

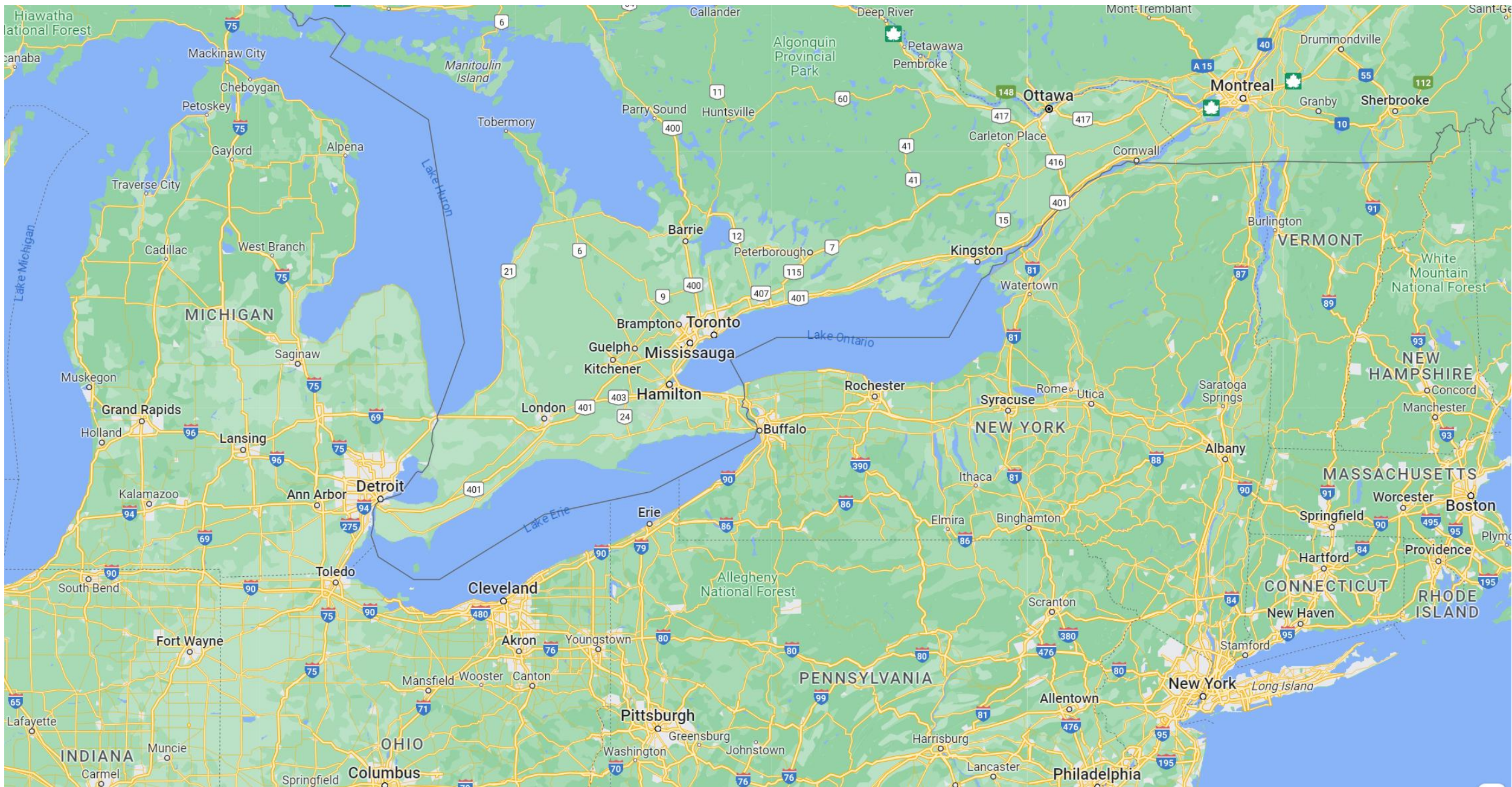
Buffalo Sewer Authority BOD₅ Bird Island WWTF Percent Removal and Hauled Waste Review

Jeff Tudini/AECOM – Process Engineer
Alex Emmerson/BSA – Superintendent

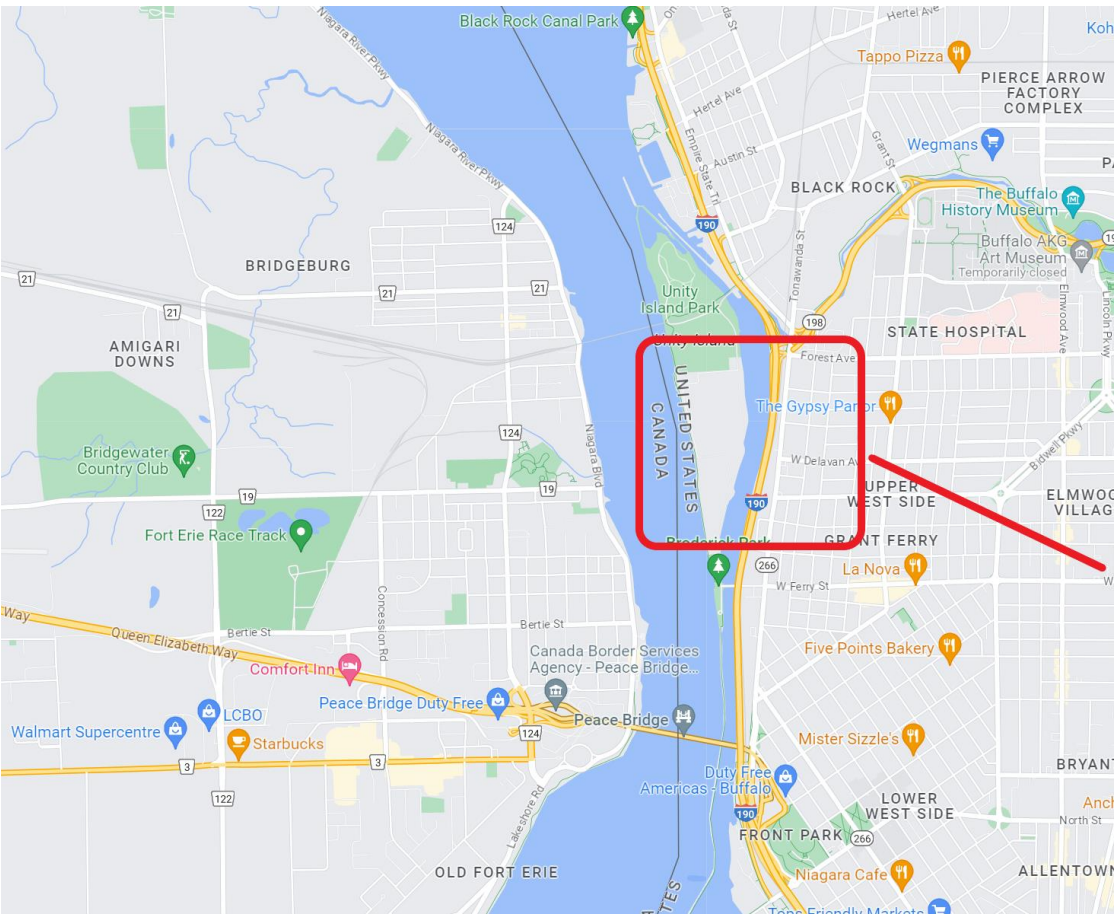
6/8/2023

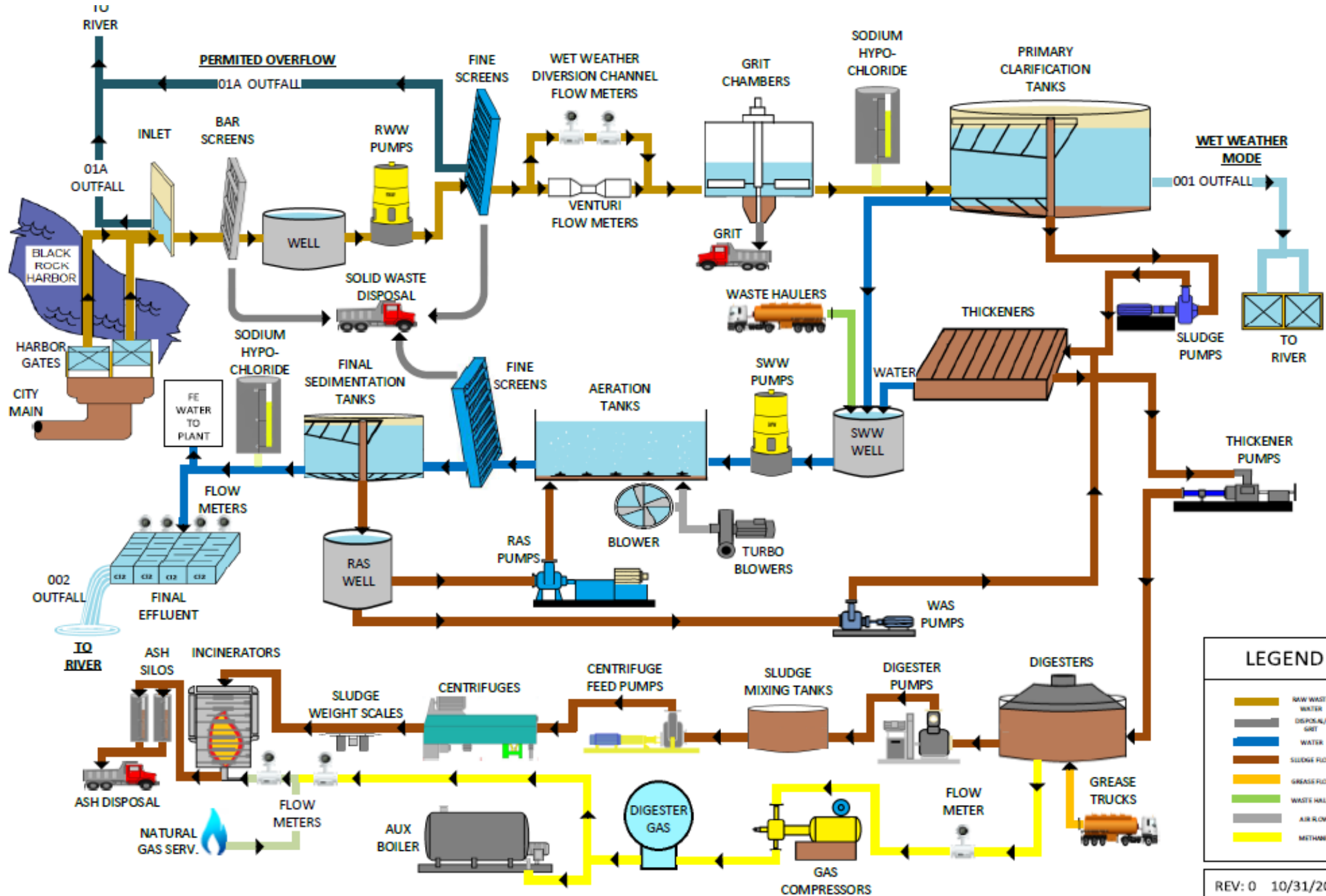
Agenda

- Bird Island WWTF Background
- BOD₅ Percent Removal Challenges
- Process Data Analysis
 - Effluent Total Suspended Solids
 - Seasonal Effects
 - Weekday and Weekend Effects
 - cBOD₅ and Total BOD₅
 - Shifting Hauled Waste – via calculation
- May 2022 Data Analysis
- Model Simulations
 - Optimize Performance to Meet 85% BOD₅ Removal
 - Investigate Performance w/ and w/o Hauled Waste
 - Evaluate Performance with Tanks Out of Service



