PHOSPHORUS REMOVAL AT AN SBR PLANT

Plainville, CT

Paul Moran, PE

Tighe&Bond

1. PROJECT DRIVERS

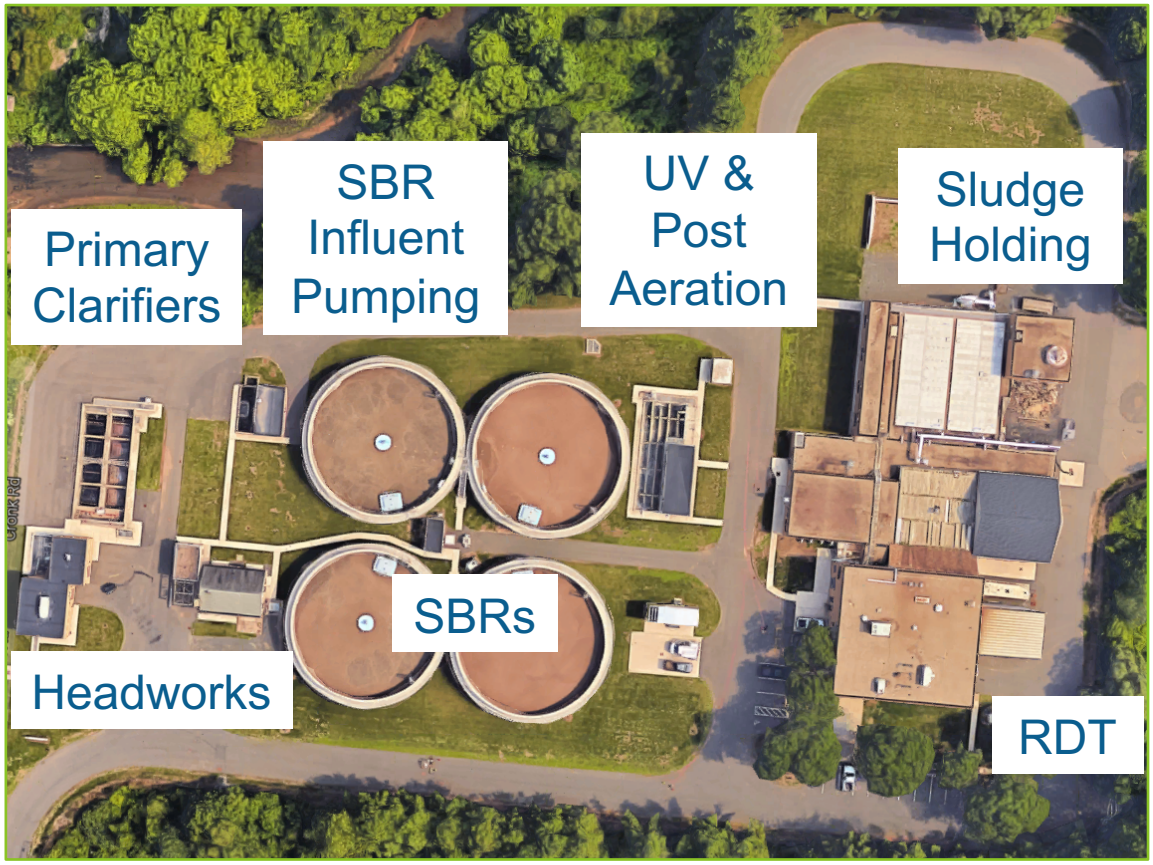
2. PHOSPHORUS REMOVAL PLAN

3. IMPLEMENTATION

STARTING CONDITIONS

- **Flows (MGD)**
  - Current avg: 2.0
  - Design avg: 2.6
  - Max Day: 6.0
  - Peak Hour: 7.5

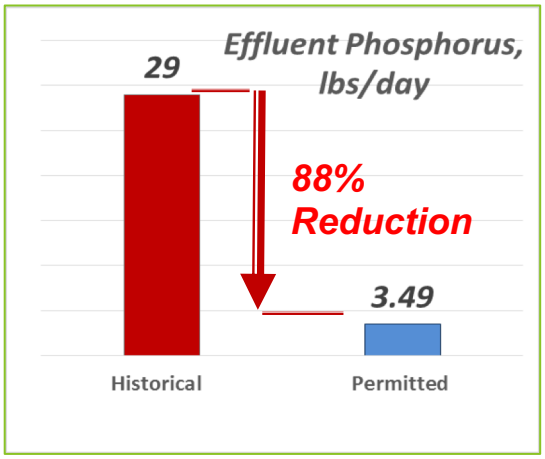
- **’06-‘10 Upgrade**
  - New SBRs
  - New UV System
  - Sludge Tanks
  - Nitrogen Removal



