Full-Scale Demonstration of a BioMag™ Treatment System for Capacity Expansion at the Kemptville, ON WPCP

Presentation Outline

- Background and Project Objectives
- BioMag™ Process Overview
- Demonstration Methodology
- Results
  - Biological Treatment Performance
  - Clarifier Stress Testing
- Conclusions

Background and Project Objectives

Existing Kemptville WPCP

- **CAS with tertiary filtration**
- **ADF capacity 1.2 MGD**
- **Peak capacity 3.0 MGD (exceeded)**

Environmental Assessment 2010 (future needs/growth)

- **Expand CAS process**
- **Two stages:**
  - Stage 1 ADF of 2.4 MGD
  - Stage 2 ADF of 3.1 MGD

Background and Project Objectives

- **Initial Stage 1 Expansion Requirements:**
  - Equalization to attenuate peak flows and minimize footprint for expansion
  - Expand CAS process (2 X); aeration and clarification
  - Expand filtration system
  - Land Acquisition

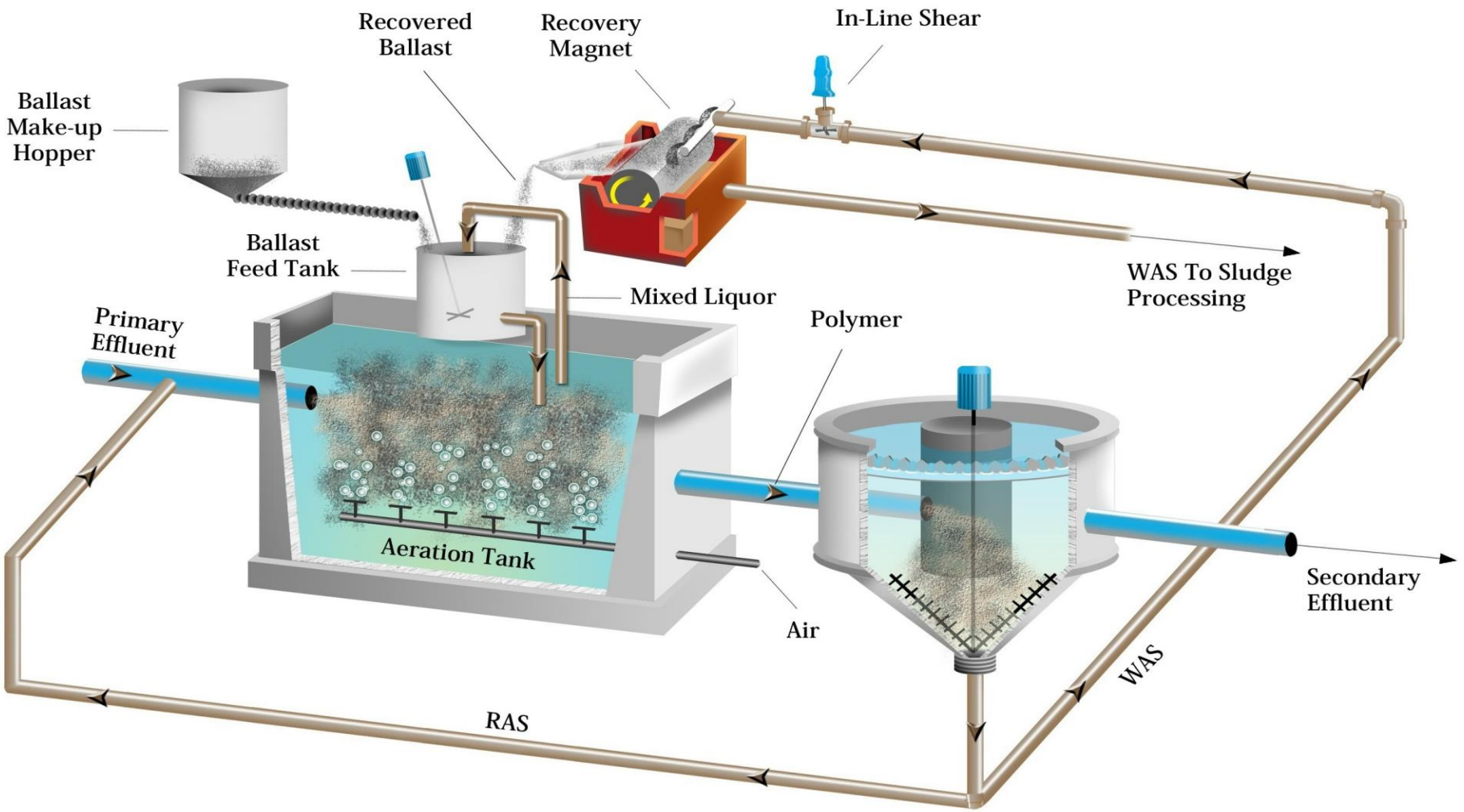
BioMag Potential Benefits

- Improved Secondary Settling; Increased Capacity & Reliability
- Ability to Operate at Higher MLSS; Increased Capacity
- Reduced Footprint; Use Existing Tankage
- Longer Sludge Age; Improved Nitrification
- Reduced Lifecycle Costs

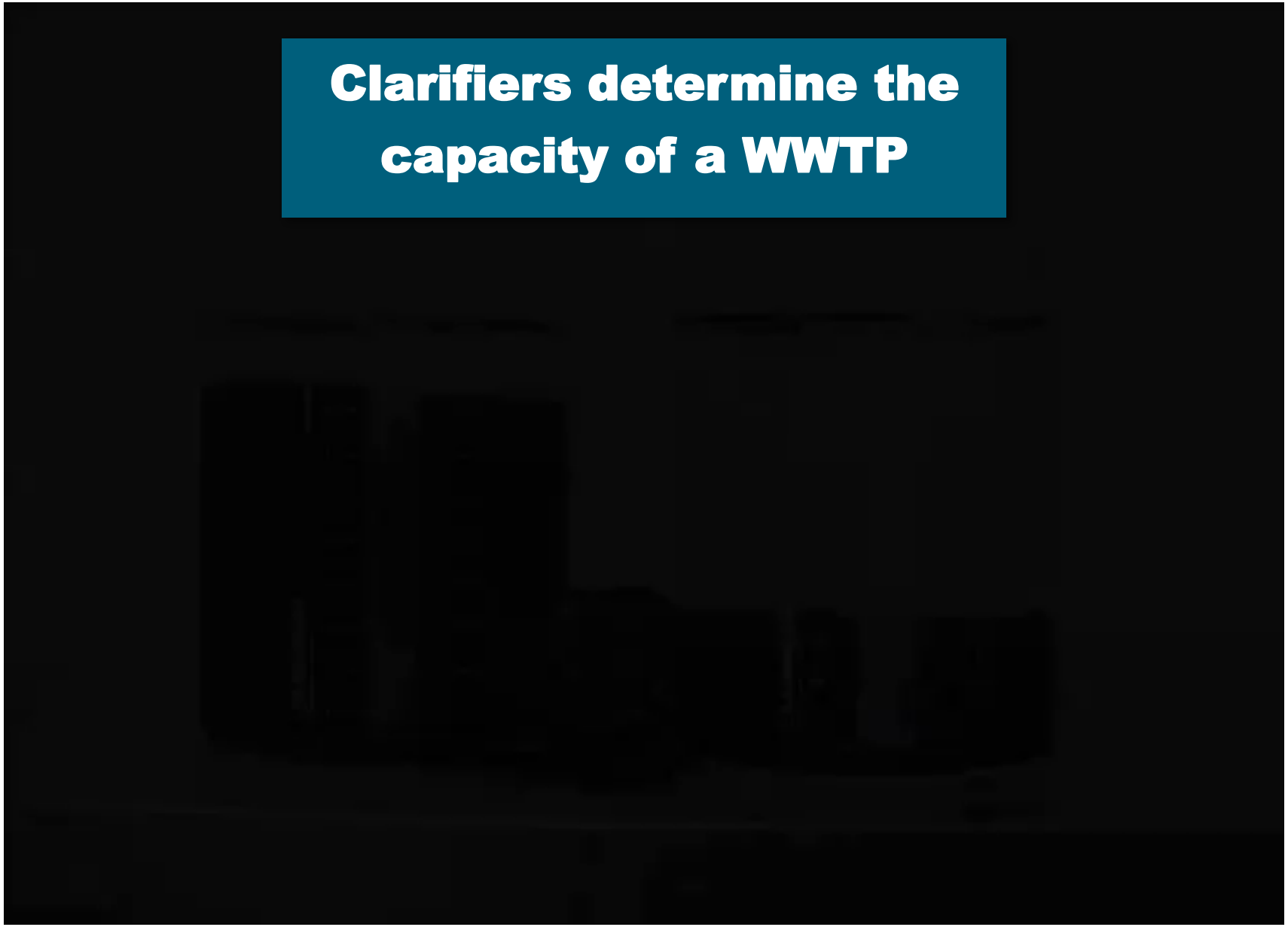
Demonstration Project Objectives

- Evaluate BioMag alternative to conventional expansion
- Determine feasibility of converting CAS to BioMag™
- Confirm treatment capacity (average and peak)
- Achieve secondary effluent targets: 10/10/1/0.3
- Potential elimination of EQ and land acquisition

