# Challenges in Upgrading One of the Last Municipal Powdered Activated Carbon/Wet Air Oxidation Plants in the U.S to achieve Low Level Nutrient Removal


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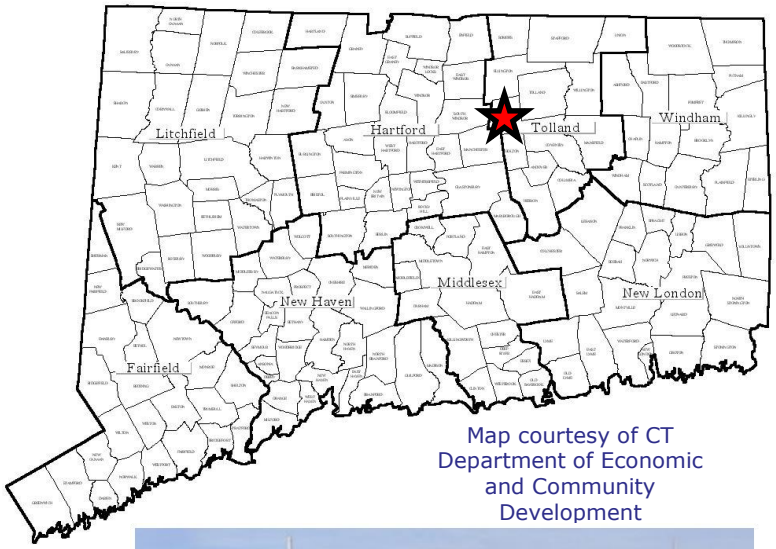
# Overview

- Plant Overview
- Nutrient Permit Drivers
- Unique Plant Operations
- Upgrade Plan
- Challenges & Construction Status

# Treatment Plant Overview

- **Located North Central CT**
  - Hockanum River -> CT River
- **Plant Design Capacity**
  - 7.1 MGD Average Day
  - Average @ (Now → 20 yrs.)
    - Flows @ 42% → 70%
    - Loads @ ~48% → 75%
- **Treat for BOD, TSS, Color, & Ammonia Removal)**
  - Zimpro PAC WAR




Map courtesy of CT Department of Economic and Community Development

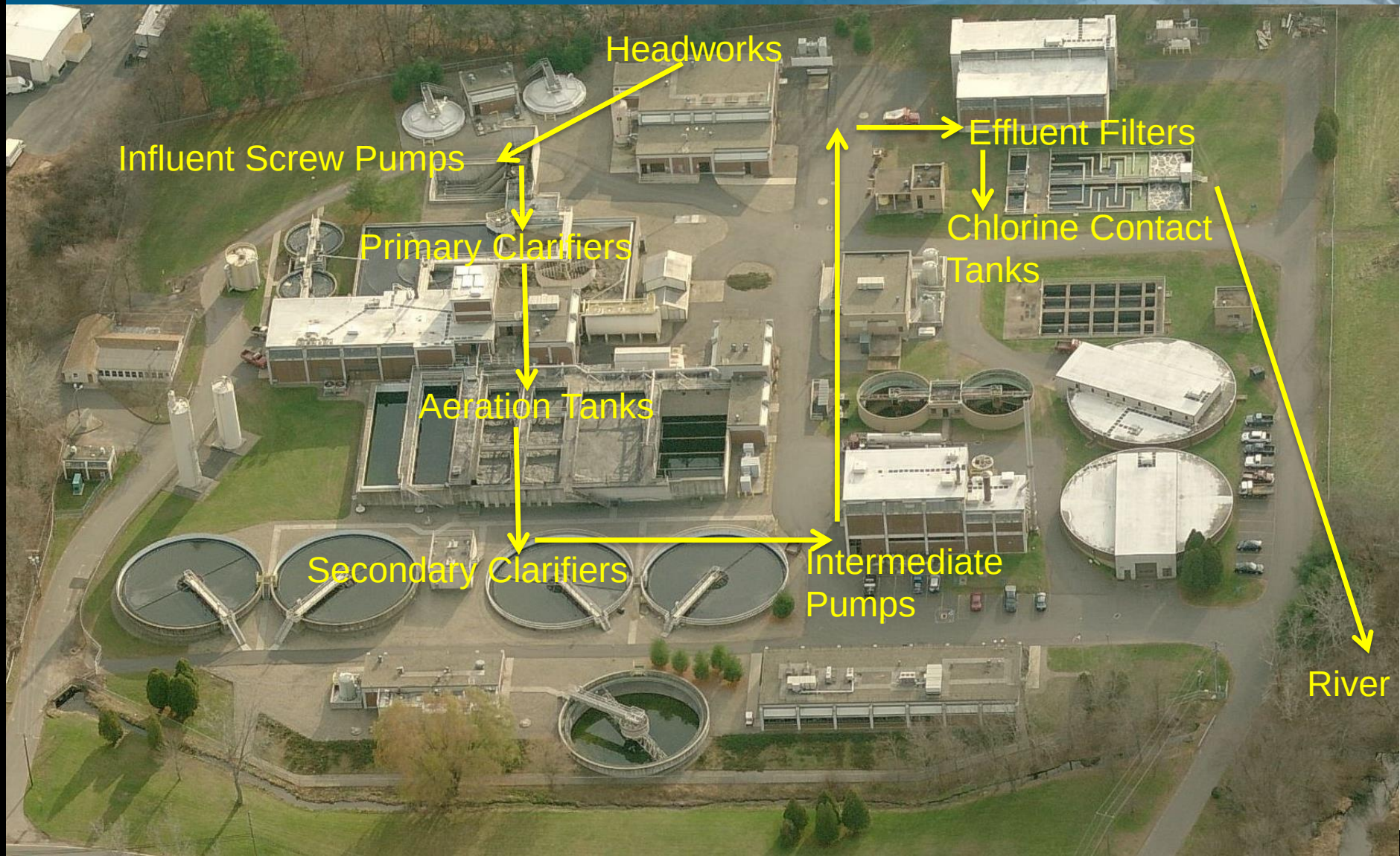
# Treatment Plant Upgrade Plan

- **2017 Facilities Plan**
  - Color No Longer a Concern
  - Nitrogen – 400  to < 184 lbs/day
  - Phosphorus – 93 to < 4.5 lbs/day
  - Modernize the Plant
  - Go from 8 to 2 Substations
  - Go from 2 to 1 Generator
  - Eliminate Zimpro System
  - Go Three to One Shift Operation
  - Reduce Operating Cost

