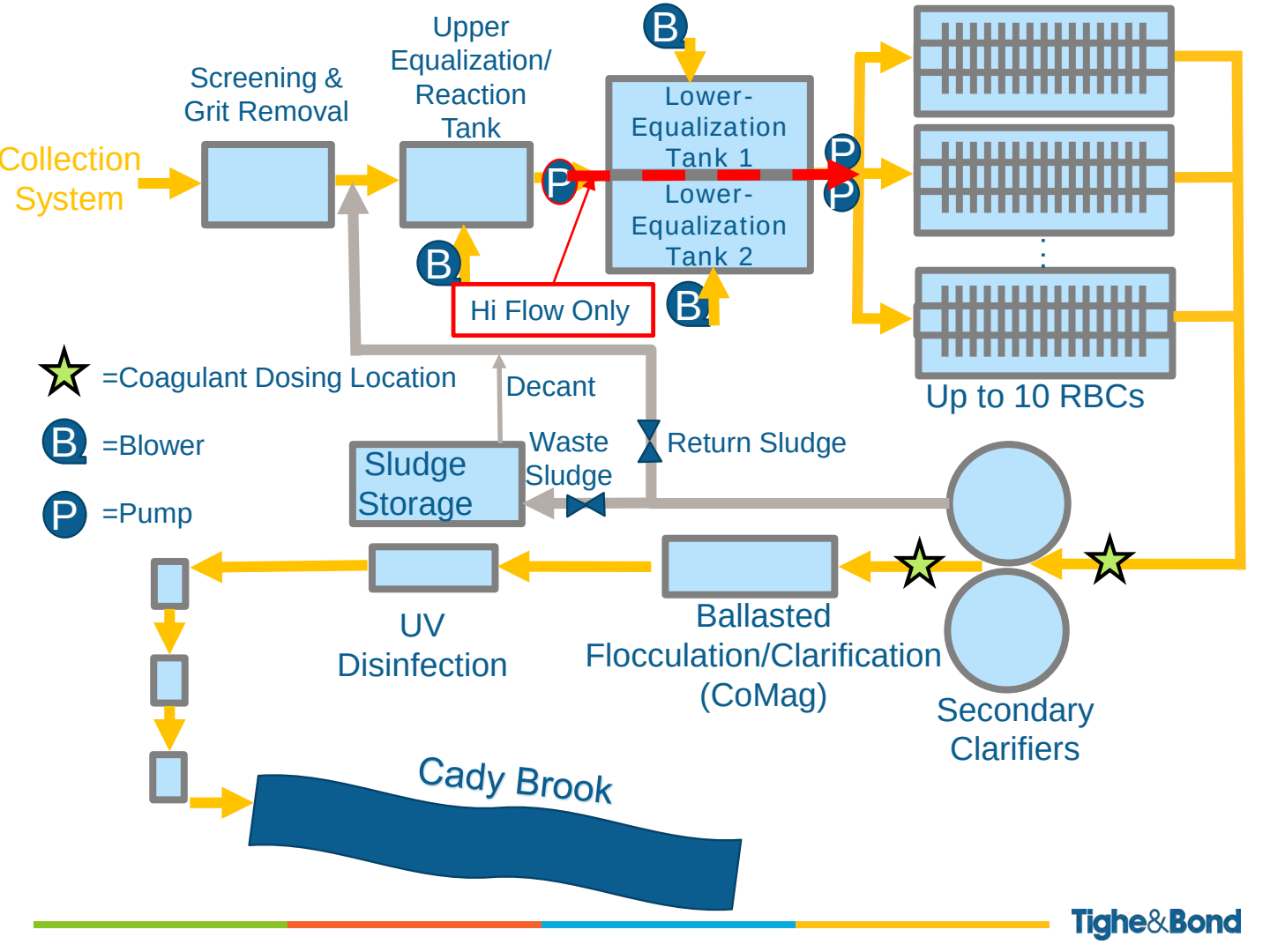
AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Town of Charlton
Board of Sewer Commissioners
37 Main Street
Charlton, MA 01509

Charlton Wastewater Treatment Facility
Junction Routes 20 and 169
Charlton, MA 01509

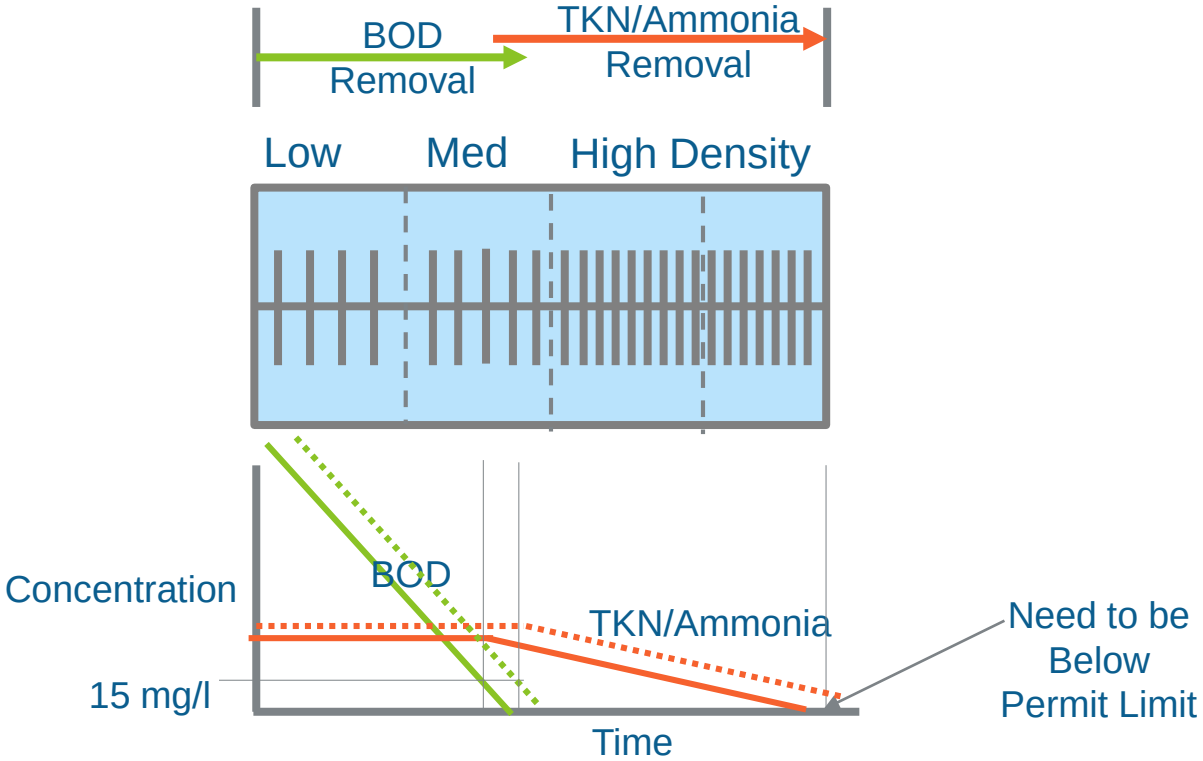
Cady Brook (State Basin Code 41 – Quinebaug)