BIWWTF





LEGEND

- RAW WASTE WATER
- DISPOSAL/ GRIT
- WATER
- SLUDGE FLOW
- GREASE FLOW
- WASTE HAULERS
- AIR FLOW
- METHANE

REV: 0 10/31/2018



SEPTIC
←

SLUDGE
←

SEPTIC
&
LEACHATE
↘

SOO2078

8A-1157

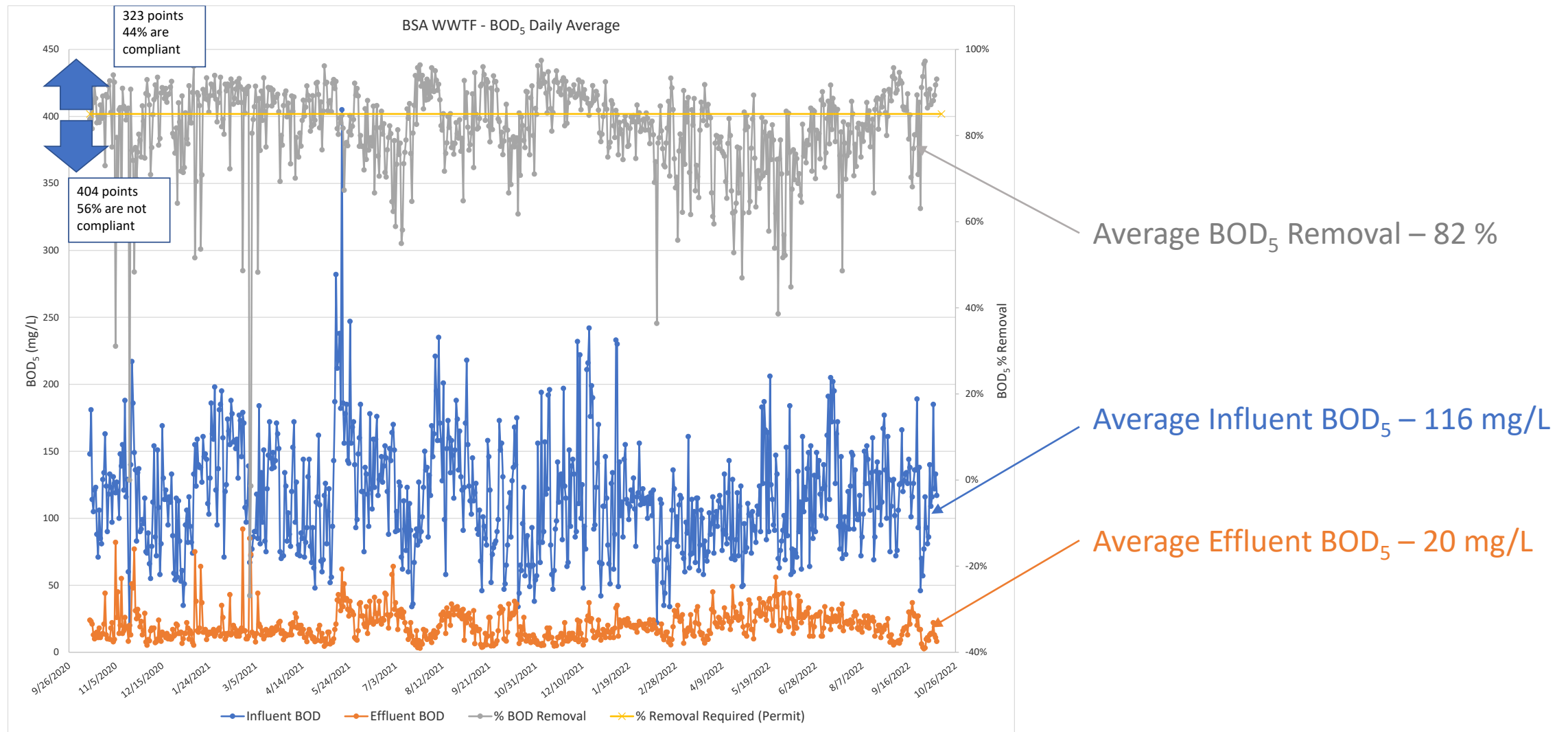
T-132

9A-662

DO NOT
REVERSE
OPERATING

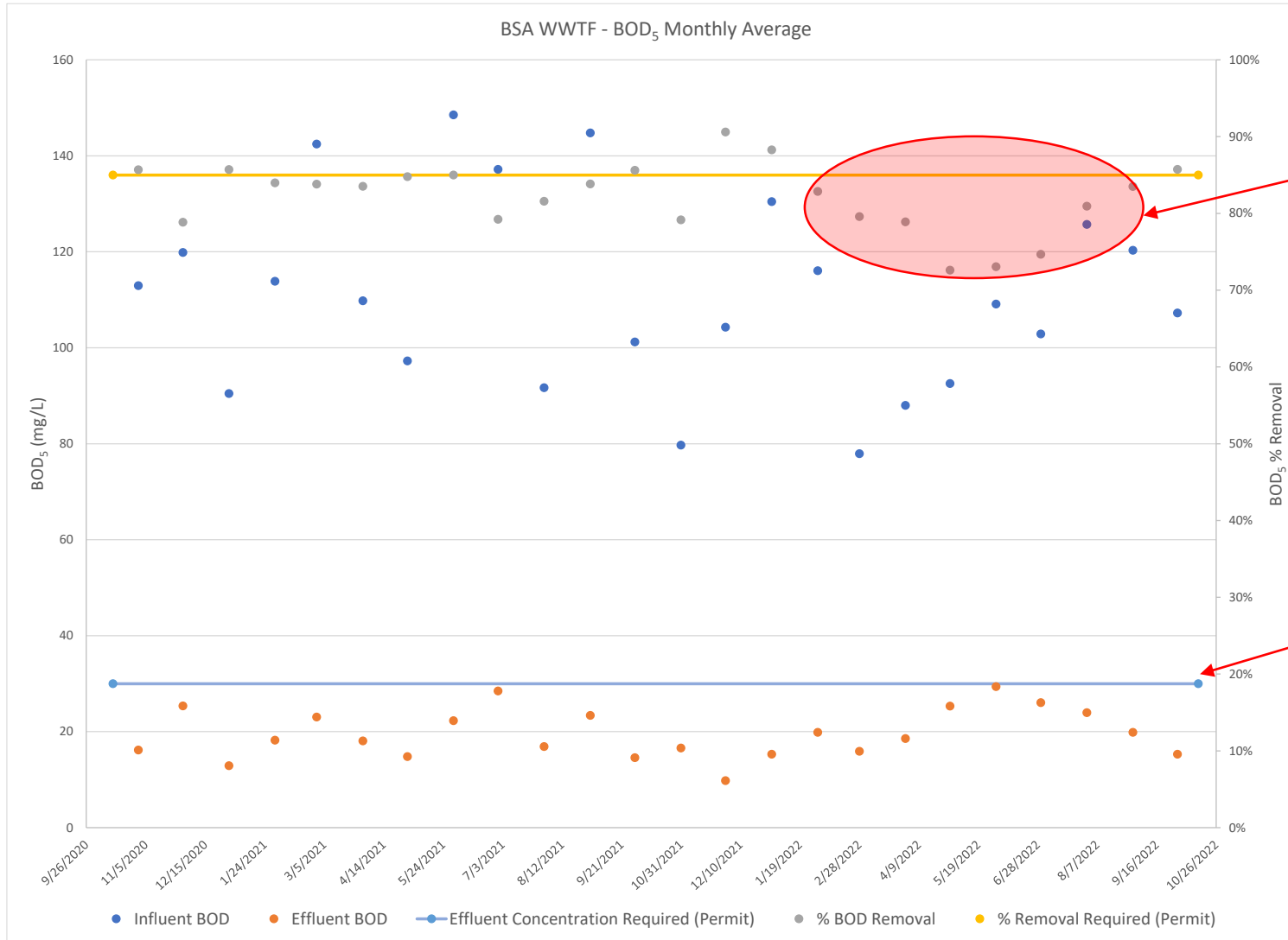
BOD₅ Percent Removal Challenges

- Received Notice of Violation (NOV) – June 2022
- WWTF's SPDES permit requires – 85% BOD₅ removal (minimum) flows ≤ 180 MGD.



BOD₅ Percent Removal Challenges

- Received Notice of Violation (NOV) – June 2022
- WWTF's SPDES permit requires – 85% BOD₅ removal (minimum) flows ≤ 180 MGD.