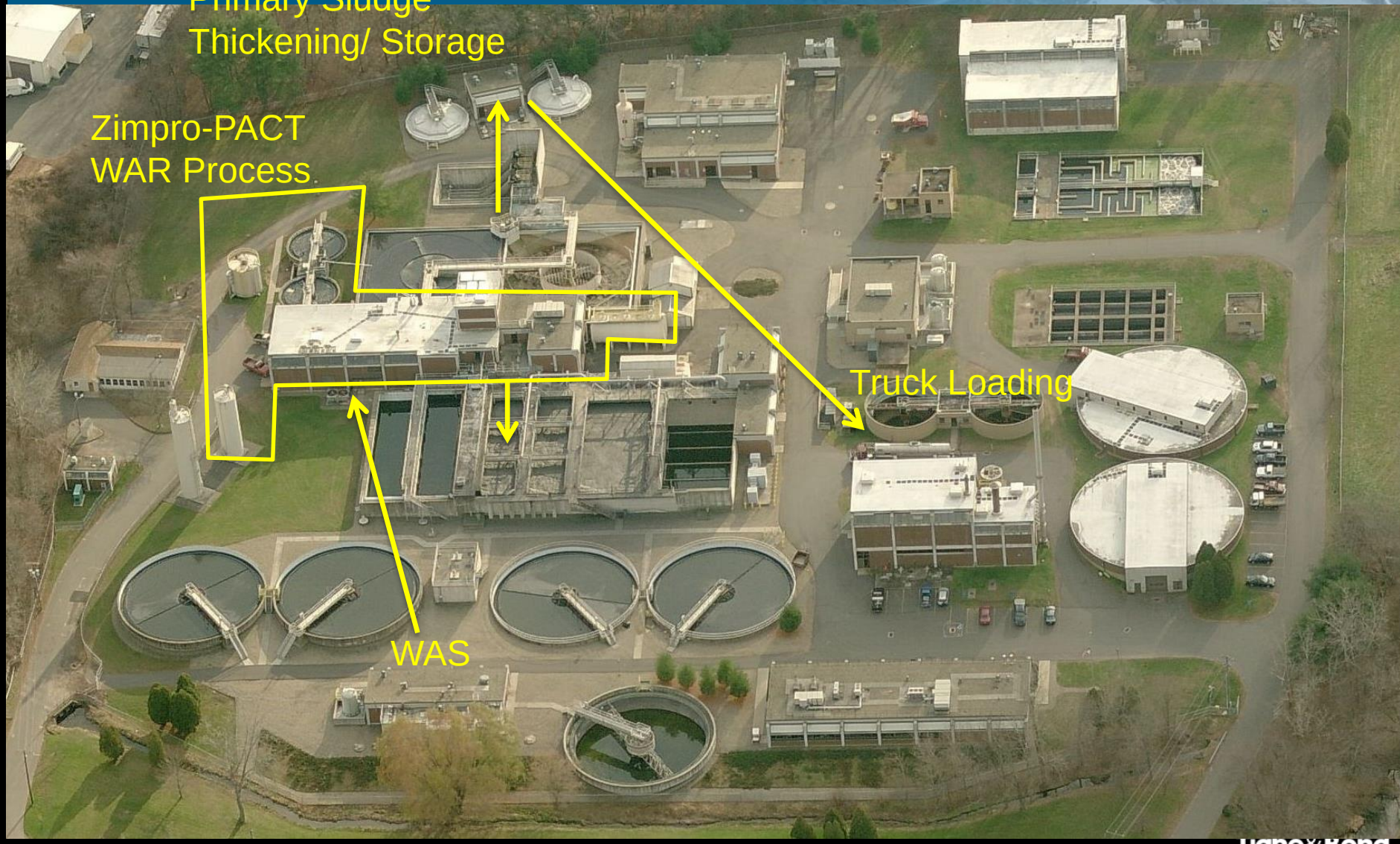
  (2018 NEWEA Presentation)

www.patch.com

# Plant - Liquid Process Train



# Plant - Solids Process Train



# ZIMPRO PACT WAR SYSTEM

- **PACT – Powdered Activated Carbon Treatment**
  - Carbon Adsorbs Color + Hard to Treat Organics
  - Ballasts MLSS  Allows high MLSS levels ~ 12,000 mg/l
    - 20% PAC,  40% Biology, 40% Inerts (Ash)

