30 May 2019

Lower Scioto WRF Treatability Study

Jim Fitzpatrick

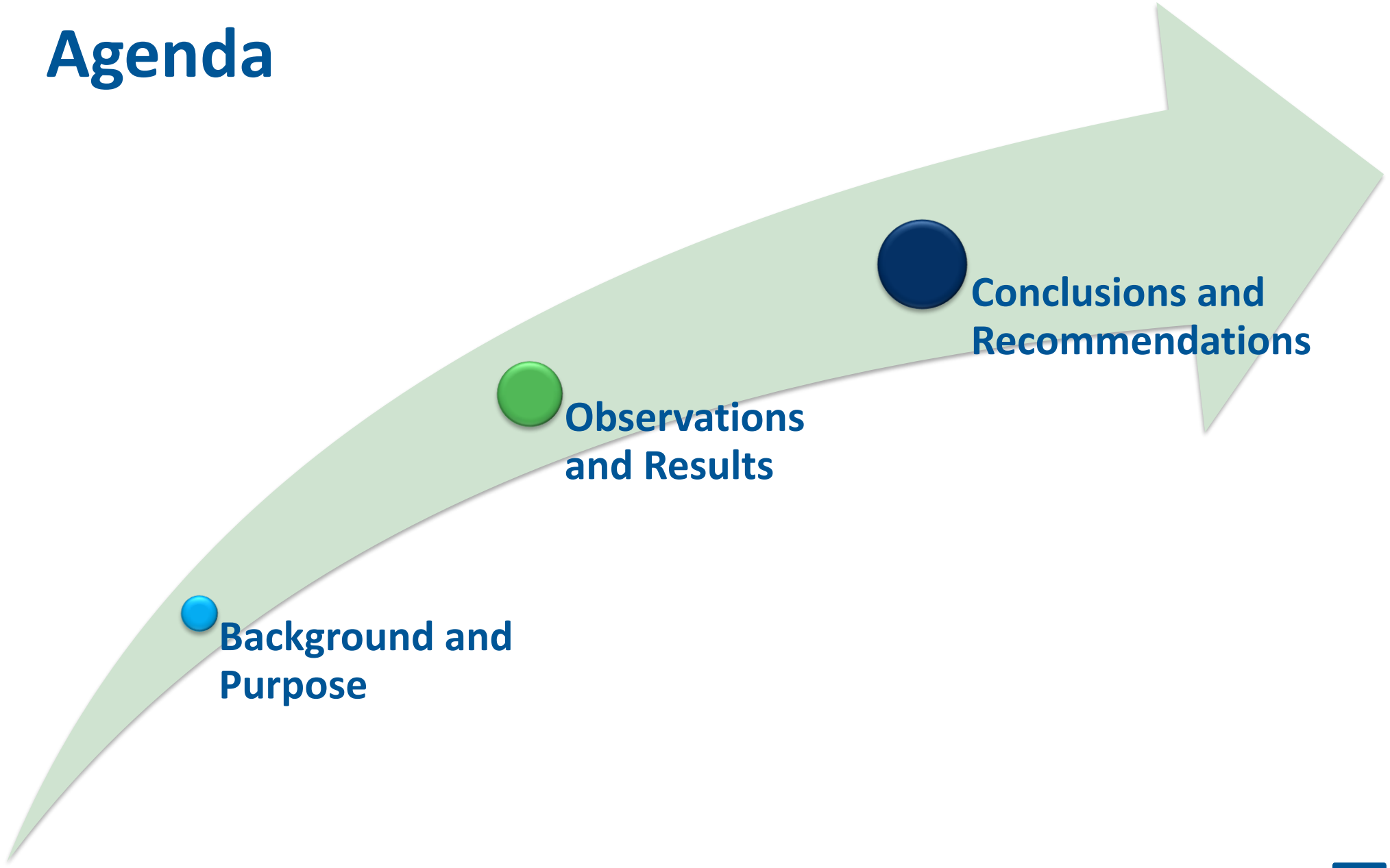
Principal Process Engineer

SEOWEA

DELAWARE COUNTY Ohio

BLACK & VEATCH

Agenda


Conclusions and Recommendations
Observations and Results
Background and Purpose

Background and Purpose

General Objectives

- Develop treatment process model for LSWRF
- Preliminary evaluation of process performance of existing facilities and operations compared to alternatives to optimize performance at current flows and loads and anticipated flows and loads for the future.

Supplemental facility planning for the future of LSWRF

PARAMETER	UNITS	FINAL EFFLUENT LIMITATIONS [A]	
		MONTHLY AVERAGE	WEEKLY AVERAGE
$CBOD_5$	mg/L	3.0	5.0
	kg/day [B]	15.9	26.5
Nitrogen, Total	mg/L	-	10
	kg/day [B]	-	53.0

Notes:

A. Maximum allowable at Final Outfall 001 unless otherwise noted

B. Based on average design flow of 1.4 mgd

OEPA Compliance Report

Part I, C - Schedule of Compliance

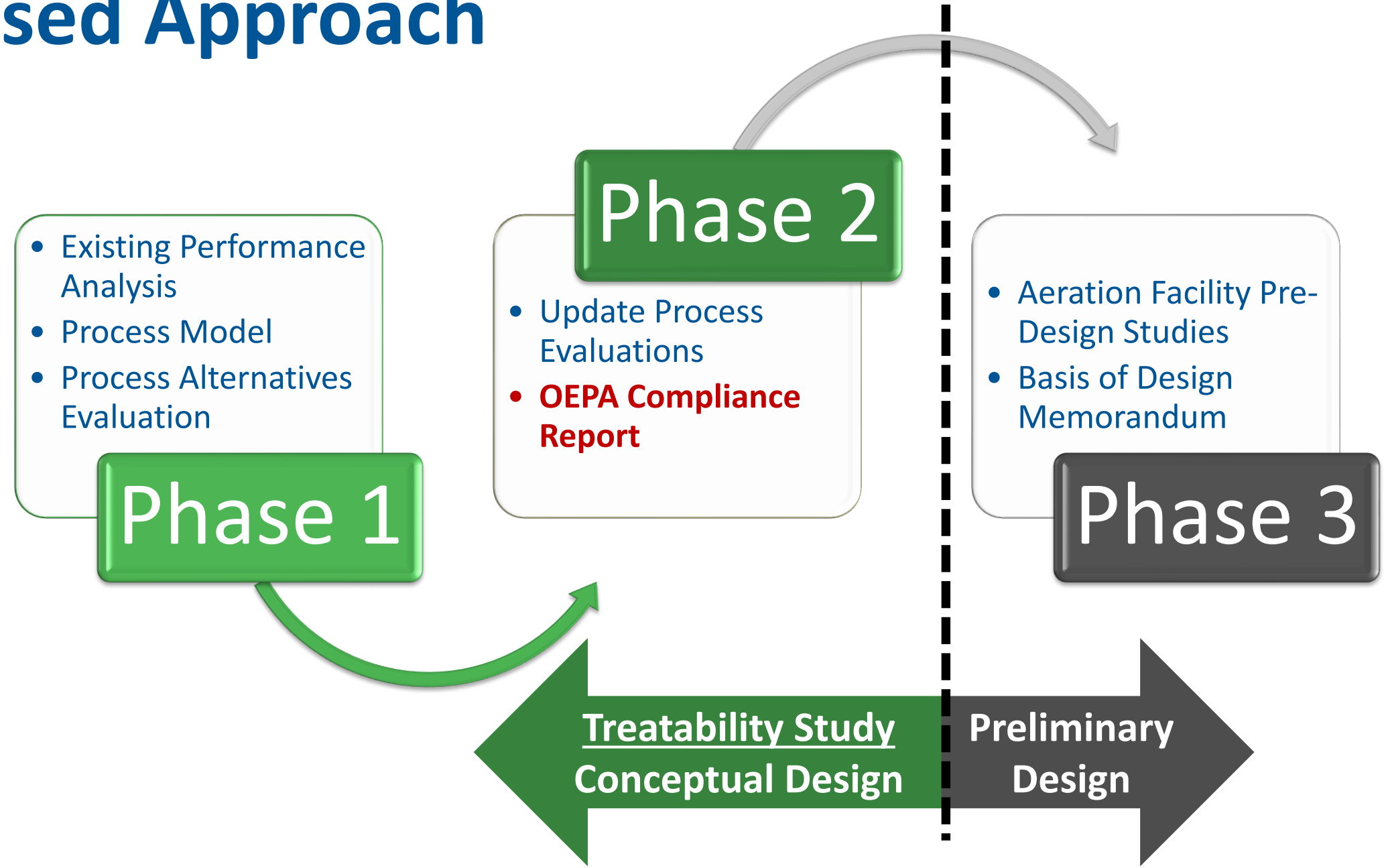
1. Compliance Report

The permittee shall as soon as possible but no later than 24 months after the effective date of the permit meet final limits for CBOD and total nitrogen at outfall 4PK00004001. The permittee shall also submit the following:

a. The permittee shall submit a report on the treatment plant effectiveness at meeting final effluent limits for CBOD and total nitrogen during the first 12 Months of the permit. {Event Code 34099}

b. Within 24 Months of the permit's effective date, the permittee shall meet the final effluent limitations. {Event Code 20099}

Phased Approach



Existing Facilities

Preliminary Treatment

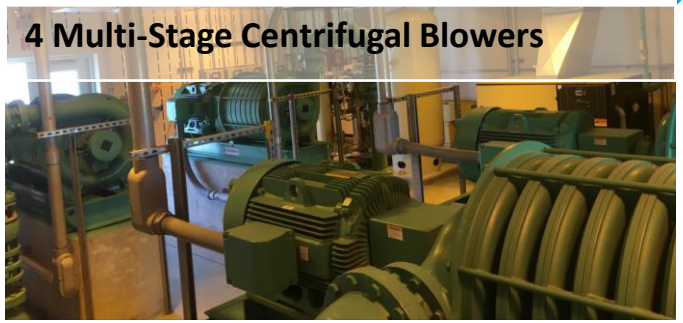
- 2 Drum Screens (1/4”)
- 1 Manual Bar Screen (1”)