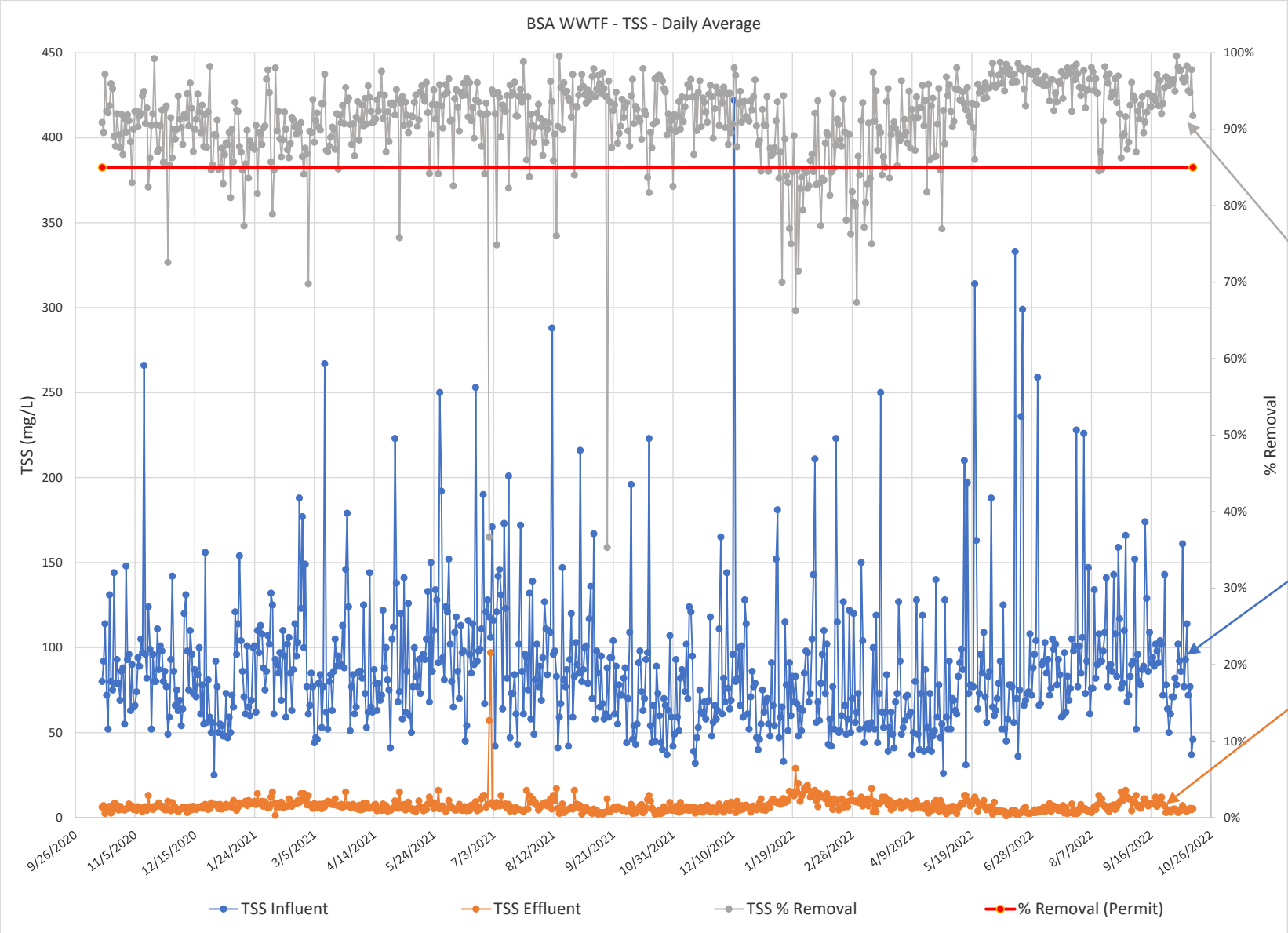


January 2022 – September 2022 = difficulty meeting BOD₅ % Removal

Monthly Average BOD5 limit – 30 mg/L

Process Data Analysis

Data Analysis – Effluent TSS

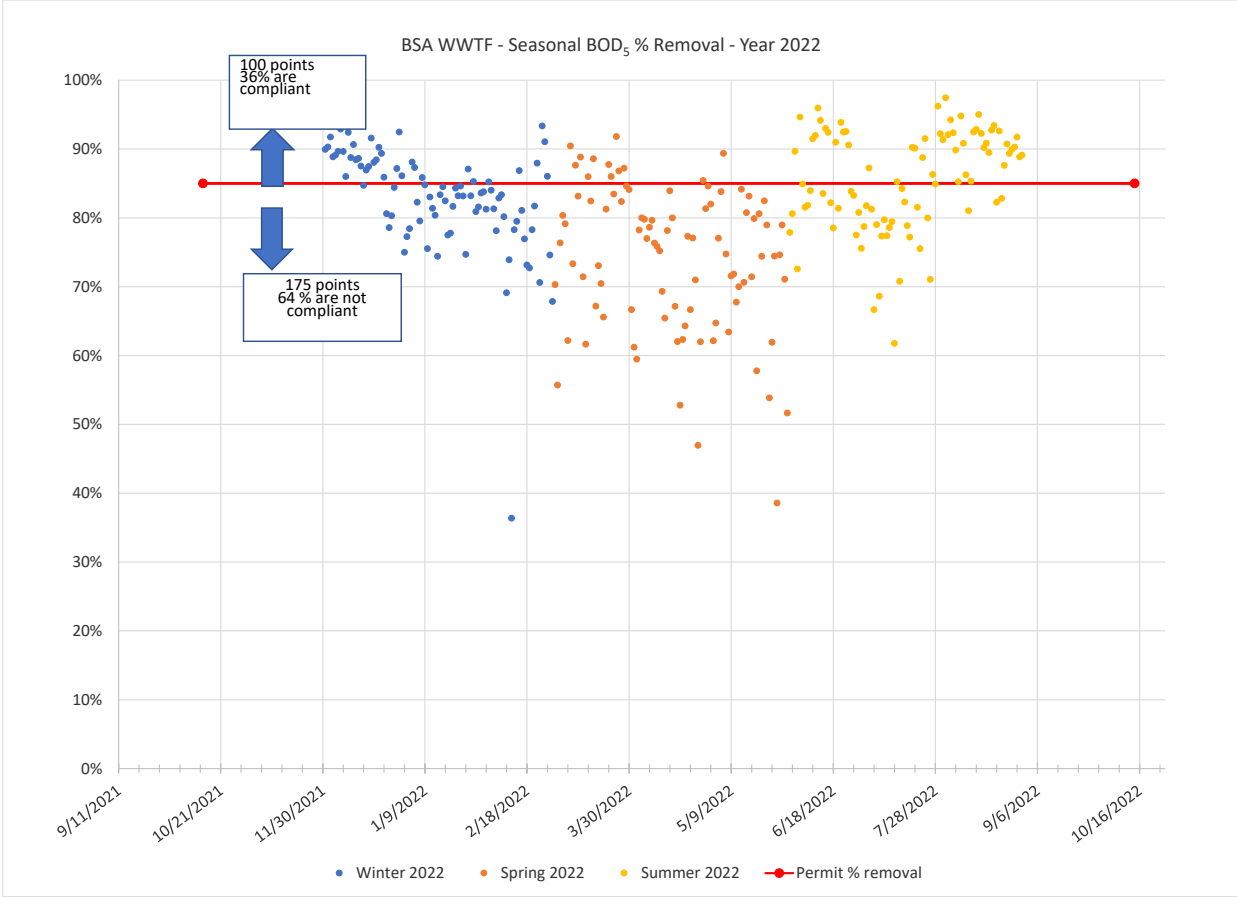
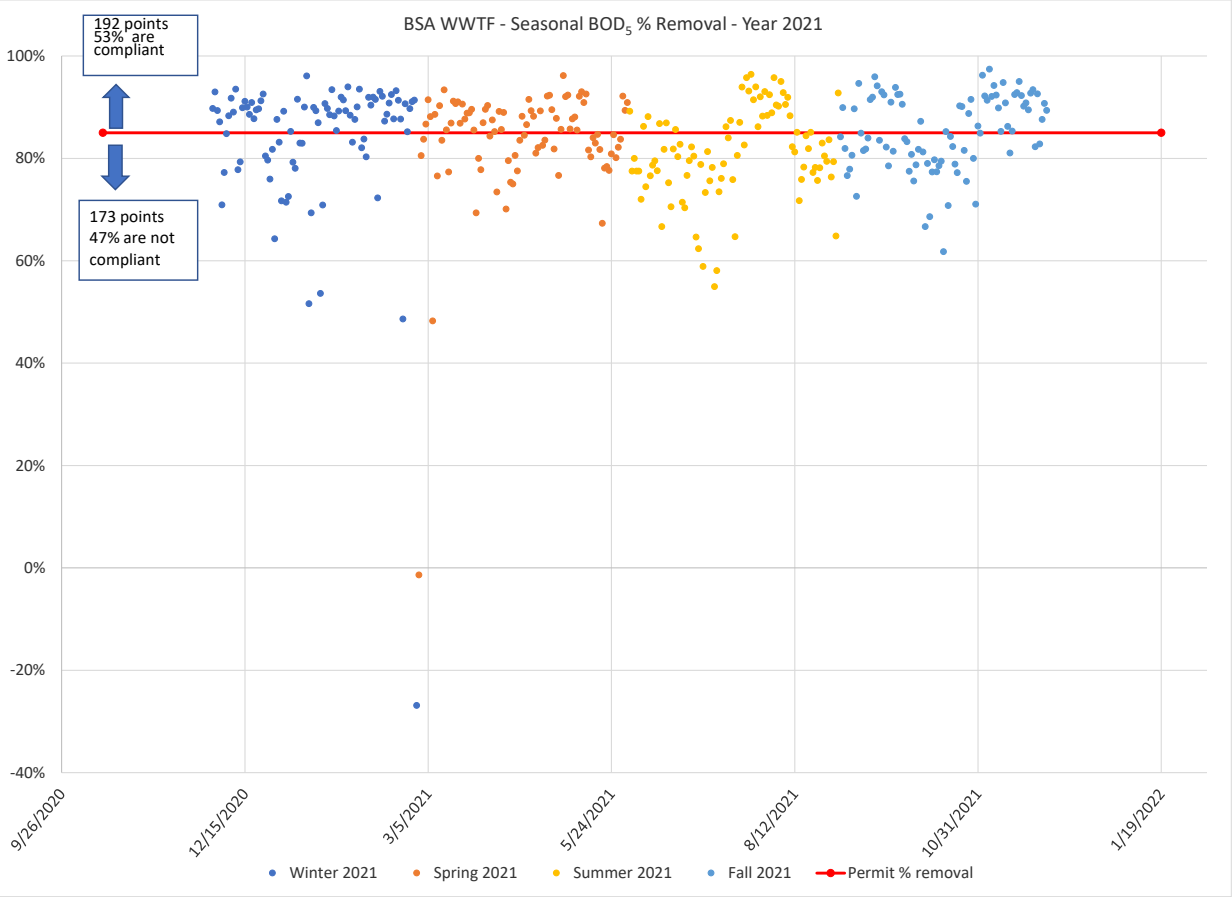