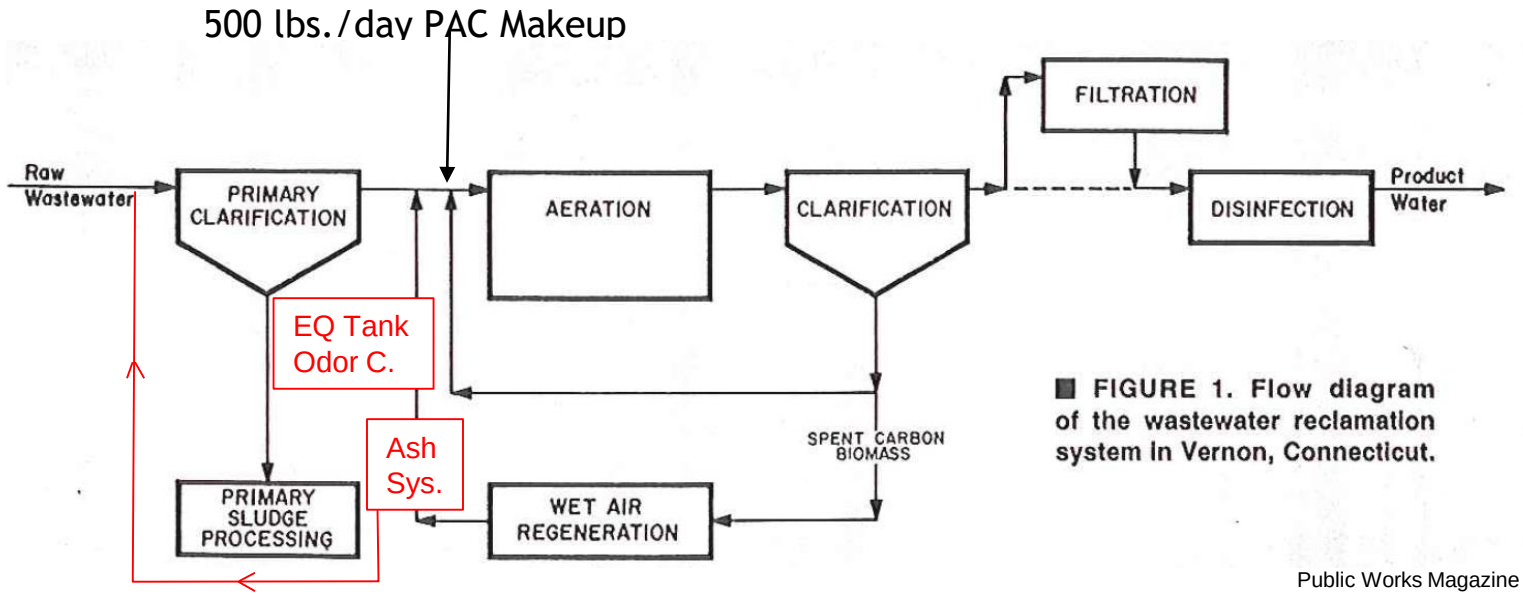
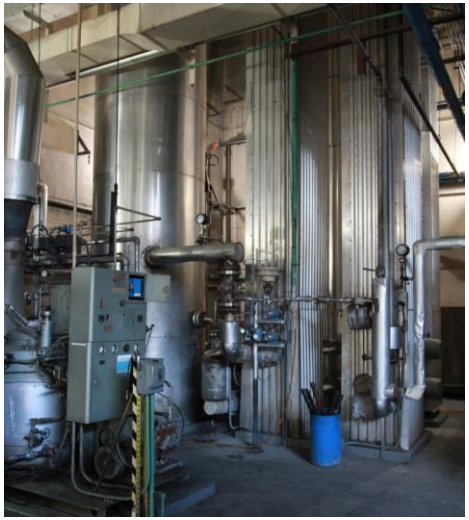



FIGURE 1. Flow diagram of the wastewater reclamation system in Vernon, Connecticut.

Public Works Magazine  1981 - Pitkat

# WAR (Wet Air Regeneration)

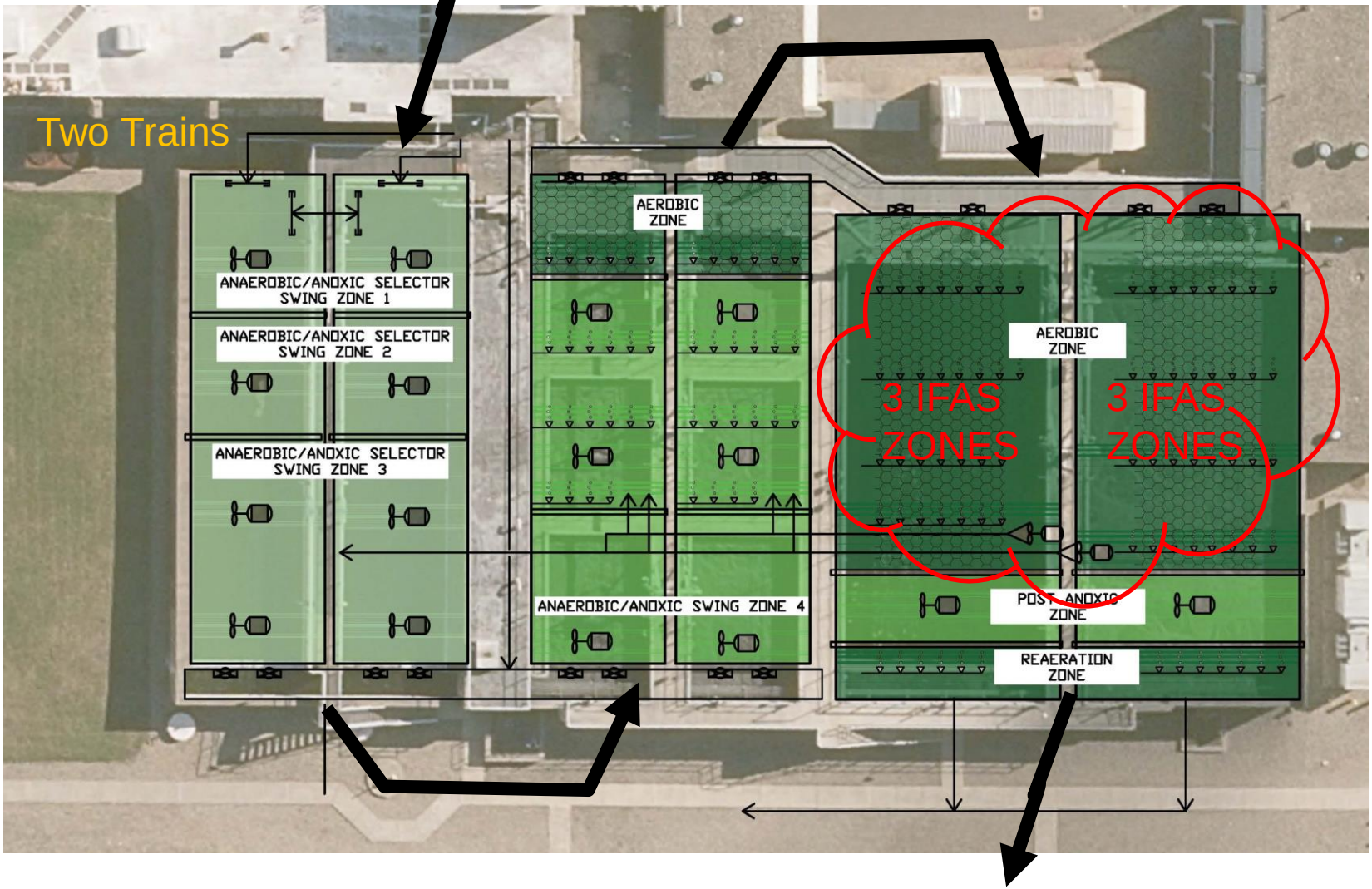
- **High Pressure (800 psi) High Temp (400F) Process**
  - Runs 3 Days /week
  - 3 Shift operation!
  - Regenerates the PAC
  - Mineralizes the Sludge
  - Recycle: High inNH3 & Acetic Acid
  - 13% of Plant Energy Costs
  - $130,000/year Energy
  - No “Secondary Sludge” goes offsite