High-Pressure Air

Air Receiver + 2 Screw Compressors

Low-Pressure Air

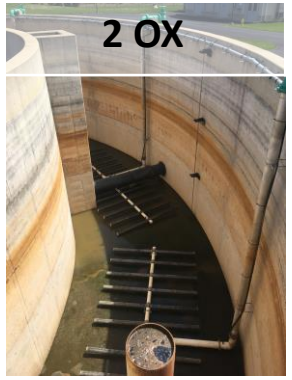
4 Multi-Stage Centrifugal Blowers



2 Aeration Basins

3 AX/OX

2 OX



3 Tertiary Filters

2 Clarifiers

RAS/WAS Pump Station

Biosolids Processing

2 Aerobic Digester Tanks

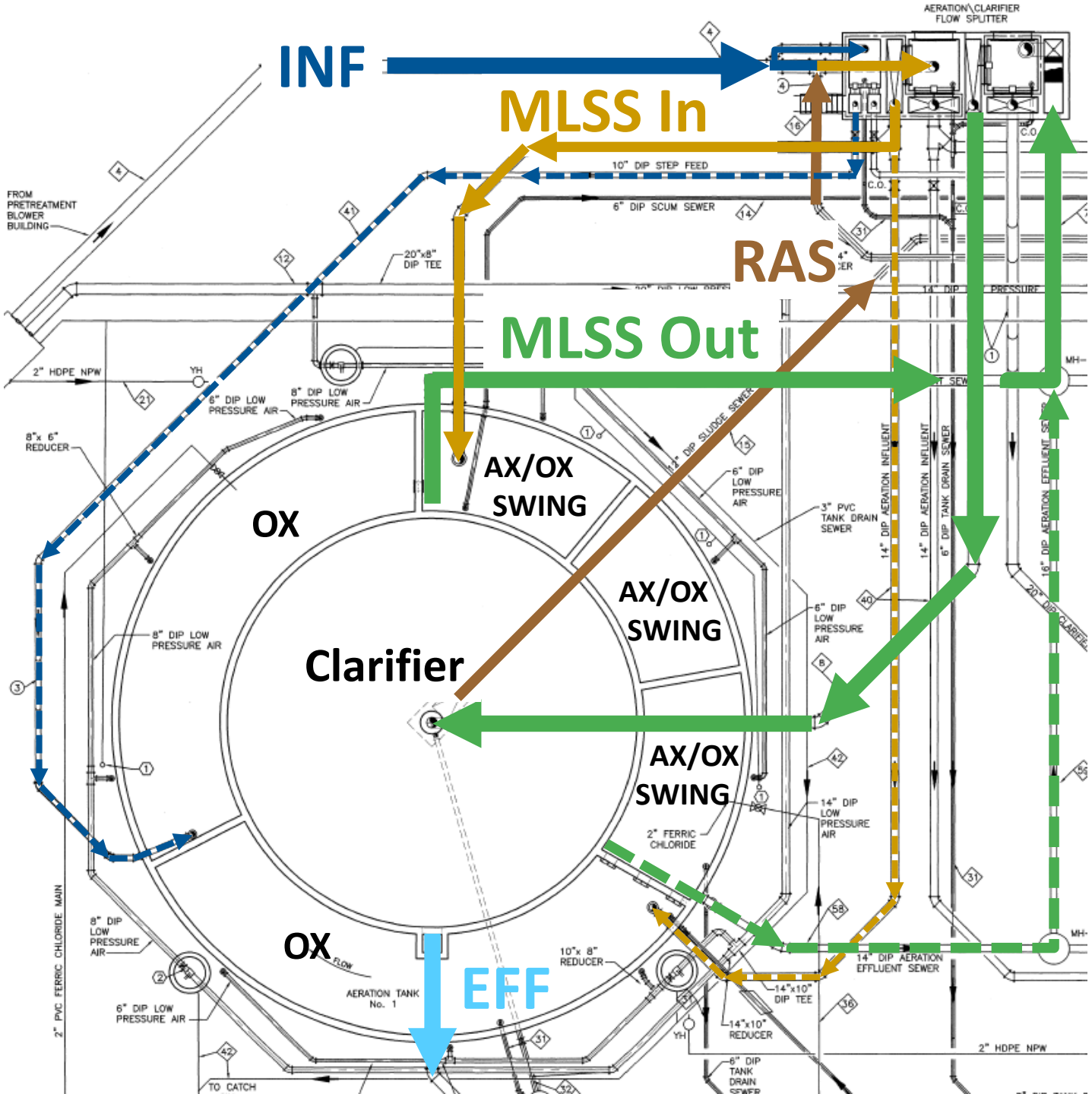
3 Blowers

1 Centrifuge

UV Disinfection

Existing Activated Sludge Process Flow Diagram

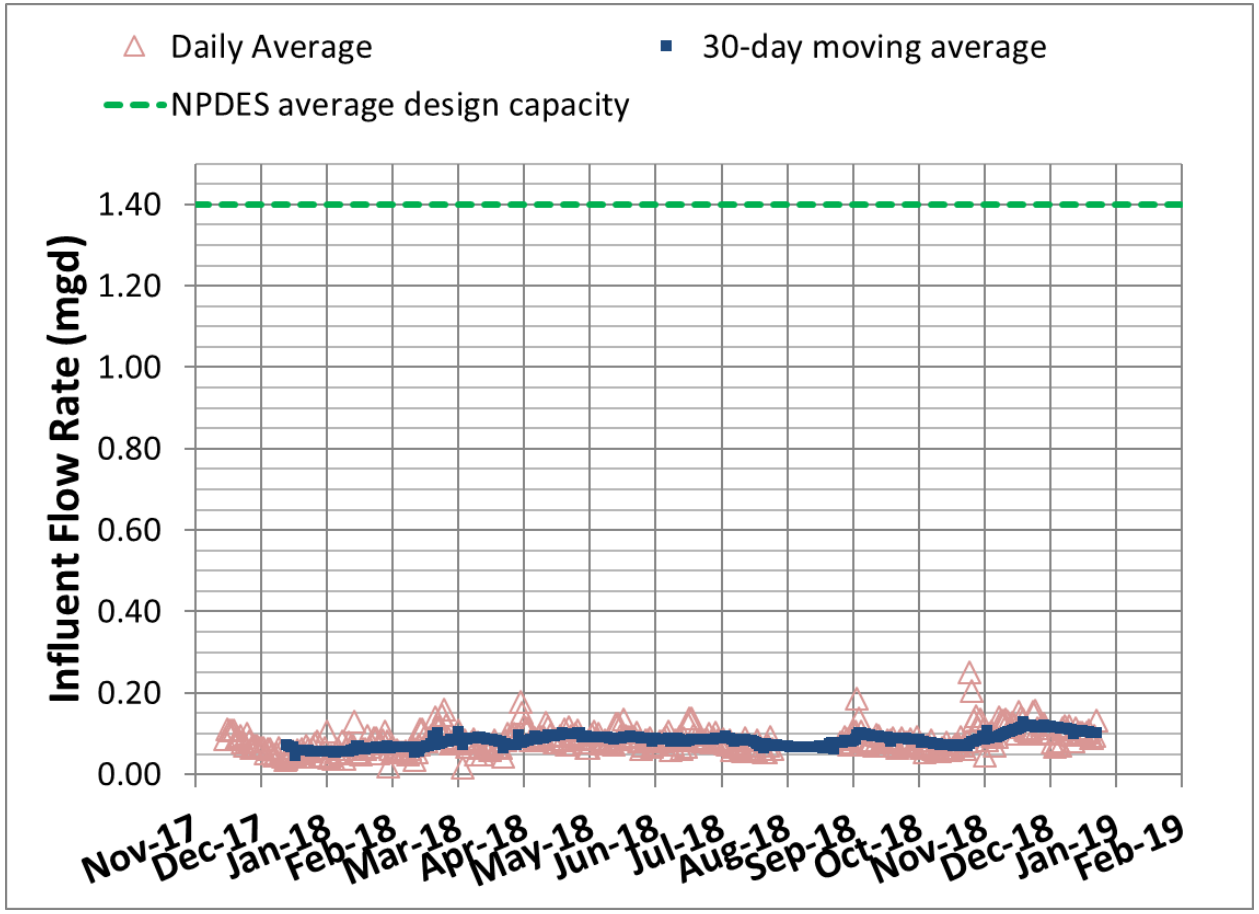
- Optional flow paths to help address:
  - low loads (--- MLSS Outlet)
  - wet-weather (--- Step-Feed)
  - nitrification/denitrification conditions (--- MLSS Feed)



