Sampling and Monitoring to Support Operations

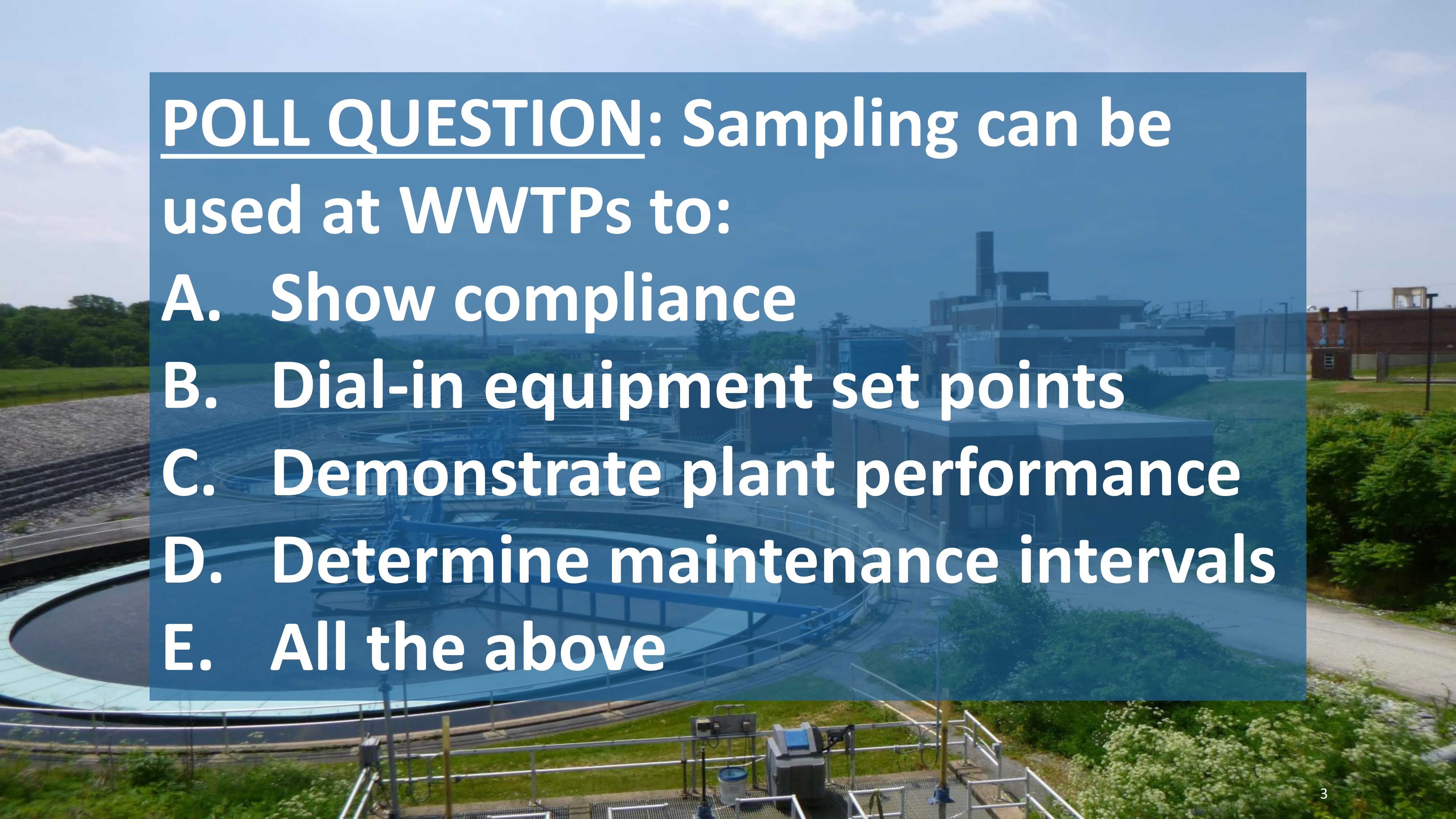
EPA Technical Assistance Webinar

August 2020

US EPA Office of Compliance Technical Assistance Webinar Series

Introduction: Seth Heminway, US EPA Office of Compliance (heminway.seth@epa.gov)

- Webinar series supports the national EPA and state initiative to reduce noncompliance among CWA - NPDES permitted facilities. Focus is on helping wastewater system operators return their facilities to compliance, and those interested in fine-tuning their systems.
- The webinar will be recorded and posted.
- Certificates of attendance will be sent to those who have registered.
- You will be in “listen only mode.”
- Use the chat box to ask questions and to suggest other training
- Speakers do not necessarily reflect EPA positions or policy.
- We strive for continuous improvement. Please complete the post webinar survey.