BioMag™ Process Overview



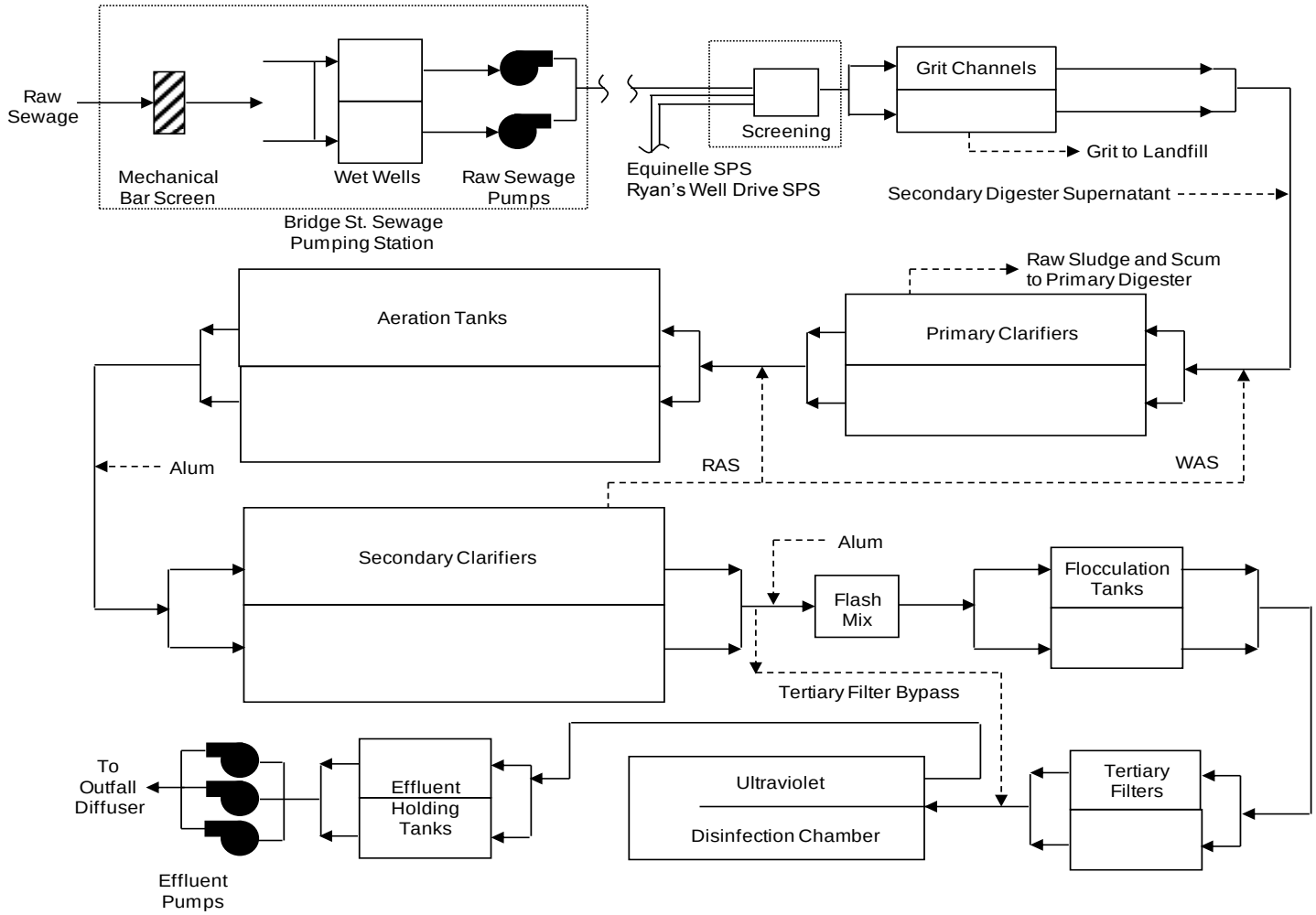
Clarifiers determine the capacity of a WWTP



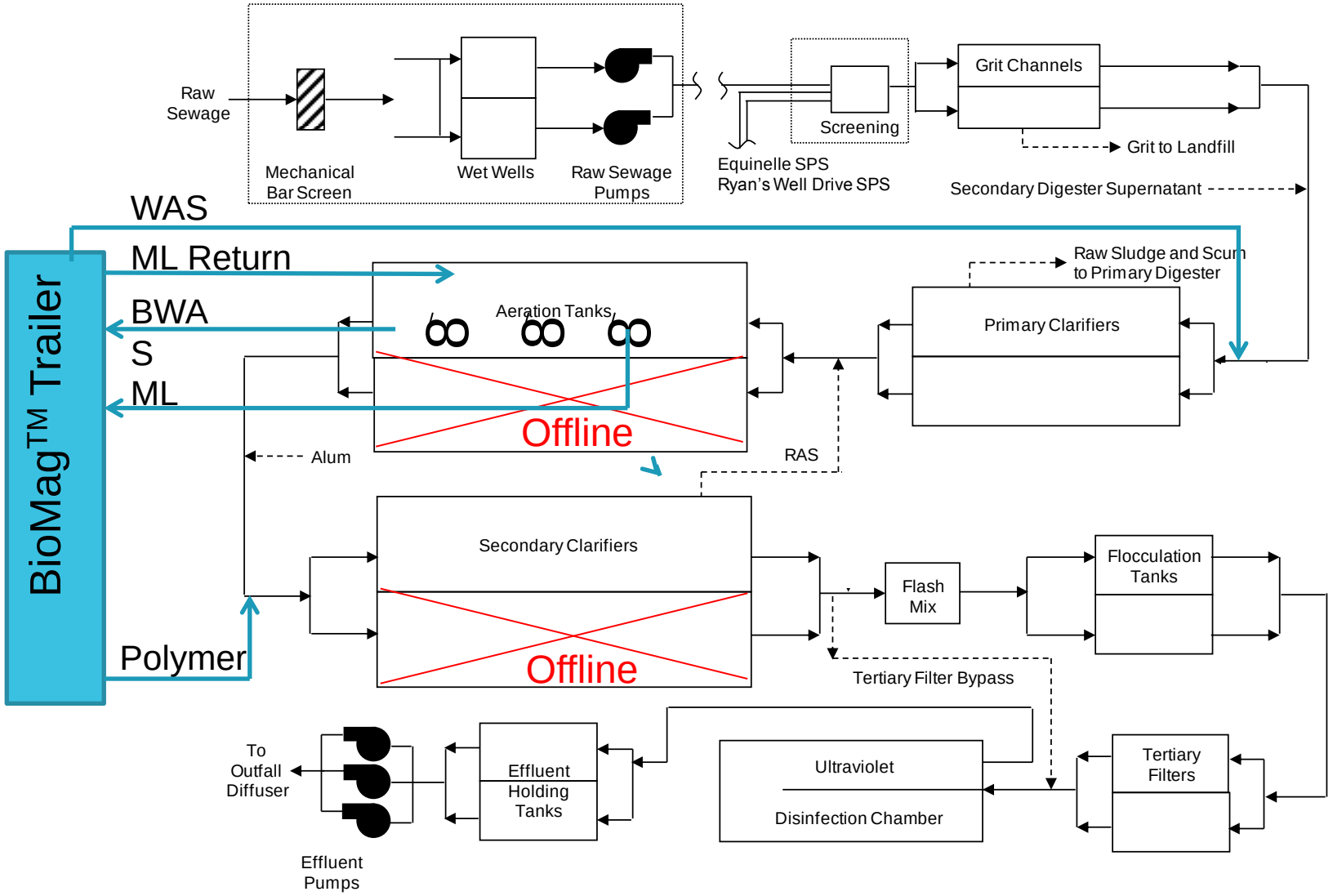
Methodology

- **Full-scale demonstration**
  - Installation of magnetite ballast feed & recovery system using on-site trailer
  - Removal of one bioreactor and one clarifier from service; isolate single train for treatment
  - Acclimation period to build MLSS and magnetite level
  - Long-term (3 month) test
  - Short-term peak flow testing (PDA & PHR)

Kemptville WPCP – Process Schematic



Kemptville WPCP – Process Schematic



BioMag™ Demonstration at Kemptville WPCP

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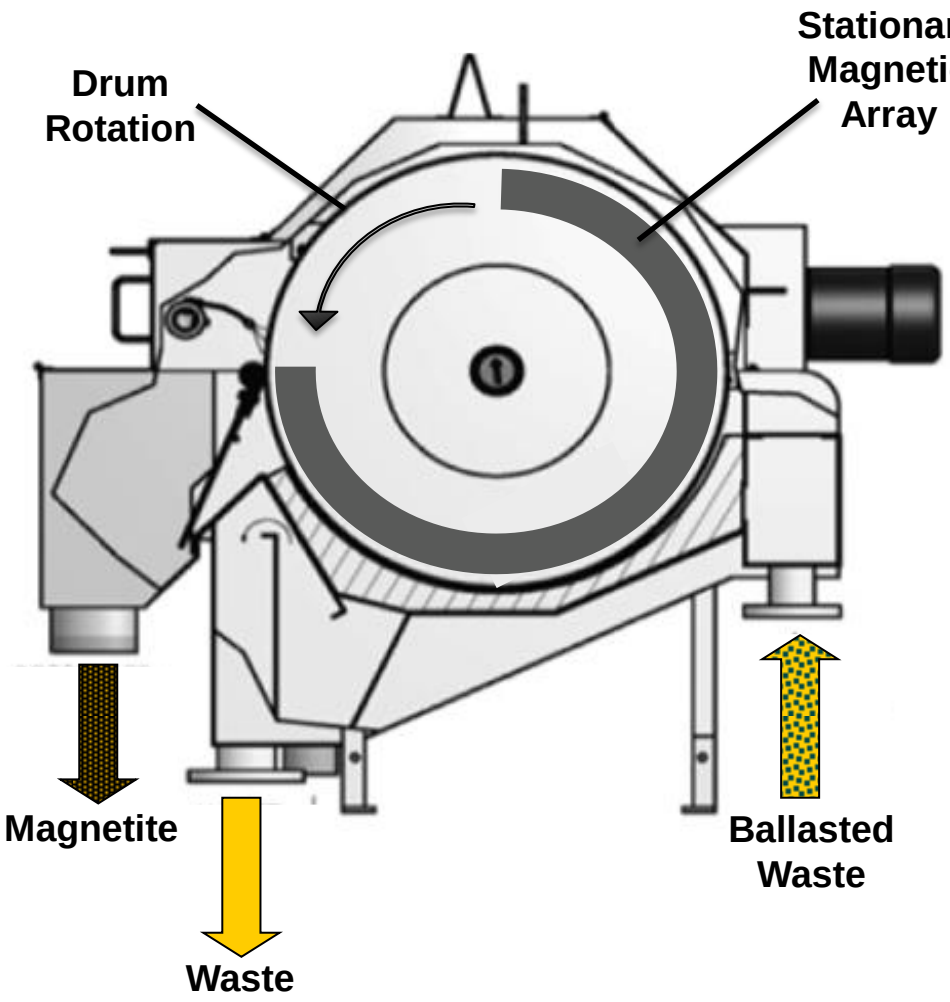
Magnetite Recovery Drum – How it Works



- **The magnetite recovery drum receives the ballasted WAS.**
- **The sludge then flows down through the sump.**
- **Magnetite is captured onto the rotating drum surface by a stationary array of magnets.**
- **Magnets are located just inside of the cylindrical stainless steel shell that rotates around the magnets.**
- **Recovered magnetite flows to the ballast mix tank**
- **Waste sludge flows by gravity and is discharged into the WAS tank.**