SIGNATURE ON FILE


Screening &
Grit Removal
Upper
Equalization/
Reaction
Tank
Lower-
Equalization
Tank 1
Lower-
Equalization
Tank 2
Collection
System
Hi Flow Only
Up to 10 RBCs
=Coagulant Dosing Location
=Blower
=Pump
Decant
Waste
Sludge
Return Sludge
Sludge
Storage
UV
Disinfection
Ballasted
Flocculation/Clarification
(CoMag)
Secondary
Clarifiers
Cady Brook
Tighe&Bond

PLANT OVERVIEW

- **RBCs – 4 Stage**



PLANT OVERVIEW

- **2009 Upgrade Design Capacity**

	Avg	Max Month
– Design Flow	0.45	0.675 MGD
– Current Flow	0.21	0.31 MGD (about 46% of design flow)
– BOD Load	1,032	1,435 lbs/day (about 55% loaded)
– Ammonia Load	189	295 lbs/day (about 50% loaded
– TKN Load	311	506 lbs/day (about 40% loaded)*

- **Basis**
  - Flow & Load are Equalized (EQ tanks)
  - 10 RBCs in Service
  - Treatment Effect from MLSS in EQ Tanks
- **Typical Operations**
  - 2 RBCs needed repair
  - 6 RBCs in service to Jan 2016
  - 7 RBCs in service to Jan 2018
  - 8 RBCs since Jan 2018

* Limited Data on TKN.

EVENTS THAT LEAD TO THE STUDY

- **2017 – Permit Violations – NH_3 (>> 1.42 mg/L)**
  - 8.8 mg/L - Columbus Day (collected Tuesday 7 AM)
  - 2.52 mg/l - Week Prior
- **Why Did this Happen?**
  - Was there a loss of Alkalinity ?
    - Recently Started Dosing Manually – No Smoking Gun
  - Did New BOD Loads from Brewery impact Capacity?
  - Did a Holiday Rush Overload Plant (7 RBCs) ?
    - Influent BOD Loads prior Monday much higher
    - TKN was typical both weeks
    - Could a BOD Overload impact the nitrifiers on RBC?

BREWERY WAS NOT FOCUS OF STUDY

- **No Problems Prior**
- **End of Summer Busy Season**
- **Estimated Loads**
  - 7,000± gpd BOD @ 1,500 mg/l = 90 lbs/day (< 10% of Plant)
- **Recent Brewery Improvements**
  - Recently Installed a 15,000 gallon EQ tank
  - Switching from Batch to Continuous Discharge
  - Investing in Aquapoint Pretreatment System