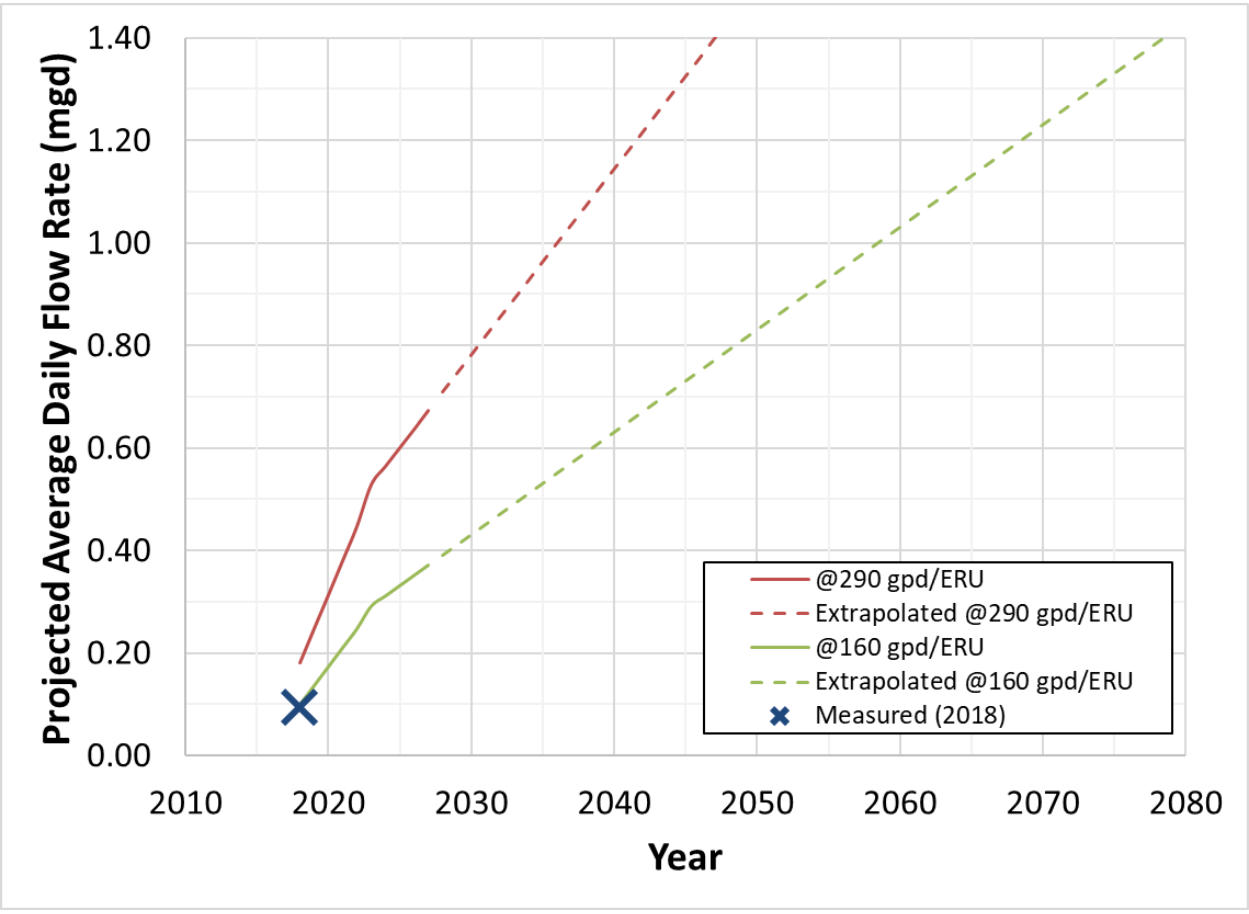
Observations, Results and Conclusions

Influent Flow Rate

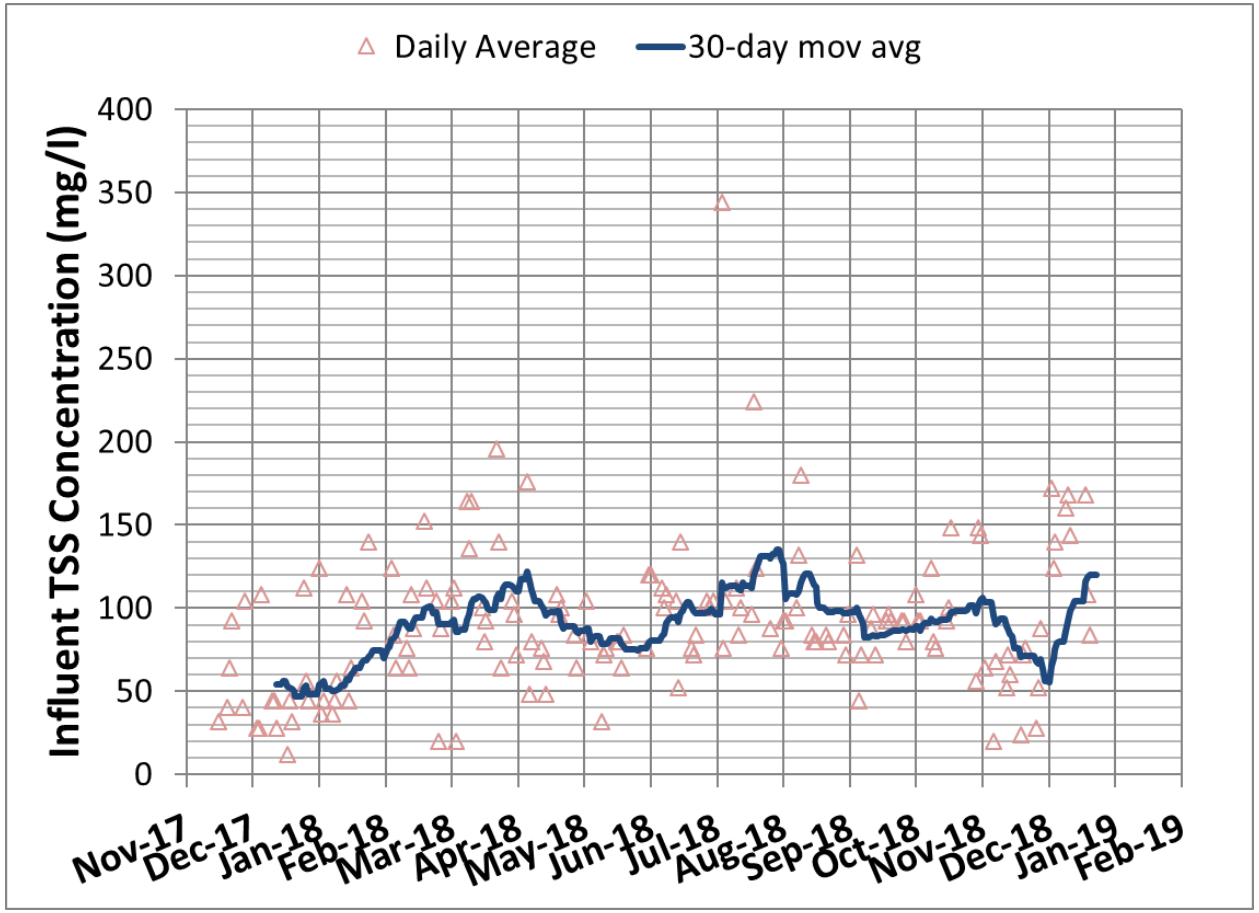
Historical

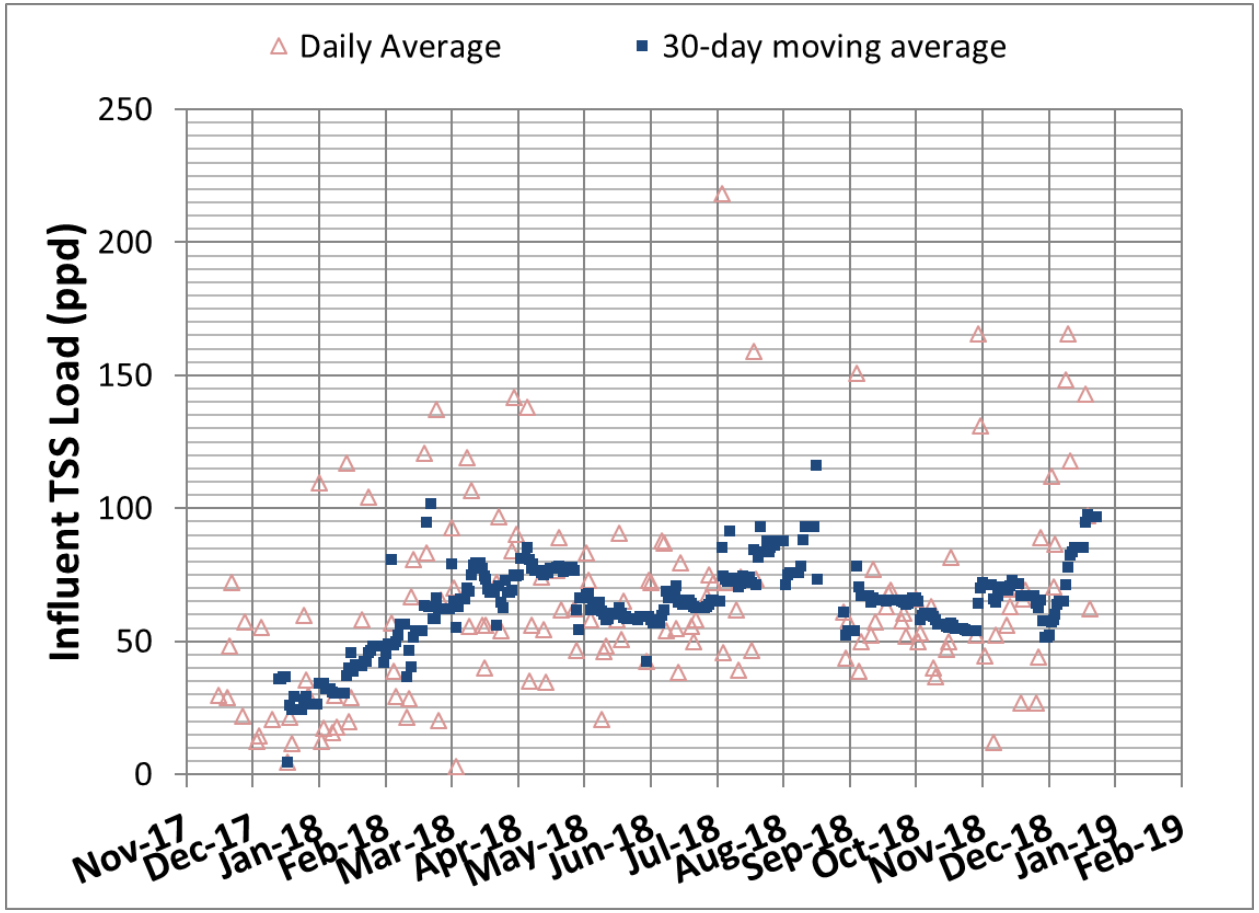


Future Projections



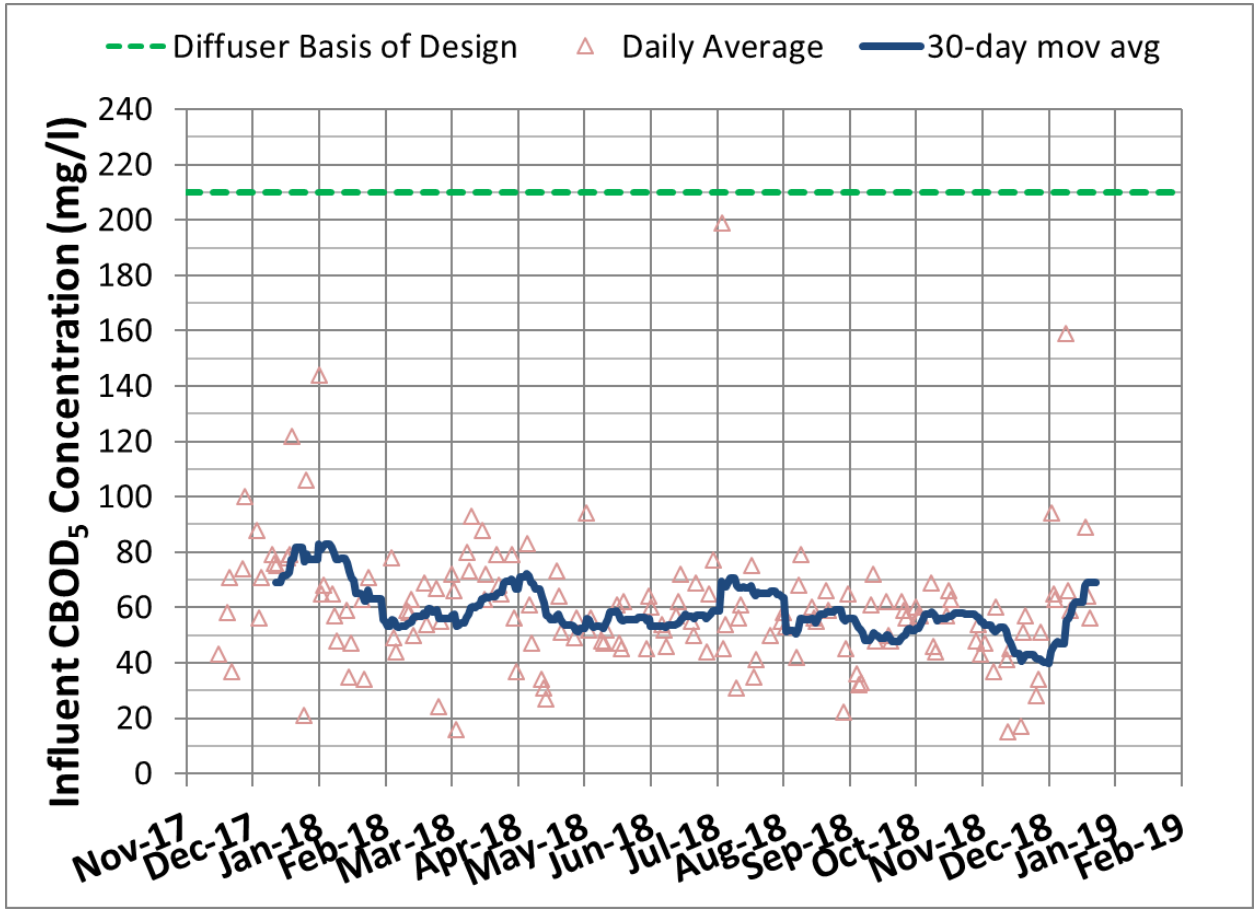
Influent TSS