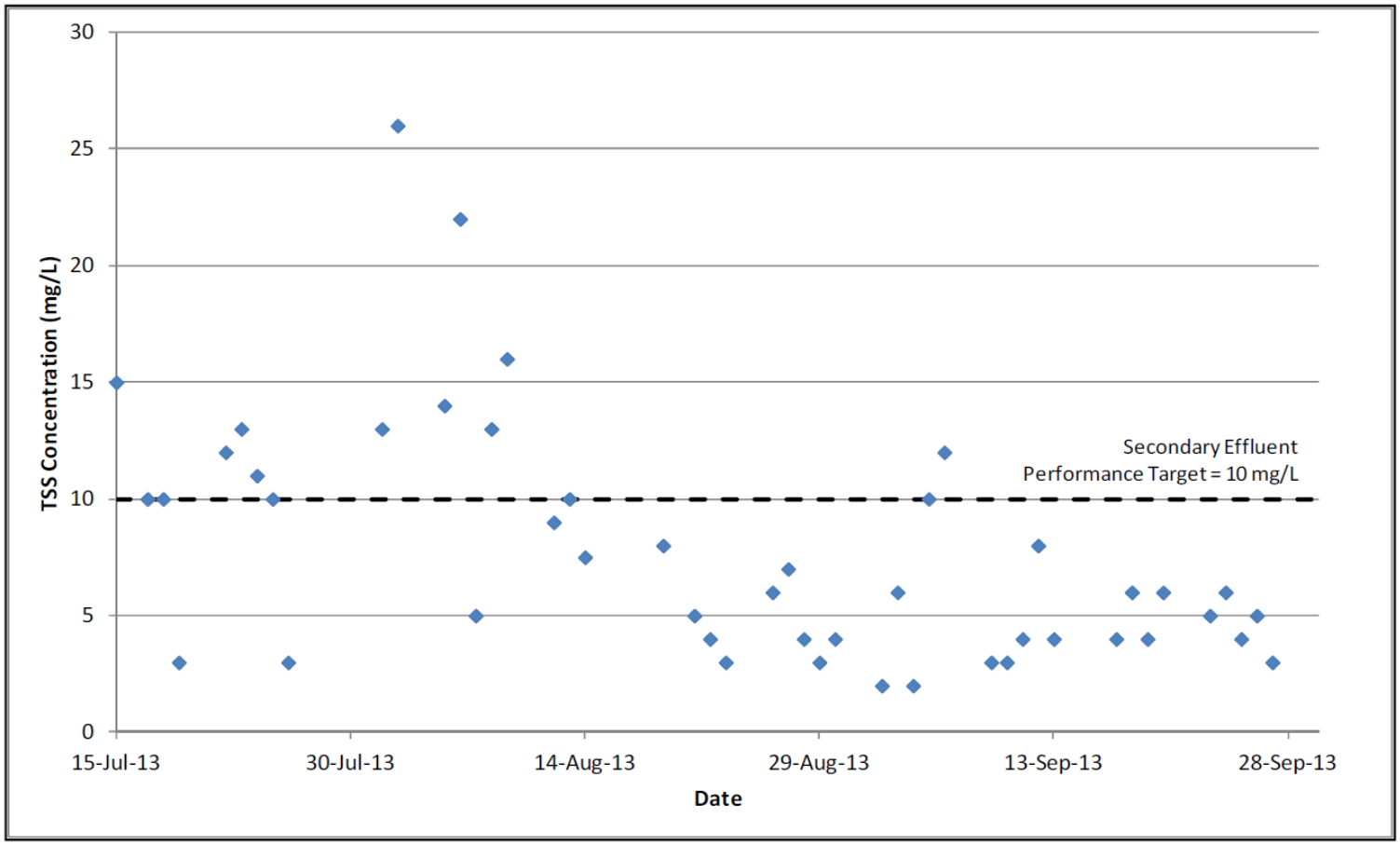
BioMag™ Demonstration at Kemptville WPCP

Long-Term Test Results

- Operating Conditions:
  - Total MLSS: 20,036 mg/L
  - Magnetite: 13,091 mg/L
  - Effective MLSS: 6,945 mg/L
  - ADF: 0.55 MGD
- Performance - Secondary Effluent:
  - TSS: 7.7 mg/L
  - cBOD5 3.9 mg/L
  - TAN 0.10 mg/L
  - TP 0.18 mg/L

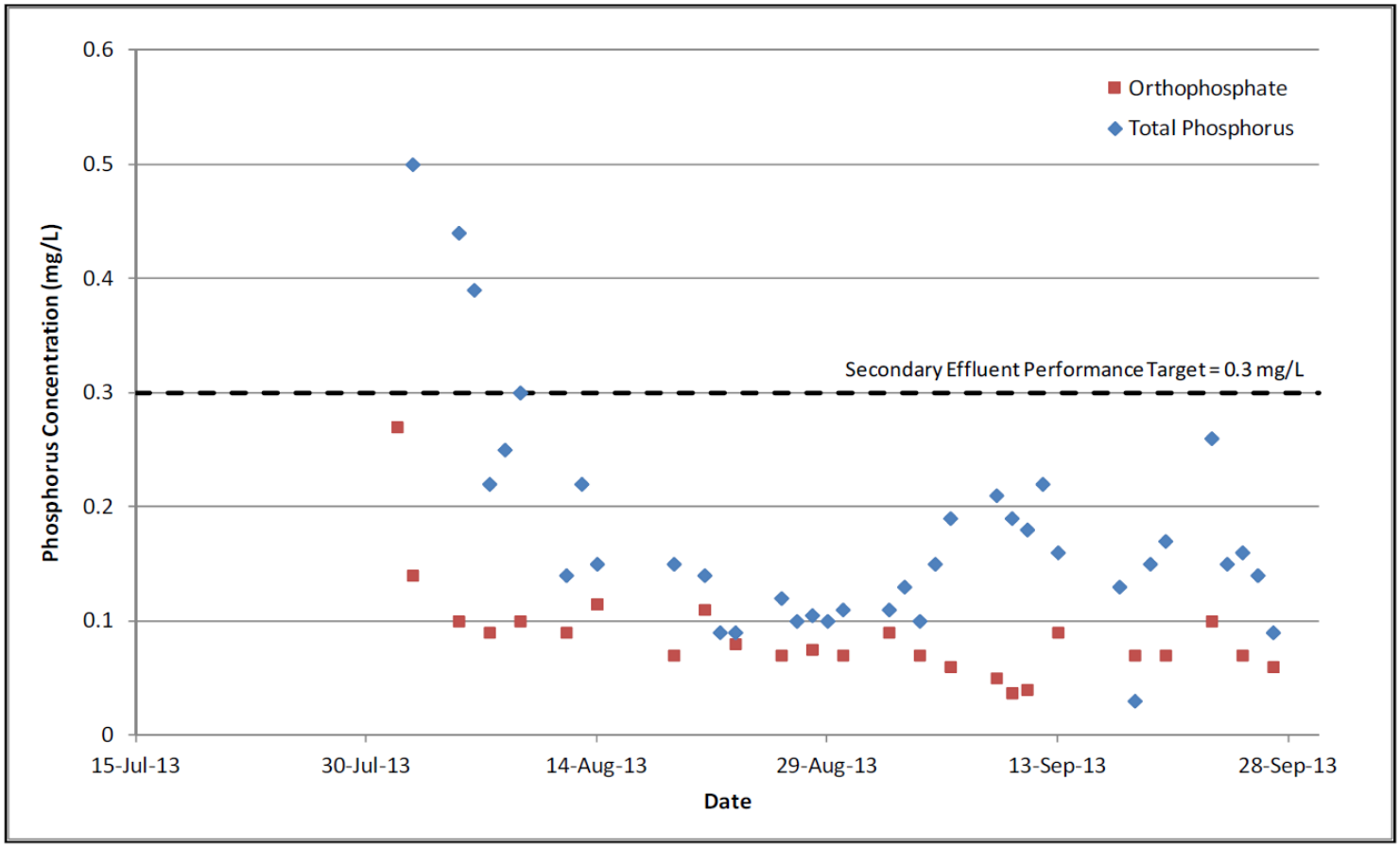
Average SVI: 50 mL/g

Long-Term Test Results



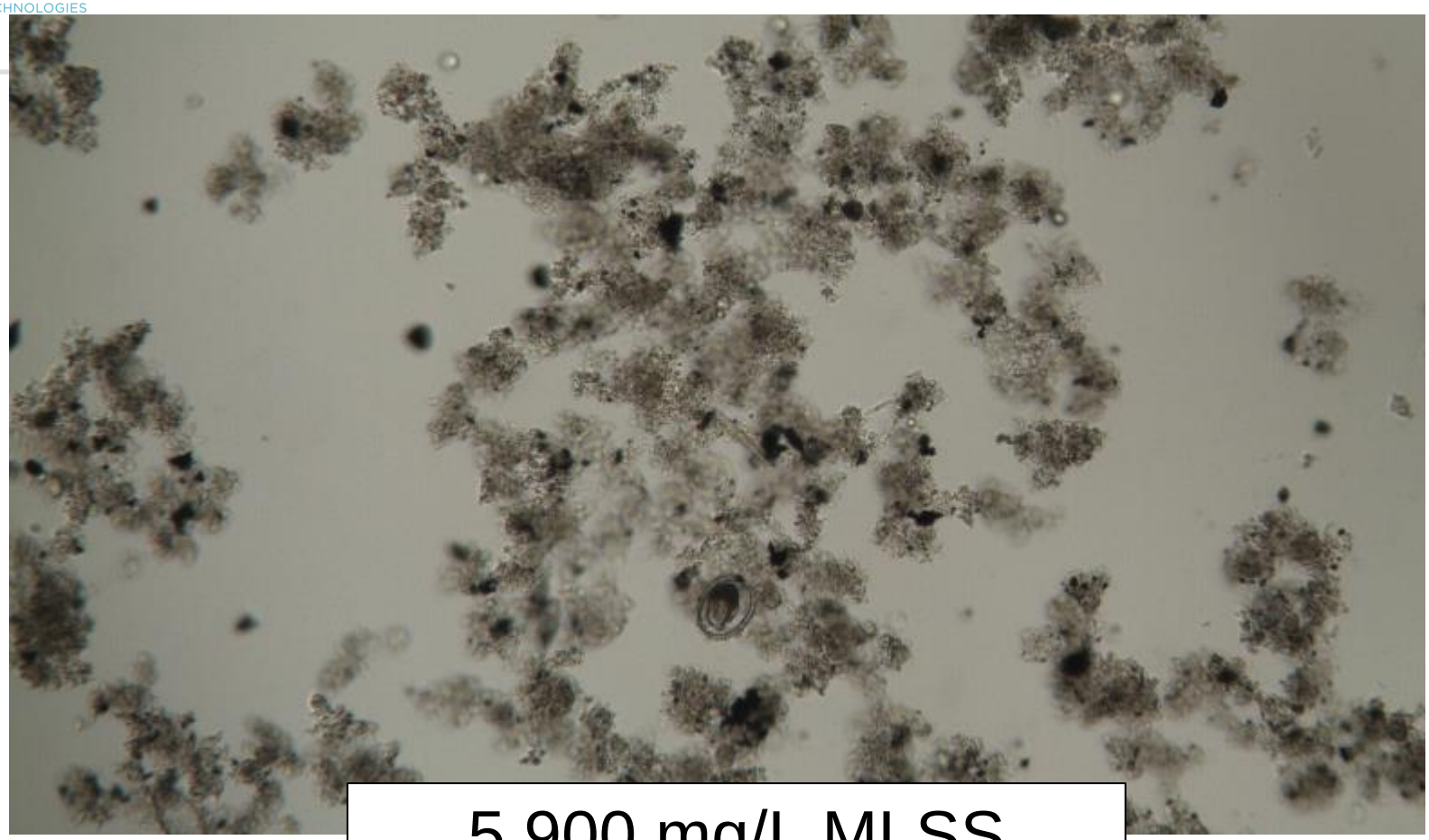
BioMag™ Demonstration Secondary Effluent TSS Concentration