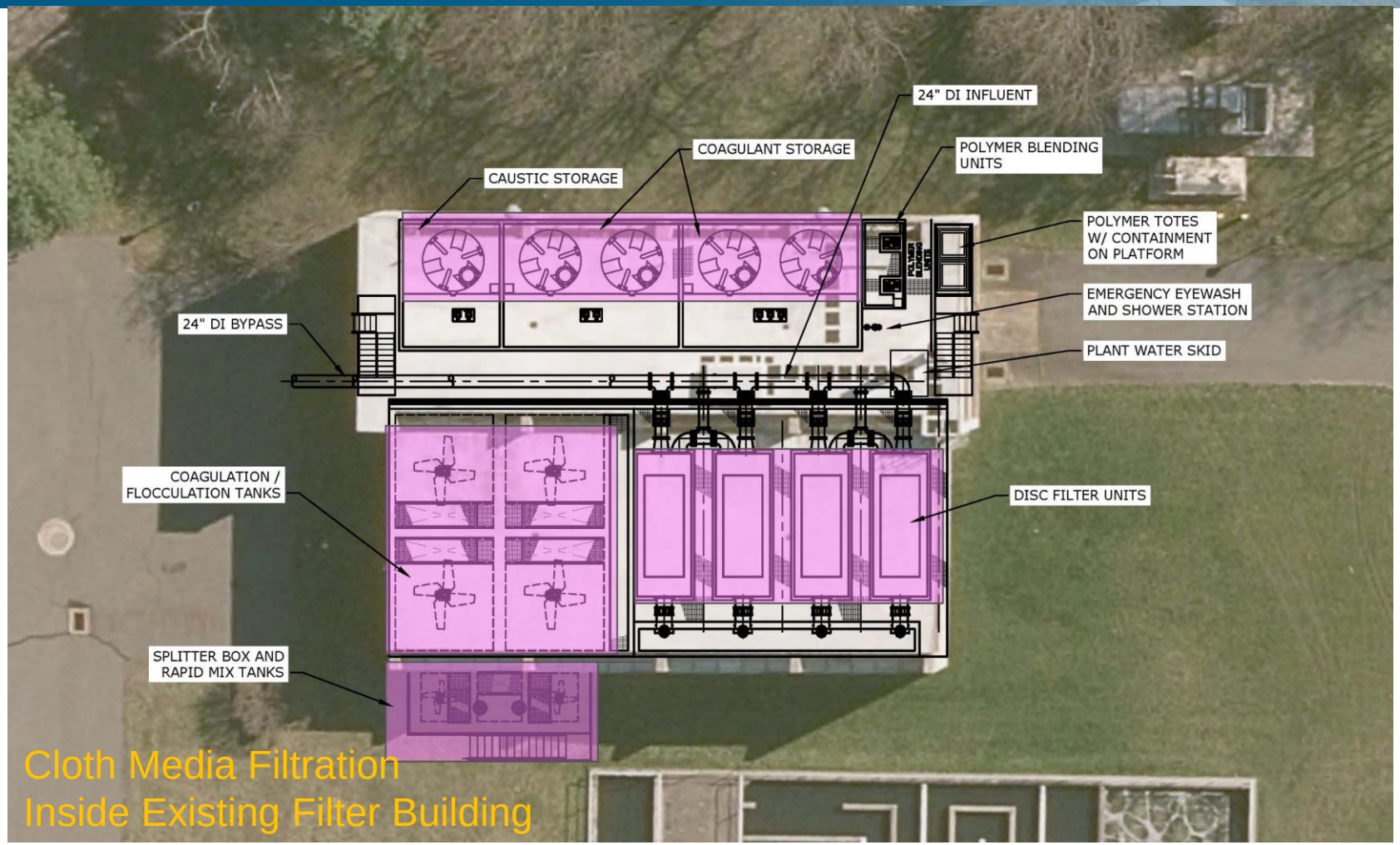
# Major Upgrades Plans

- **Nutrient Removal - 5 Stage Bardenpho**
  - Avoid New Tanks – 3,100 mg/l MLSS Limit (all 5 clarifiers in service @ Peak Hour flow)
  - No PAC WAR – Need to Build WAS Storage and RDT Thickening
  - IFAS – Need to phase out PAC Ballast prior to adding Media
- **Low Level Phosphorous with Cloth Media Filtration**
  - Multipoint Chemical Addition – Primary, Secondary
  - Biological P removal – once IFAS in place.
- **UV Disinfection**
- **Replace/Upgrade Aging Pumps, and Equipment**