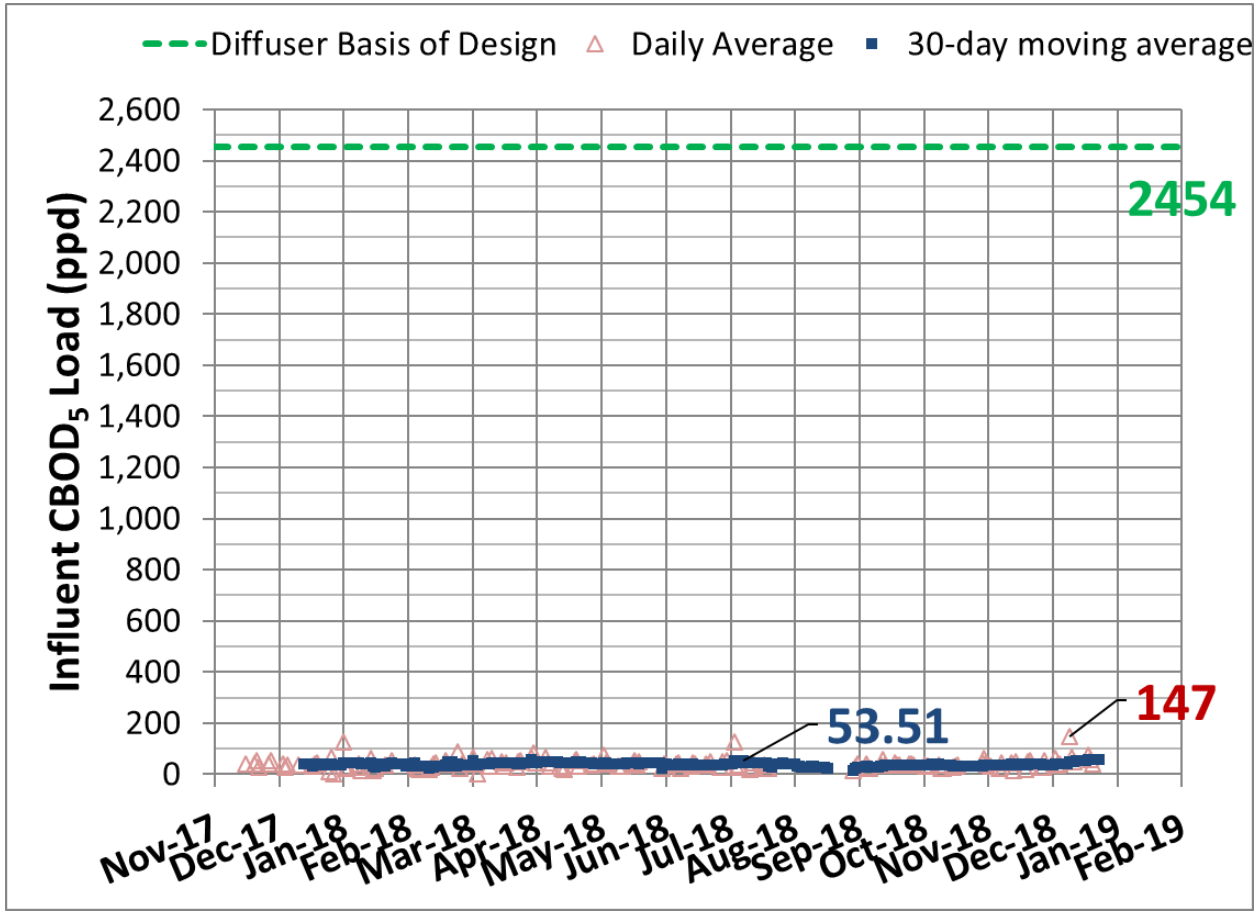




Relatively low-strength wastewater

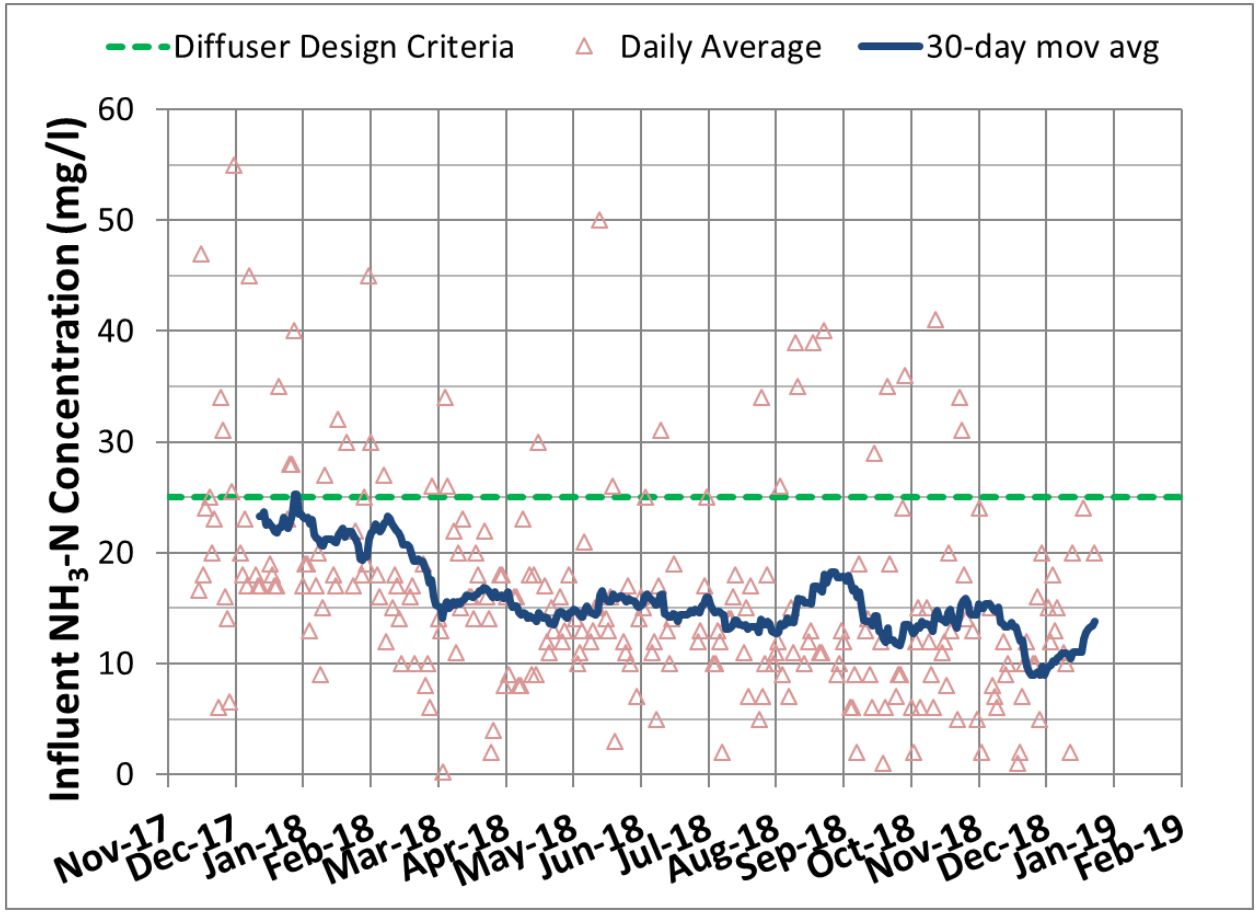
Influent $CBOD_5$

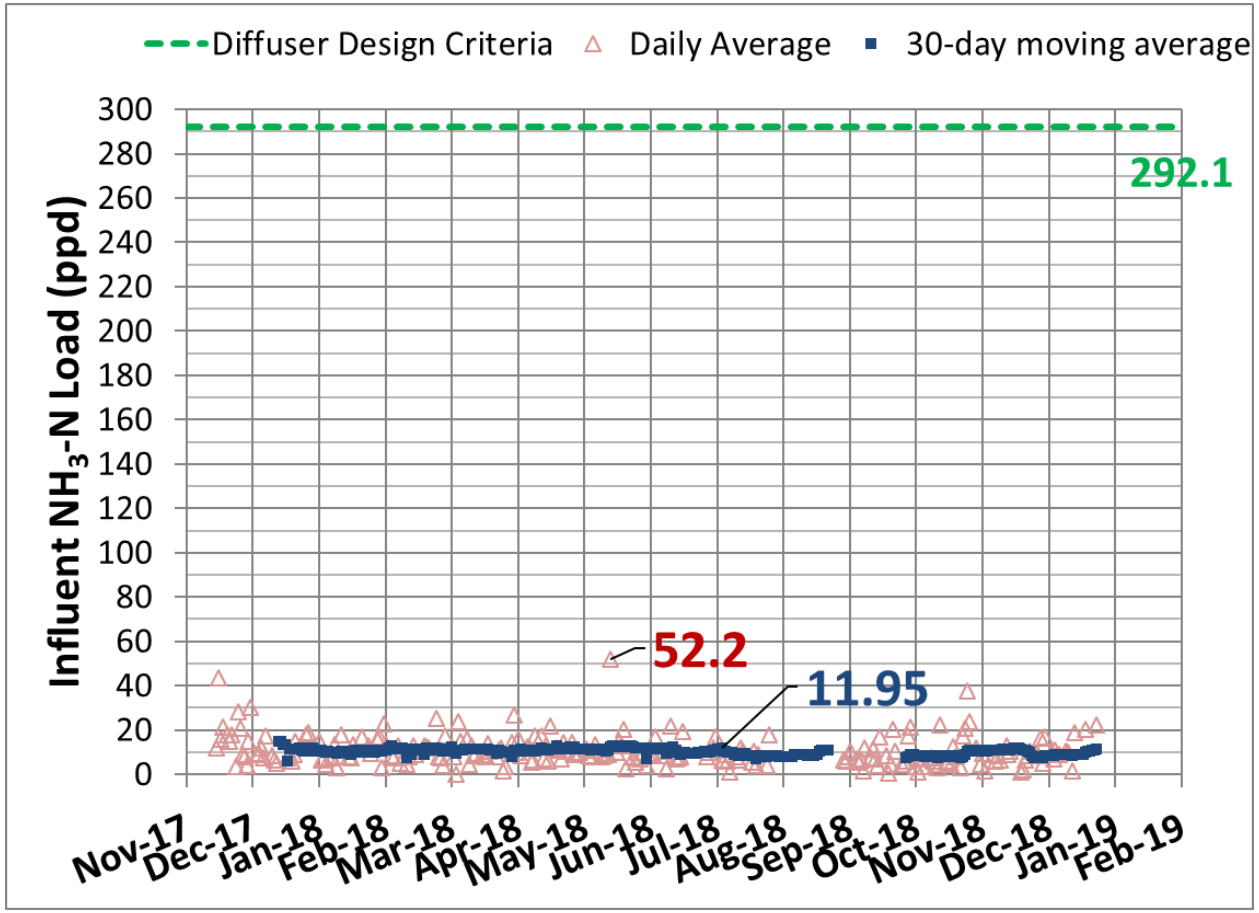




Carbonaceous oxygen demand 16 to 50x less than basis of design for existing fine-bubble diffusers.