Average TSS Removal – 91 %

Average Inflow TSS – 93 mg/L

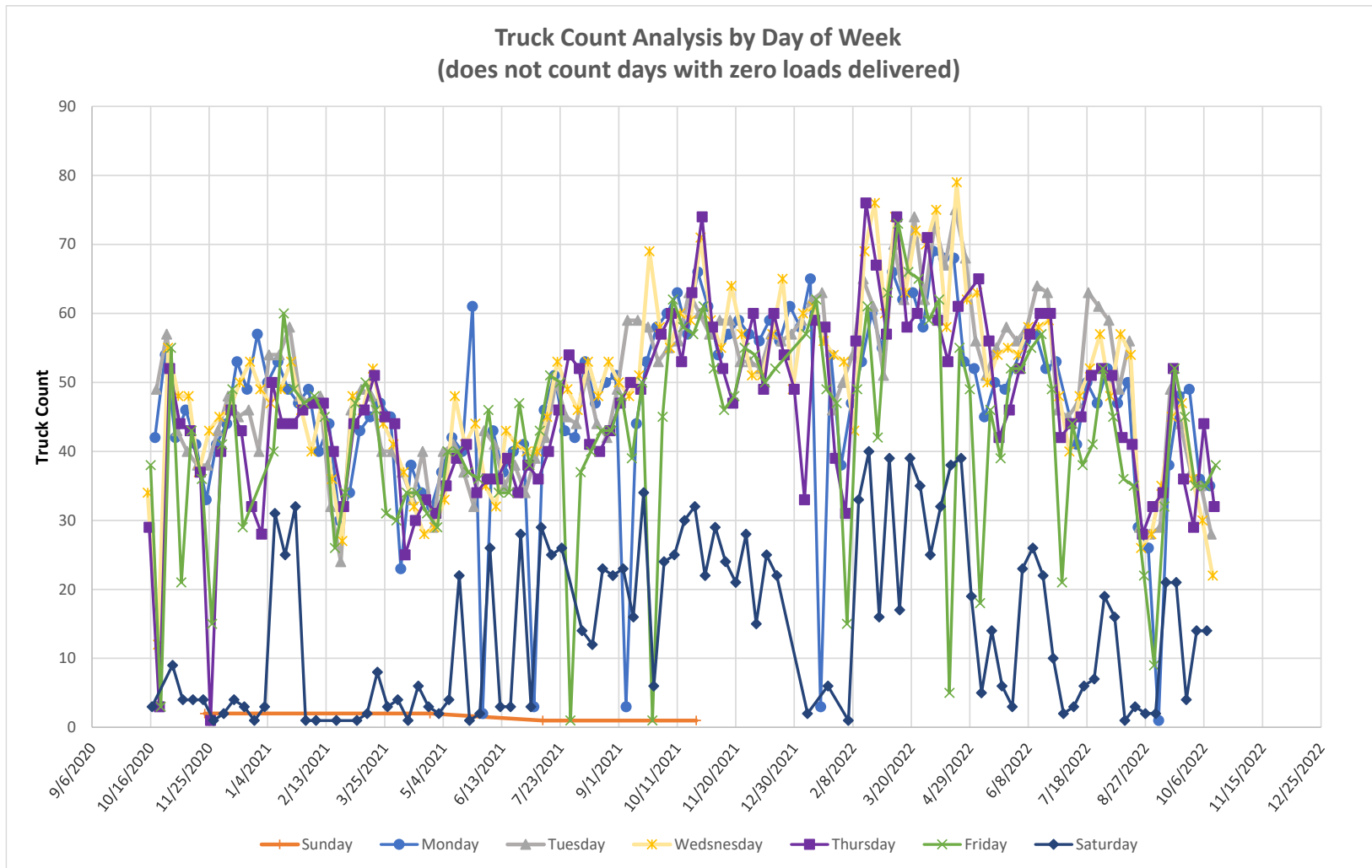
Average Effluent TSS – 7 mg/L

Data Analysis – Seasonal



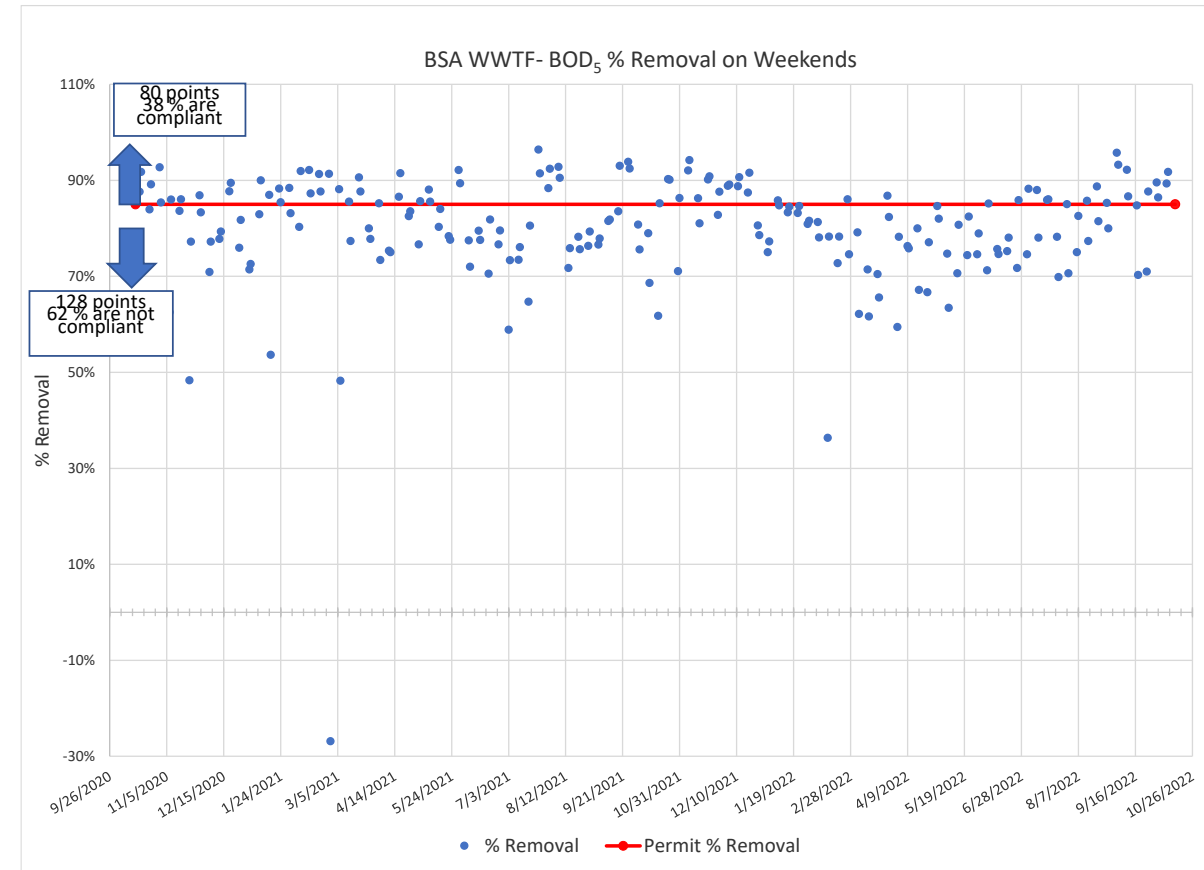
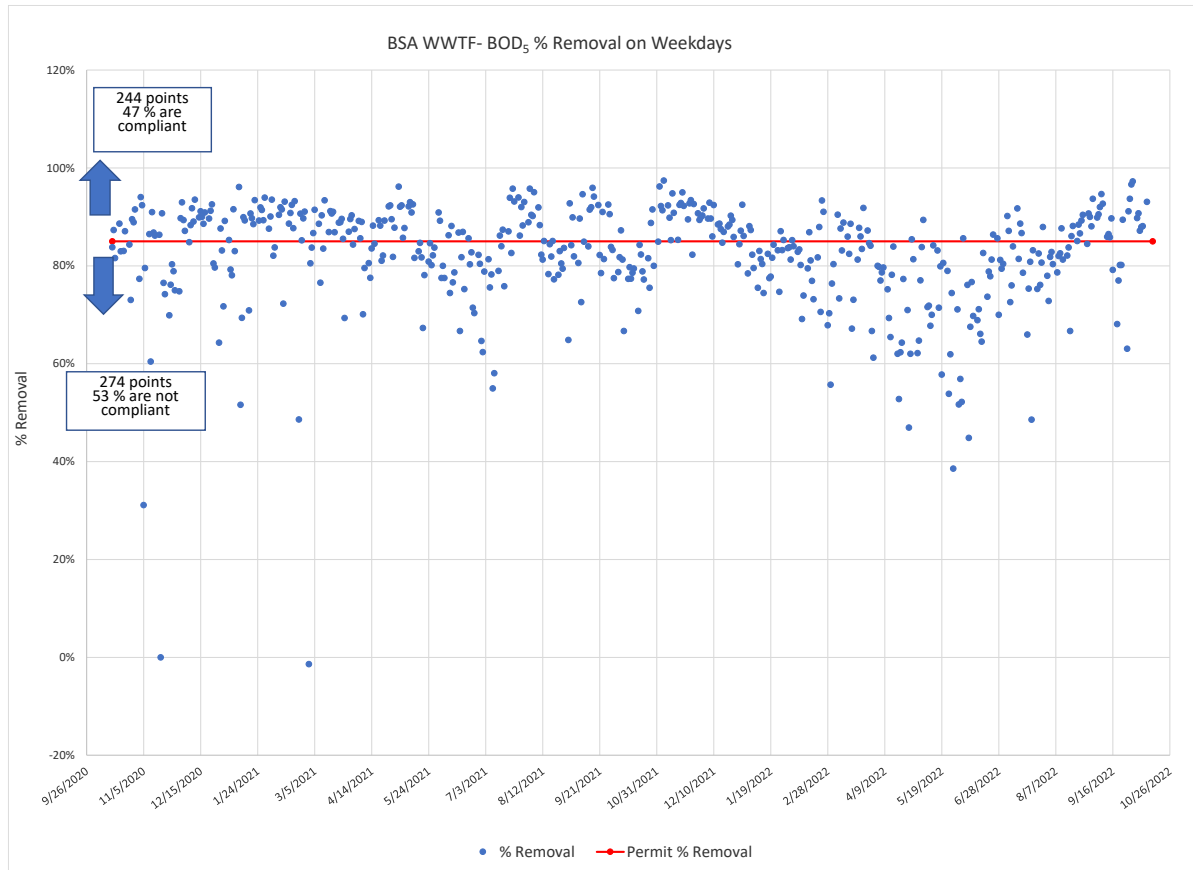
Data Analysis – Weekend and Weekdays