<u>POLL QUESTION</u>: Sampling can be used at WWTPs to:

A. Show compliance
B. Dial-in equipment set points
C. Demonstrate plant performance
D. Determine maintenance intervals
E. All the above

Different types of sampling/monitoring can tell us different things about a treatment plant.

In all cases, sampling needs to be representative of what’s trying to be demonstrated/solved in order to provide useful data.

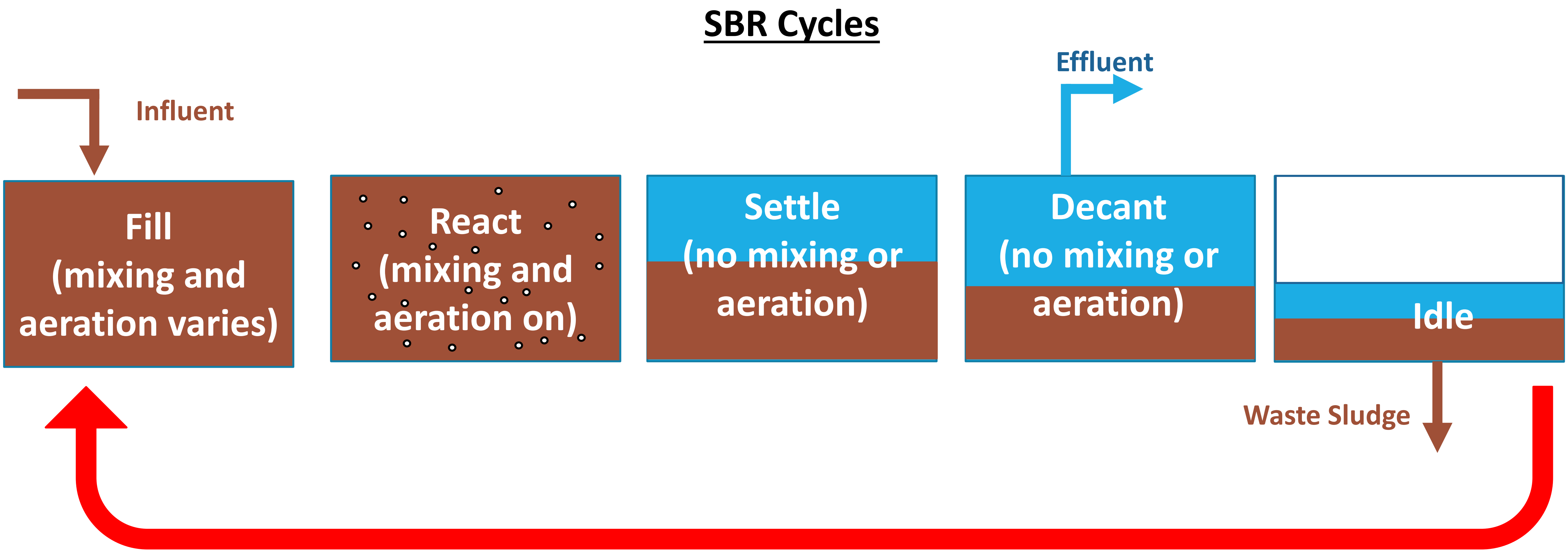
Compliance Sampling and Monitoring

Sampling and Monitoring for Process Control

- Evaluate influent and effluent quality at different stages of the treatment train
- Determine process or equipment performance
- Dial-in set points and dosing rates – plant optimization
- Identify problems before they become failures