Influent NH_3-N



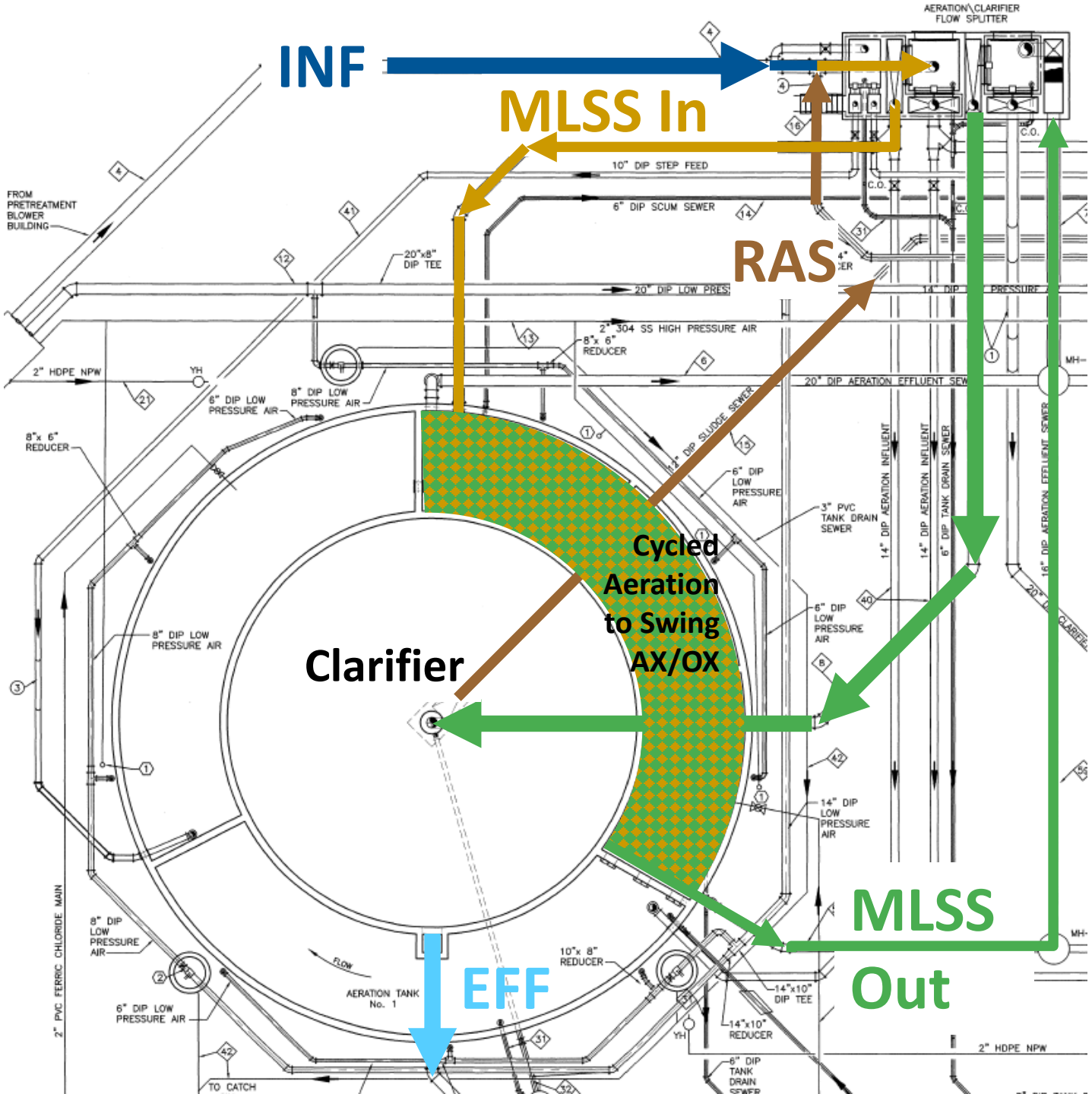


Nitrogenous oxygen demand 5 to 25x less than basis of design for existing fine-bubble diffusers.

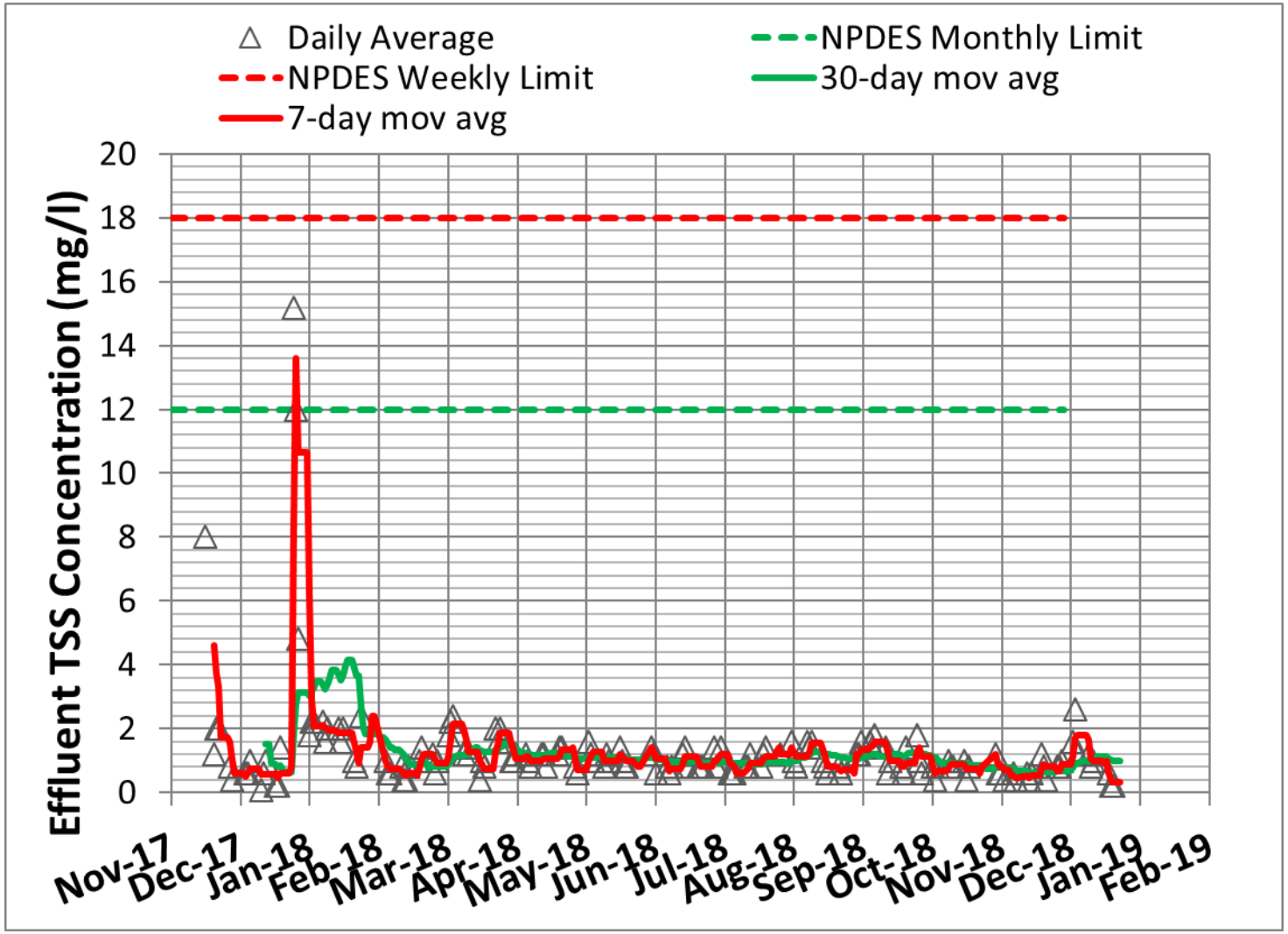
Operations Modified for Extremely Low Loads

- 1/3 of existing basin in service
- Timers used to cycle DO in the OX zone
  - 60 min on, 150 min off

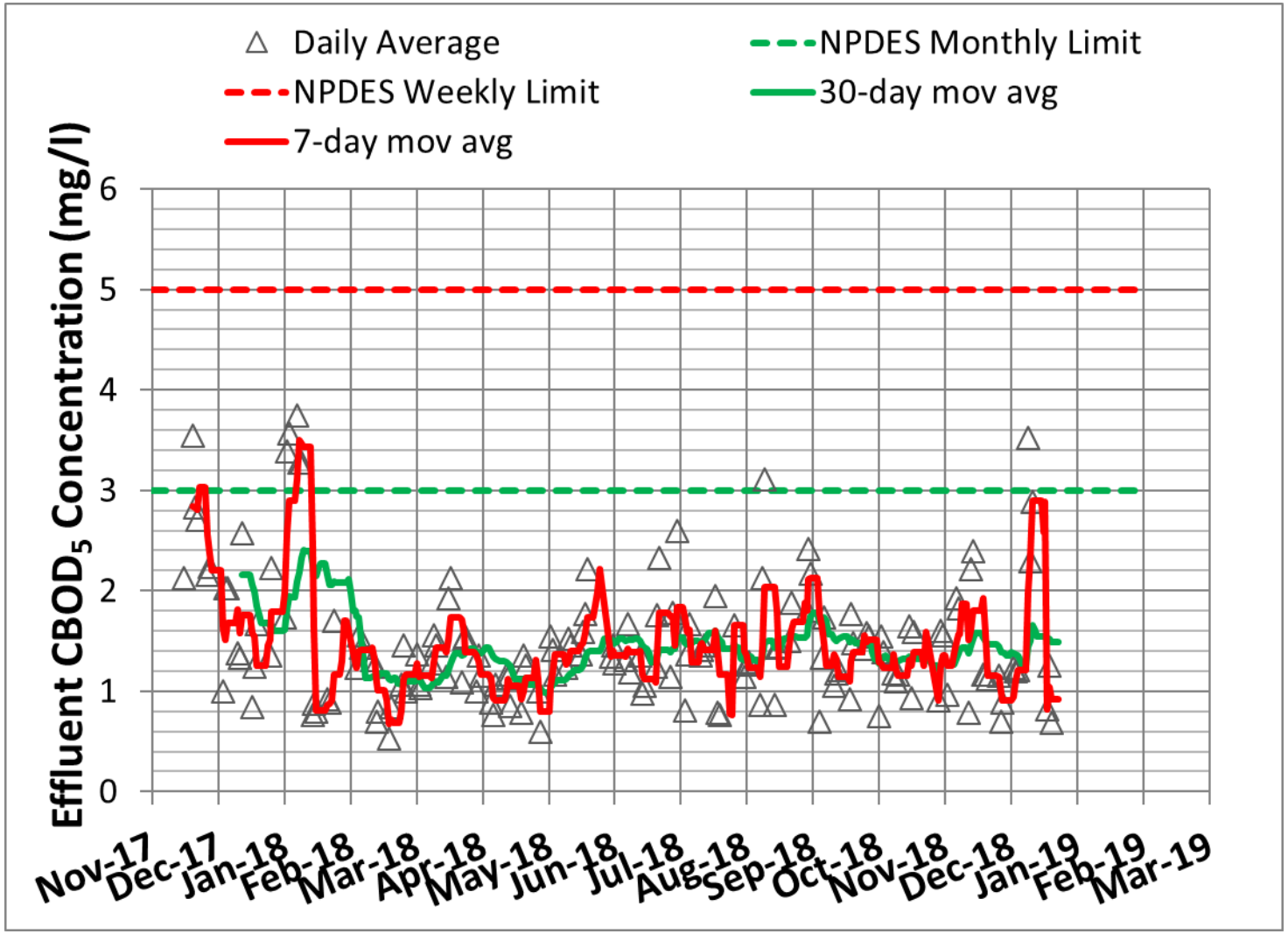
Cyclic on/off operation with existing aeration system to prevent over-aeration and comply with TN limits.