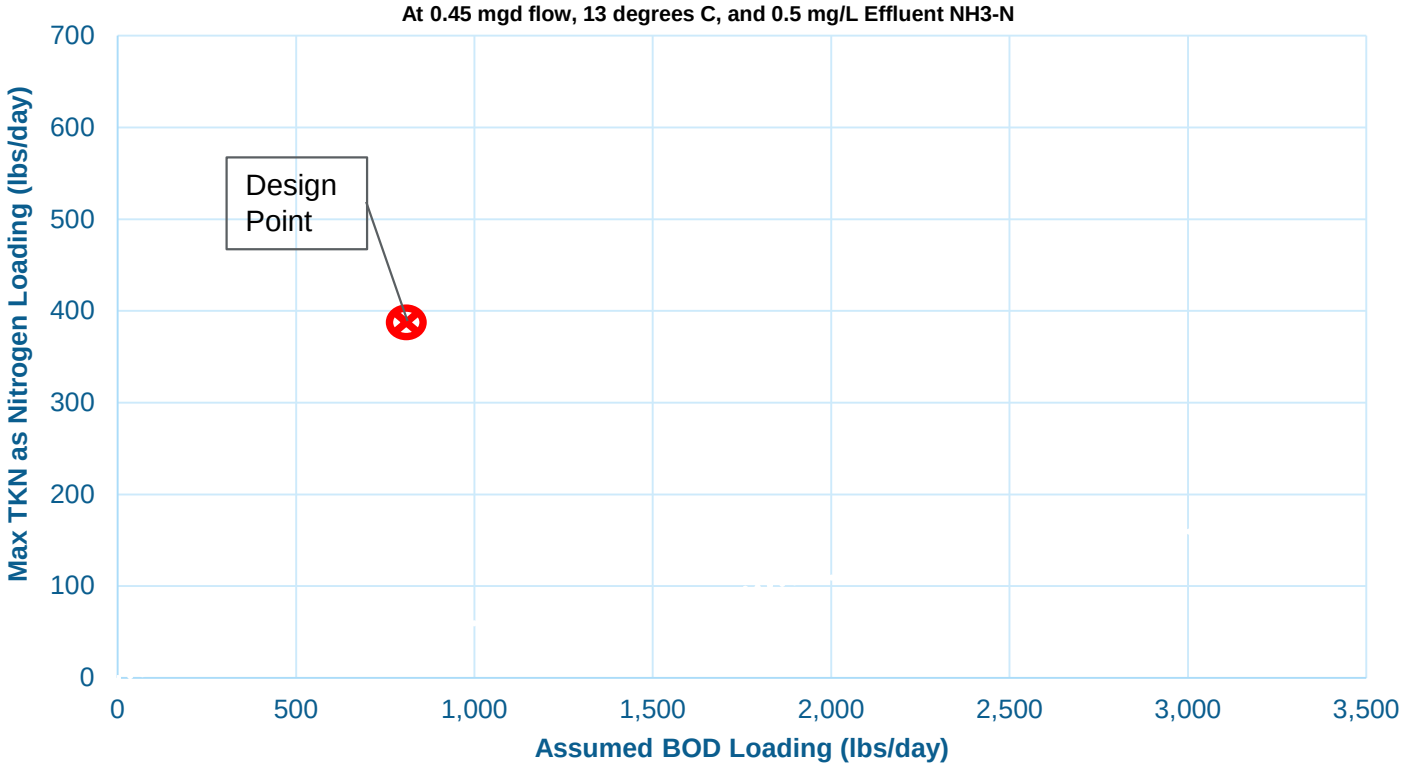
STUDY GOALS

- **Complete a Maximum Headworks Loading Analysis**
  - What was actual Plant Capacity?
  - How does it change?
- **Factors Considered**
  - BOD vs TKN/Ammonia Treatment Capacity
  - # of RBCs on line
  - Season (water temperature)
  - EQ Tank Operations
    - MLSS Concentration
    - Operating Levels
    - Air Delivered