- **No Provisions for Phosphorus**

NEW PHOSPHORUS LIMIT

- **CT DEEP Phosphorus Strategy**
  - Published in 2011
  - 3.49 lbs/day Apr – Oct
    - 0.16 mg/l at plant design flow rate (2.6 mgd)
    - 0.11 mg/l at permitted flow rate (3.8 mgd)



- **Final NPDES Permit**
  - Issued June 20, 2015
  - Phosphorus Removal Deadline: July 10, 2019
  - DEEP suggested future limits may be lower
    - Design for 0.10 mg/l

TR-16 UPDATE: FLOOD RESILIENCY

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- Cr
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    f

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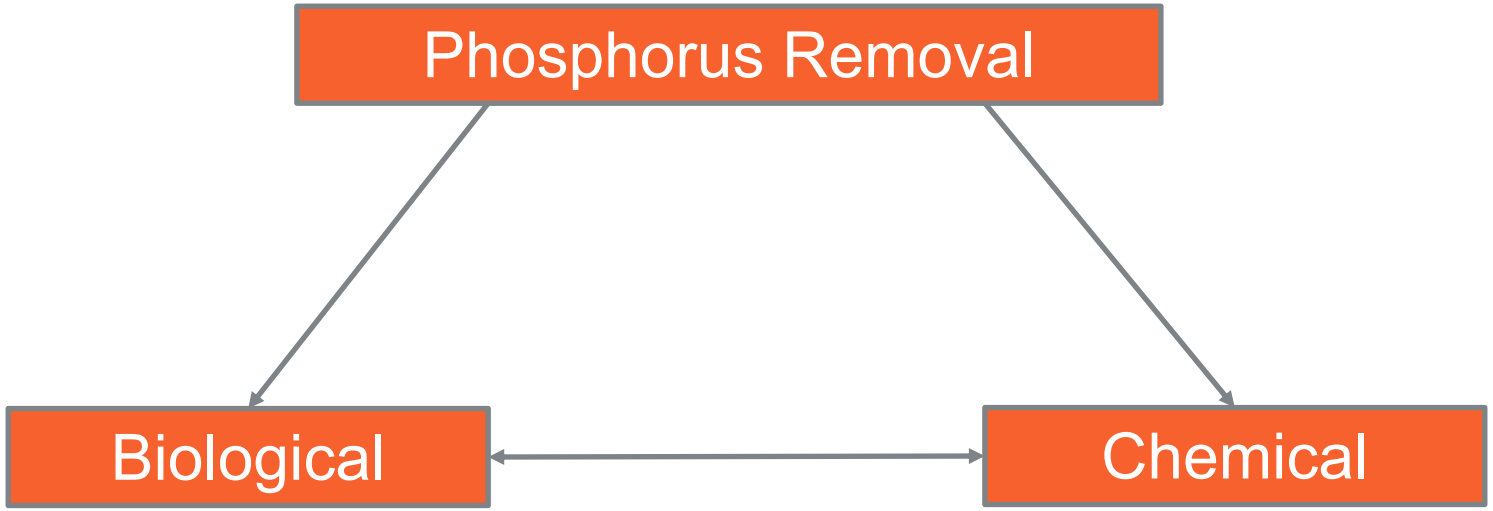
PHOSPHORUS REMOVAL OVERVIEW