- Limited/No Hauled Waste received on weekends
- Assess if there are operating changes or significant loading differences.
- Hauled Waste Received:
 - Septage
 - Landfill leachate
 - Oil & Grease
 - Brines
 - Miscellaneous liquid waste
 - Liquid sludge
 - Sludge cake

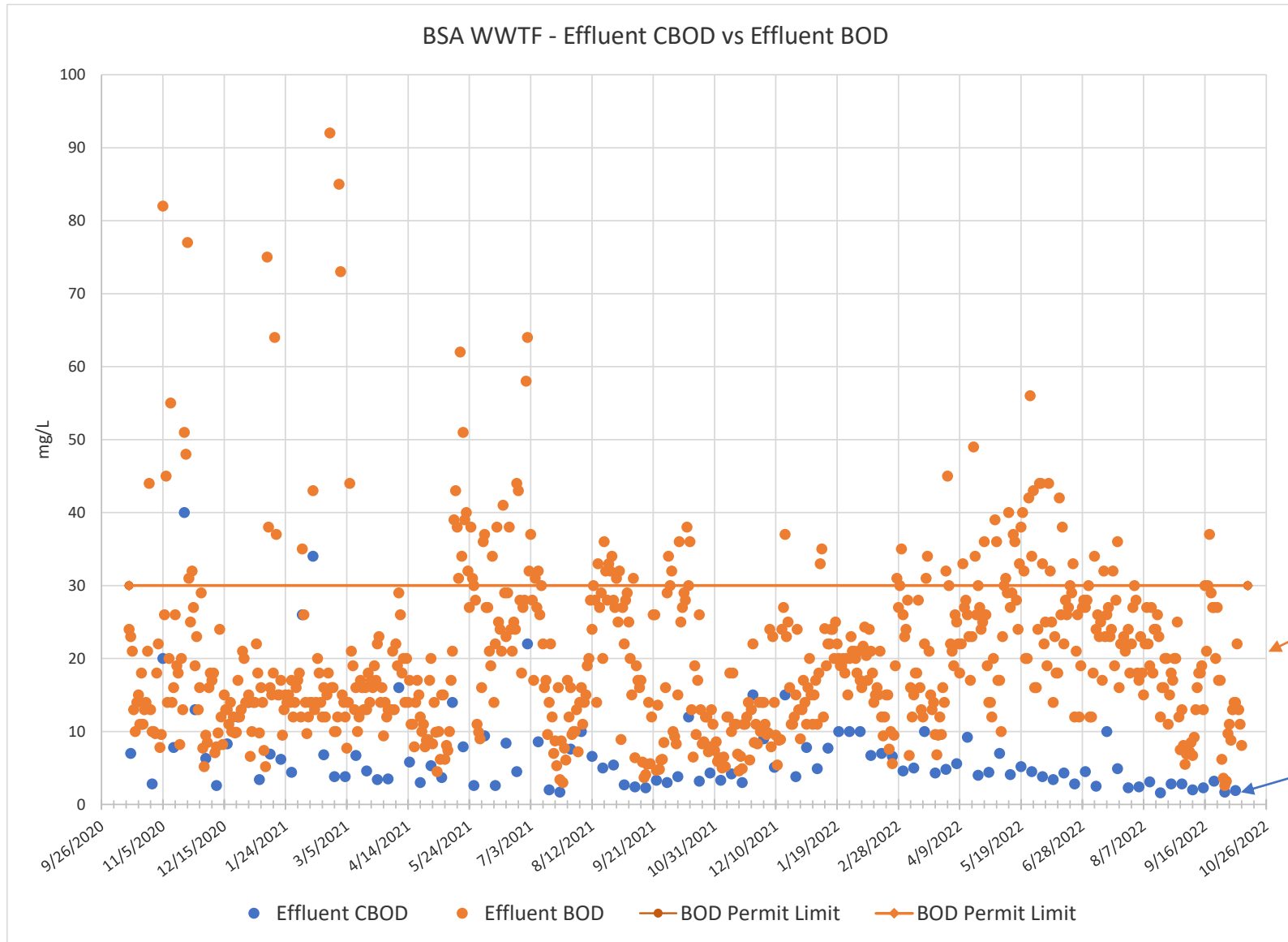


Data Analysis – Weekend and Weekdays

- Limited to no Hauled Waste received on weekends
- Higher compliance on Weekdays



Data Analysis – cBOD₅ and Total BOD

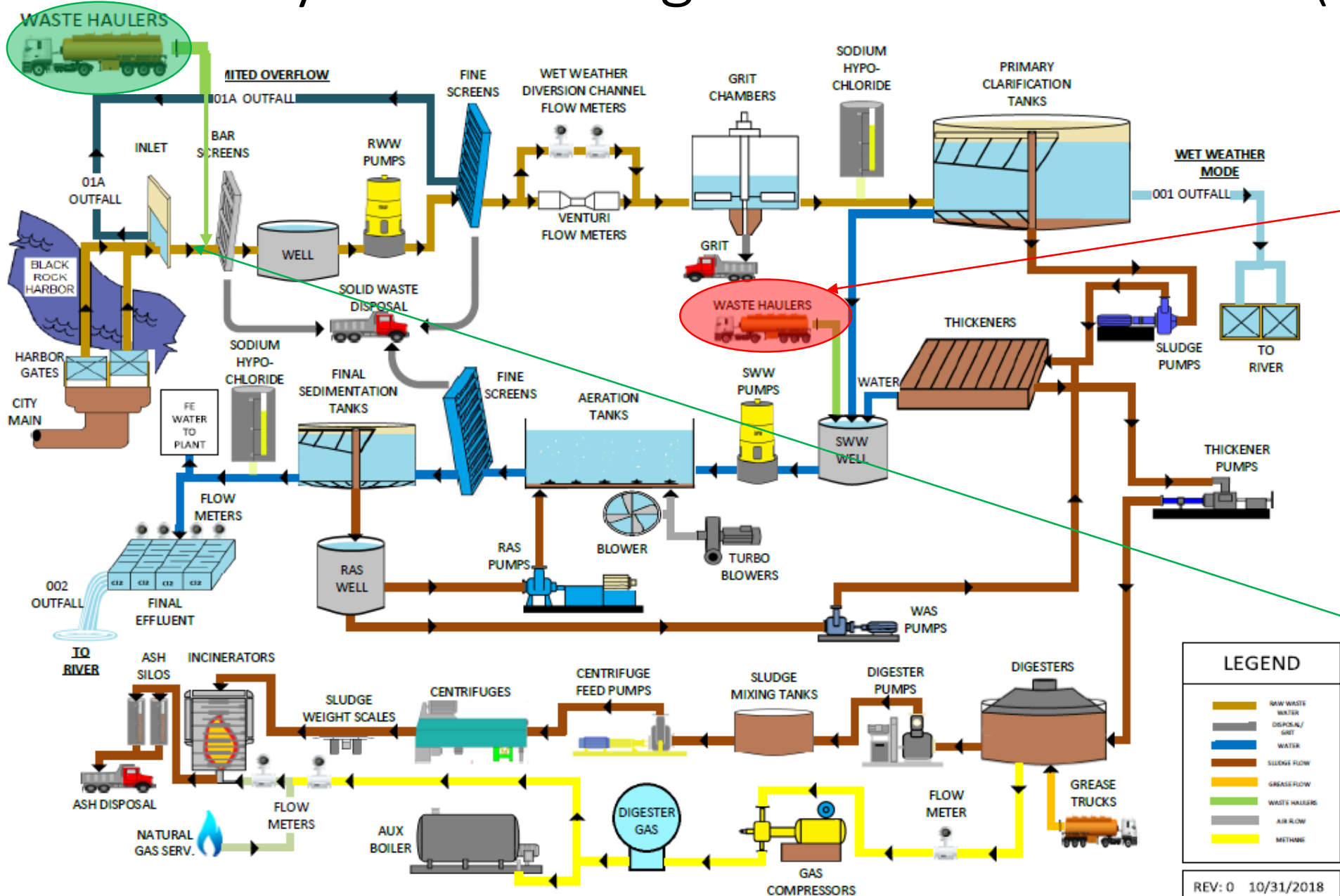


- Data indicates that effluent total BOD₅ has nitrogenous oxygen demand.
- 4.57 mg/L of oxygen (i.e., demand) to oxidize ammonia to nitrate

