Staged Thermophilic Anaerobic Digestion

for Class A Exceptional Quality Biosolids

METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI

Jacobs

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Little Miami WWTP Solids Disposal & Odor Control Progressive Design-Build Project

- January 2023 to Fall of 2028
- Project includes:
  - Sludge Receiving Station & Blend Tanks
  - Screening and Thickening
  - Anaerobic Digestion
  - Dewatering & Loadout
  - Digester Gas Conditioning and Utilization
  - Odor Control

Little Miami Wastewater Treatment Plant

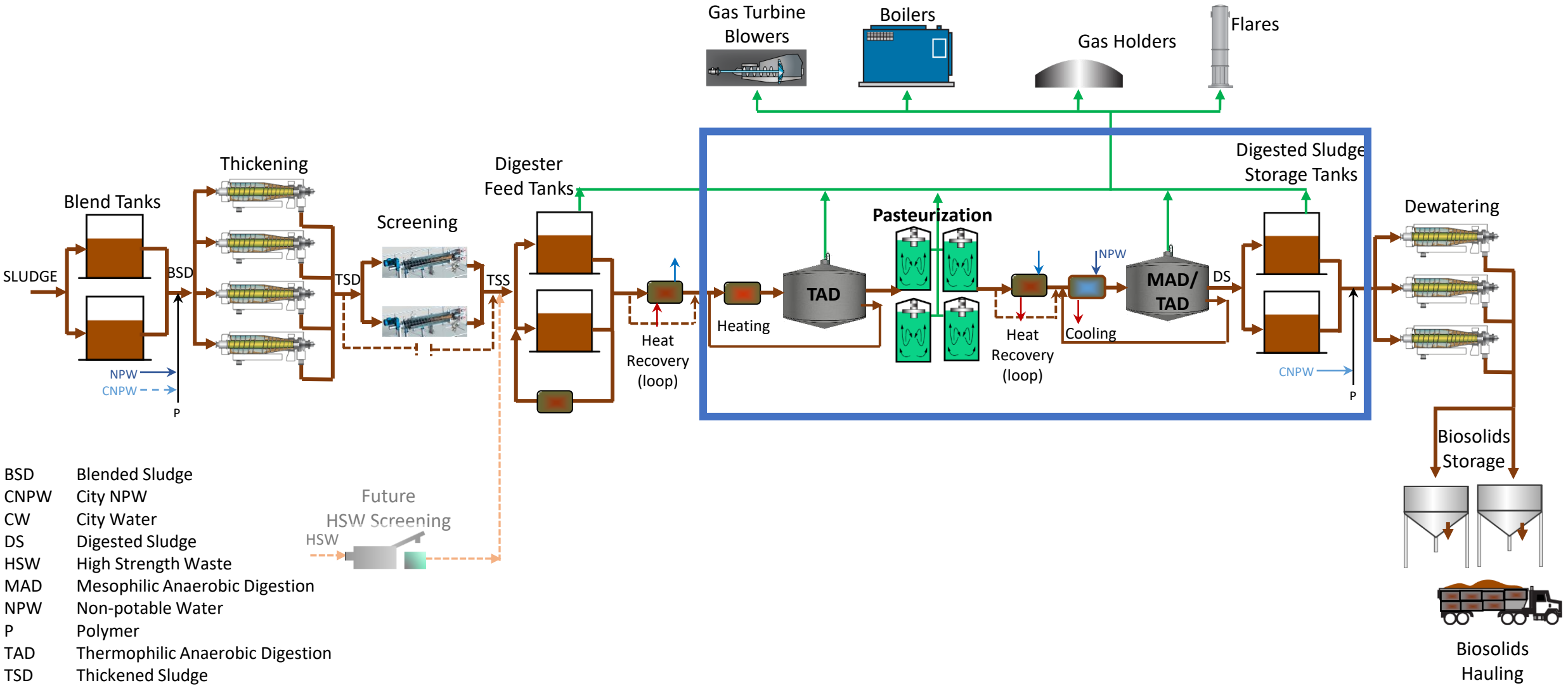
Courtesy of Google Maps

Site Rendering

Digester Rendering

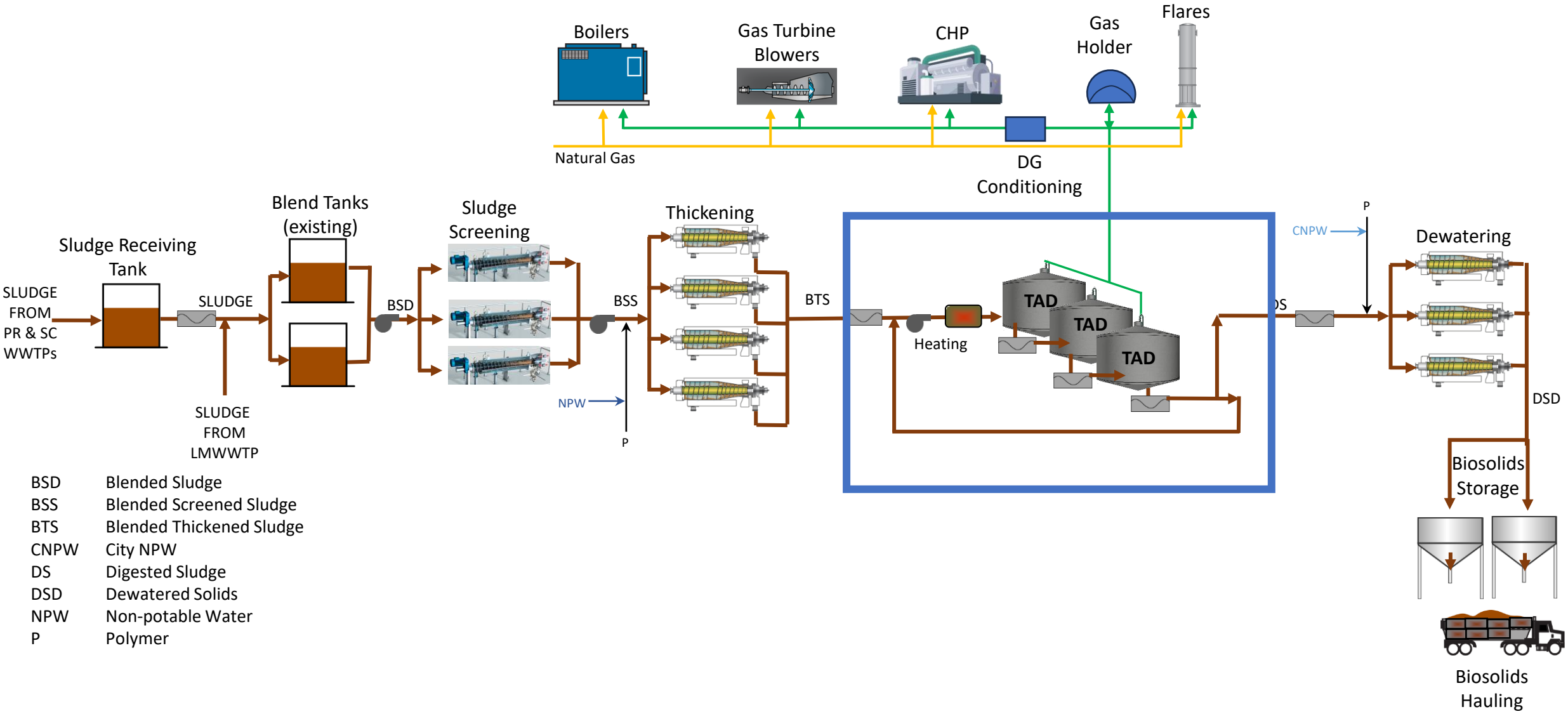
Digester Gallery Rendering

Pre-BODR Solids PFD



BSD	Blended Sludge
CNPW	City NPW
CW	City Water
DS	Digested Sludge
HSW	High Strength Waste
MAD	Mesophilic Anaerobic Digestion
NPW	Non-potable Water
P	Polymer
TAD	Thermophilic Anaerobic Digestion
TSD	Thickened Sludge
TSS	Thickened Screened Sludge