RBC Prior to Covers

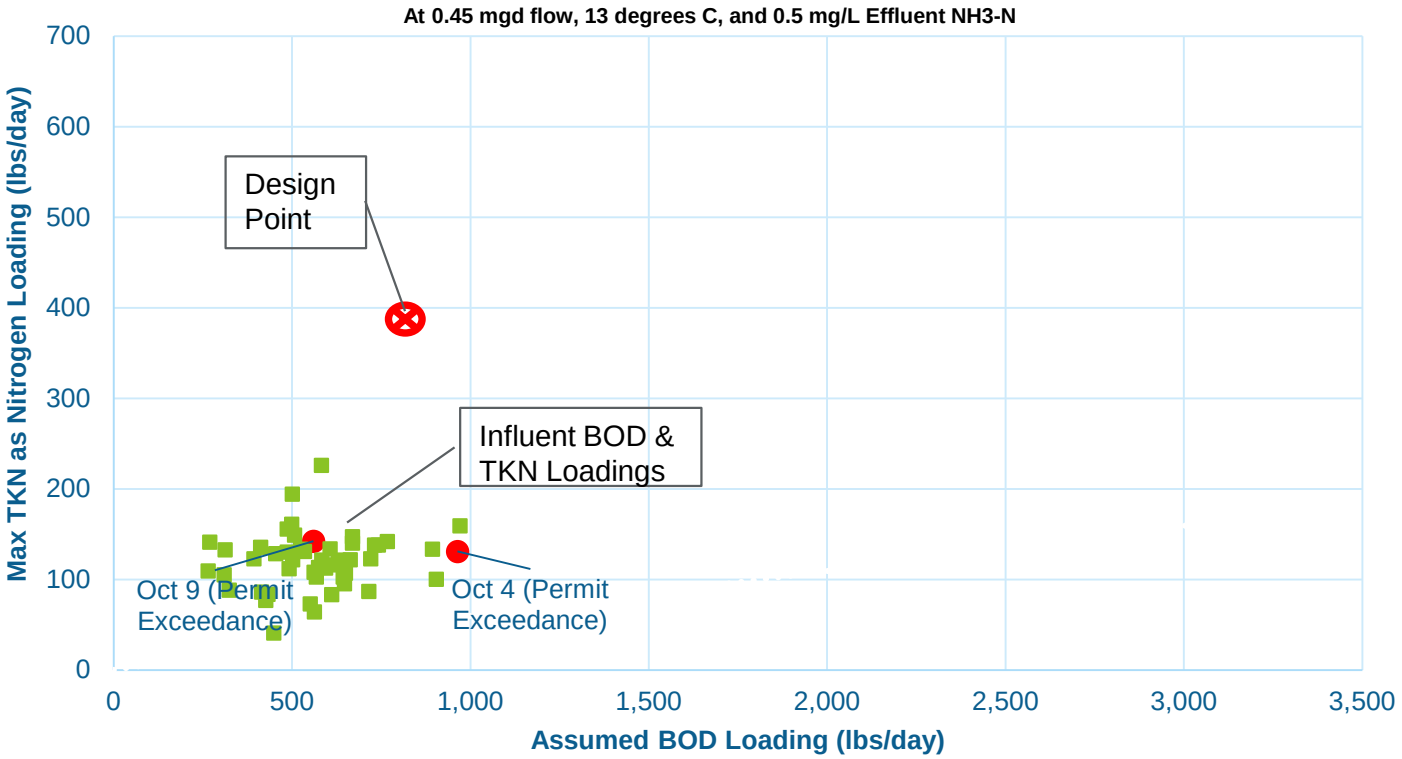
CHARLTON, MA HEADWORKS LOADING

10 RBCs; Summer Conditions

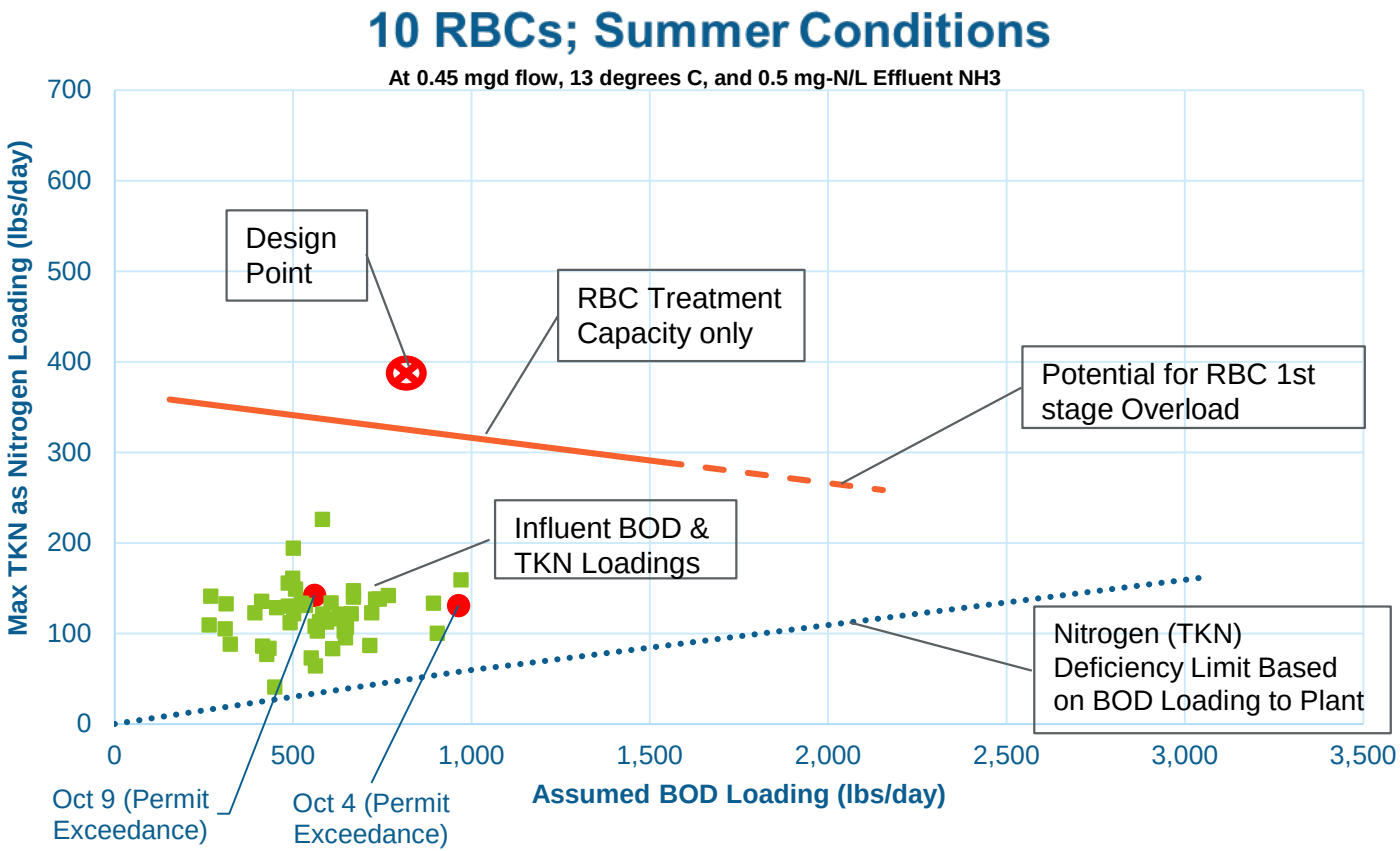


CHARLTON, MA HEADWORKS LOADING

10 RBCs; Summer Conditions

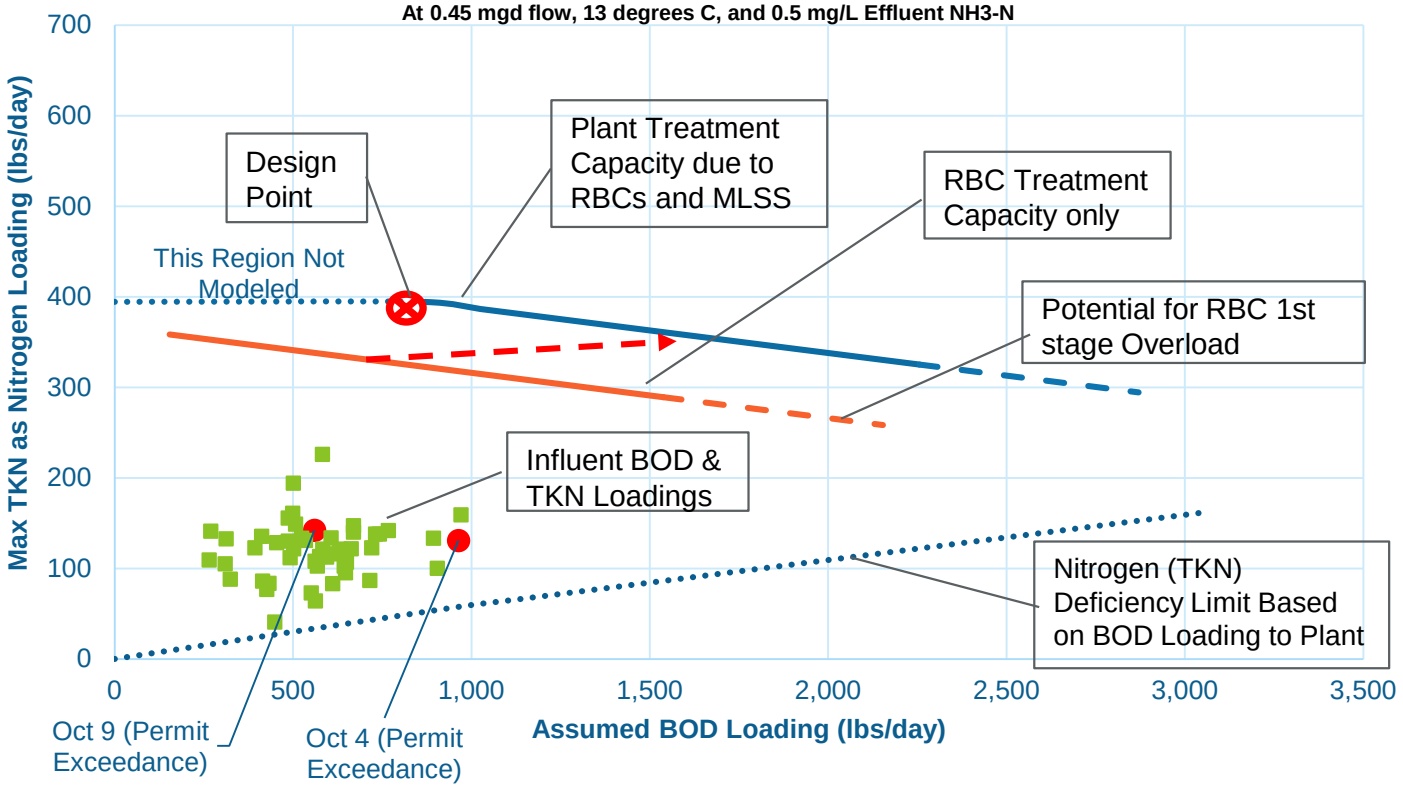


CHARLTON, MA HEADWORKS LOADING



CHARLTON, MA HEADWORKS LOADING

10 RBCs; Summer Conditions