Average Effluent BOD₅ – 20 mg/L

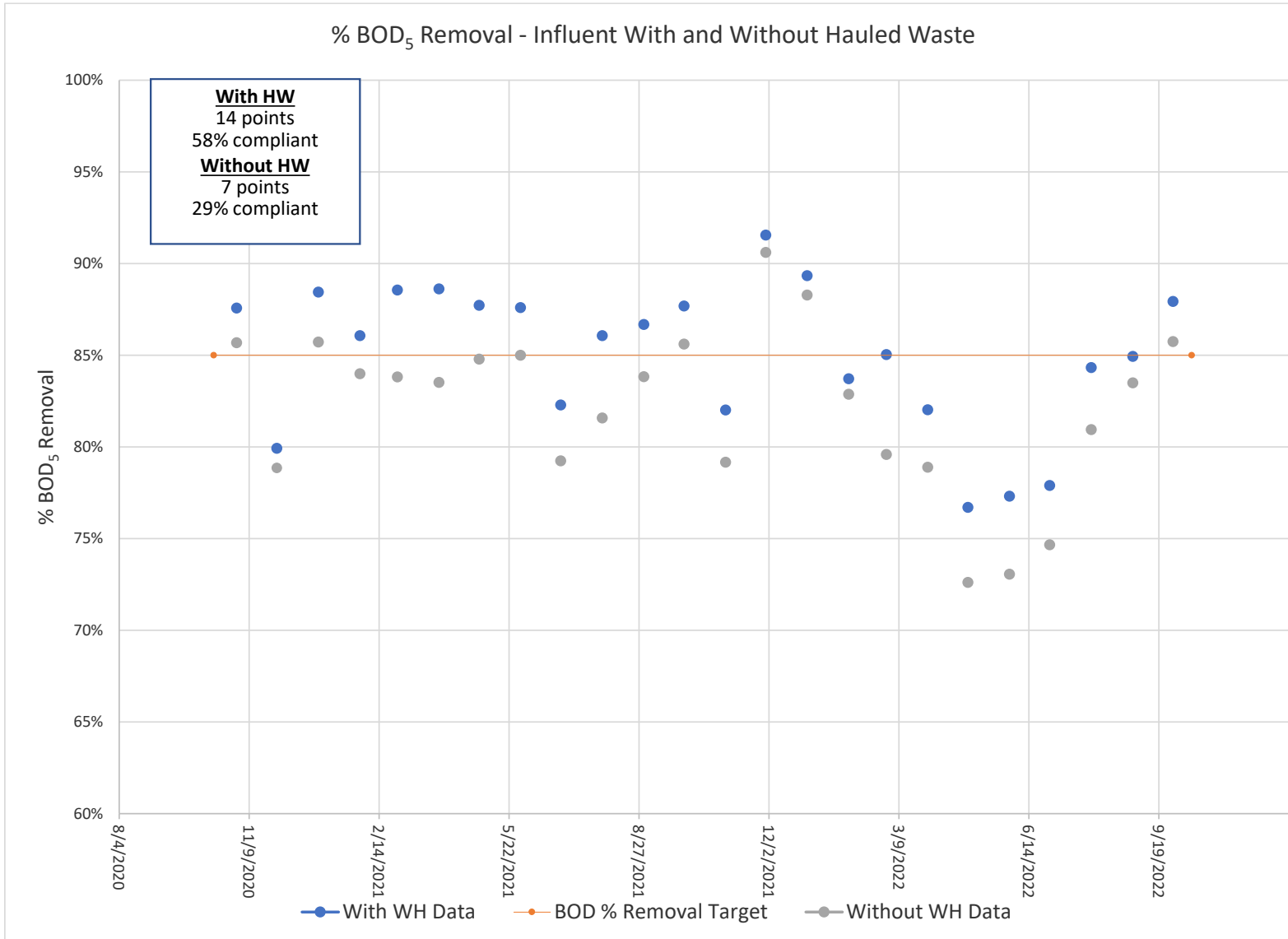
Average Effluent cBOD₅ – 7 mg/L

Data Analysis – Shifting Hauled Waste Load (Calculation)



- HW received ahead of secondary process
- Not accounted for with influent loading
- Shift HW flow and load to influent via calculation
- Mitigate feasibility and cost issues with physically relocating

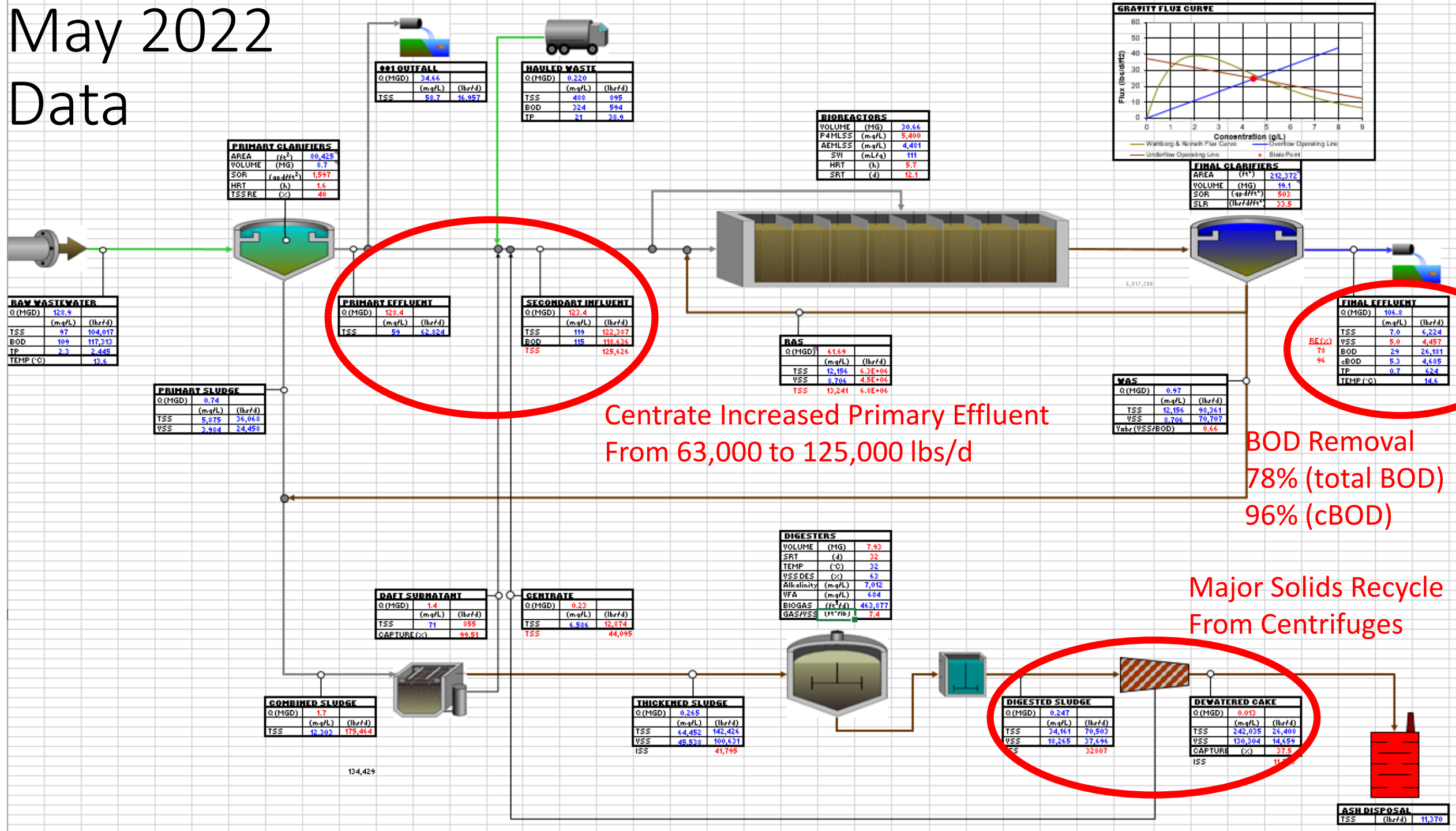
Data Analysis – Shifting Hauled Waste Load (Calculation)



- Improve BOD₅ 85 percent removal by ~ 30%.
- Still have a % removal compliance challenge with 10-months.

May 2022 Data Analysis

May 2022 Data

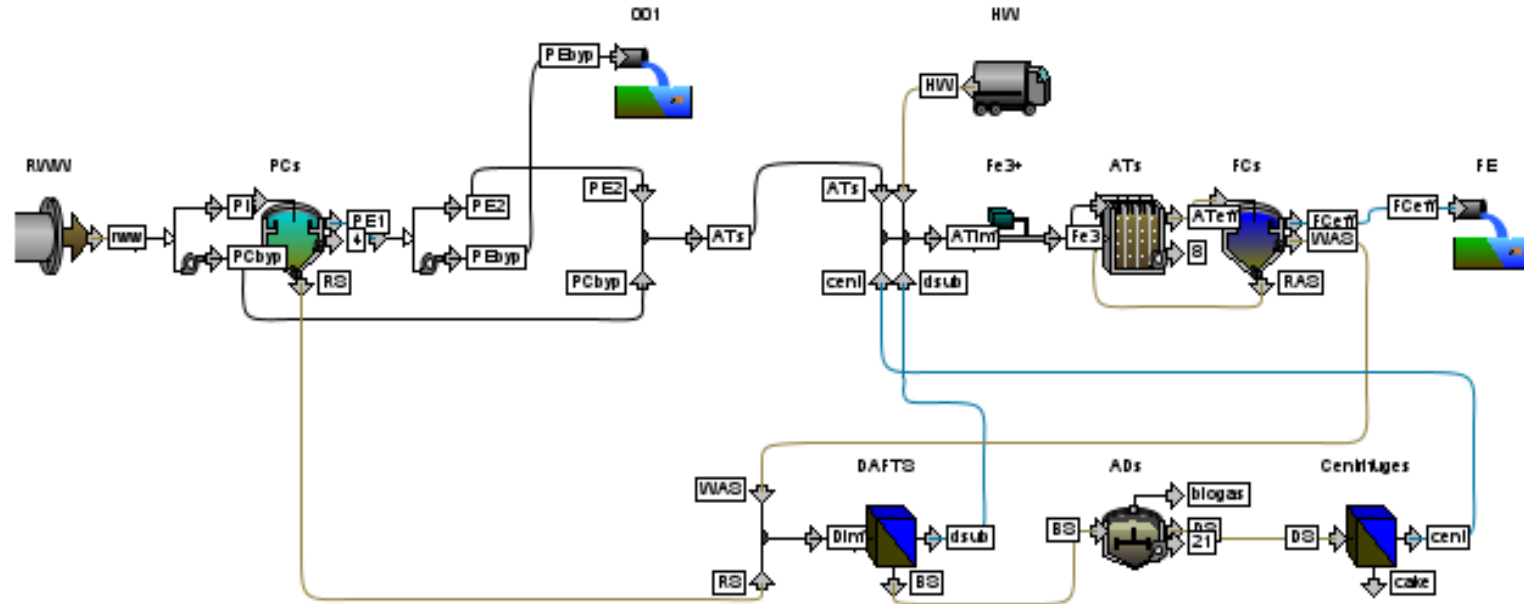


May 2022 Data Analysis/Mass Balance Findings

- Centrifuge solids capture only **38%**
 - Major source of solids recycle back to primary effluent
 - Increased primary effluent TSS loading from **63,000 lbs/d** to **125,000 lbs/d**
 - Increased AEMLSS from historical value of **2,800 mg/L** to **4,500 mg/L**
 - Increased secondary clarifier SLR from historical value of **19 lbs/d/ft²** to **34 lbs/d/ft²**
- Performance was still very good
 - Effluent TSS averaged 7 mg/L
 - Effluent BOD₅ averaged 29 mg/L
 - Effluent **cBOD₅** averaged **5 mg/L**
- BOD removal should be computed based on cBOD₅
 - Influent BOD₅ only **~100 mg/L**
 - Removal based on BOD₅ = **78%**
 - Removal based on cBOD₅ = **96%**