Long-Term Test Results



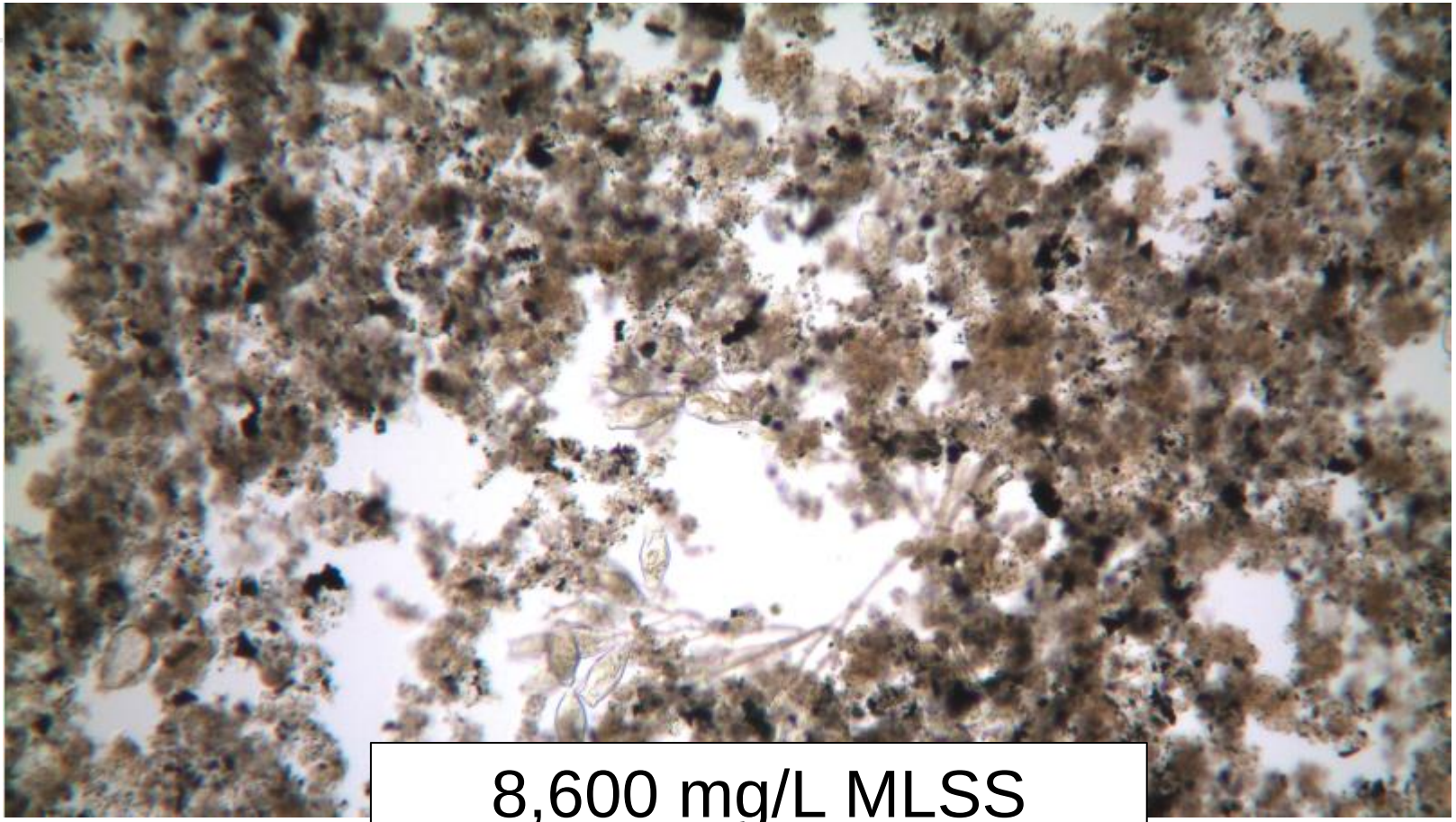
BioMag™ Demonstration Secondary Effluent TP Concentration

BioMag™ – Microscopic Mixed Liquor Analysis



5,900 mg/L MLSS
2,150 mg/L magnetite
Magnetite:MLSS ratio
0.36

BioMag™ – Microscopic Mixed Liquor Analysis



8,600 mg/L MLSS
10,000 mg/L magnetite
Magnetite:MLSS ratio
1.2

Stress Testing

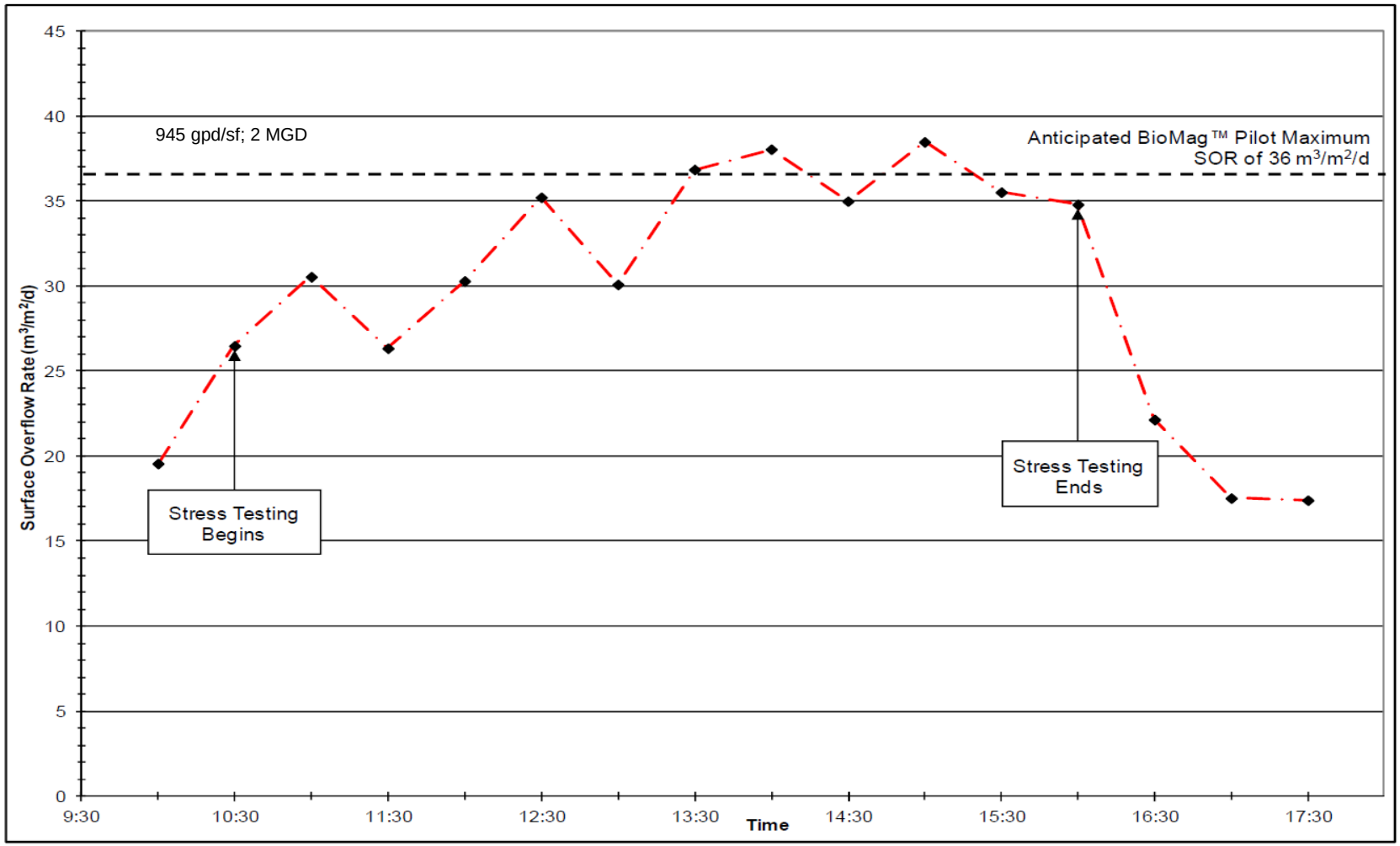
- 2 day simulation; PkDa; PkHr
- Recirculate from tertiary floc tank