# Secondary Treatment Alternative 4: *IFAS*

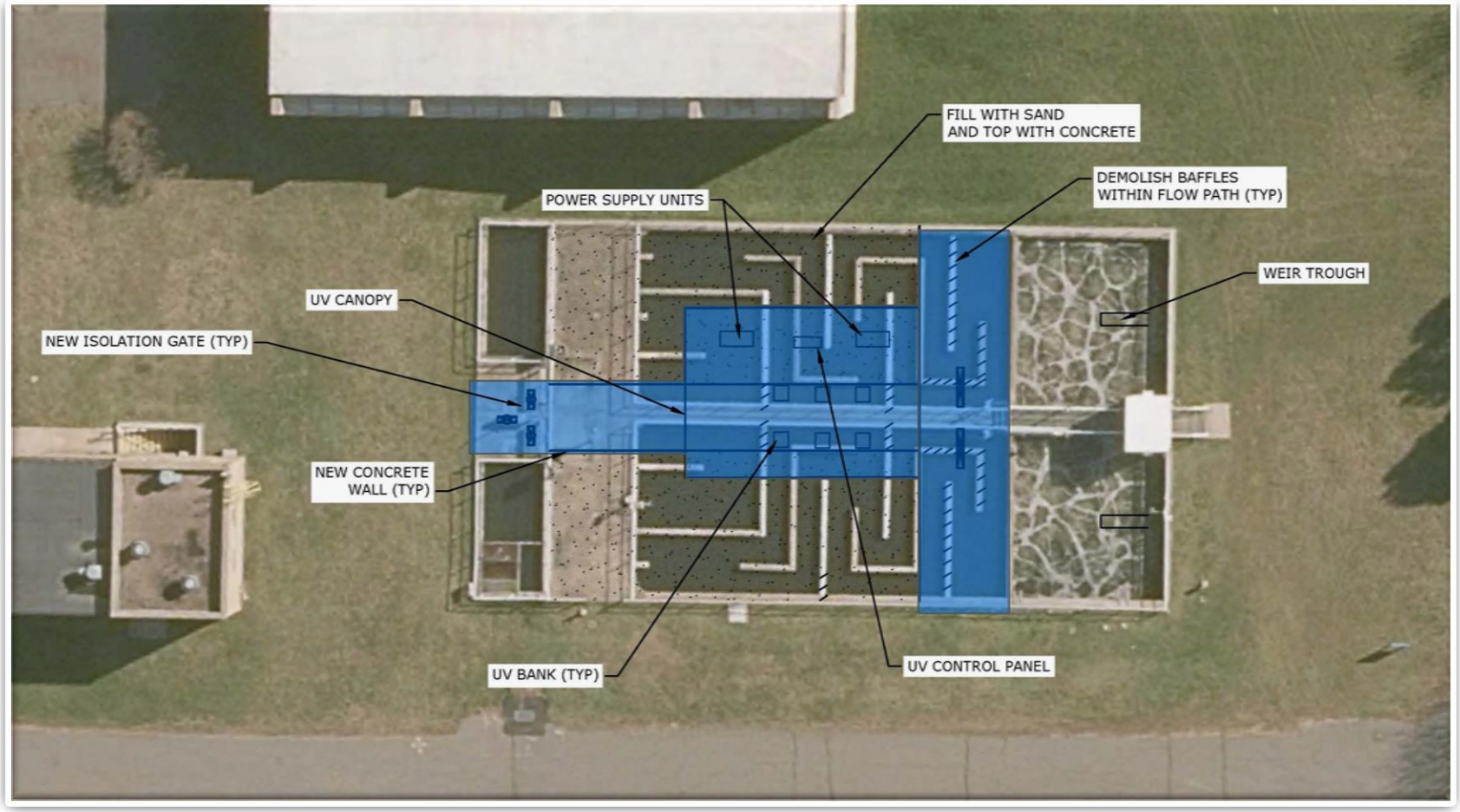


# Phosphorous Treatment - Filters




Cloth Media Filtration
Inside Existing Filter Building

# UV Disinfection Plan



# Aggressive Design Schedule
# 50 % Low Level P grant Funding

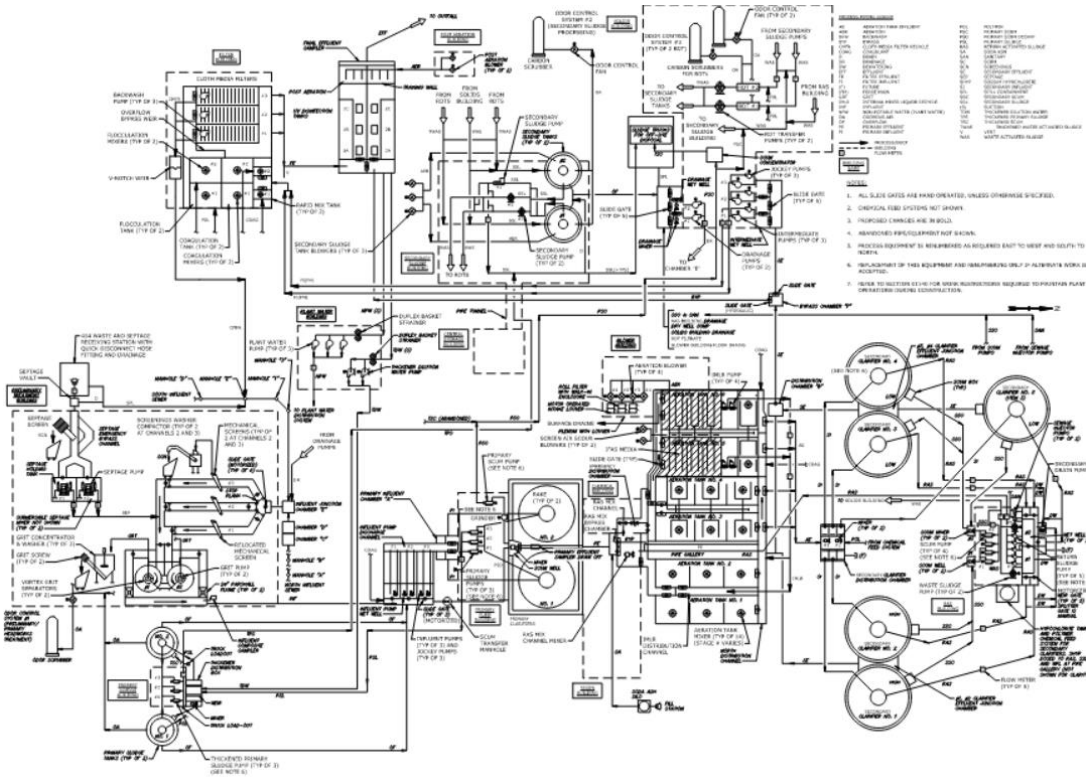
- **9/2016 Facility Plan Started**
- **9/2017 Design Started ($80M Project Cost)**
- **1/2018 Preselection Bids Open**
  - UV (Suez & Trojan)
  - Cloth Media Filtration (Aqua, Kruger)
  - IFAS (Headworks, Kruger, Suez)
- **12/2018 – Design to DEEP**
- **6/2019 – Contractor Award (by July 1)**