1. **Make it Solid**

2. **Remove the Solid**



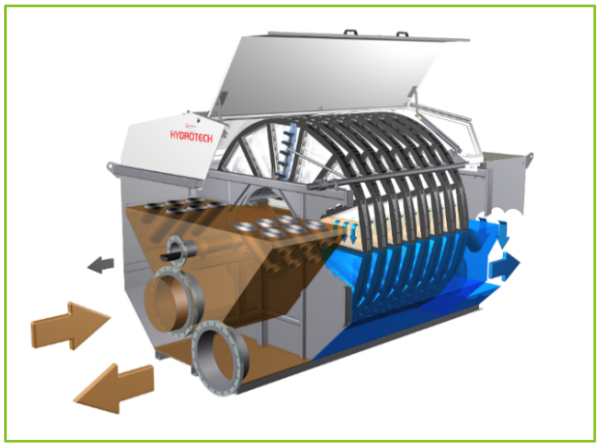
TYPICAL APPROACHES

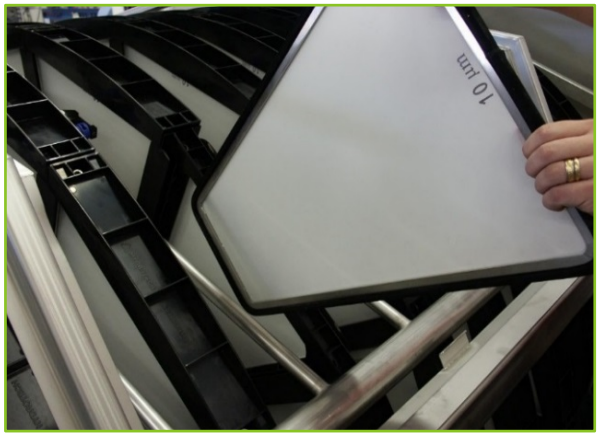
- **For Moderate Level of P Removal (to 0.5 mg/l)**
  - Enhanced Biological Phosphorus Removal (EBPR) and/or Chemical
- **For Lower Level of P Removal (to 0.2 mg/l)**
  - Above with more chemical
  - Tertiary clarification or filtration (remove the solids)
  - Some facilities have demonstrated <0.2 mg/L with only EBPR and good clarification/filtration
- **For Lowest Levels of P Removal (<0.2 mg/l)**
  - Advanced treatment/solids removal
  - Often with biological and/or chemical upstream of advanced treatment so that influent phosphorus <1.0 mg/l
  - Greater control of chemical process

SELECTED APPROACH

- **Upstream: to 1 mg/l**
  - Options:
    - EBPR
    - Chemical Addition
      - Primary Clarifiers
      - SBRs
      - Recycle Stream
  - **Selected:**
    - **Make some provisions for EBPR**
    - **But count on Multi-Point Chemical Addition**

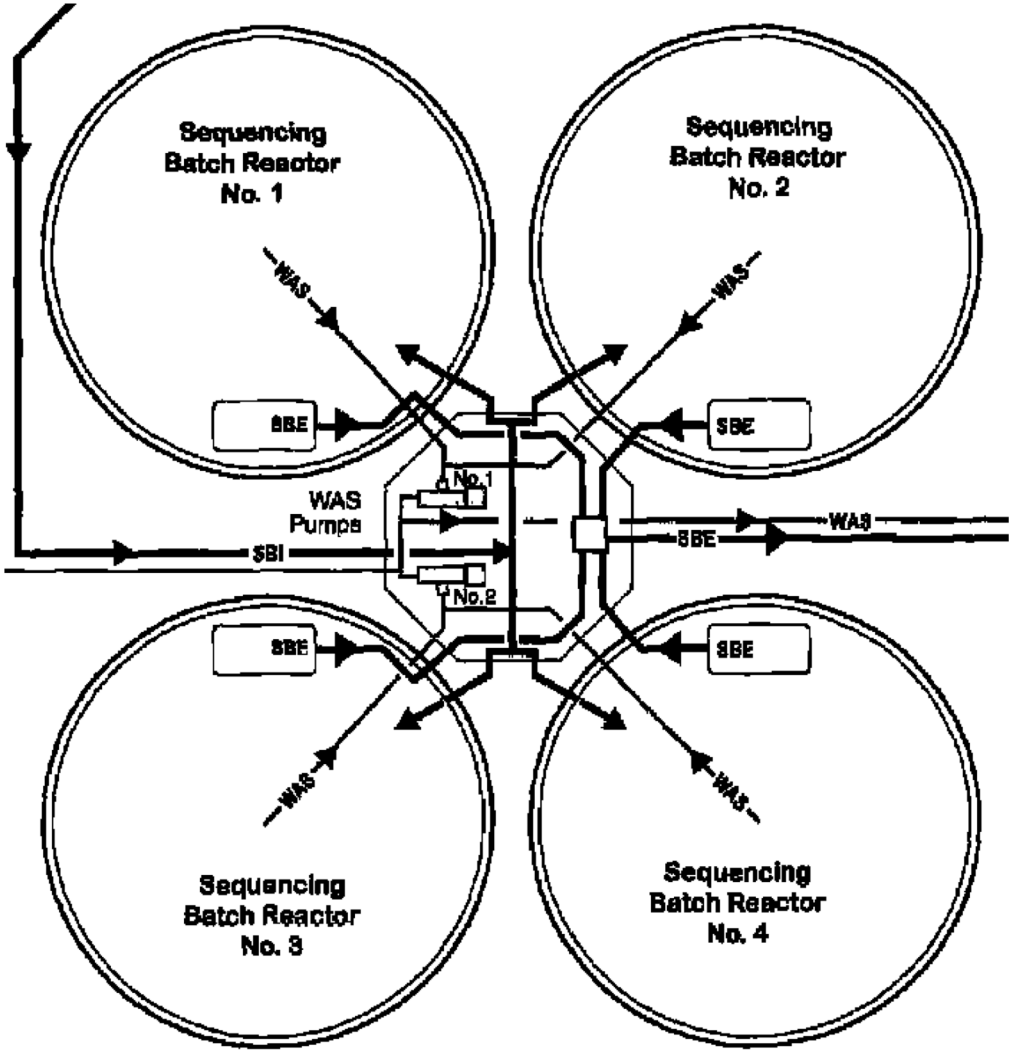
- **Tertiary: to 0.1 mg/l**
  - Options:
    - Ballasted Flocculation
    - Deep Bed Sand Filtration
    - Discfilters
  - **Selected: Discfilters**