Flow Ramp-Up

- Day-1: Flow increased on hourly intervals from 1.0 MGD to 2.0 MGD

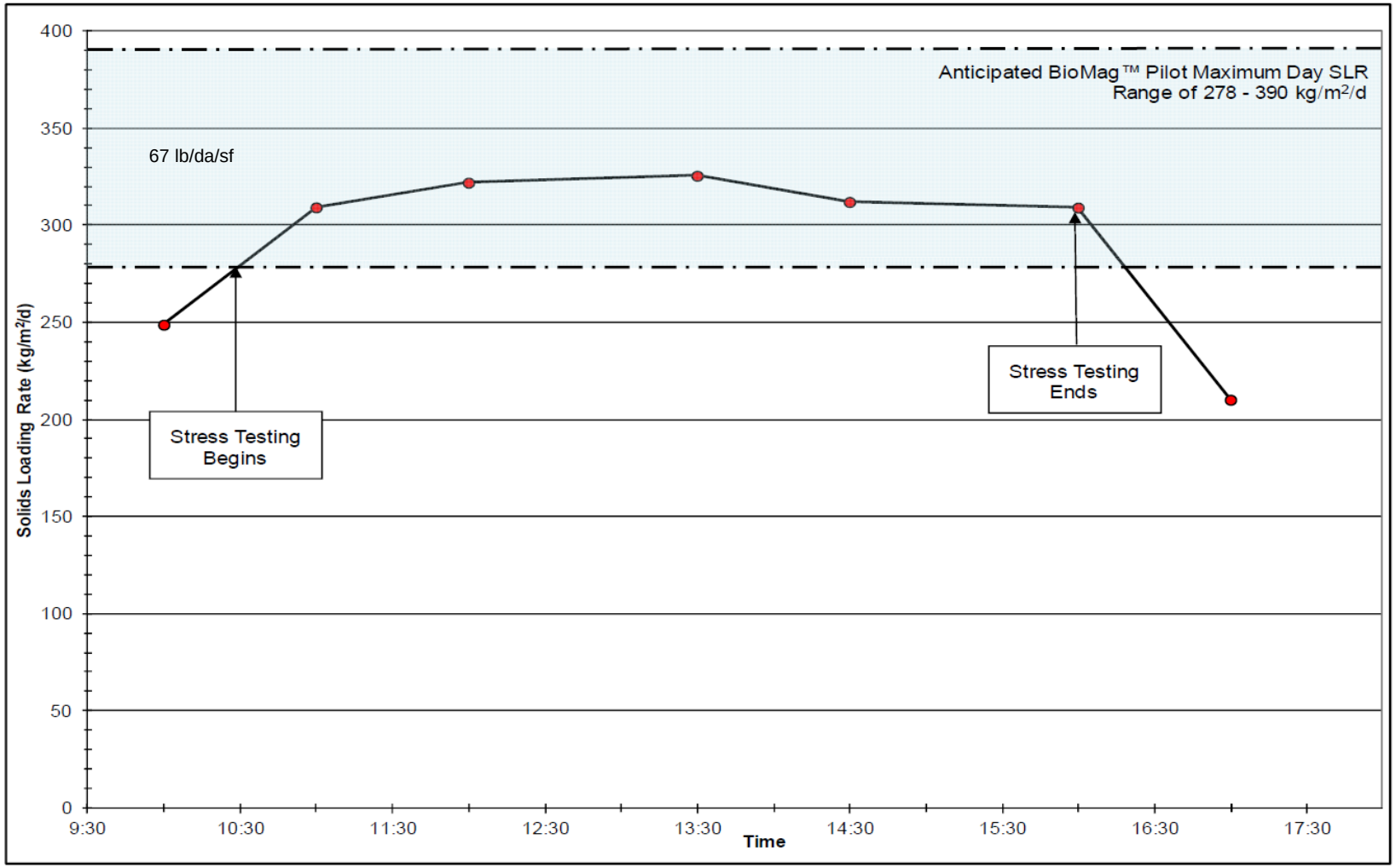
- Day-2: Brought flow up to approximately 2.64 MGD for a sustained 3 hours