# Challenges Faced

- COVID-19
- Supply Chain Issues
- Existing Conditions
- Schedule
- Permit Compliance
- Maintenance of Plant Operations (MOPO)
- Startup

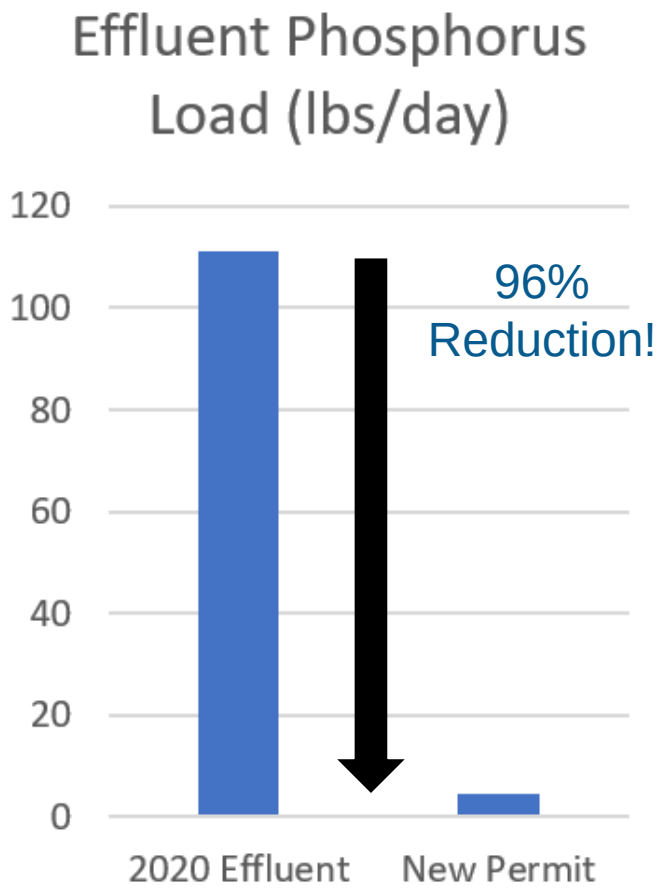
# Construction Schedule

- **Baseline schedule submitted 5 months after Notice of Award**
- **Work Restrictions**
- **Durations:**
  - Original: 42 months
  - Currently at: 43 months
  - Projection: 57 months



# Phosphorus Limit Compliance

- **Phosphorus Limit: April 1, 2021**
- **Ultimate Treatment:**
  - Upstream Bio-P / Chem Addition
  - Tertiary Discfilters
- **Contract Awarded July 2019**
  - 42-month duration anticipated
  - Not possible to achieve ultimate treatment by deadline

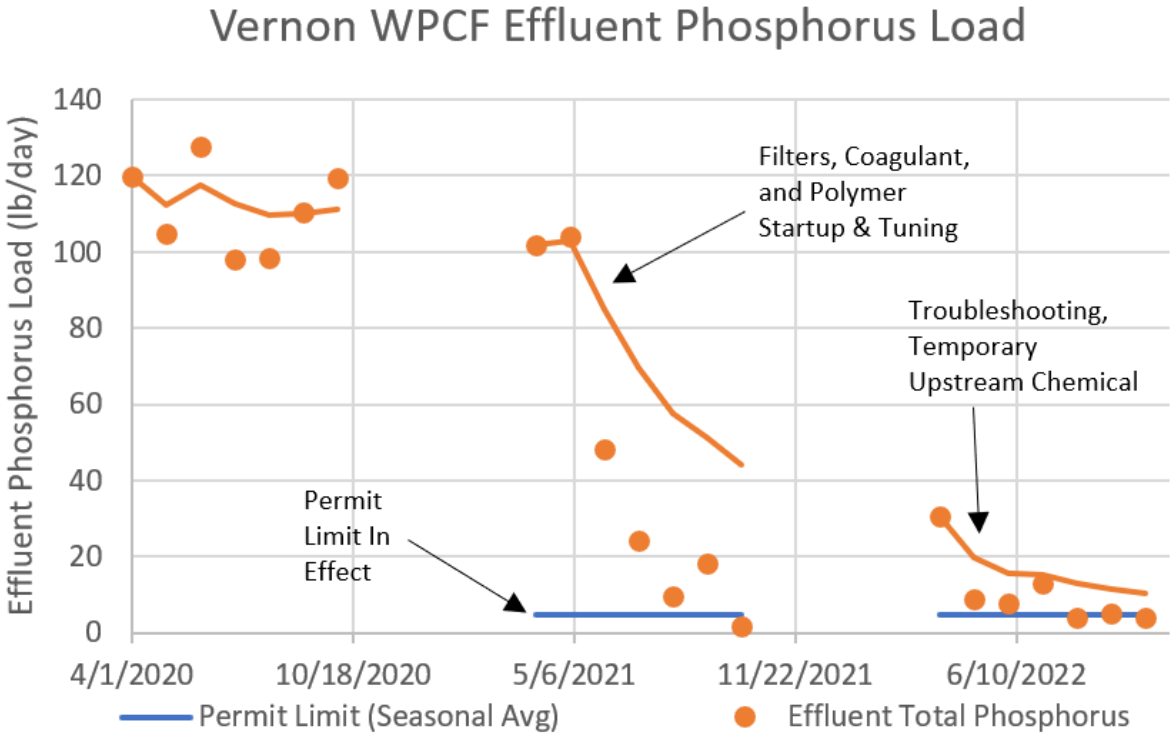


# Phosphorus Limit Compliance

- **Plan:**
  - Aggressive Contractual milestone
  - Use discfilters under temporary conditions
  - Use temporary upstream chemical addition