For Example…

- ~1 MGD SBR Plant
- Two SBRs with post-aeration and UV disinfection

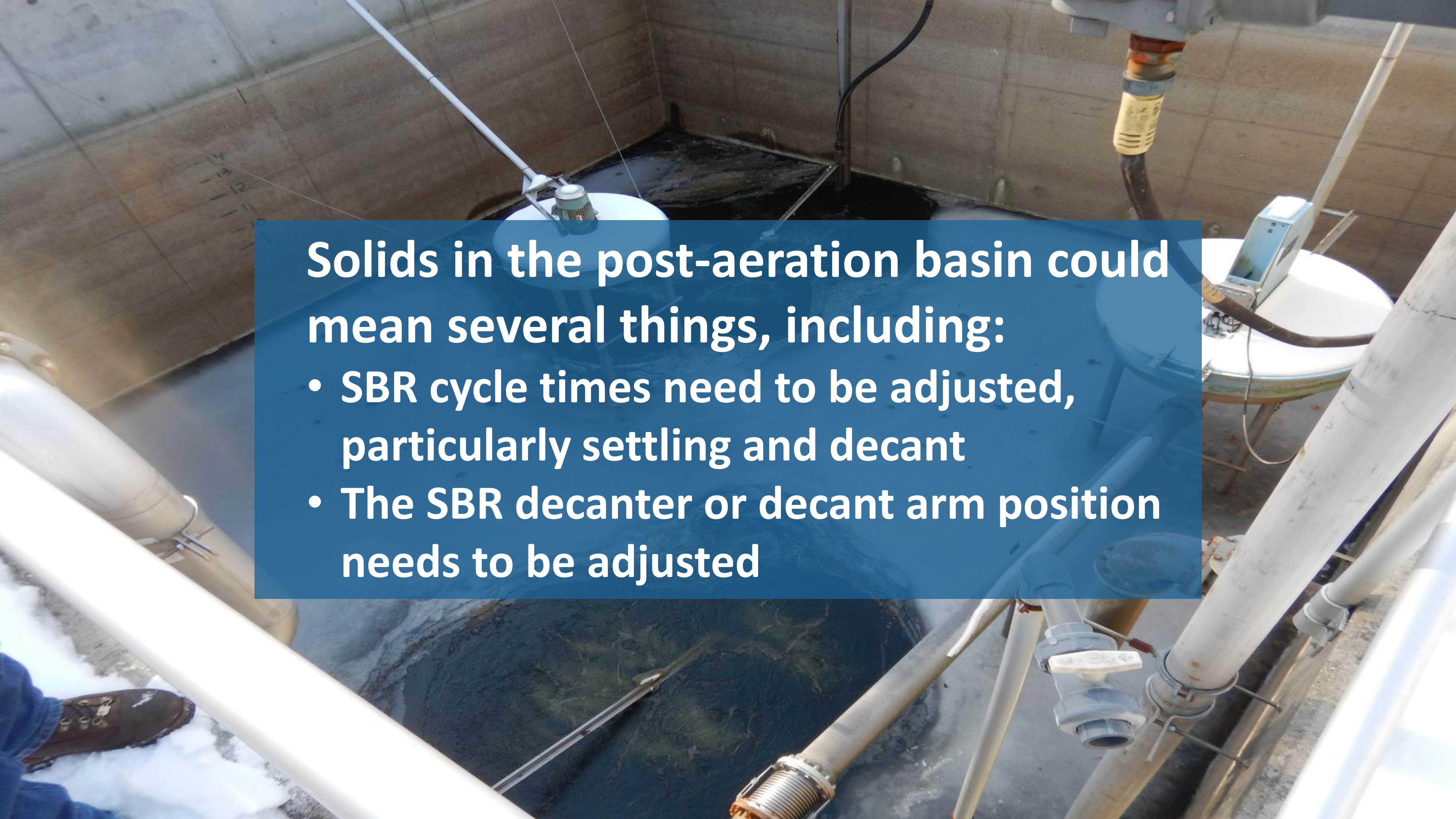


The Problem: Solids were washing out from the SBRs to the Post-Aeration Basin and Receiving Water

Not the actual location or event

Working towards a Solution:

- Conduct root cause analysis
- Establish baseline or benchmark conditions
- Develop and implement a process control protocol for routine monitoring and operational evaluation/ adjustment

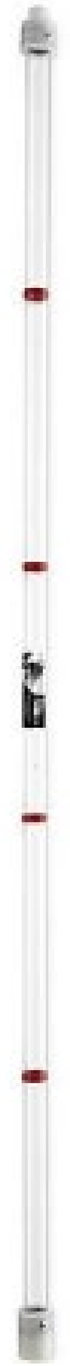


Solids in the post-aeration basin could mean several things, including:

- SBR cycle times need to be adjusted, particularly settling and decant
- The SBR decanter or decant arm position needs to be adjusted

No historic data was available, so we worked with the operators to assess current conditions and develop and implement an SOP to routinely monitor solids accumulation in the post-aeration basin going forward.