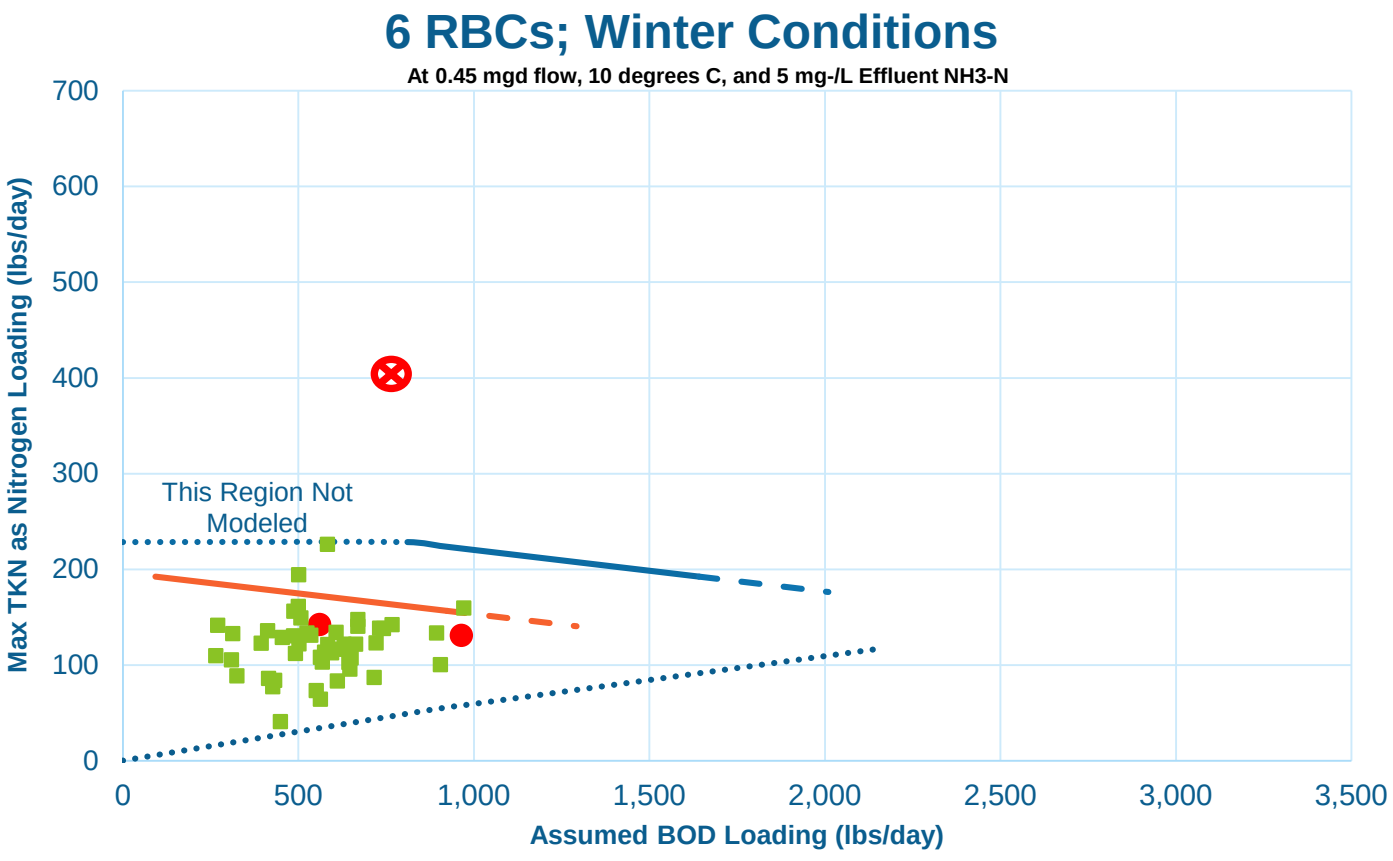


Tighe&Bond

STUDY RESULTS

- **Provided Multiple Capacity Charts:**
  - Different # of RBCs in Service
  - Winter/Summer Seasons
  - Assumed EQ Tank Operations
    - Typical levels in Past (4-5.5 feet)
    - Existing Aeration Blower Capacity (4 @ 180 SCFM)
    - Typical MLSS Levels (3,500-4,000 mg/l)