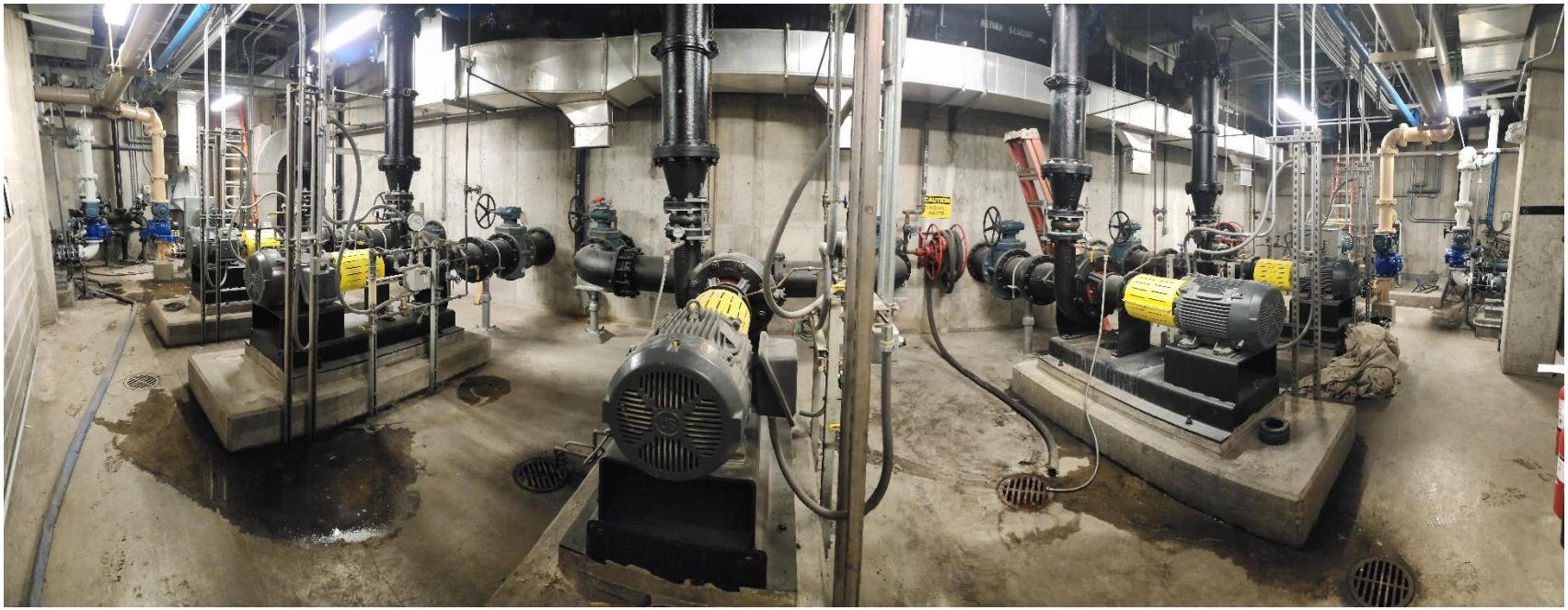
# Phosphorus Limit Compliance

- **Challenges:**
  - Covid-related delays
  - Water supply
  - Bearing failures
  - Breaker tripping
  - Blown fuses
  - Dry polymer
    - Blower failure
    - Program changes
  - Emulsion polymer
    - repeat clogging
    - required significant manufacturer adjustments



# RAS Building Sequencing

- **Project Scope:**
  - Replace 5 RAS Pumps
  - Replace 2 WAS Pumps
  - Replace 4 Scum Pumps
  - Piping & valves
- **Our Work Restrictions:**
  - One pump at a time
  - Brief clarifier shutdowns for valves
  - Assumed no bypass pumping

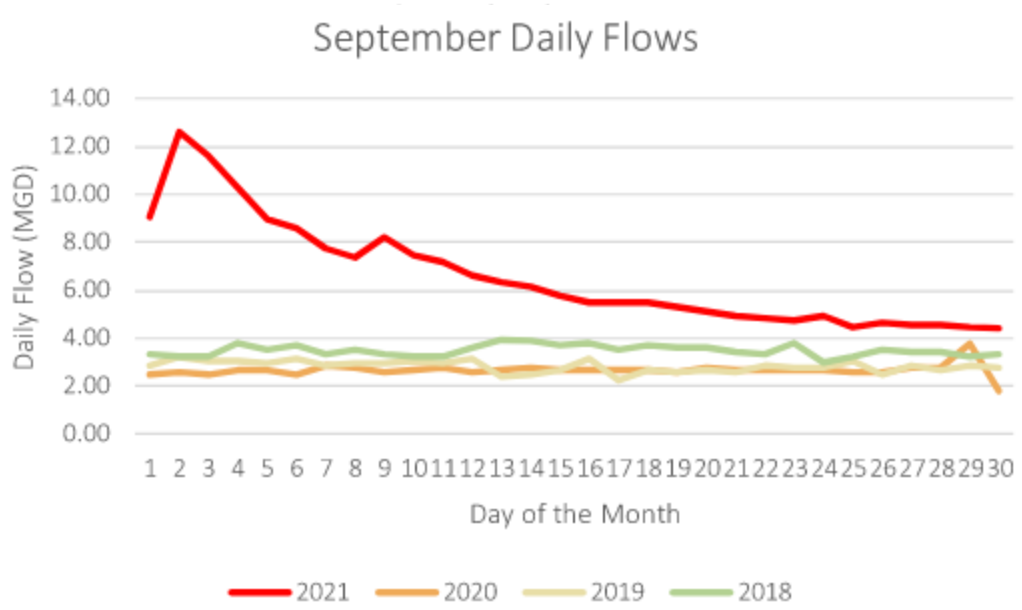


# RAS Building Sequencing

- **Challenges:**
  - Tight electrical room
  - Power wiring required broader shutdowns
  - Concurrently working Clarifiers
- **Approach:**
  - Contractor proposed alternative plan with bypass pumping
  - Allowed for completing all pumps in three phases – Summer/Dry Weather