- Target the most stressed conditions for evaluation (e.g., conditions with most solids – after decant cycles and wet weather events)



Before

After


Questions

Using Microbiology to Inform Process Control and Troubleshooting

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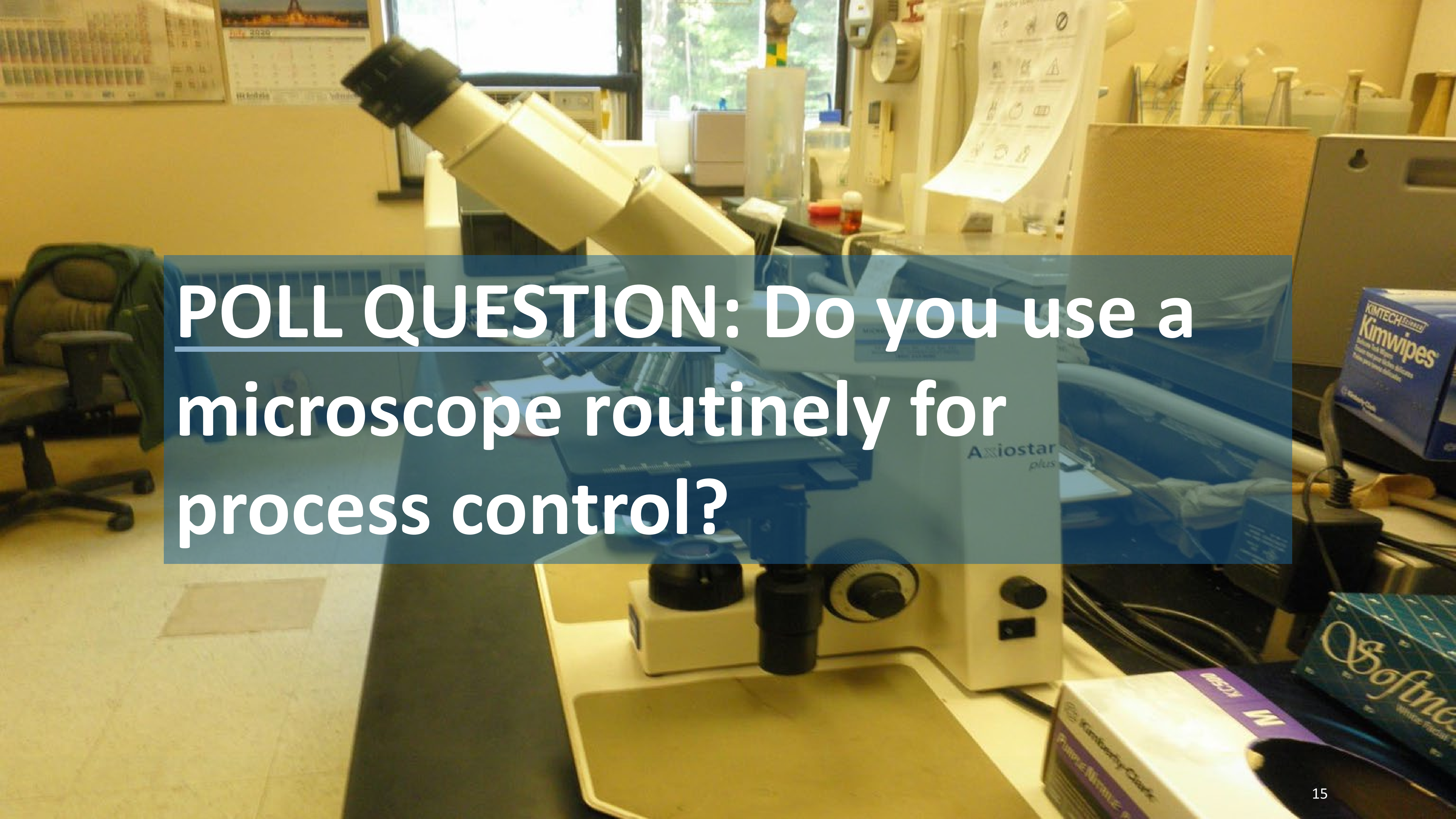
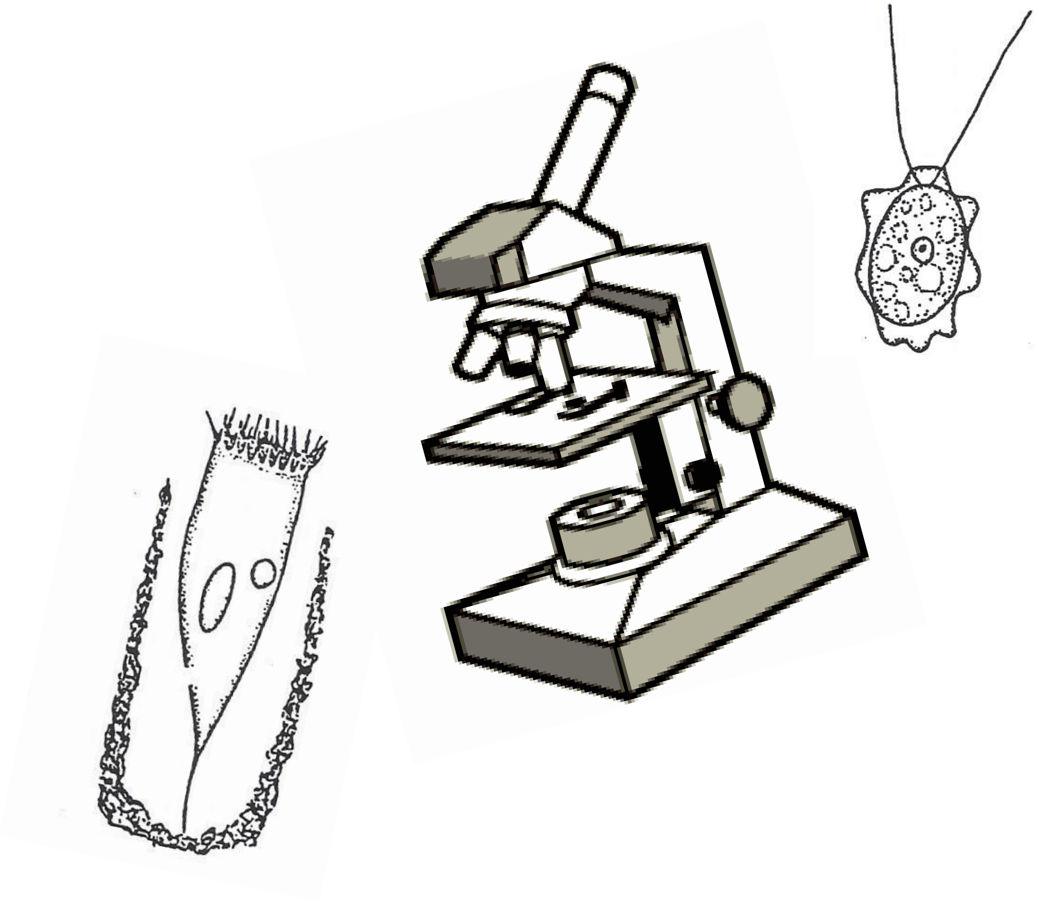