Bird Island WWTP Process Model

- Developed in January 2020 in GPS-X
 - Provide aeration system upgrade design support
 - Wet weather solids holdup operation
 - Dynamically calibrated to January 2019 Data
- Updated in April 2023
 - Investigate 85% BOD₅ removal violation for May 2022
 - Investigate hauled waste processing
 - Investigate performance with aeration tank downtime associated with aeration upgrades
 - Dynamically validated to May 2022 data



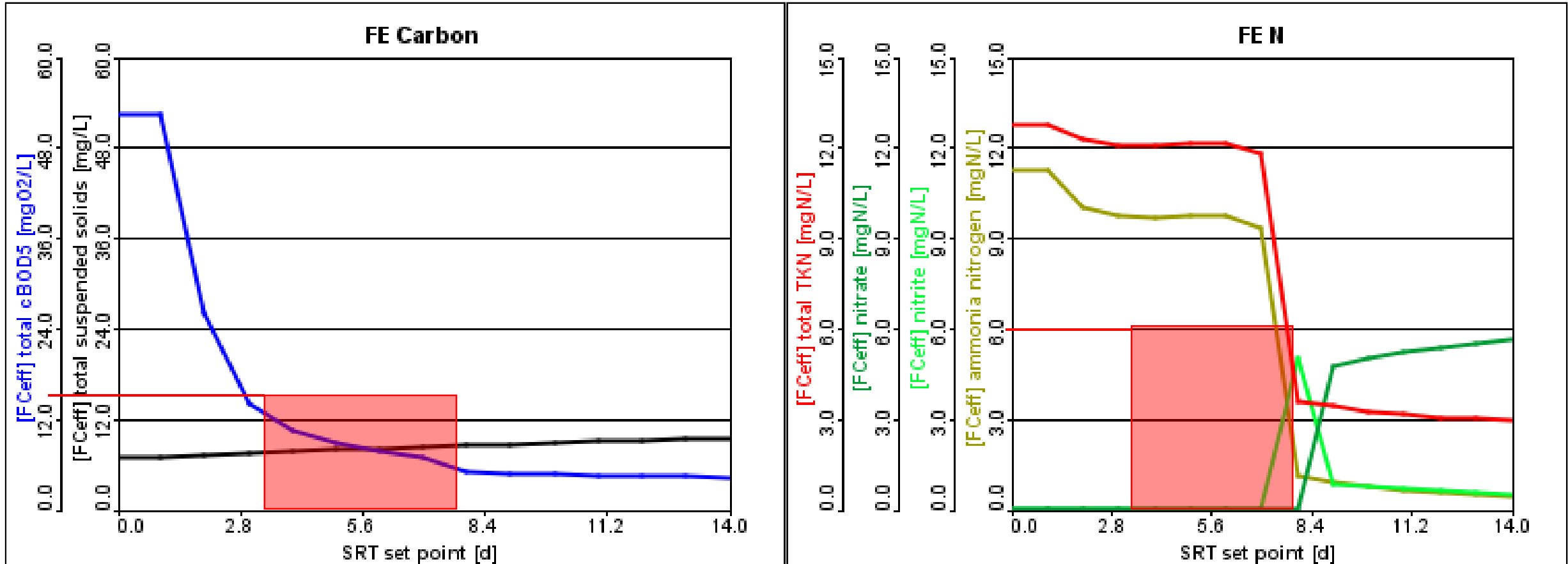
Model Simulations

Optimize Performance to Meet BOD₅ % Removal

Existing Annual Average and Maximum Month Flow and Loadings

| Parameter | Unit | | Existing Annual Average Conditions | | Existing Maximum Month Conditions | |
|-----------|---------|--------|------------------------------------|-----|-----------------------------------|------|
| Flow | (MGD) | | 126.5 | | 182.5 | |
| TSS | (lbs/d) | (mg/L) | 102,908 | 98 | 137,896 | 91 |
| BOD | (lbs/d) | (mg/L) | 104,735 | 99 | 125,681 | 83 |
| TKN | (lbs/d) | (mg/L) | 17,752 | 17 | 21,302 | 14.0 |
| TP | (lbs/d) | (mg/L) | 2,387 | 2.3 | 2,864 | 1.9 |

Effluent Performance and SRT Relationship (Startup AAC, 7°C)