Current 90% Design Solids PFD

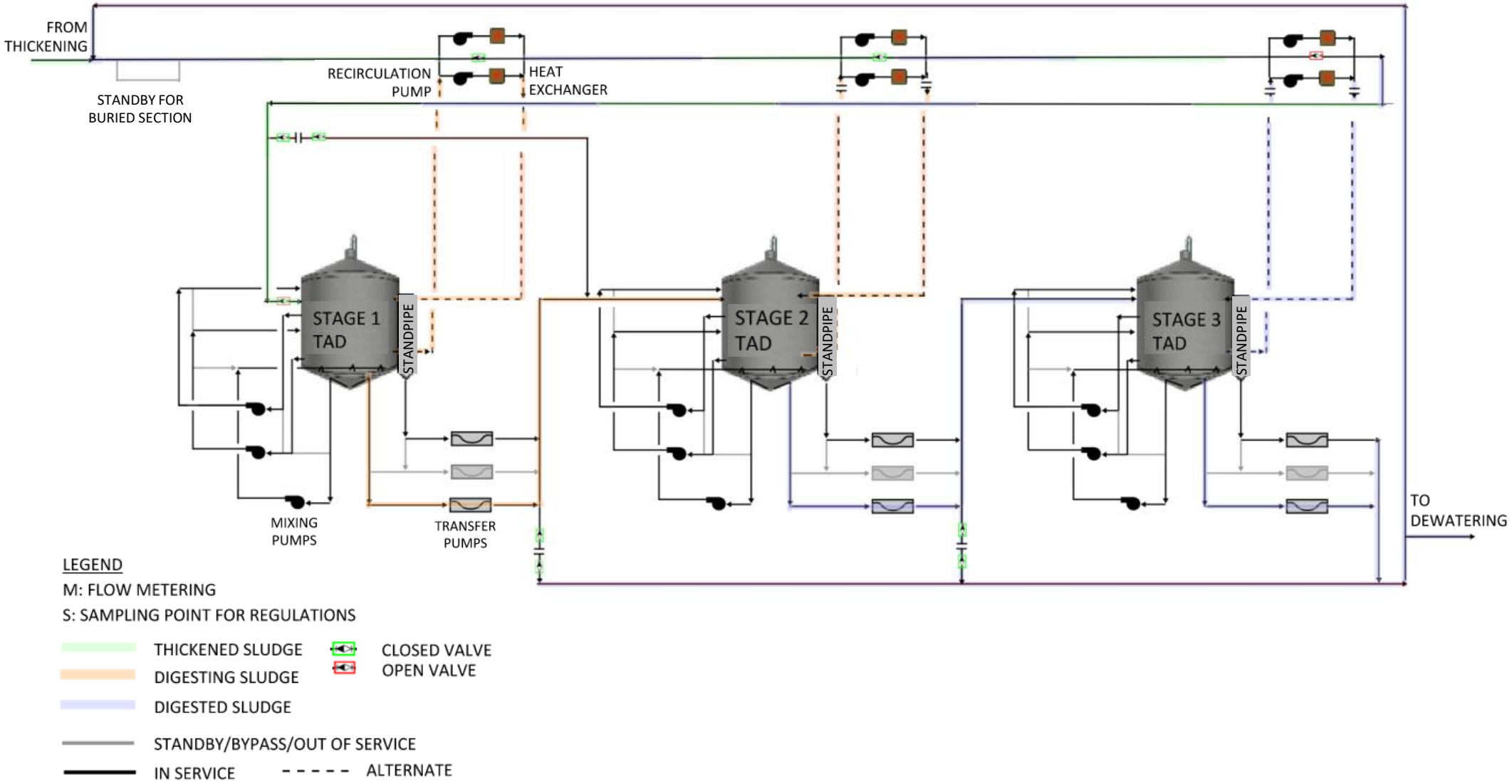


BSD	Blended Sludge
BSS	Blended Screened Sludge
BTS	Blended Thickened Sludge
CNPW	City NPW
DS	Digested Sludge
DSD	Dewatered Solids
NPW	Non-potable Water
P	Polymer

Objective of Staged Thermophilic Anaerobic Digestion

- Cost reduction
- Staged Thermophilic Anaerobic Digestion achieves EQ Biosolids as defined by Ohio EPA through P-8 and Class A EQ as defined by Federal EPA through Alternative 1 - time and temperature requirements (24 hours at 55^{o}C)
  - Digesters Fed at Thermophilic Temperature
  - Digesters Computational Fluid Dynamics (CFD)
  - Operating Routine(s)

Staged Thermophilic Anaerobic Digestion



STAD – Case Studies

WRRF	Similarities to LMWWTP	Differences to LMWWTP
Shafdan Tel Aviv, Israel	• Multi-staged TAD • Silo-shaped • Hydraulic pumped jet mixed • Operated at 55°C • Produces equivalent US EPA Class A Biosolids	• Three stages • Shorter silo-shaped • Complete mixed
Annacis Island Vancouver, British Columbia	• Multi-staged TAD • Silo-shaped • Mixed digesters • Operated at 55°C • Produces equivalent US EPA Class A Biosolids	• Smaller flow through vessels • Shorter silo-shaped • Complete mixed
Oceanside San Francisco, CA	• Multi-staged AD • Mixed plug-flow digesters • Operated at 55°C • Met US EPA requirements for Class A Biosolids	• Temperature Phased AD (thermophilic followed by mesophilic digester) • Egg-shaped digesters