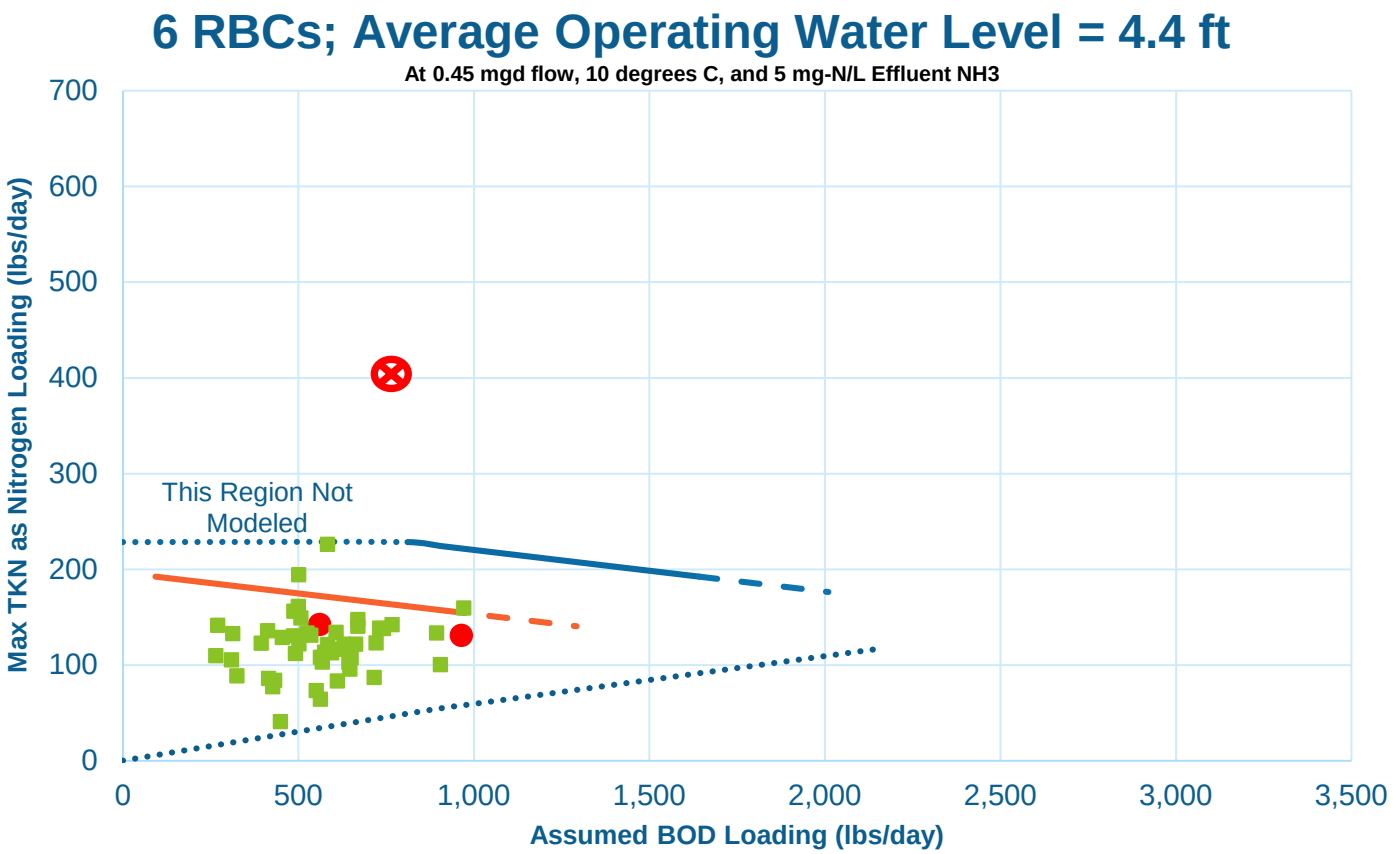
STUDY RESULTS



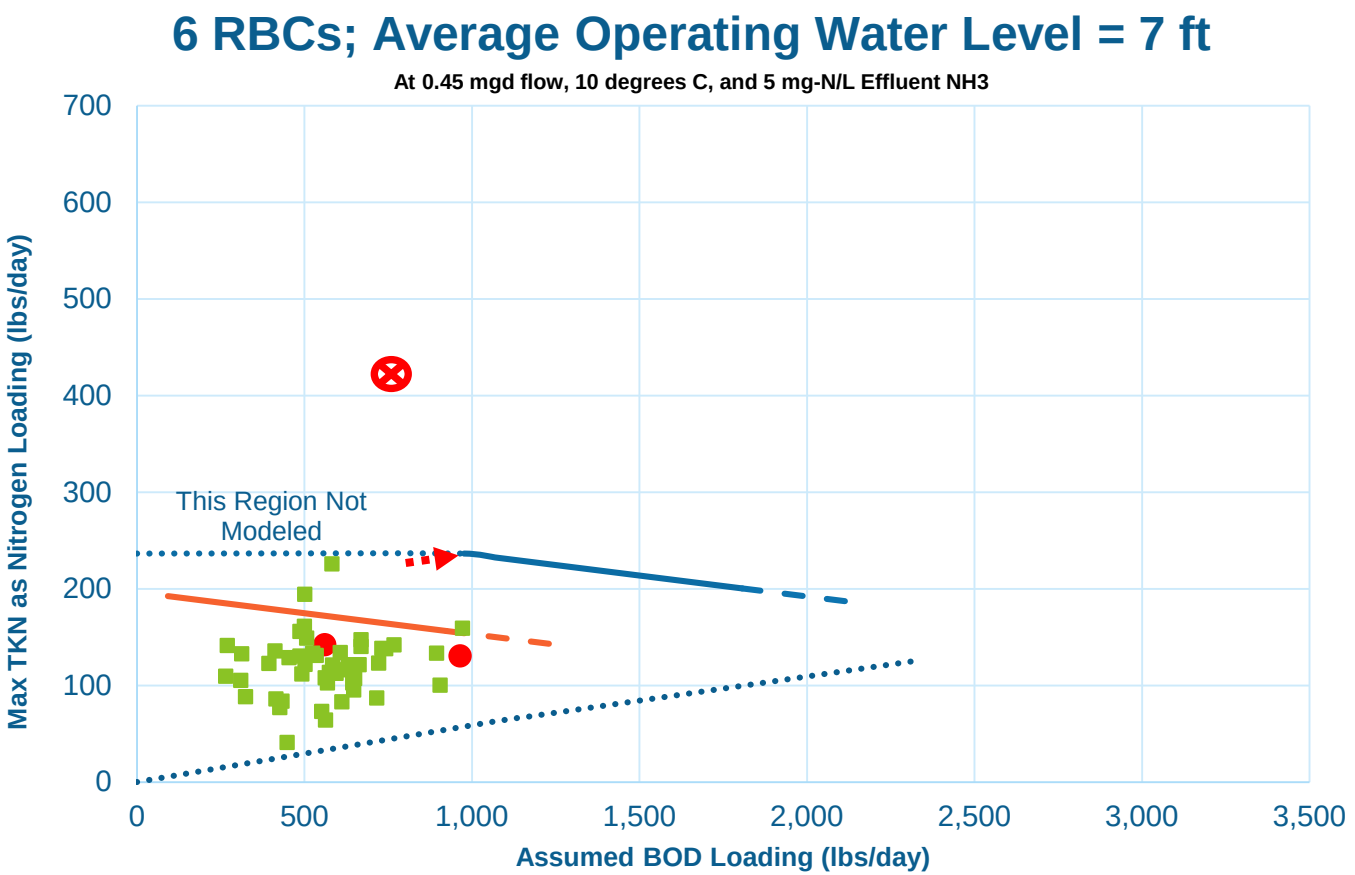
STUDY RESULTS

- **Sensitivity Analysis on EQ Operation:**
  - EQ Tank
    - Modify Pumping Controls
      - Increase Lower EQ Tank Operating levels (7+/- feet)
    - Was MLSS Optimized
      - Clarifier Capacity?