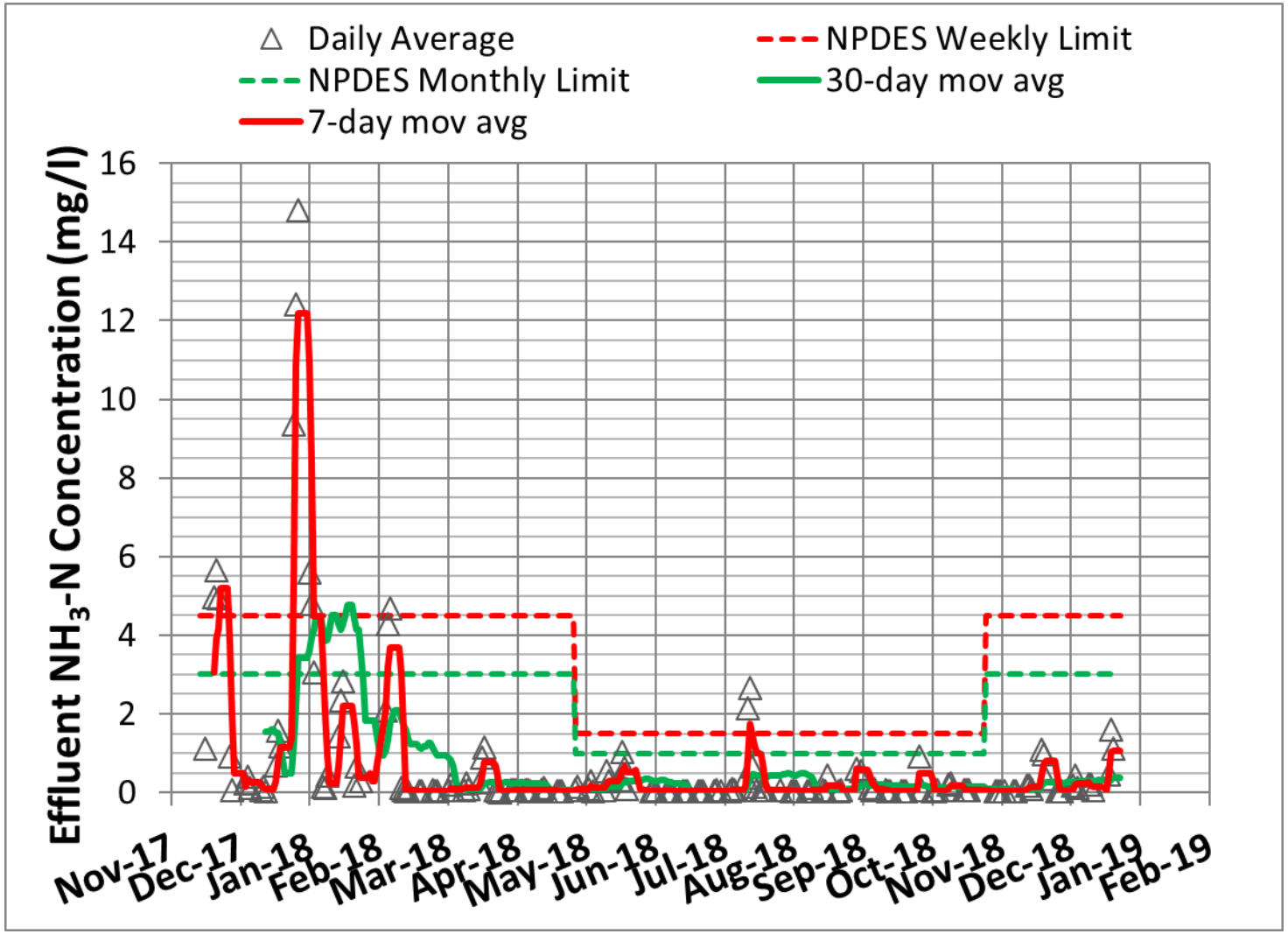
Effluent TSS Trend



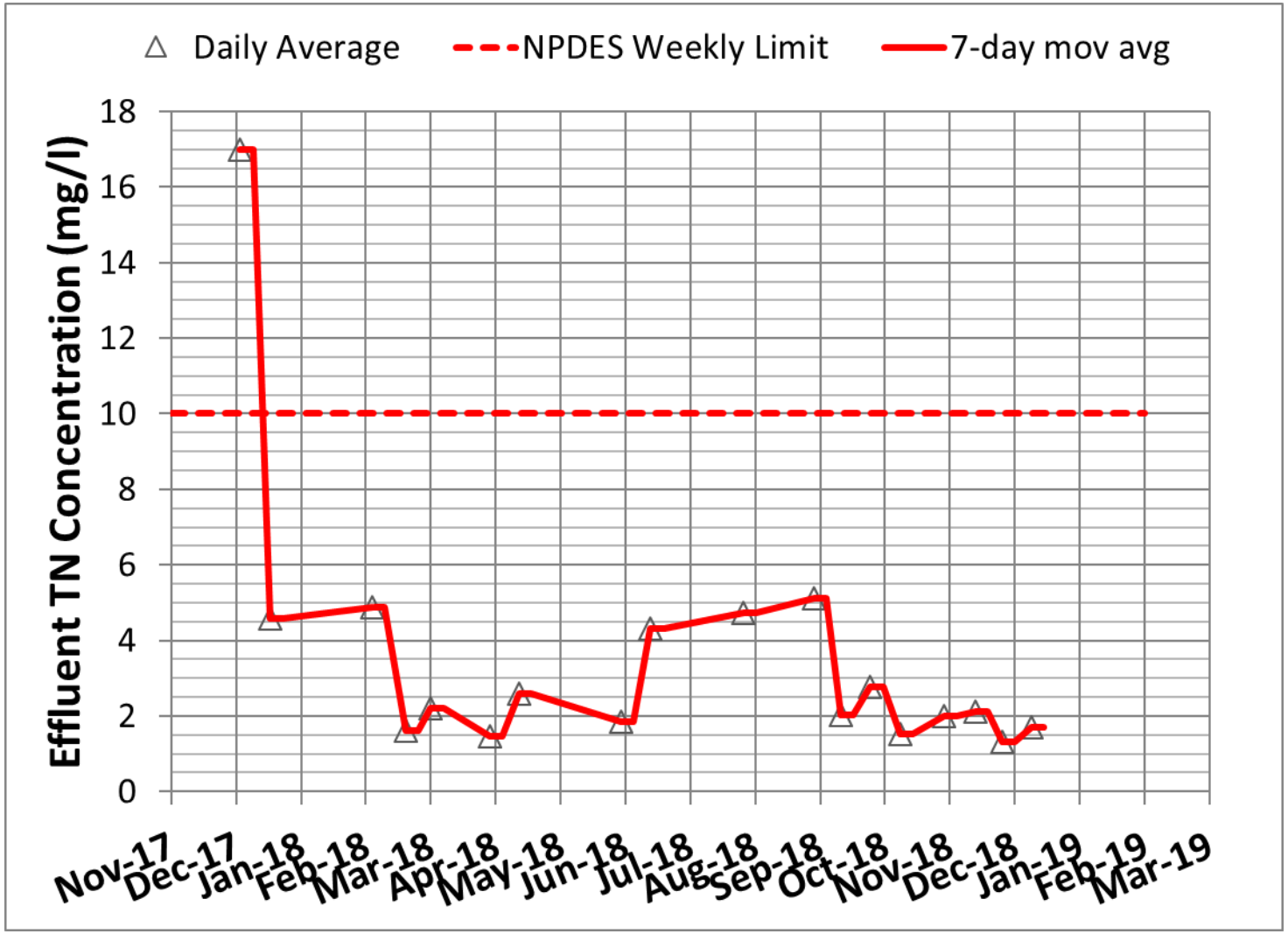
Effluent $CBOD_5$ Trend



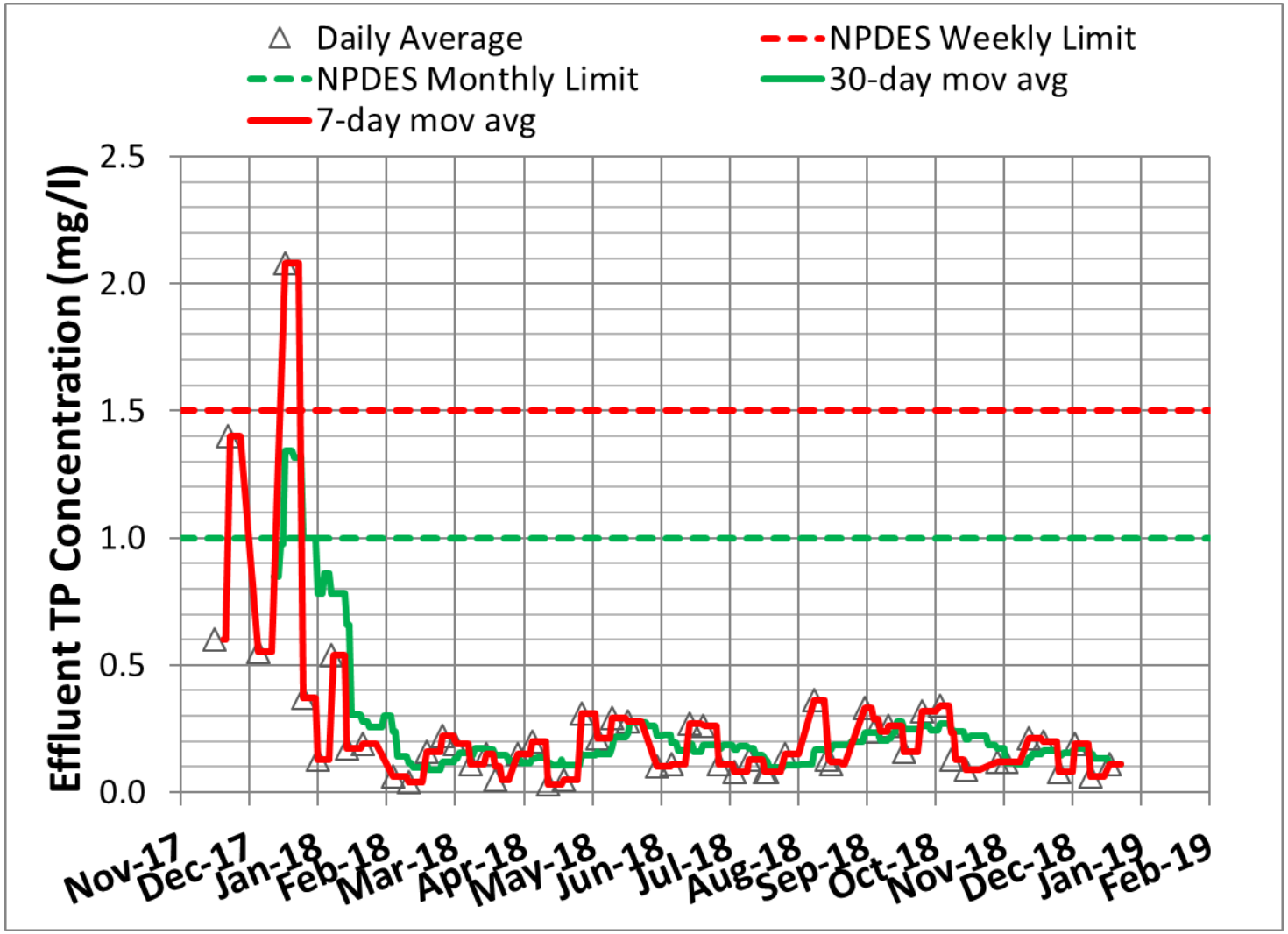
Effluent NH_3-N Trend



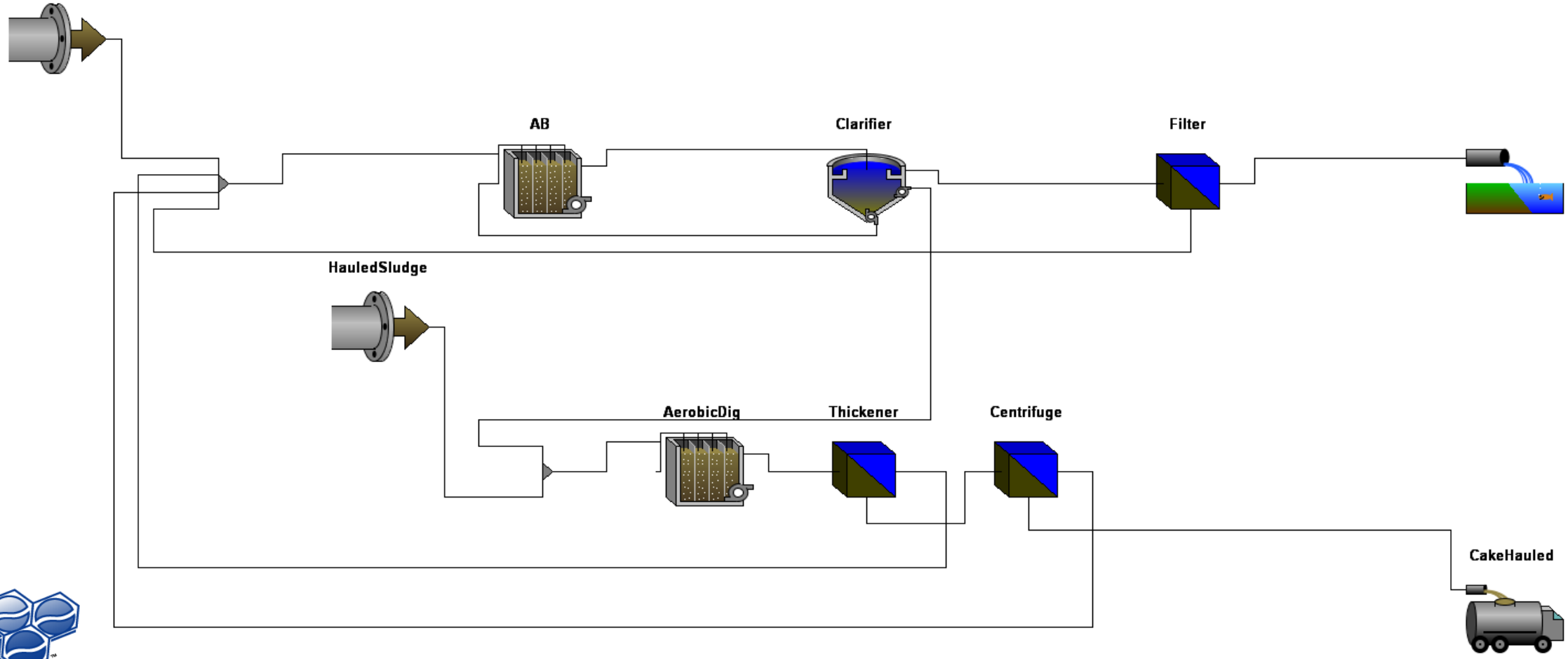
Effluent TN Trend



Effluent TP Trend



Process Model to Evaluate Performance and Alternatives for Future Conditions



Hydromantis
Environmental Software Solutions, Inc.

Model Calibration and Scenarios

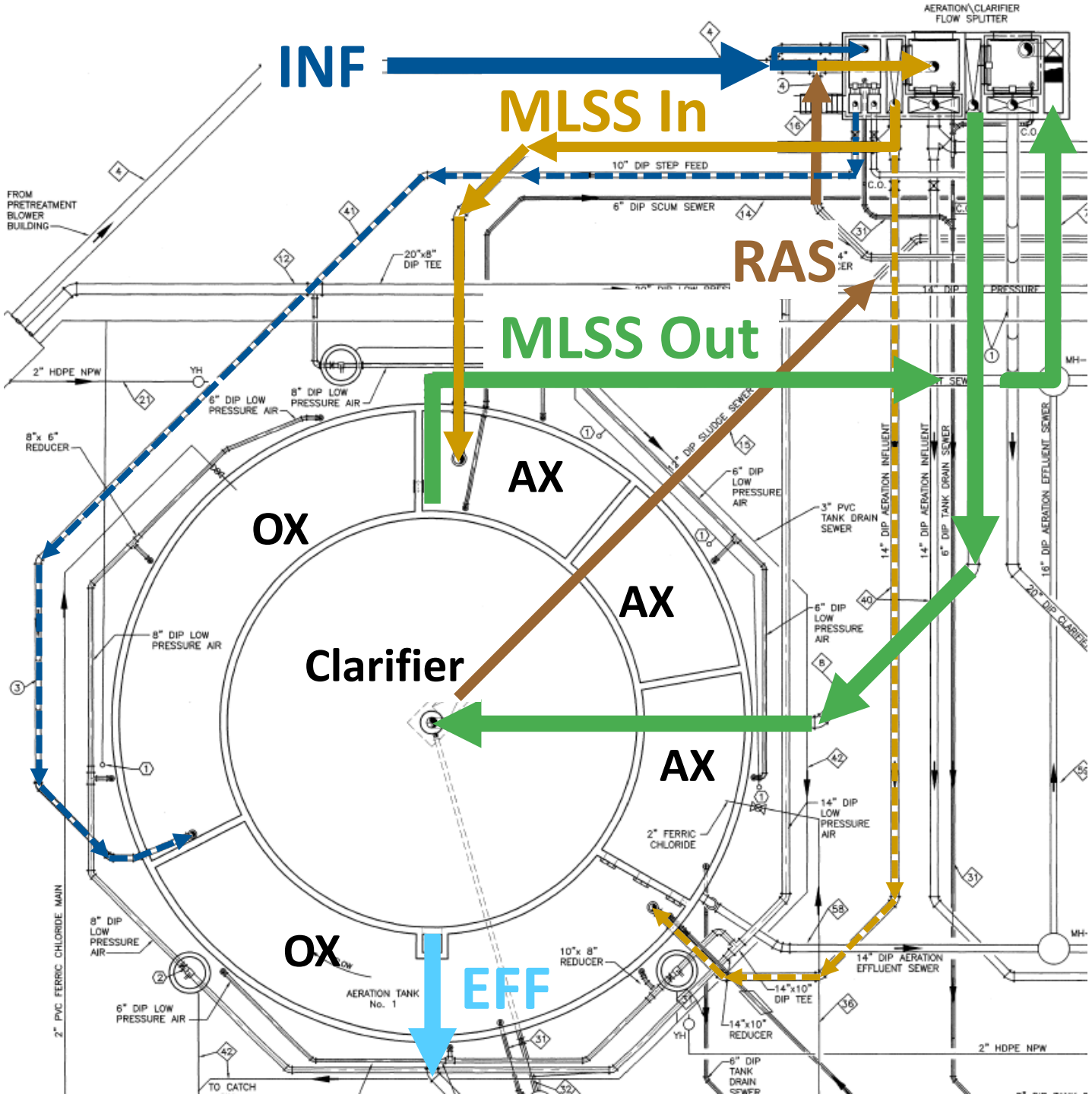
Calibration