STAD – Sampling Plan

Analysis	Sample Location(s)[1]	Sampling Frequency
Fecal Coliform	• Upstream of Stage 1 Digester • Downstream of Stage 2 Digester • Downstream of Digester 3 • Downstream of dewatering (cake)	Weekly at Start, 3 times per week after results meet EQ for first time
Metals	Downstream of dewatering (cake)	Every 2 weeks at Start, Monthly after results meet EQ twice in the row
TSS, VSS, VSR	Before and after each unit process	3 times per week[2]
pH, Alkalinity, VFAs, COD	Each digester	

[1] Upstream of the digester: at the digester feed pump discharge
Downstream of the digester: at the digester transfer pump discharge

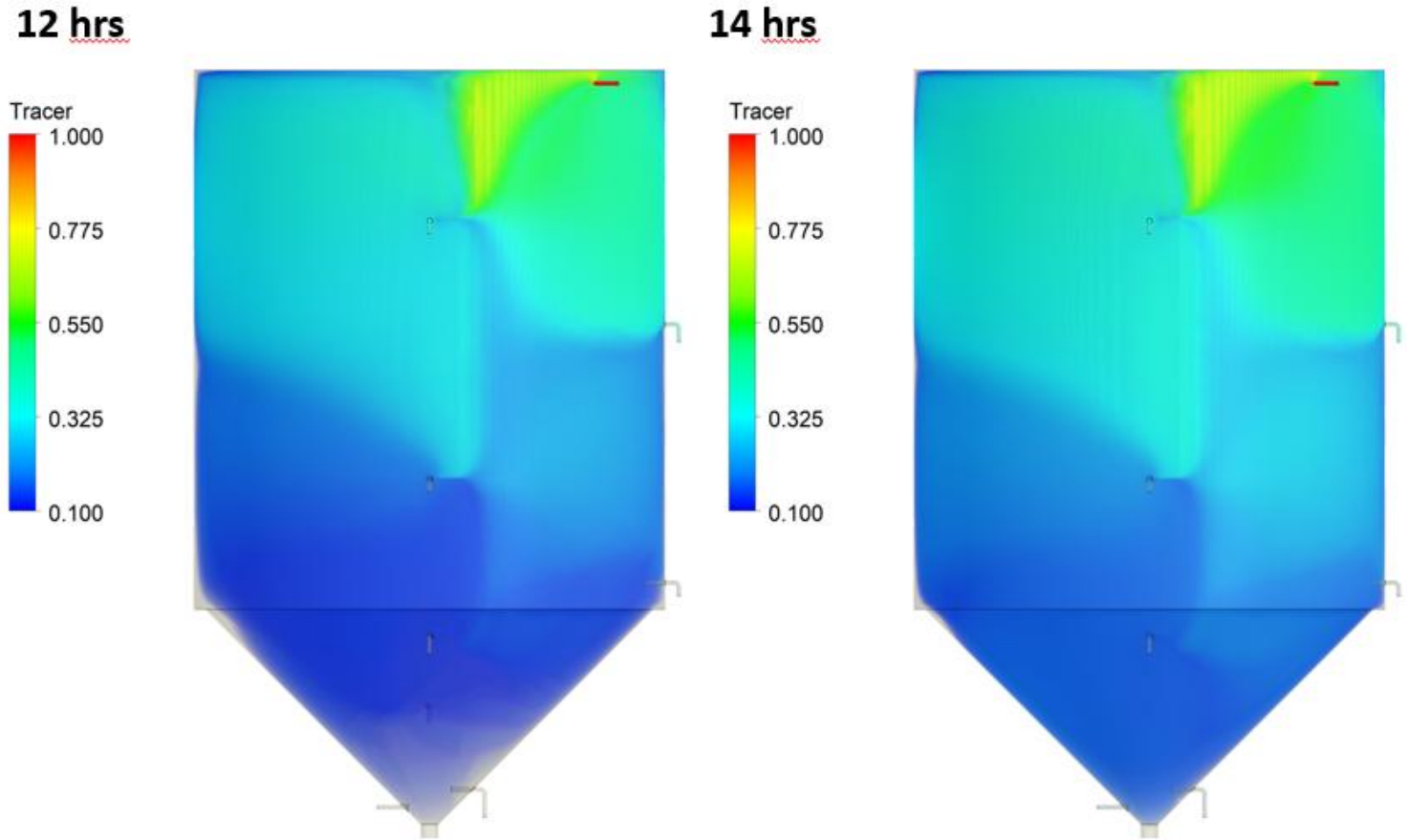
[2] Assumes solids removal from the plant for beneficial use or disposal 3 times per week (Rule 745-40-09-(B)(1) requires sampling for TS each day solids leave the plant for beneficial use or disposal)