Stress Test Results



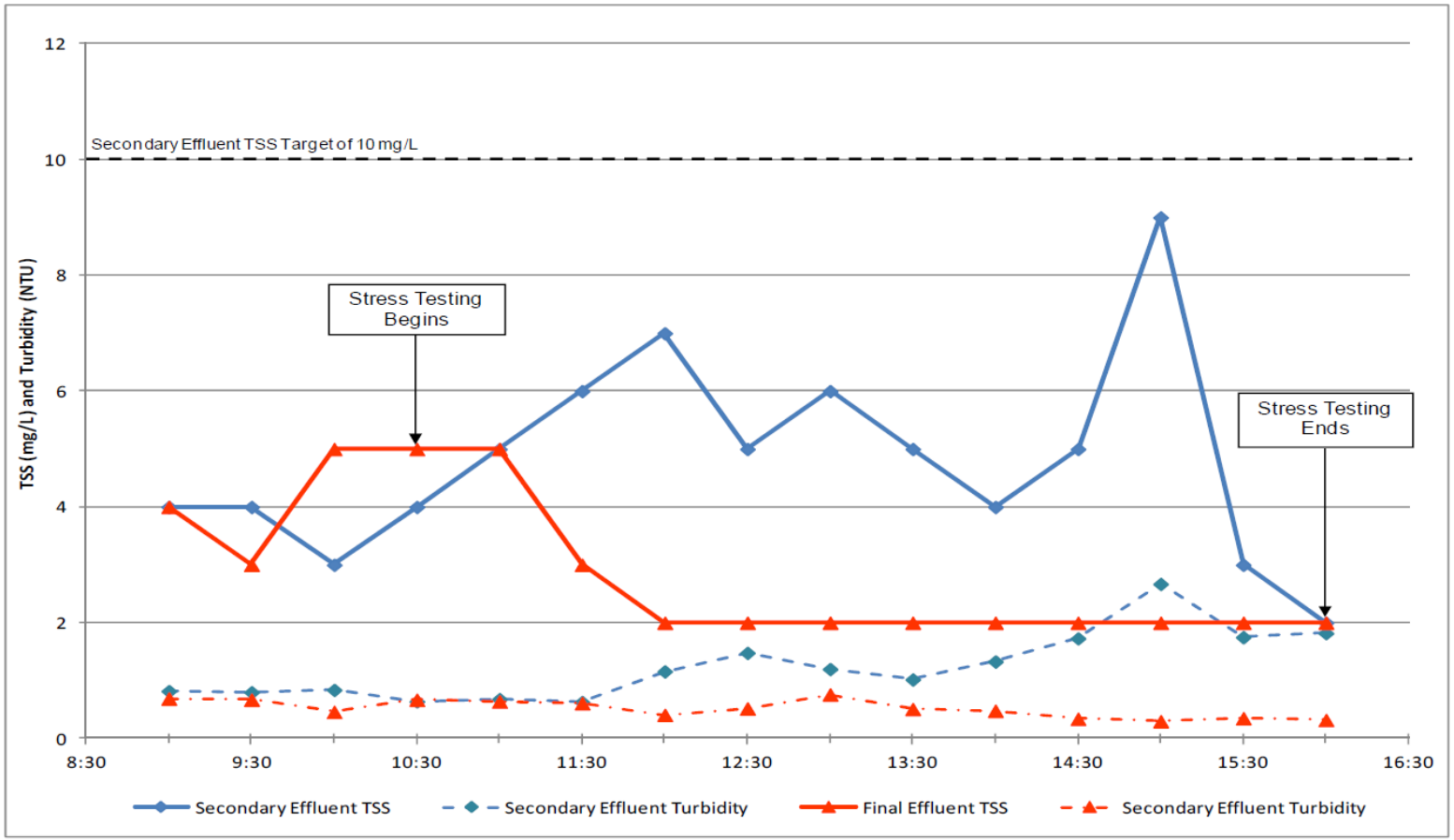
Day 1 – Surface Overflow Rate

Stress Test Results



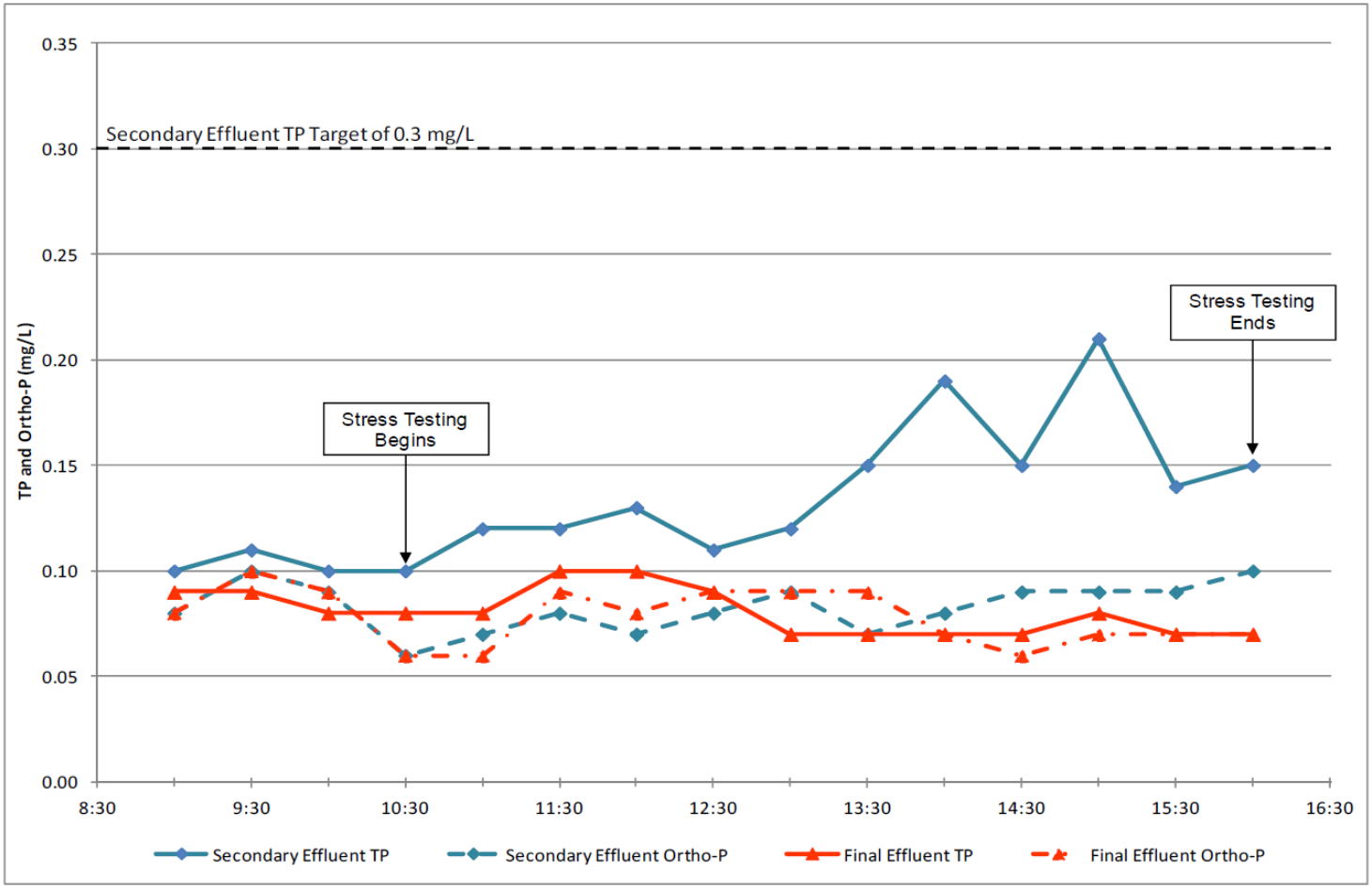
Day 1 – Solids Loading Rate

Stress Test Results



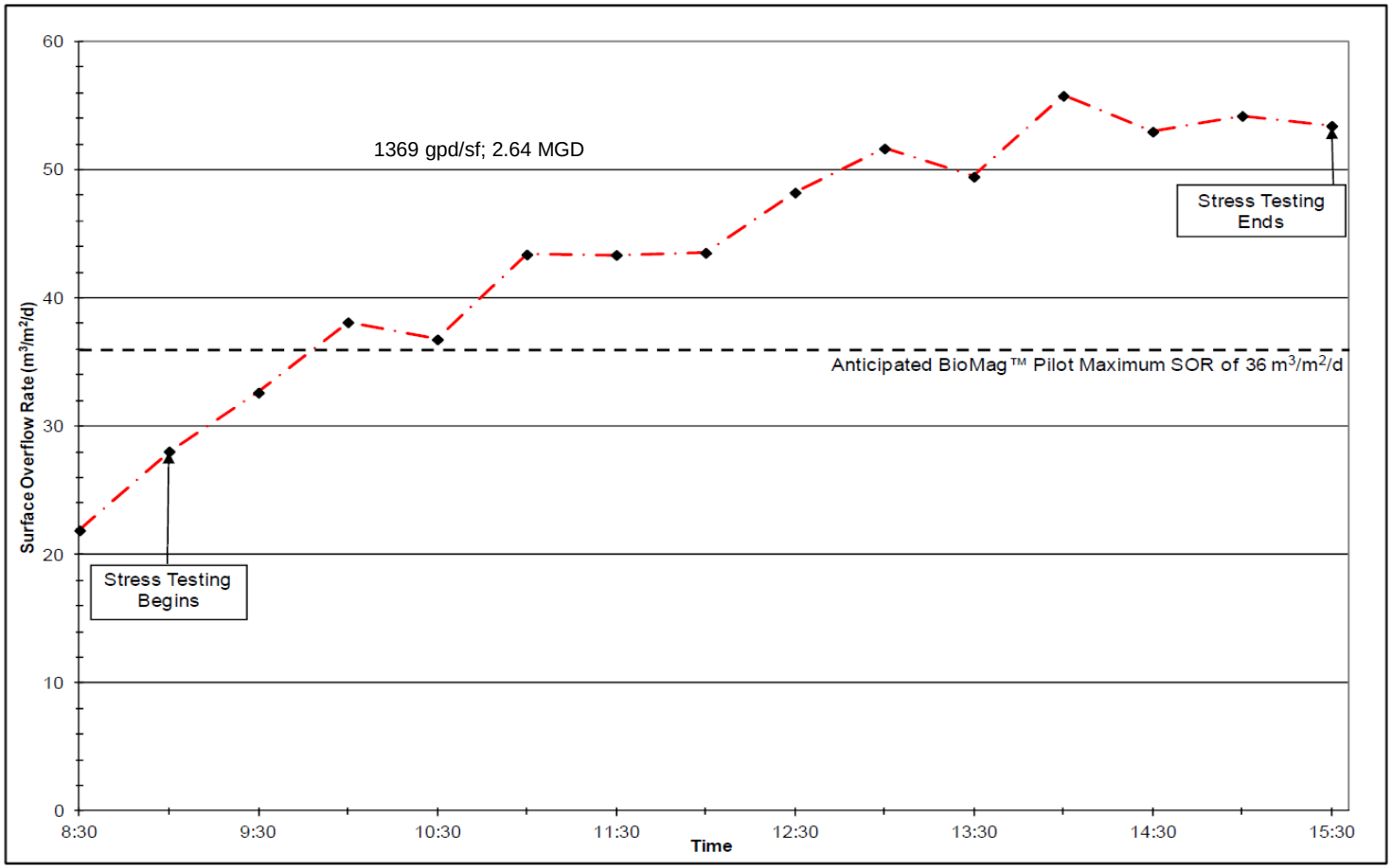
Day 1 – Effluent TSS Concentrations and Turbidity

Stress Test Results



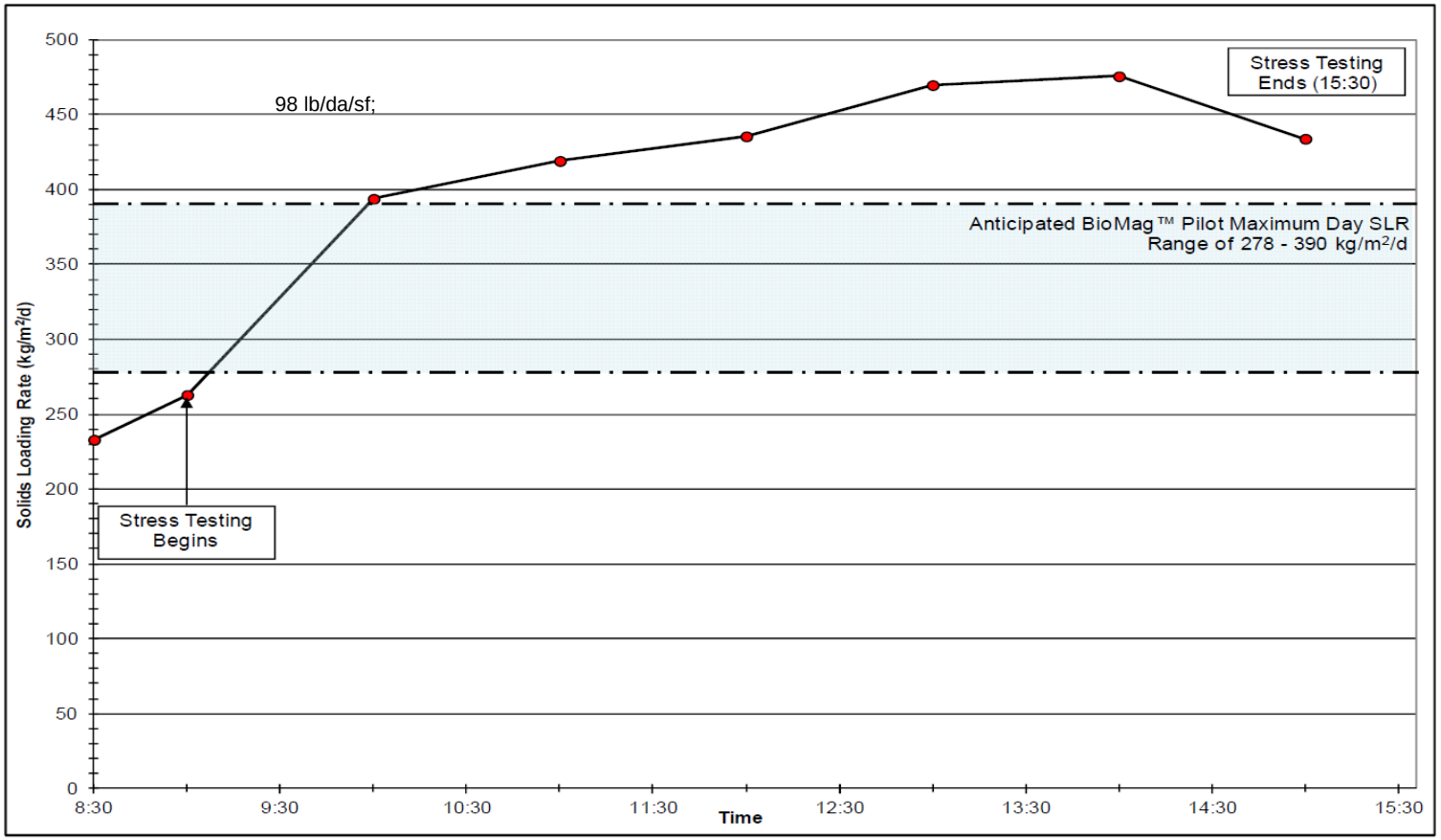
Day 1 – Effluent TP and Orthophosphate Concentrations