- B&V/GPS-X default fractionation for C, N and P species. Soluble:particulate, biodegradable:total, etc.
- B&V/GPS-X default kinetic parameters
- Calibration month: April 2018. Cyclic aeration (60 min ON / 150 min OFF).

Flow/Load Condition	Process Configuration		
	Existing	Modified Ludzack Ettinger (MLE)	Anoxic Step-Feed
Current	0.1 mgd	0.1 mgd	0.1 mgd
50% Design	0.7 mgd	0.7 mgd	0.7 mgd
100% Design	1.4 mgd	1.4 mgd	1.4 mgd

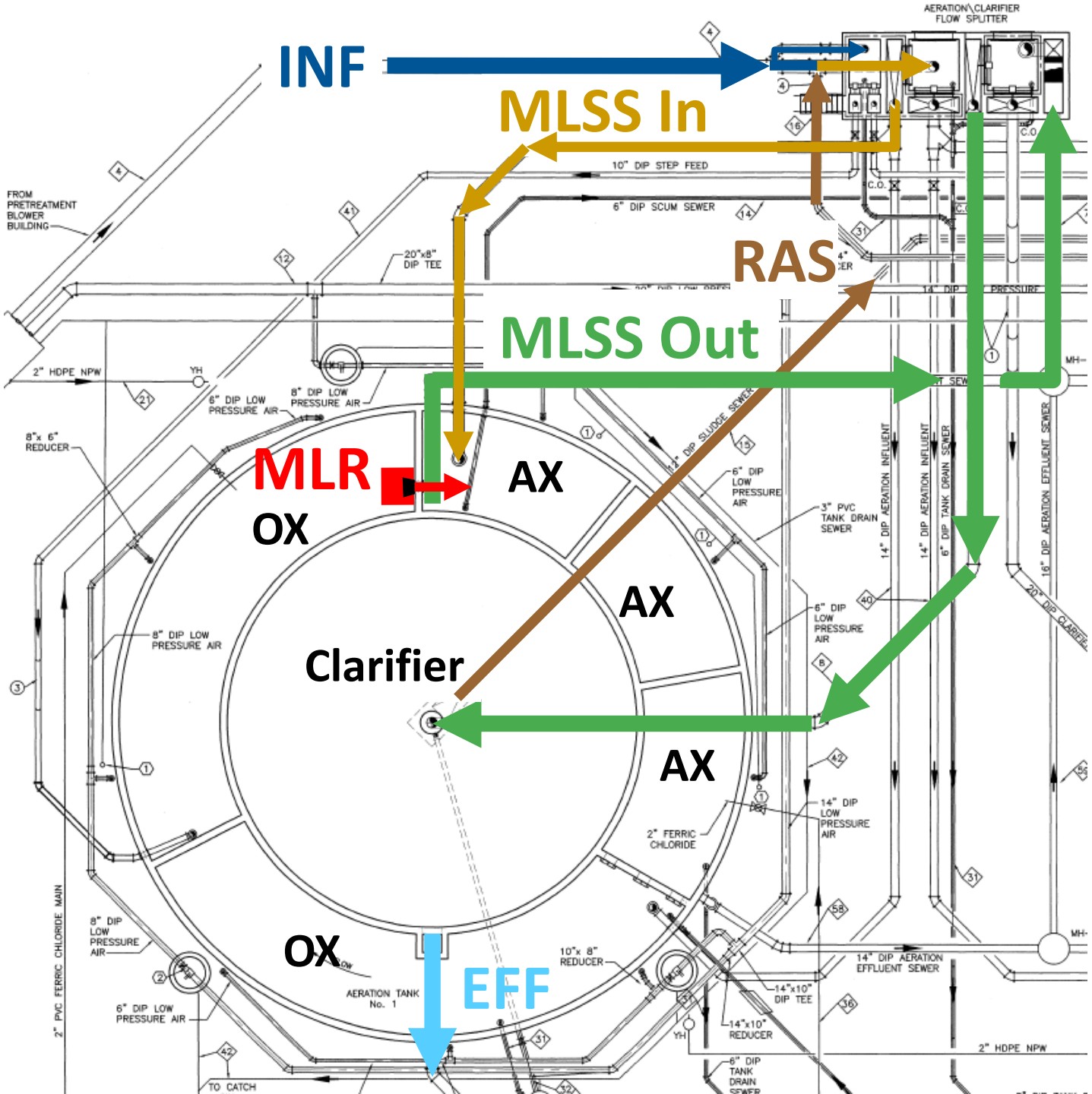
Existing Configuration

- One train in service
- 1/3 anoxic (AX), 2/3 oxic (OX)
- Continuous mixing / aeration
- Step-feed options