TS = total solids
VSS = volatile suspended solids
VSR = volatile solids reduction
VFAs = volatile fatty acids
COD = chemical oxygen demand

Computational Fluid Dynamics (CFD)

CFD

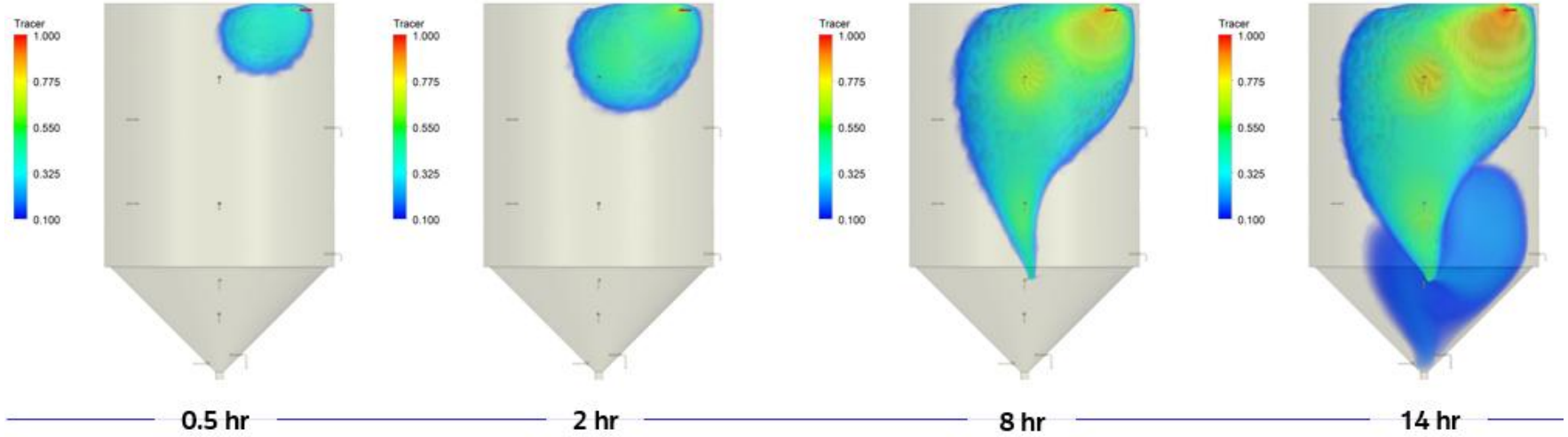
- CFD implemented to
  - Ensure compliance with EPA time and temperature requirements



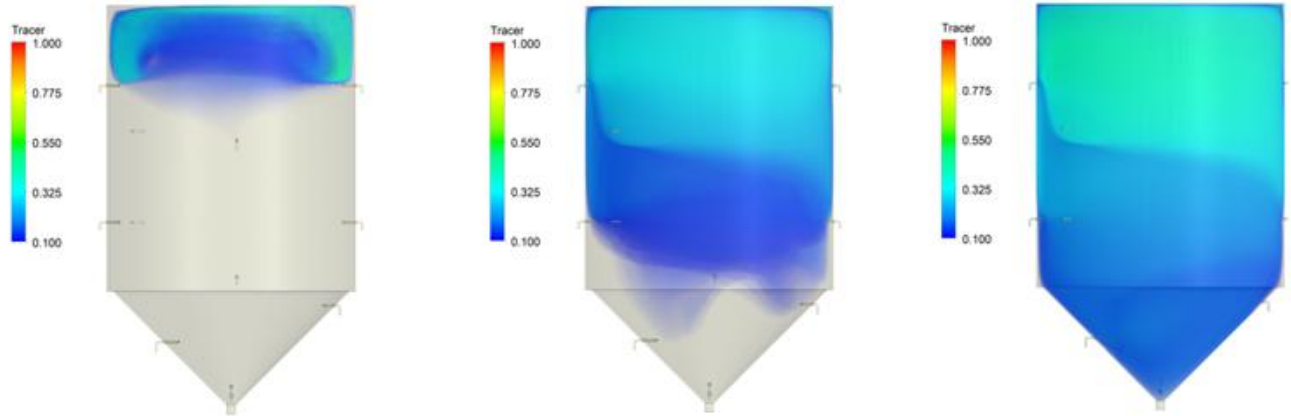
CFD (continue…)