THE CHALLENGE: SBR'S

- **Entire Aeration Train Occurs in 1 Tank!**
  - Anaerobic
  - Anoxic
  - Aerobic
  - Settling
- **Fill 1 Tank At A Time**
- **Empty 1 (2?) Tanks At A Time**



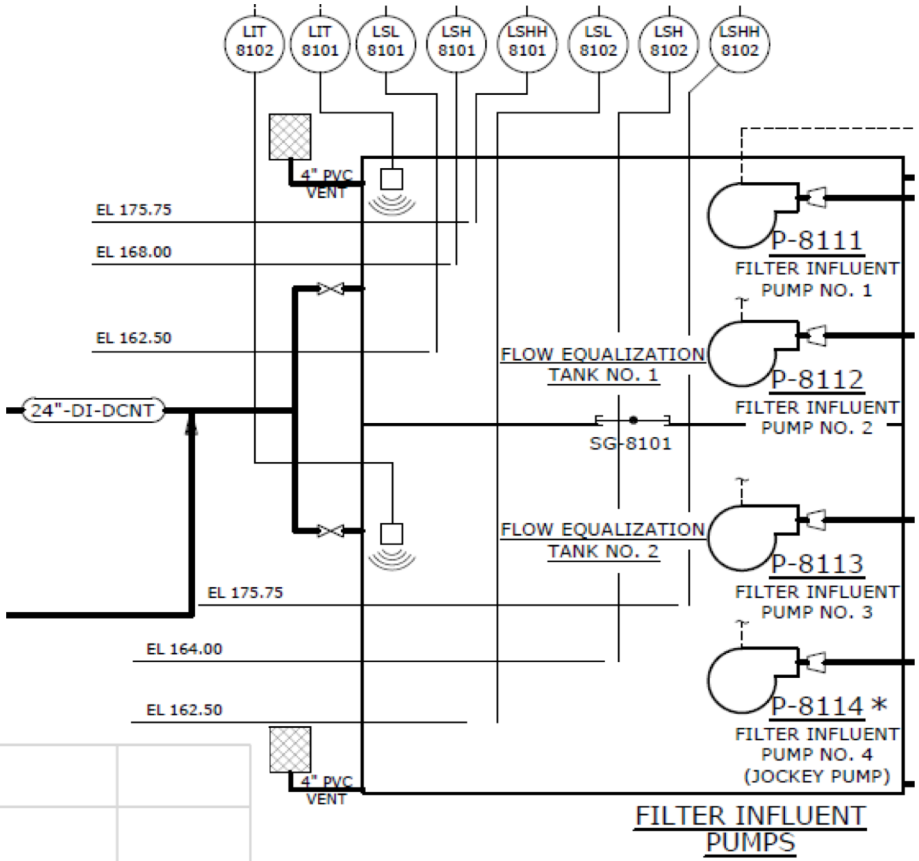
SBR CHALLENGE: BATCH CHEMICAL

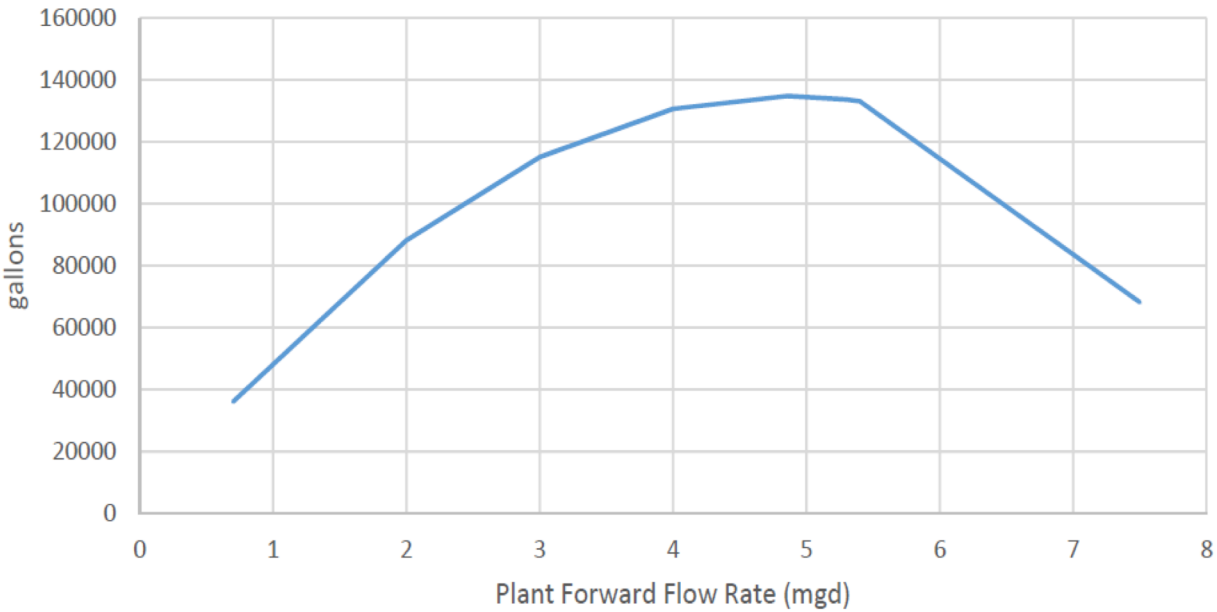
- **Conventional Activated Sludge System:**
  - Add chemical before settling
  - Simple flow pace
- **SBR system:**
  - Not just where – but *when* do you batch?
    - Influent, before splitting and aeration?
    - SBR, timed before settling?
  - How quickly?
  - Will it mix well enough?
- **Solution: dump a bucket of chemical at just the right time**

SBR CHALLENGE: BATCH DECANT

- **Original Design:**
  - Modulating valves to equalize flow
  - Too difficult to tune – never worked
- **Actual Conditions:**
  - Decant at constant valve open
  - Starts fast and slows down as water level drops
  - No flow for 20-30 minutes between decants
- **Phos Removal Needs:**
  - Steady influent flow
  - Consistent chemical dose
  - Stable mixing

SOLUTION: A FLOW EQUALIZATION TANK





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SBR CHALLENGE: STORM MODE

- **Storm Mode:**
  - SBRs sized for Max Day of 6 mgd
  - Design Peak Hour is 7.5 mgd
  - SBRs must not overfill!
  - SBR Influent wetwell must not flood!
  - If “filling” SBR is full, SBR must start filling another SBR.
  - Programmed to short-cycle and decant early if necessary
- **The challenge:**
  - If one SBR decants early, then 2 are decanting at the same time!
  - Instead of 6 mgd to Tertiary System, actual peak flow rate is up to 12 mgd
- **Design Filters and UV for 12 mgd?**

SOLUTION: A BIGGER FLOW EQ TANK

+ 12 mgd IN

- 7.5 mgd OUT

x 75 minutes

225,000 gallons

WHAT ABOUT FLOODING?