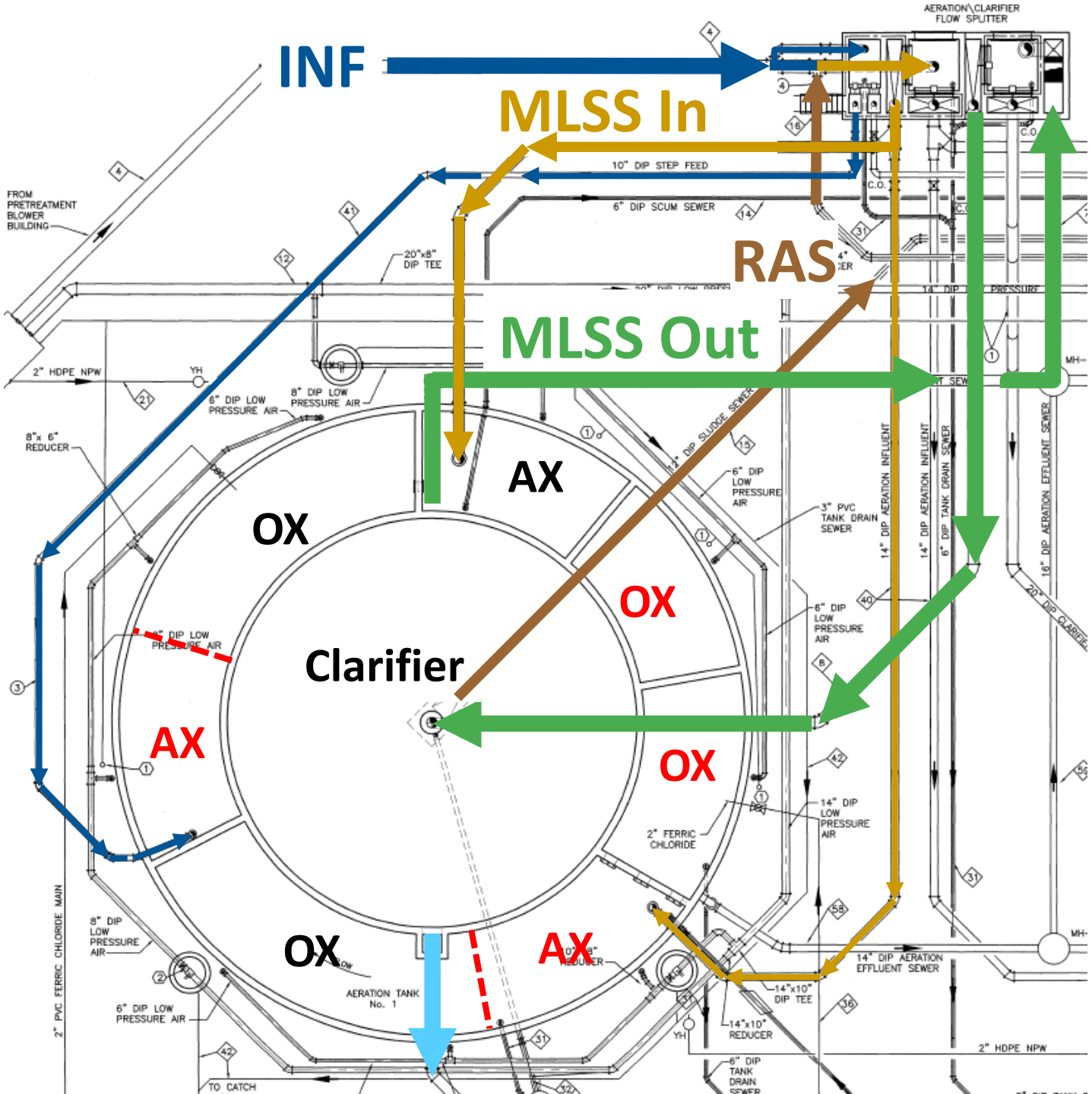
MLE Alternative

- One train in service
- 1/3 anoxic (AX), 2/3 oxic (OX)
- Continuous mixing / aeration
- 3Q mixed liquor recycle pump
- No step feed



Anoxic Step-Feed Alternative

- One train in service
- 1/3 anoxic (AX), 2/3 oxic (OX)
- Continuous mixing / aeration
- **AX zones at step-feed locations**
- **No MLR pumping**

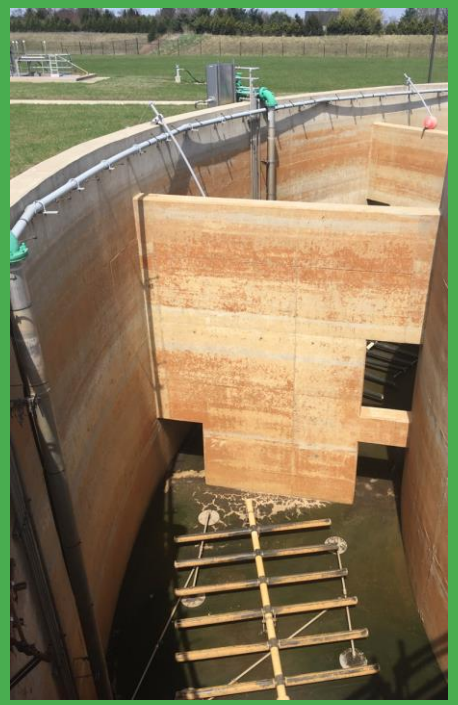


Summary of Model Results

Parameter	Existing	MLE	AX Step-Feed				
Flow, mgd *	1.4	1.4	1.4	1.4	0.7	0.25	0.1
MLSS, mg/L	1450	1450	1450	1600	900	600	650
SRT_a, days (20°C)	9	9	9	9	10	20	48
Clarifier SLR, ppd/sf	10.2	10.2	10.2	11.4	3.2	0.8	0.4
Clarifier SOR, gpd/sf	420	420	420	430	217	82	37
WAS, lb/day	475	470	475	530	287	105	49
Effluent							
TSS, mg/L	1.8	1.8	1.8	1.8	0.9	0.4	0.2
$CBOD_5$, mg/L	1.6	2.0	1.9	1.9	1.6	1.3	1.2
NH_3-N, mg/L	0.07	0.10	0.15	0.15	0.15	0.1	0.1
TN, mg/L	13.4	10.0	9.0	9.1	8.6	7.4	6.2
	No biosolids dewatering returns			Biosolids dewatering centrate including 150,000 gal/wk imported WAS from package plants			
* COD = 144 mg/L, BOD/COD=0.45, CBOD/BOD=0.85, TKN=24 mg/L, NH_3-N = 18 mg/L							

Air Flow Estimates for Low-Pressure, Fine-Bubble Diffusers

Design Load Condition	Projected Year	Air Demand, scfm		
		Biological Process		Mixing
		Minimum	Maximum	*
0.1-mgd AADF	Now	24	29	298
0.31-mgd AADF	2024	78	88	298
1.4-mgd AADF	>2047	346	463	298
* Based on 5 scfm/kcf				



Existing Aeration System

Low-Pressure Air (11 psig)	High-Pressure Air (60 psig)
For process dissolved oxygen and mixing	For mixing only
Multi-Stage Centrifugal Blowers	Screw Compressors
2 x 1,100 scfm	2 x 188 scfm @ 115 psig
2 x 2,200 scfm	Air Receiver (1)
Fine-Bubble Diffusers	Air Valve Panels (4 per basin)
FlexAir™ MiniPanel™	Large-Bubble Mixing Plates
216 per basin	Pulsair™
	36 per basin

- **Inadequate turndown for process air at extremely low startup loads**
- **Blower system not designed for frequent on/off operation**

Conclusions and Recommendations

Treatability Study Conclusions and Recommendations

Short Term

- Extremely lower influent loading than original design
- Turndown constraints of existing aeration and RAS systems limit operational options and energy efficiency
- Cyclic aeration can comply with permit, but at higher O&M cost than utility standards
- Current 1/3 basin operation can treat up to about 0.31-mgd AADF, which is projected to occur in about five years (2024).

Long Term

- 1.4-mgd AADF is projected to occur 27 to 60 years from now.
- Proceed with preliminary-level design of anoxic step-feed process retrofits to improve performance and O&M costs:
  - Anoxic zone baffle alternatives
  - High-pressure air mixing modifications
  - Low-pressure diffused air modifications, including smaller blowers
  - RAS pumping alternatives
  - Basis of Design Memorandum

O'Shaughnessy Dam and Bridge
Scioto River, Ohio

From maps.roadtrippers.com

THANK YOU!!

Jim Fitzpatrick
Principal Process Engineer
+1 913-458-3695
FitzpatrickJD@bv.com

Sierra McCreary
Project Manager
+1 614-454-4394
McCrearySB@bv.com

Jonathan Leonard
Project Engineer
+1 614-454-4393
LeonardJ@bv.com

Bullpen

Existing Facilities

2 Aeration Basins

3 Anoxic Zones
- Mixing Plates (High-Pressure Air)
- Fine-Bubble Diffusers (Low-Pressure Air)

2 Oxic Zones
- Fine-Bubble Diffusers (Low-Pressure Air)
- 1 Mixing Zone (High-Pressure Air)

2 Clarifiers

- 65-ft Diameter
- Center Feed
- Flocculator Feedwell
- Spiral Scraper
- Ducking Skimmers
- Interior Launders (Covered)

Preliminary Treatment

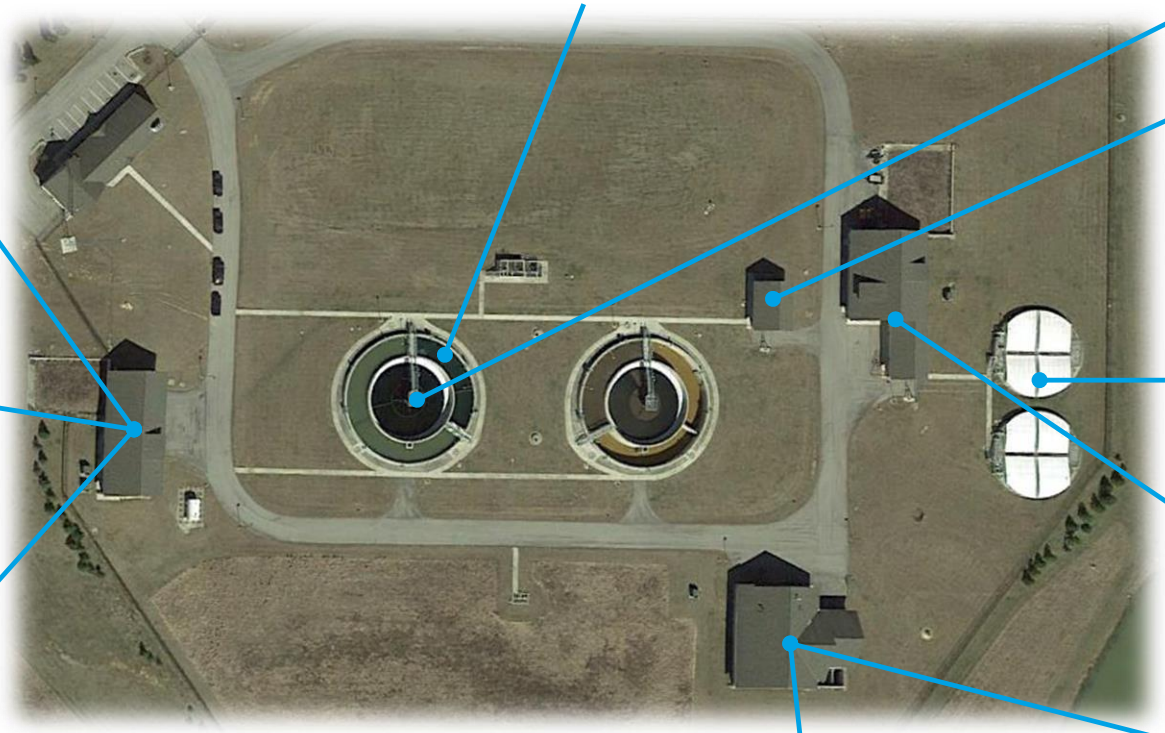
- **2 Drum Screens (1/4")**
- **1 Manual Bar Screen (1")**

Low-Pressure Air (11.1 psig)

Multi-Stage Centrifugal Blowers
- 2 @ 1100 scfm
- 2 @ 2200 scfm

High-Pressure Air (60 psig)

Air Receiver
Screw Compressors
- 2 x 188 scfm @ 115 psig



RAS/WAS Pump Station

3 x 650 gpm @ 35 ft TDH

Biosolids Processing

2 Aerobic Digester Tanks
- 65-ft dia x 15-ft SWD
- Coarse-bubble diffusers
- 3 Heliflow PD Blowers (1500 scfm @ 8.3 psig)

Dewatering Centrifuge

Tertiary Treatment

3 Traveling Bridge Filters
- Anthracite/Sand

Effluent Disinfection

UV Vertical LPHO