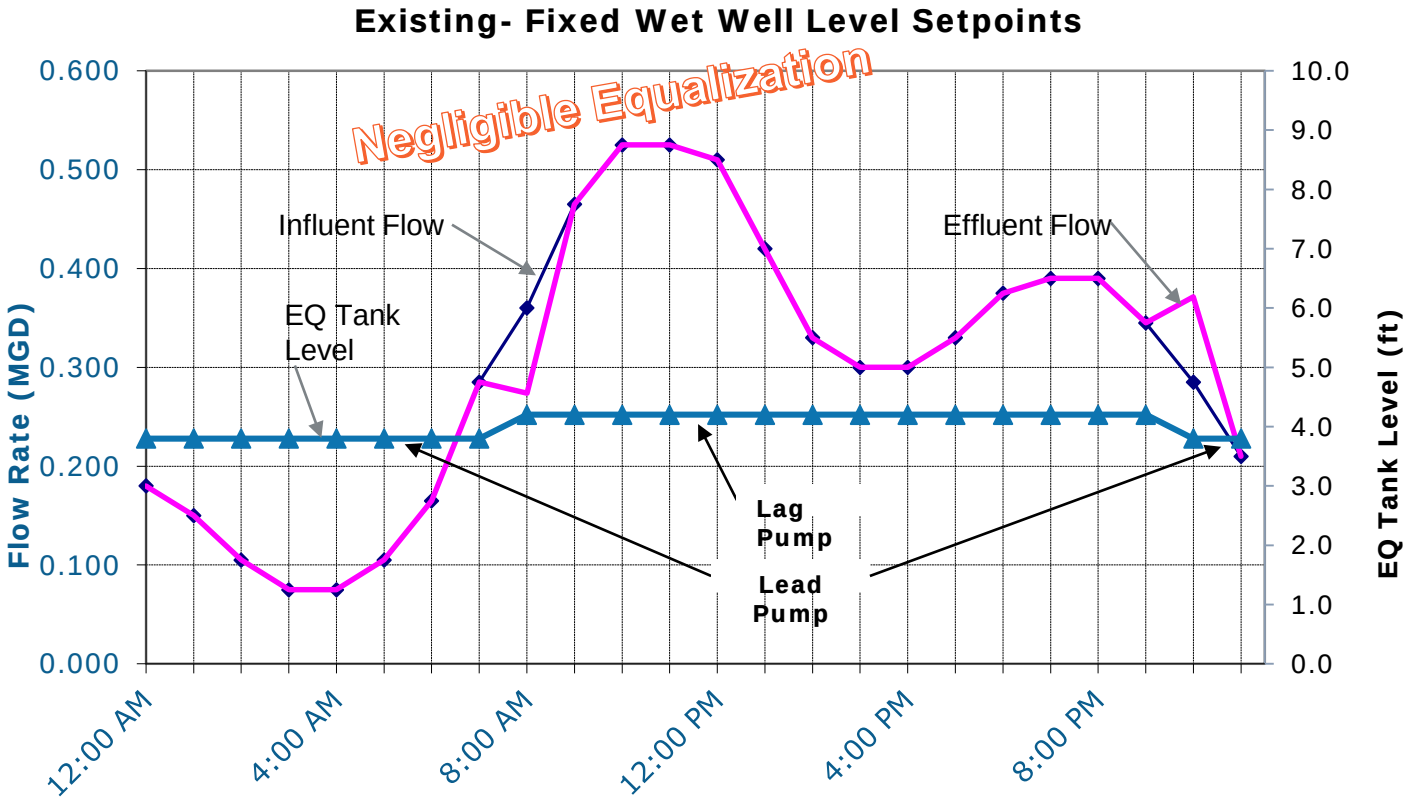
STUDY RESULTS



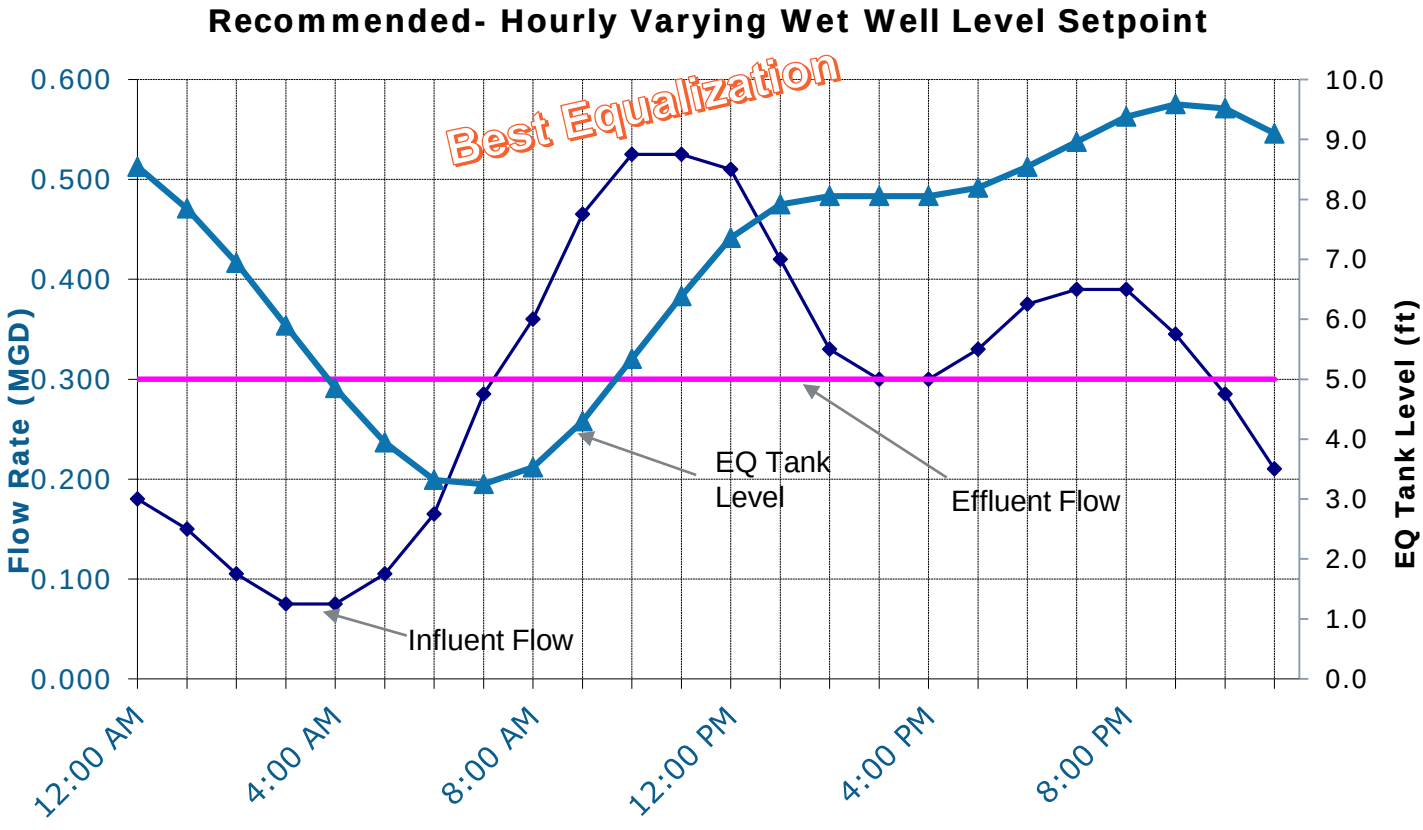
STUDY RESULTS



STUDY RESULTS- EQ TANK OPERATION

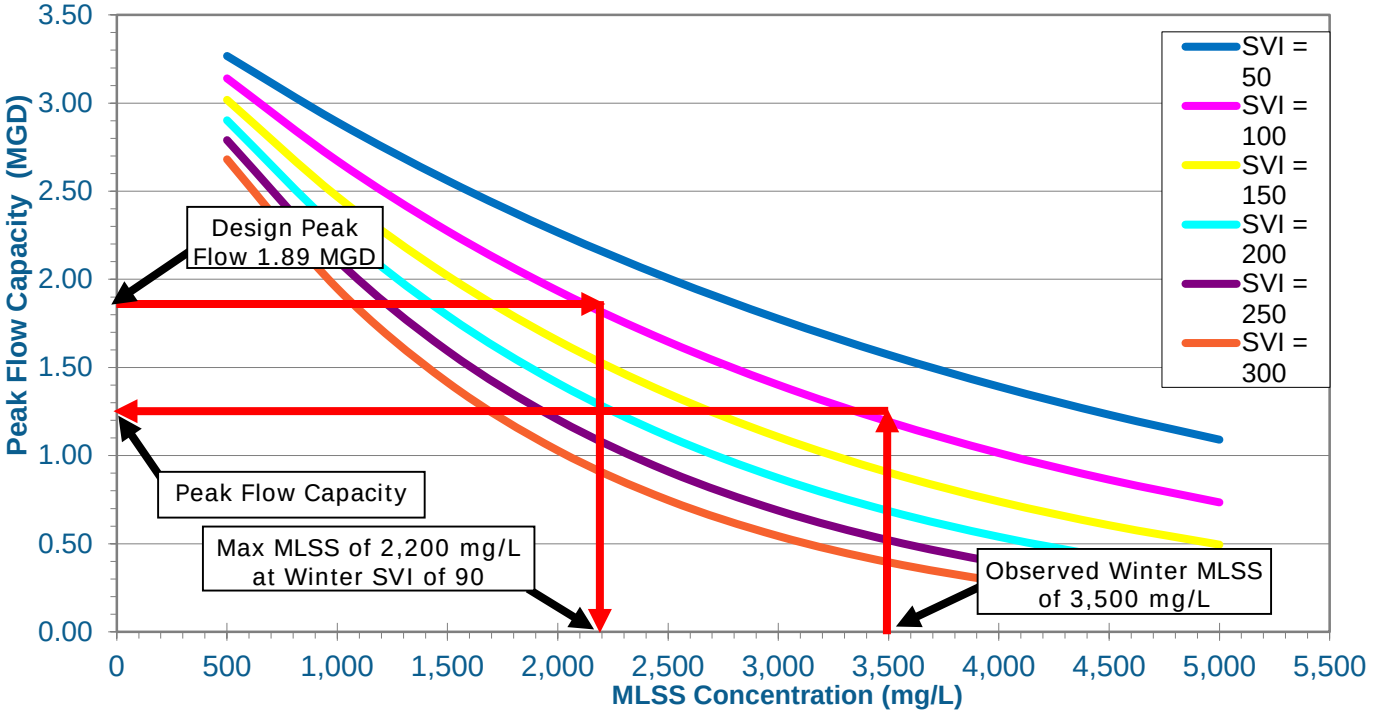


STUDY RESULTS- EQ TANK OPERATION



STUDY RESULTS

- **Clarifier Capacity & EQ Tank Operations Limit Max MLSS. (Capacity Diagrams)**



SAMPLES COLLECTED FOR MICROBIAL ECOLOGY SURVEY*

- **MLSS Samples**
  - Nitrifiers: 0.06% abundance Nitrosonomas (Very Low)
  - PAOs: 4 % abundance Dechloromonas
- **RBC 1st Stage Fixed Film Samples**
  - Nitrifiers: 1.1% abundance Nitrosospira (Low)
  - PAOs: 10 % abundance Dechloromonas

*Center for Microbial Communities
3/18-6/19 study facilitated by
(Prof. Nick Tooker

UMass Amherst

AALBORG UNIVERSITY
DENMARK

SAMPLE COLLECTION FOR MICROBIAL ECOLOGY SURVEY

- **Conclusions:**
  - Confirmed EQ Tank MLSS Model:
    - Is helping: BOD removal
    - Not helping: Ammonia removal.
- **New Questions (Not answered)**
  - Is abundance of PAOs due to alternating anoxic/anerobic then Oxic conditions?
    - Anaerobic? in EQ tank then Oxic at RBCs
    - Anaerobic? In RBC Media Underwater, Oxic in Air
  - No evidence luxury uptake P was being performed
  - Can chemical usage be reduced?
    - Anaerobic Tank prior to EQ tanks
    - Would need RDT to thicken sludge (No Decant)

PLANT CHANGES SINCE STUDY

- **Repaired Original 2 RBCs**
  - Repaired leak in steel tanks
- **EQ Tank Operations**
  - Inspected Tanks (Covered) – Repaired Diffusers
  - Operating at Higher EQ Tank Levels
  - Considering Increasing Blower Size
- **No Violations**

Tighe&Bond
Engineers | Environmental Specialists

Acknowledgements
Steve Wandland - Charlton Water & Sewer
John Oatley – Veolia
Keith Labbe – Veolia

Frederick Mueller, PE
Tighe & Bond, Inc
213 Court Street
Middletown CT 06457
P: 860-704-4768
E: famueller@tighebond.com

Peter Boria
Charlton Water & Sewer
37 Main Street
Charlton, MA 01507
P: (508) 248-2225
E: Peter.Boria@townofcharlton.net

THANK YOU

Tighe&Bond

Engineers | Environmental Specialists