- Since we're already pumping up to the filters…
- Let's raise the UV system

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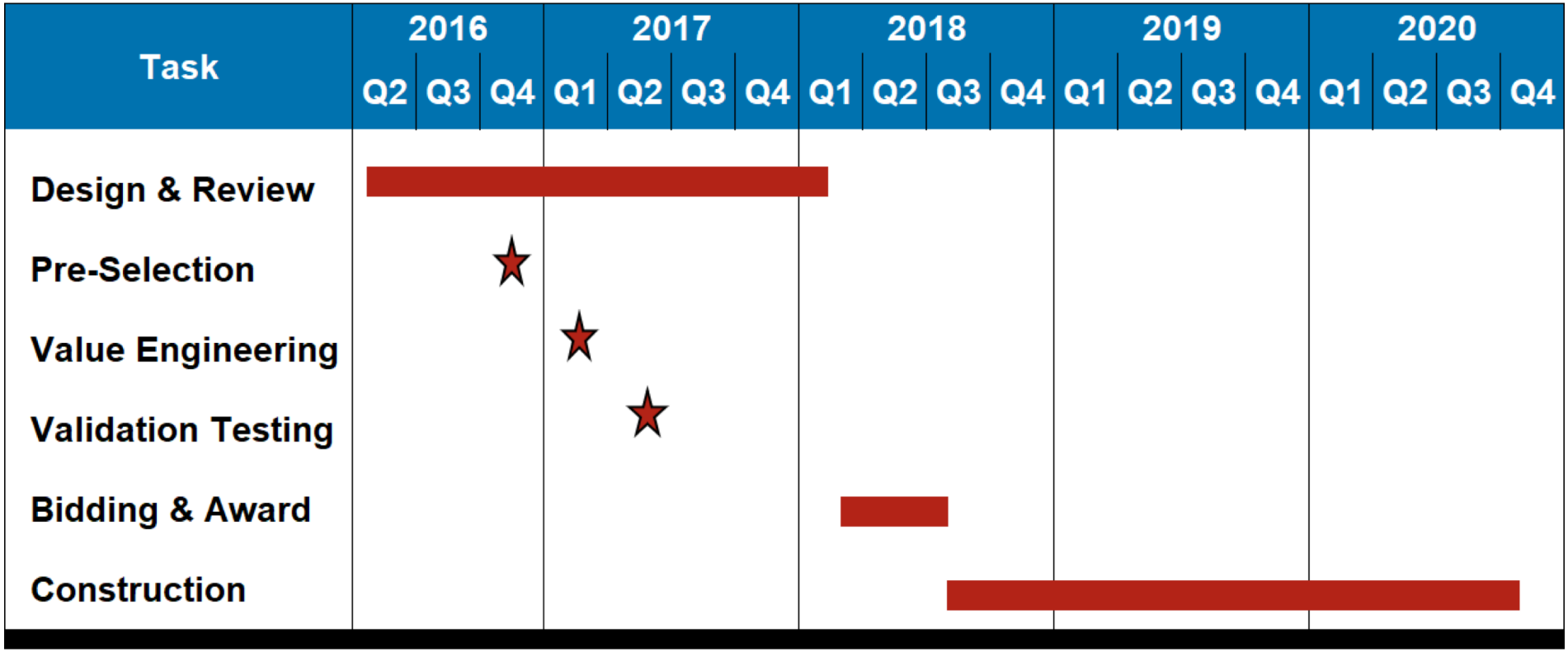
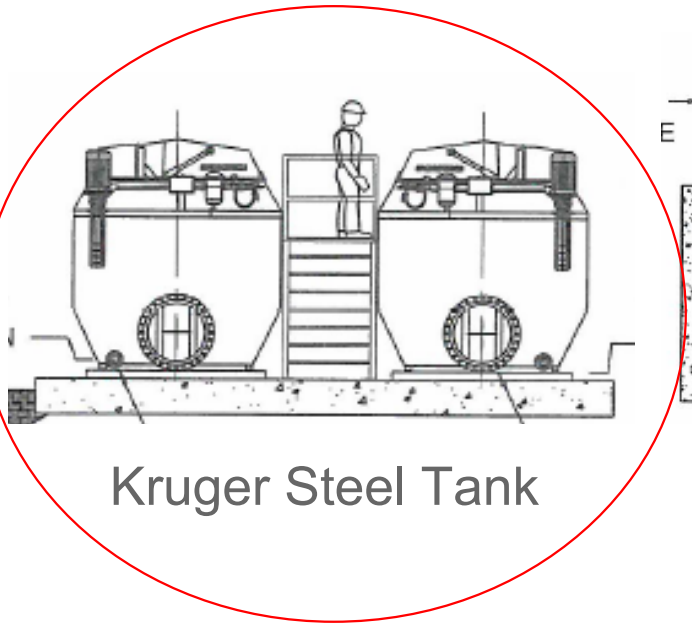
SCHEDULE