Stress Test Results



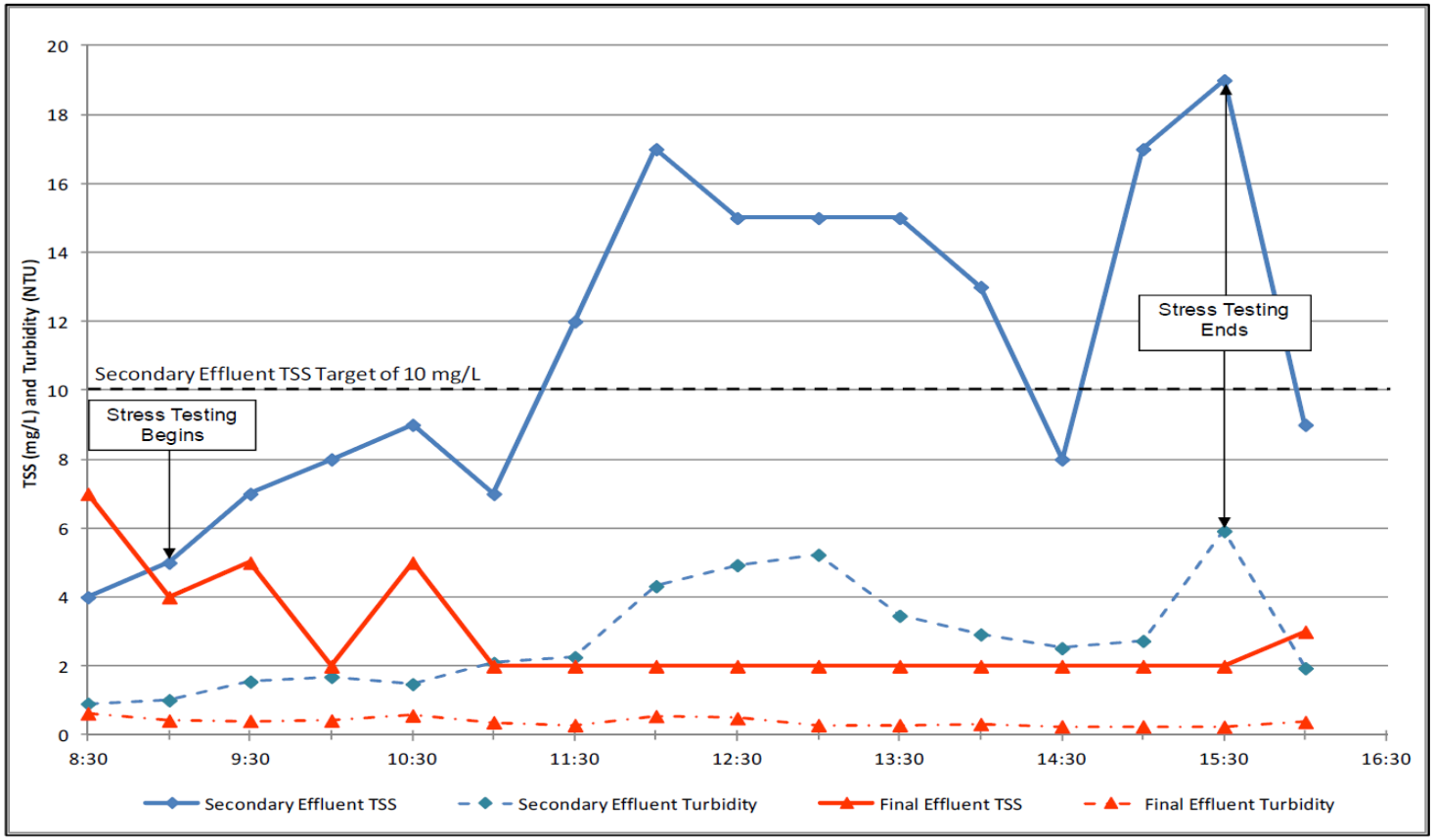
Day 2 – Surface Overflow Rate

Stress Test Results



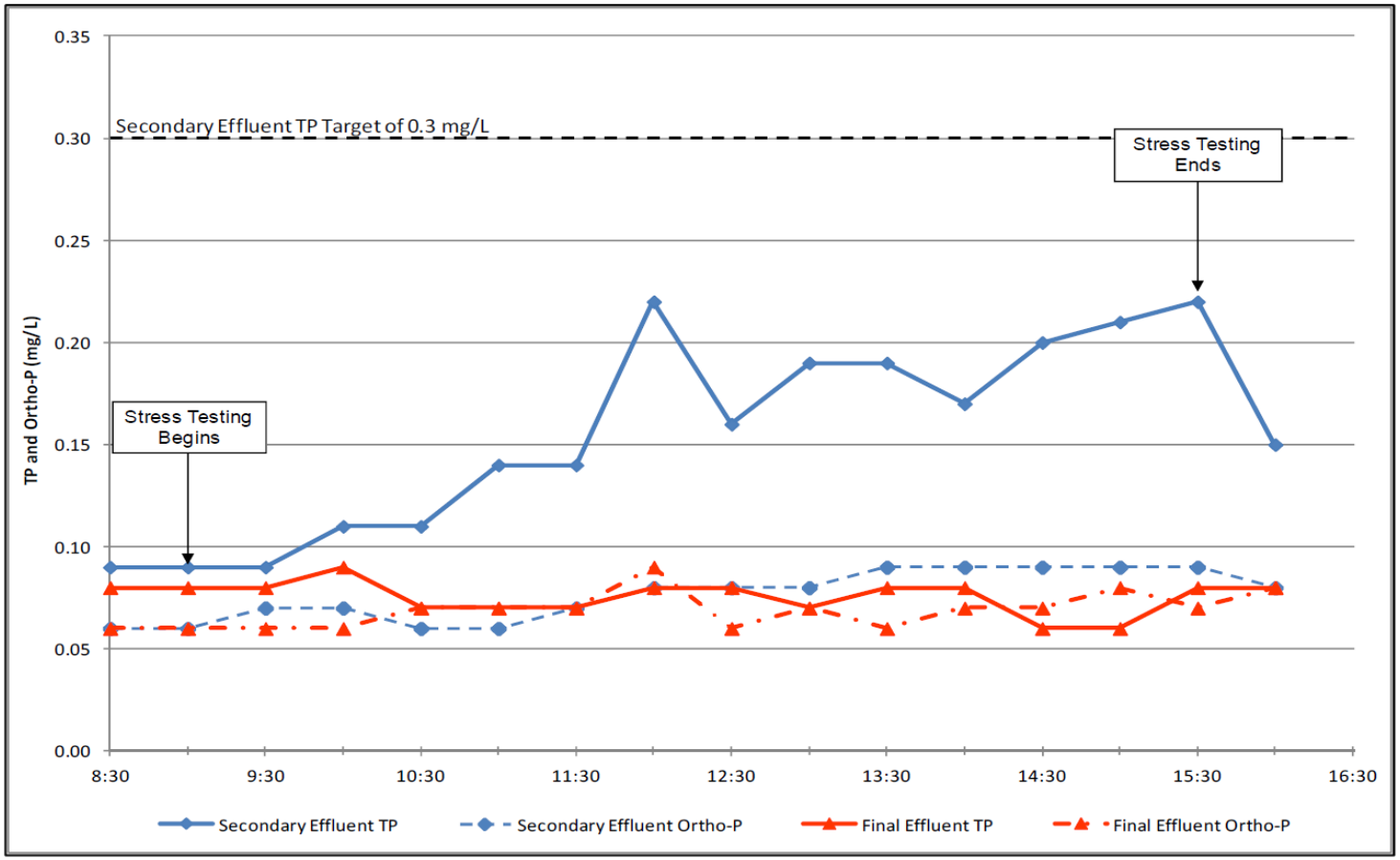
Day 2 – Solids Loading Rate

Stress Test Results



Day 2 – Effluent TSS Concentrations and Turbidity

Stress Test Results



Day 2 – Effluent TP and Orthophosphate Concentrations

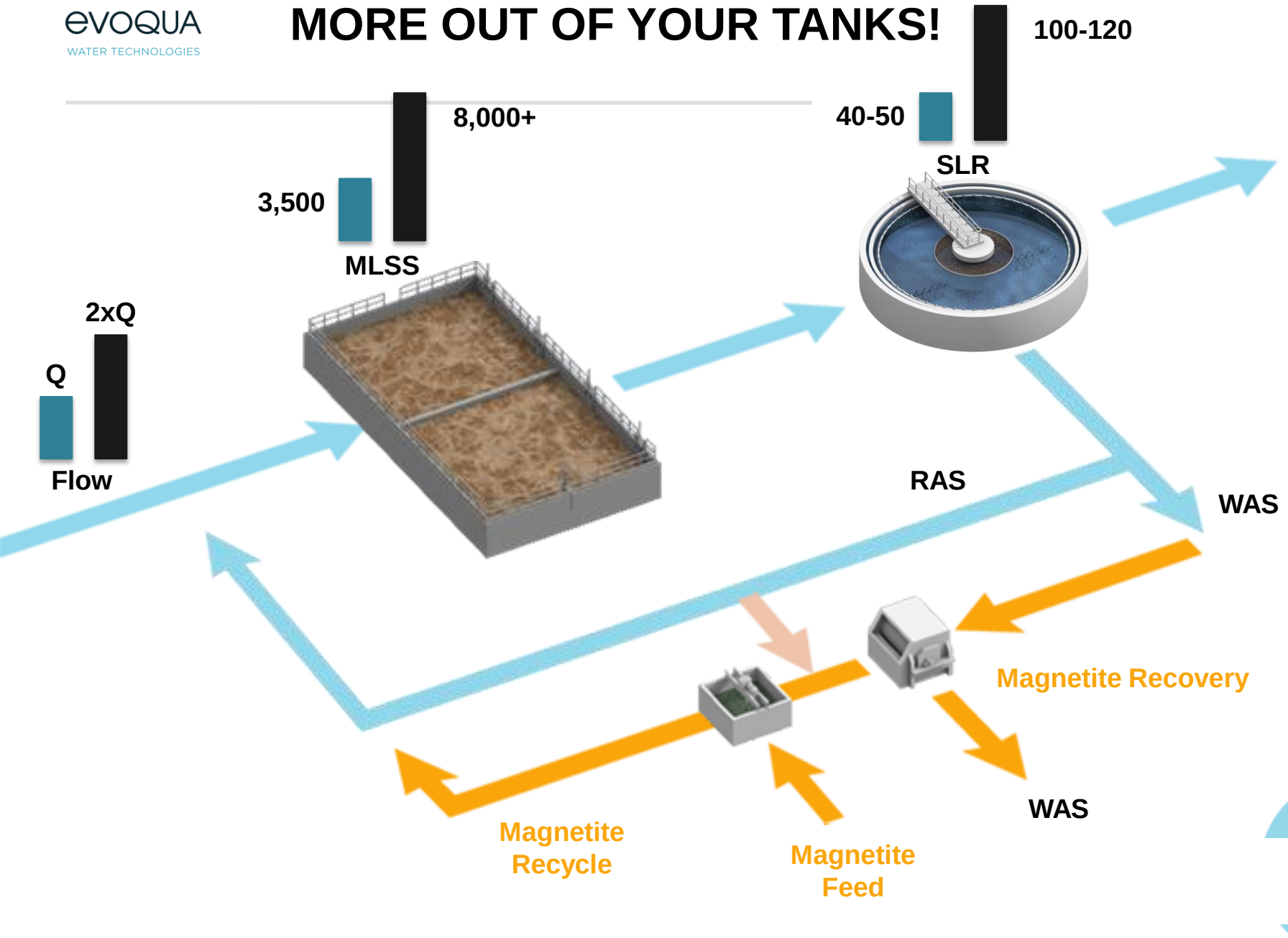
Stress Test Results

Day of testing	Max SOR Gpd/sf	Max SLR Lb/da/sf	Sec Effluent TSS (mg/l)	Sec Effluent TP (mg/l)
Day 1	945	67	5.4	0.14
Day 2	1369	98	12	0.17
Target	883	57-80	10	0.3
Flow	Limiting SOR	SOR Capacity	Limiting SLR	SLR Capacity
Peak Day	945	3.94 MGD	67	4.23 MGD
Peak Hour	1369	5.71 MGD	98	5.88 MGD

Conclusions

- Conversion of CAS process to BioMag™ is a very feasible option, eliminating additional CAS and clarification tank expansion, saving space and land $.
- Potential capacity of existing bioreactor and secondary clarifier tankage operated as BioMag™:
  - ADF: 2.4 MGD (200% of existing rated capacity)
  - Peak flow: > 5.8 MGD (193% of existing rated capacity)
  - Able to meet MOE effluent requirements
- Potential cost savings for secondary treatment expansion
  - Estimated 25% capital cost savings BioMag™ retrofit vs. expanding CAS

MORE OUT OF YOUR TANKS!



BIOMAG APPLICATIONS

- Capacity increase: 2X – 3X
- TN removal within existing tanks
- Ultra low TP without filters
- High peaking factors
- Process stability
- Site constraints
- Tight budgets

The cheapest concrete is the one you own!