Photo source: Bing.com/maps

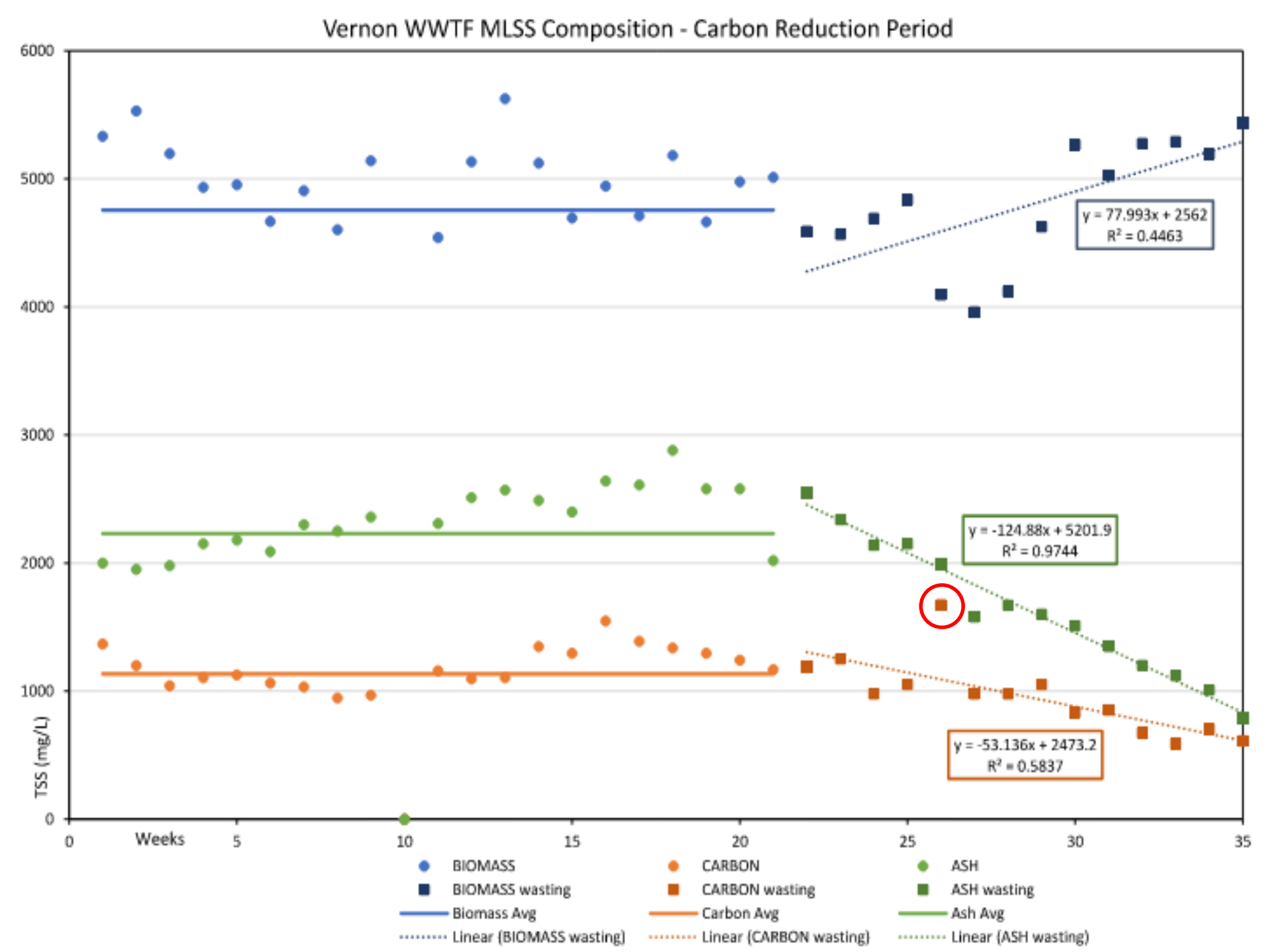
# RAS Building Sequencing




| Month | Avg Rain (in) | 2021 Rain (in) |
|---|---|---|
| Jul | 4.18 | 10.66 |
| Aug | 3.93 | 8.80 |
| Sept | 3.88 | 6.81 |

# Startup – IFAS Transition

- **Carbon Reduction**
  - Carbon cannot be present when screens & media are installed
  - Removing carbon requires months of wasting
  - Without carbon or media, permit compliance is challenging


Vernon WWTF MLSS Composition - Carbon Reduction Period
6000
5000
4000
3000
2000
1000
0
TSS (mg/L)
0
Weeks
5
10
15
20
25
30
35
y = 77.993x + 2562
R² = 0.4463
y = -124.88x + 5201.9
R² = 0.9744
y = -53.136x + 2473.2
R² = 0.5837
BIOMASS
BIOMASS wasting
Biomass Avg
Linear (BIOMASS wasting)
CARBON
CARBON wasting
Carbon Avg
Linear (CARBON wasting)
ASH
ASH wasting
Ash Avg
Linear (ASH wasting)

# Startup – IFAS Transition

- **Media installation in one tank at a time**
  - Acclimation period for each change
- **Commissioning & Startup**
- **Hydraulic Testing (one train)**
- **Performance Testing**

# Goals Completed To Date

- **2017 Facilities Plan**
  - Nitrogen – 400 to < 184 lbs/day
  - ✓ Phosphorus – 93 to < 4.5 lbs/day
  - Modernize the Plant
    - ✓ UV Disinfection
  - ✓ Go from 8 to 2 Substations
  - ✓ Go from 2 to 1 Generator
  - ✓ Eliminate Zimpro System
  - ✓ Go from 3 Shift to 1
  - ✓ Reduce Operating Cost

# Conclusions

- **Given project complexity and world events, project has gone well!**
- **Currently 86% complete by cost**
  - Change Orders:
    - 3.3% of Contract Price
    - 1.3% is for additional scope
    - 2.0% for unknowns & changes
- **Secret Sauce?**
  - Design excellence?
  - Teamwork!

# Closing

- **Acknowledgements**
  - Robert Grasis – Vernon WPCF Director (& Staff)
  - The Many Managers - Methuen Construction/MWH

- **Discussion & Questions**

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