- CFD implemented to evaluate short circuiting

Low zone mix only



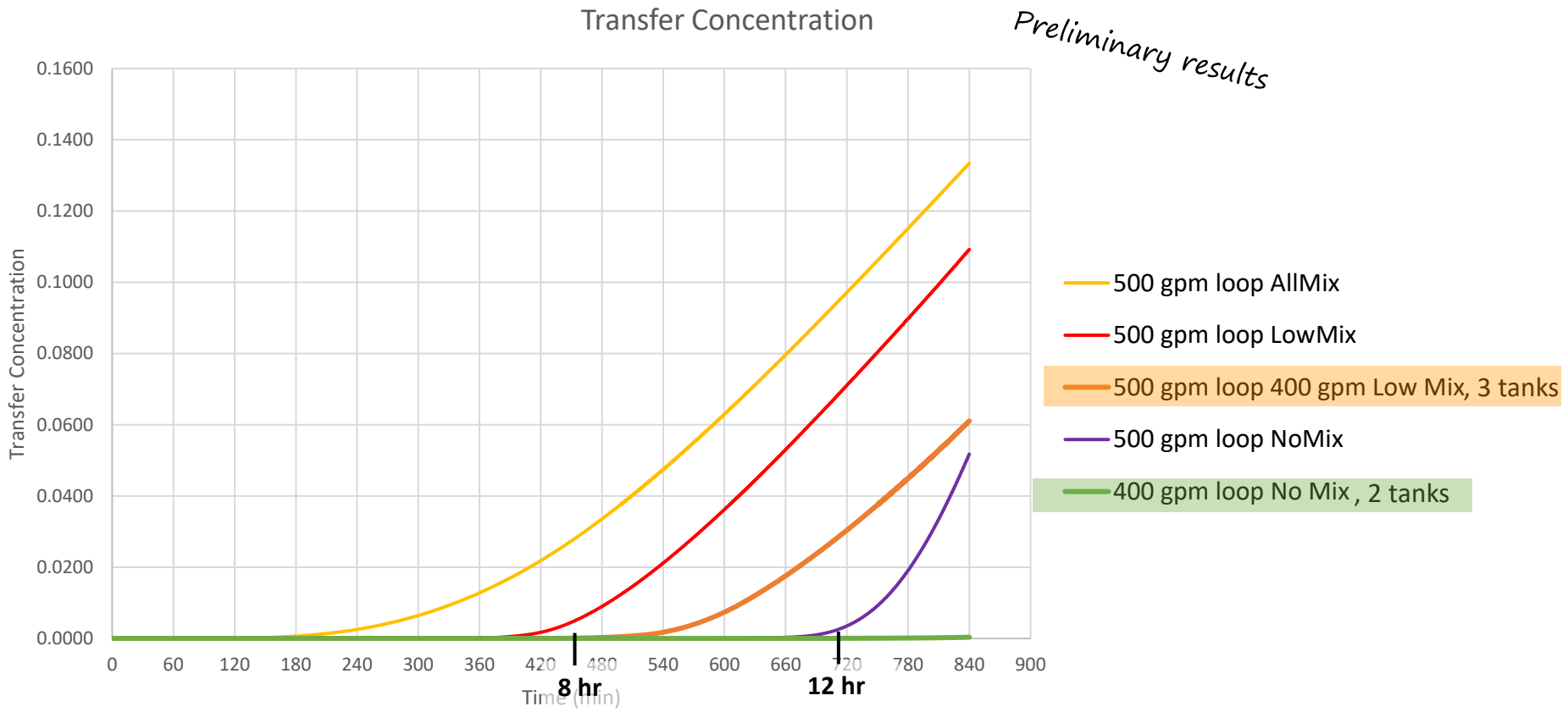
All zones mix



Operating Scenarios

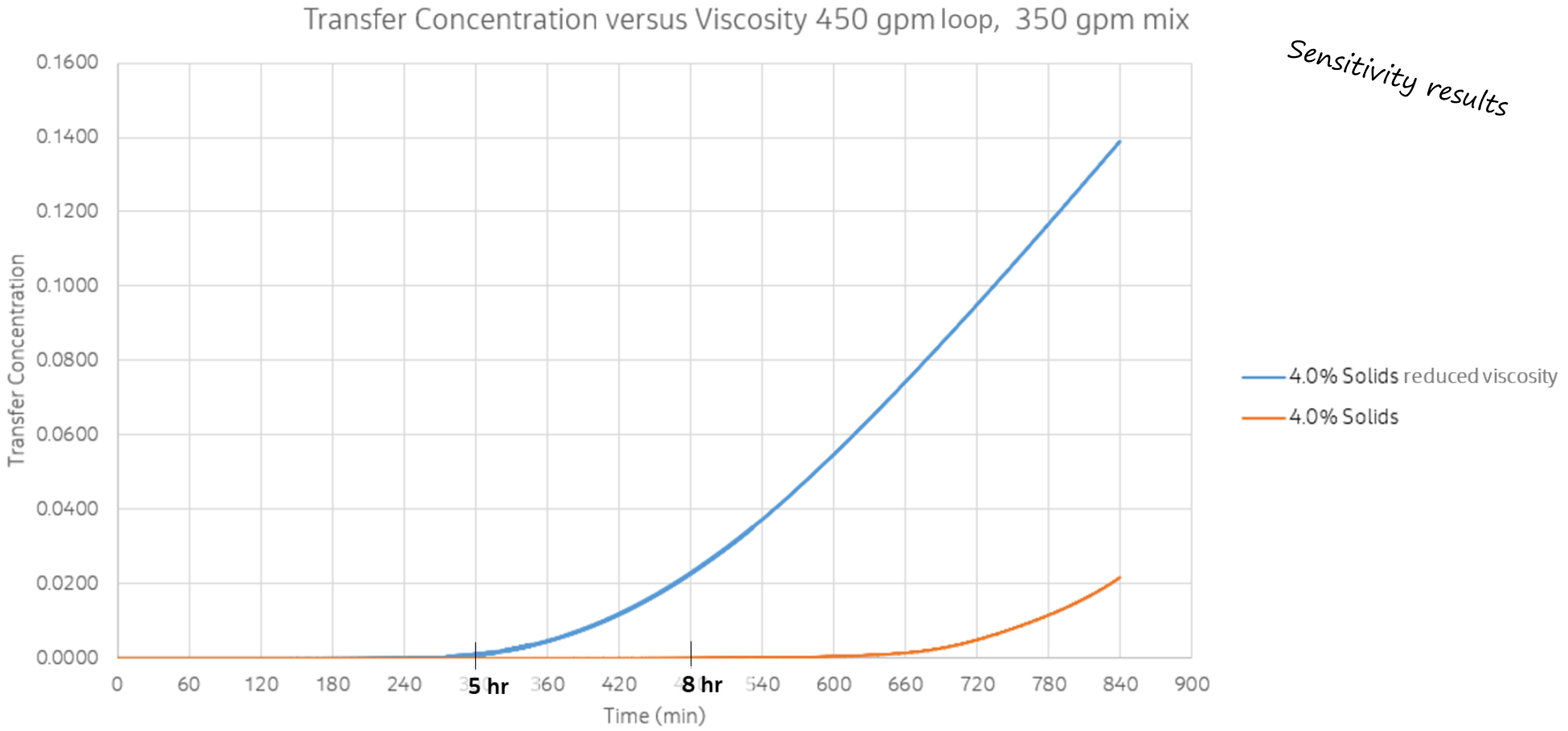
Normal Operating Scenario

- Goal is a total of 24 hr contact time at 55 °C
  - 3 tanks In Service: 8 hr per tank achieved w/500 gpm loop & low zone mixing only
  - 2 tanks In Service: 12 hr per tank achieved w/400 gpm loop & no mixing