BioMag System Case Studies

Sturbridge, MA

Allenstown, NH

Smithsburg, MD

Upper Gwynedd, PA

Mystic, CT

STURBRIDGE, MA

Master Plan

- Increase capacity 0.75 to 1.3 MGD
- Replace aging equipment
- New limits (TN, TP)

Removal Capabilities Req'd

New NPDES limits expected

- BOD_5 & TSS <5.0 mg/l
- TP <0.2 mg/l
- TN <10 mg/l

Upgrade Alternatives

- MBR vs. BioMag
- Final Design: BioMag & CoMag Systems

Sturbridge, MA – Site Constraint

2008

2011

Allenstown, NH (eff issues, sewer moratorium)

Enhance solids settling and reliability

- Capacity increase 1.0 to 1.3 MGD
- Shallow clarifiers (7-ft SWD)
- Handle a peaking factor of 5
- Manage settling during filament outbreaks

Increase treatment capacity

- Be able to increase MLSS as needed
- Control load swings from septage

Minimize project cost

- Use of existing infrastructure

MLE Converson

ALLENSTOWN, NH – BIOMAG BUILDING

SMITHSBURG, MD

Two SBRs with surface aerators & mixers

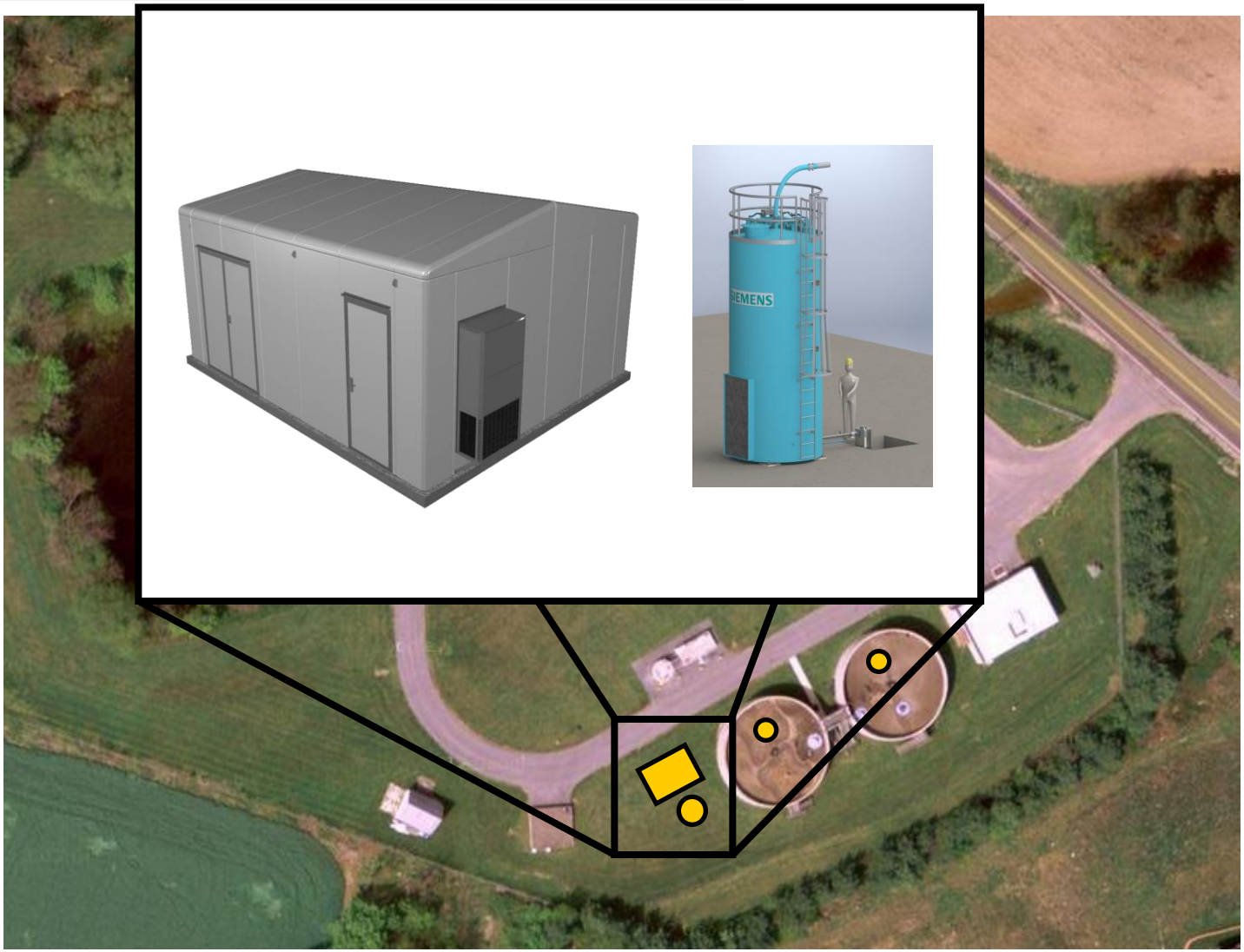
- 0.33 MGD design flow

Challenges:

- Cold temperature for nitrification (6.5C 3.9 NH3, can't meet)
- I/I affecting cycles
- Poor settling → MLSS capped at 2,700 mg/l

Successful BioMag full scale demonstration in 2013

SMITHSBURG, MD
BIOMAG EQUIPMENT



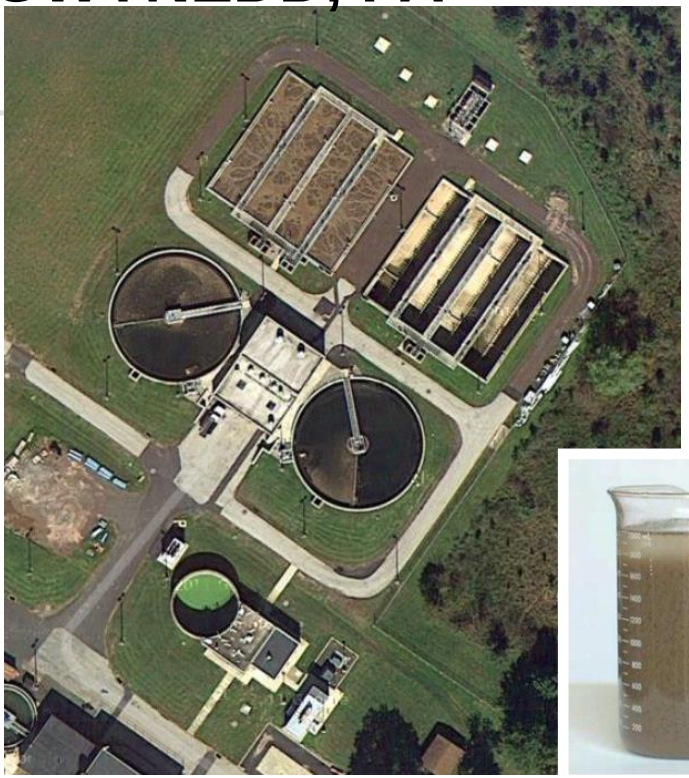
UPPER GWYNEDD, PA

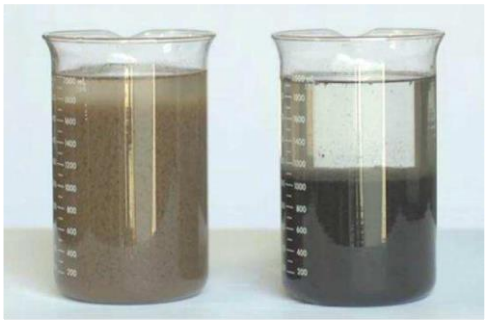
Challenge

- Consent Order imposed major plant upgrade to address reliable BOD/TSS removal prior to discharge into fresh water stream.
- Existing system could not handle the 4-5 times peak flows due to I&I/storm events.
- Total Phosphorus will be reduced at some point in future.

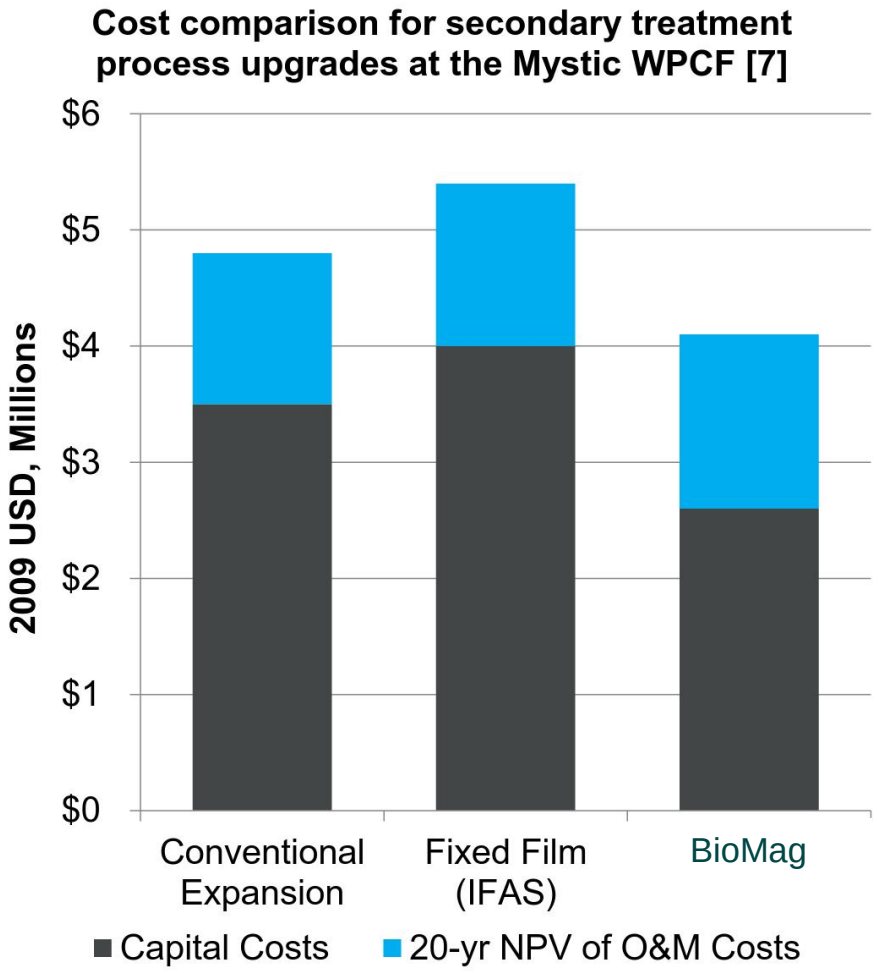
Value Provided

- Full-scale demonstration in 2009
- BioMag allowed the plant to reliably treat all of their flow even during I&I events
- Reliable settling of solids achieves low TP levels (<0.2 mg/l) in order to meet future limits.





CASE STUDY 2: MYSTIC, CT



- Anticipated startup in July 2014
- No additional site footprint available
- Expanded from 3.3 to 5.3 MLD in existing tankage while implementing nitrogen removal
- Full-scale pilot in 2009 able to achieve < 4 mg/L TN, < 5 mg/L TSS [2]

THANK YOU FOR YOUR ATTENTION

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