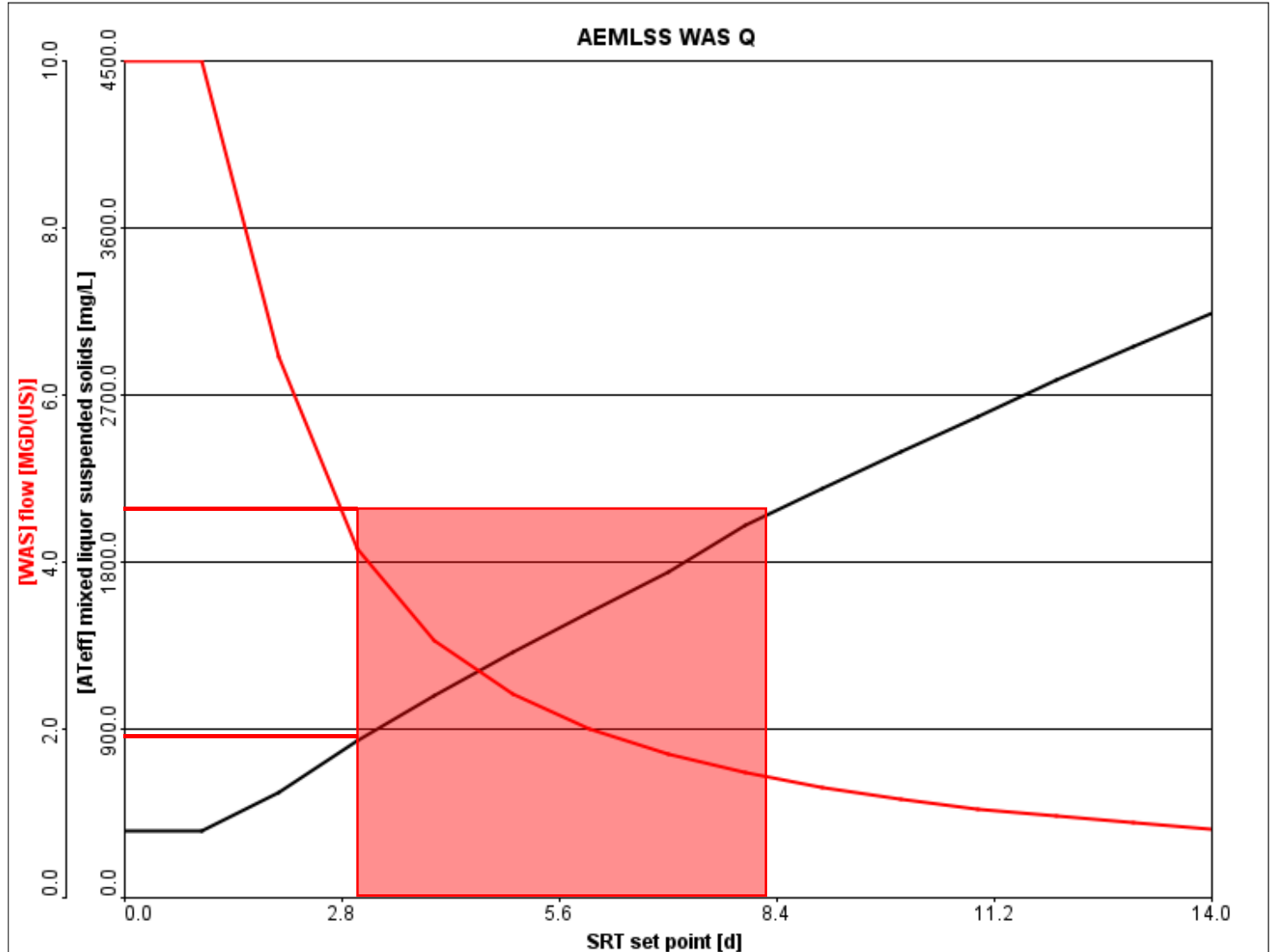
Eff BOD₅ < 15 mg/L to meet 85% Removal

Required SRT > 3 days

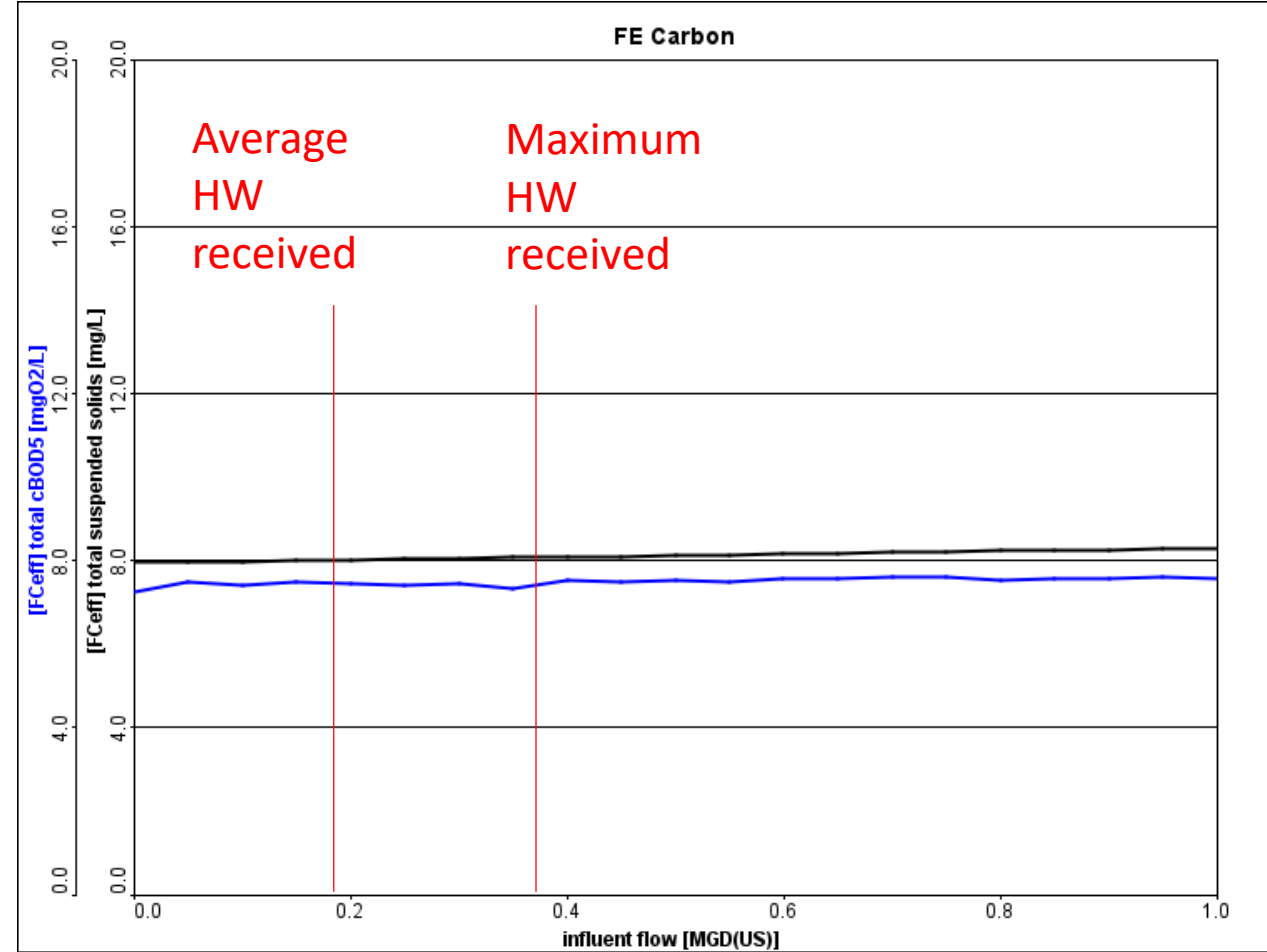
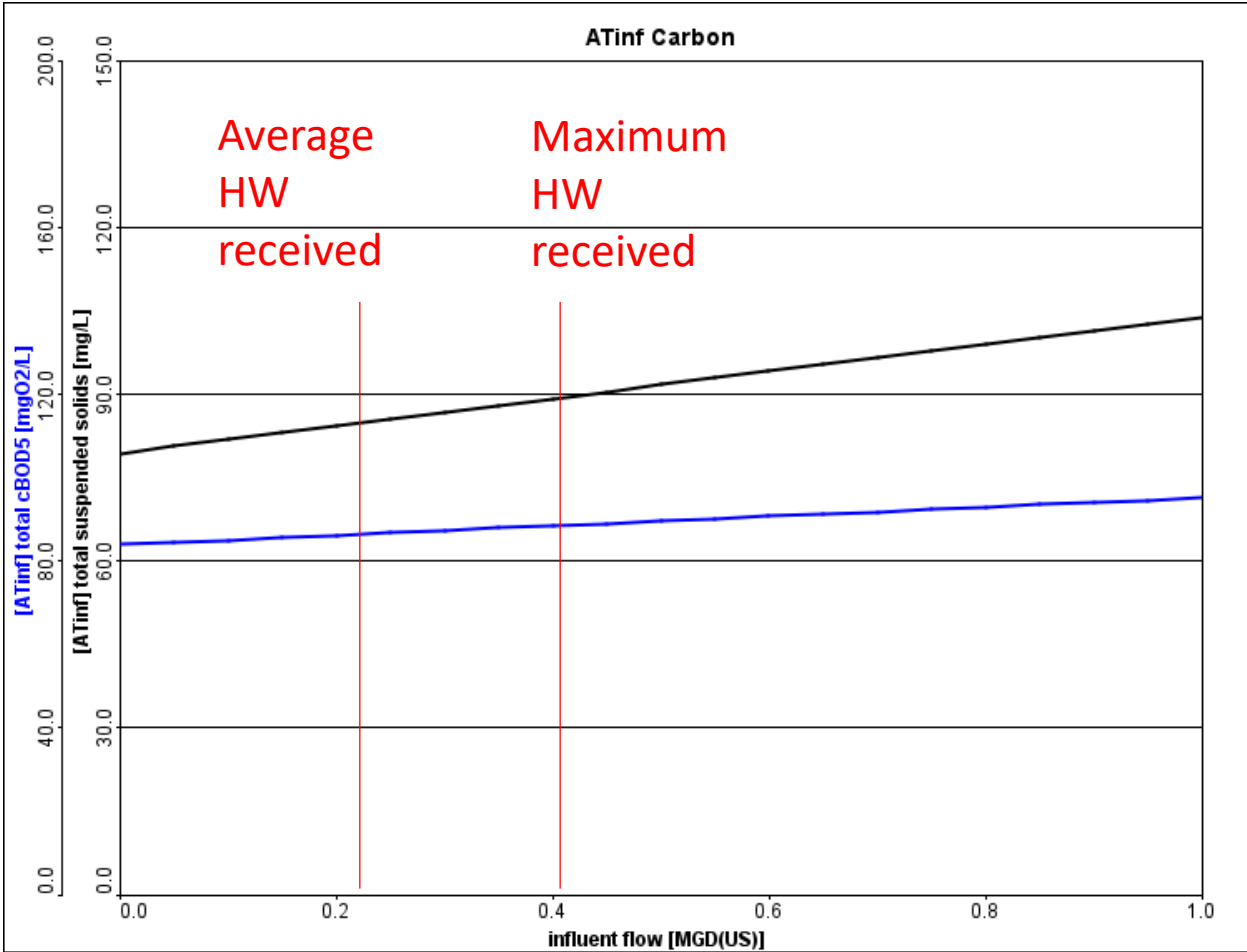
Effluent Performance and SRT Relationship (Startup AAC, 7°C)

Observed impacts to the BIWWTF secondary aeration system with elevated solids loading and MLSS.

The model shows that at the targeted SRT range (3 to 8-days) the aeration basin MLSS should be maintained between 1,000 and 2,000 mg/L.



Hauled Waste Varied from 0 to 1 MGD, SRT set @ 5d



Modeled Performance During Aeration Upgrades

- Half of aeration tanks out of service for a full year
- One primary clarifier out of service for a full year
- Performed existing annual average and maximum month winter conditions simulations with above units out of service
- Difficulty meeting 85% BOD removal at max month loadings because influent BOD is only **83 mg/L; would need effluent BOD of 12 mg/L**

| Parameter | Unit | Startup Annual Average Winter | Startup Maximum Month Winter |
|--------------------------------------------------|--------------------------|-------------------------------|------------------------------|
| Wastewater Temperature | (°C) | 7.0 | 7.0 |
| Raw Wastewater Flow | (MGD) | 126.5 | 182.5 |
| Flow to Primary Clarifiers | (MGD) | 126.5 | 182.5 |
| Flow Bypassed around Primaries to Aeration Tanks | (MGD) | 0 | 0 |
| Hauled Waste Flow | (gpd) | 115,000 | 200,000 |
| Primary HRT | (h) | 1.2 | 1.0 |
| Primary Solids Removal | (%) | 29.7 | 25.7 |
| PE Flow | (MGD) | 125.4 | 158.6 |
| PE TSS | (mg/L) | 77.54 | 66 |
| PE BOD | (mg/L) | 87 | 72 |
| PE TKN | (mg/L) | 15.4 | 13.0 |
| PE TP | (mg/L) | 2.2 | 1.7 |
| Aeration Tank Influent Flow | (MGD) | 127.7 | 184.2 |
| Aeration Tank Influent TSS | (mg/L) | 88.4 | 77.9 |
| Aeration Tank Influent BOD | (mg/L) | 88.6 | 75.8 |
| Aeration Tank Influent TKN | (mg/L) | 18.3 | 15.4 |
| Aeration Tank Influent TP | (mg/L) | 2.7 | 2.1 |
| Fe ³⁺ Dosage | (mg/L) | 2.0 | 2.0 |
| Pass 1 - 4 MLSS | (mg/L) | 4,567 | 3,959 |
| Pass 1 - 4 MLVSS | (mg/L) | 3,529 | 2,574 |
| Pass 5 - 8 MLSS | (mg/L) | 2,972 | 3,043 |
| Pass 5 - 8 MLVSS | (mg/L) | 2,297 | 1,980 |
| Total SRT | (d) | 5.4 | 3.7 |
| Final Clarifier SLR | (lbs/d/ft ²) | 20.9 | 26.1 |
| Effluent TSS | (mg/L) | 9.3 | 12.6 |
| Effluent BOD | (mg/L) | 6.8 | 14.9 |
| BOD Removal | (%) | 93.4 | 82.0 |
| Effluent TKN | (mg/L) | 7.6 | 10.5 |
| Effluent NH ₄ -N | (mg/L) | 5.1 | 7.9 |
| Effluent Nitrite | (mg/L) | 1.5 | 0.0 |
| Effluent Nitrate | (mg/L) | 0.0 | 0.0 |
| Effluent TN | (mg/L) | 9.1 | 10.5 |
| Effluent TP | (mg/L) | 0.6 | 0.5 |



AECOM

B U F F A L O
SEWER AUTHORITY

Thank you.