Alternate Operating Scenario

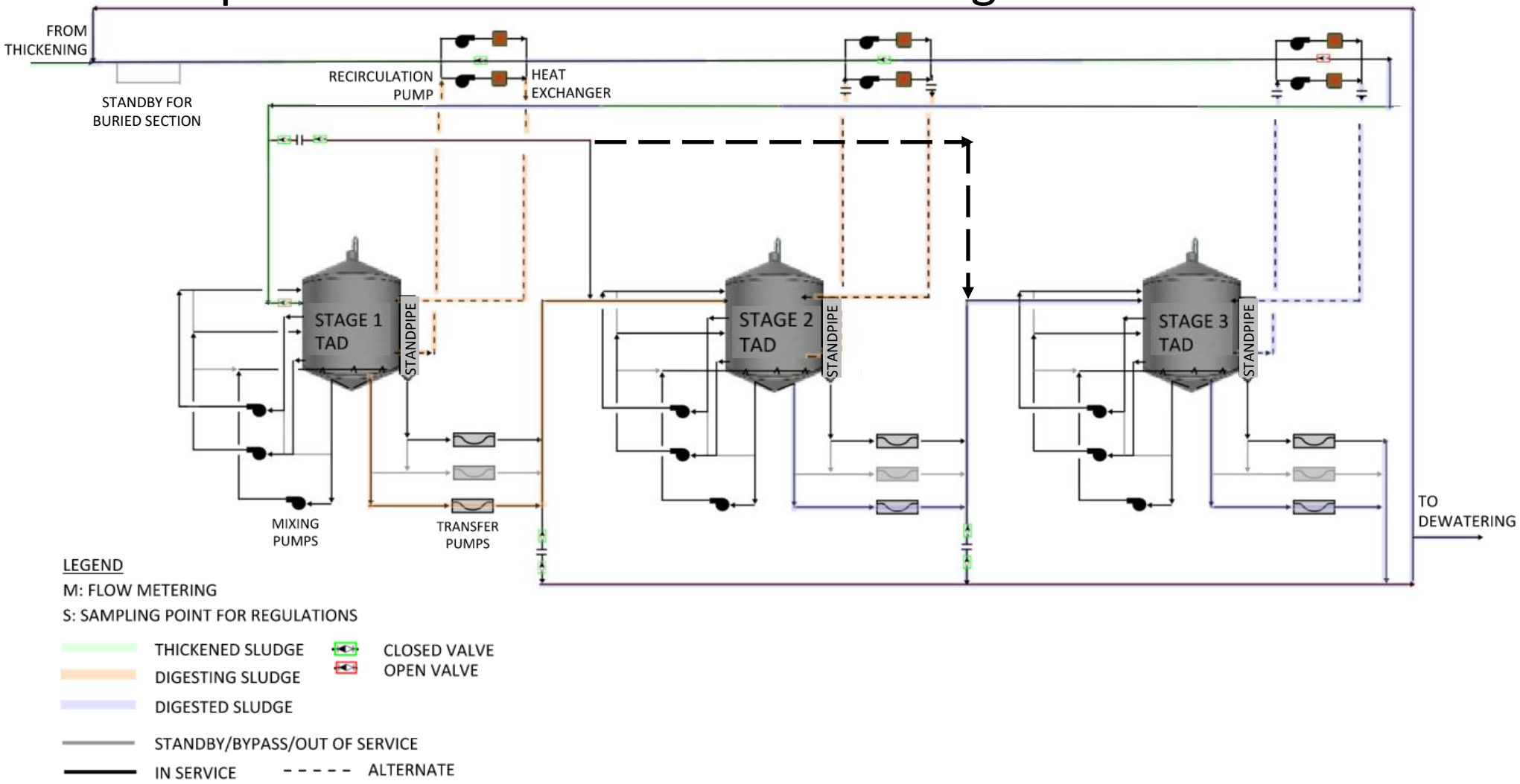
- Goal is a total of 5 hr contact time at 60 °C
  - CFD modeling results: 10 hr contact w/ 2 tanks in service



Sensitivity results

Backup Operating Scenario

- Batch operation of the three in service digesters



Project Update

- Summary
  - Achieve Class A EQ biosolids using STAD process
  - STAD process achieves Class A EQ biosolids at a reduced project cost
  - Client has pursued a progressive design-build approach to project delivery
- Project Update
  - Design currently 90% complete
  - Approval of the Permit to Install (PTI) application by Ohio EPA is anticipated this week
  - Early works packages (equipment procurement, site excavation) are currently underway
  - Close to agreement on Guaranteed Maximum Price (GMP) for the Main Works Package
  - NTP for the construction of the Main Works Package is expected in July 2025

Thank you

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