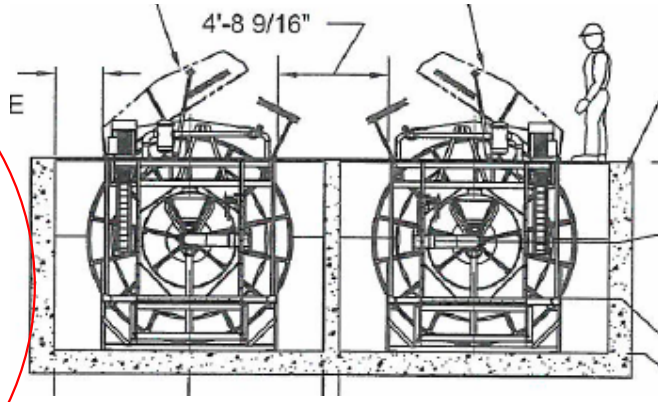

Task
2016
Q2
Q3
Q4
2017
Q1
Q2
Q3
Q4
2018
Q1
Q2
Q3
Q4
2019
Q1
Q2
Q3
Q4
2020
Q1
Q2
Q3
Q4
Design & Review
Pre-Selection
Value Engineering
Validation Testing
Bidding & Award
Construction

PRE-SELECTION

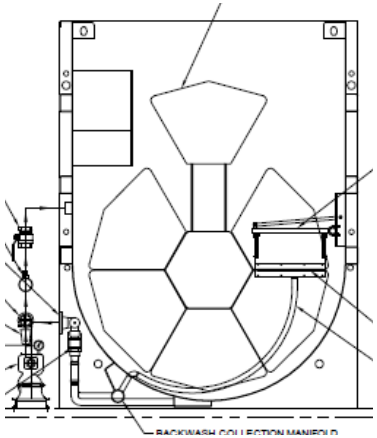
- **Significant variation in discfilter designs**
  - Select manufacturer and style based:
    - Non-monetary factors
    - Total Life-cycle Cost
  - Design building around selected equipment



Kruger Steel Tank



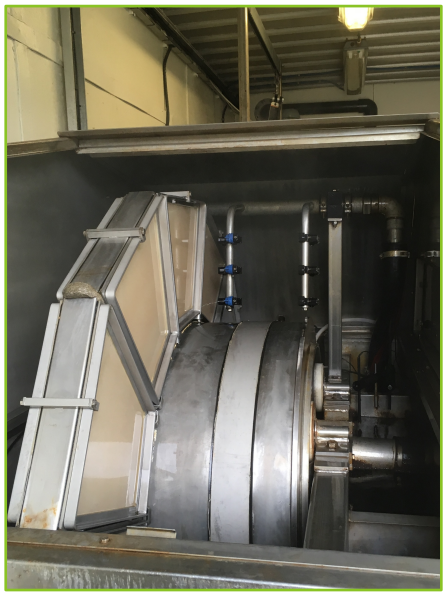
Kruger Concrete



Aqua Steel

SBR CHALLENGE: VALIDATION TESTING

- **Intermittent Influent**
  - 20-30 minute gap between decants
  - Solution: pilot scale Flow EQ Tank
- **Upstream Pre-treatment**
  - Design influent TP: 1.0 mg/l
  - Actual influent TP: 0.7 to 3.0
  - Conventional Plant Solution:
    - Temporary Chem Addition before settling
- **SBR Challenges**
  - Impractical to use timed bucket approach
    - Have to dose SBR influent
  - Each batch is only 5-30% of volume
    - 4.5 batches per day
    - Takes several weeks to reach steady state



CONSTRUCTION PROGRESS

- **Low bid: 5% < budget**
  - $11,164,800
  - Included All Alternates
  - Awarded to Daniel O'Connell's Sons
- **25% complete to date**
- **On track for Substantial Completion 6 months early**
- **Filter test: 10/19**

QUESTIONS?