POLL QUESTION: Do you use a microscope routinely for process control?

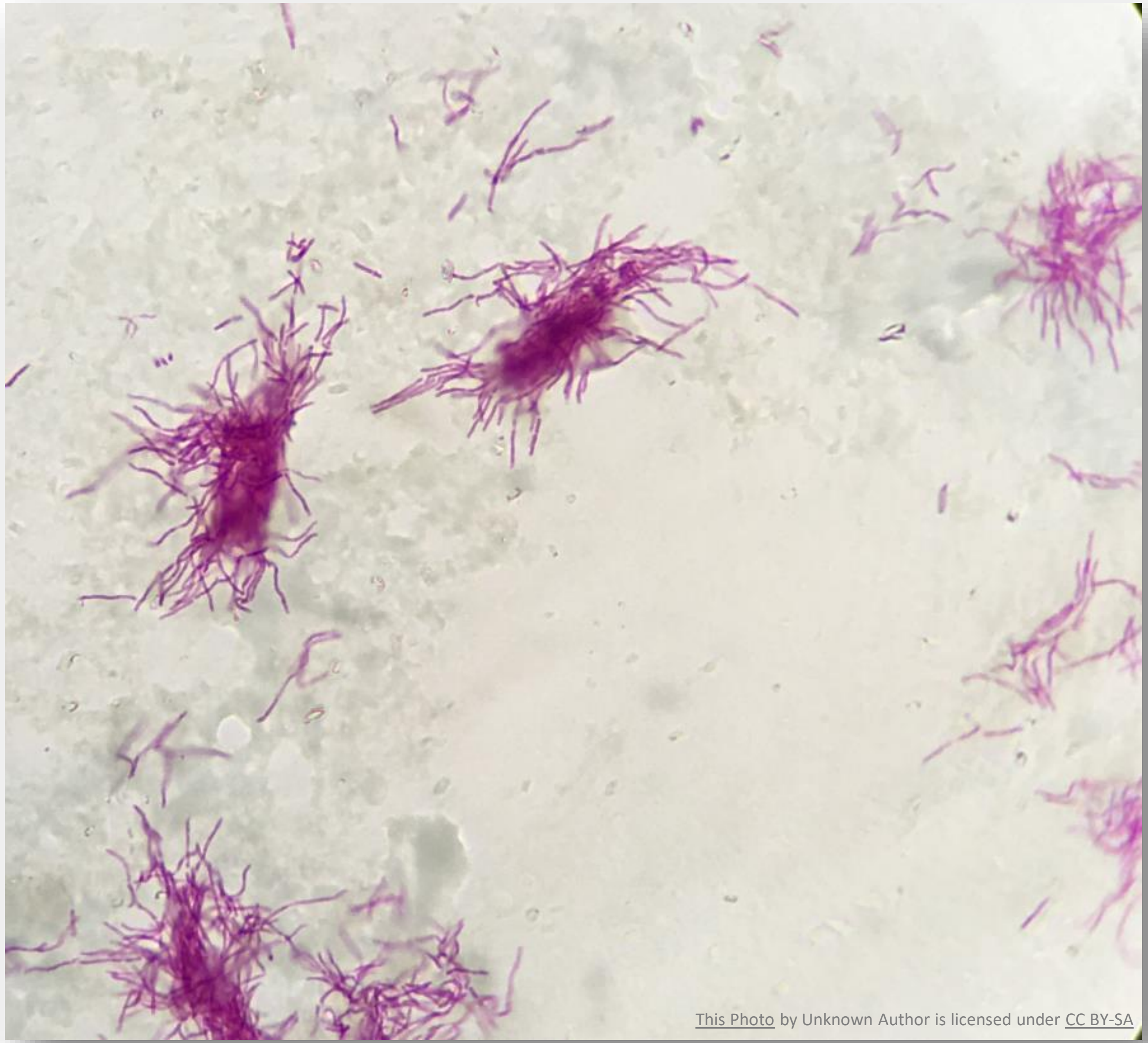
Understanding the microbiology of a treatment plant can help operators diagnose problems early, make process adjustments, and avoid major upsets.



The basics…

Wastewater treatment is a biological process.

- Good Biology
- Bad Biology



Bill Ingram

Wastewater Treatment Plant Superintendent

Great Barrington WWTP

- 37 years of experience in wastewater
- Massachusetts Wastewater Treatment Plant Operator: Grade 7
- Connecticut Wastewater Treatment Plant Operator: Grade 4
- NWEA Collection Systems Operator: Grade 4
- NWEA Wastewater Laboratory Analyst: Grade 2

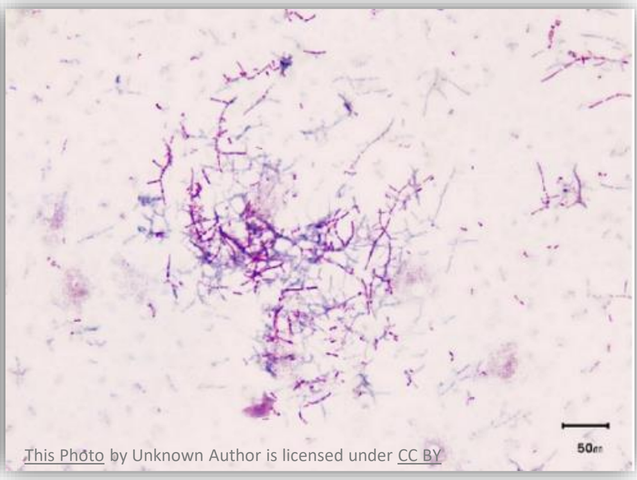
During Bill's tenure at the facility, both as an operator and superintendent, the Great Barrington WWTP was recognized with the 2016 EPA Regional Wastewater Treatment Plant Excellence Award, and one of his talented operators was recognized with EPA's New England Region Operator of the Year Award for 2018.

Regular microscopic examination can provide operators with important information about the health of the treatment plant and can be a proactive step for process control.

Rotifer

Stalk Ciliates

Amoeba

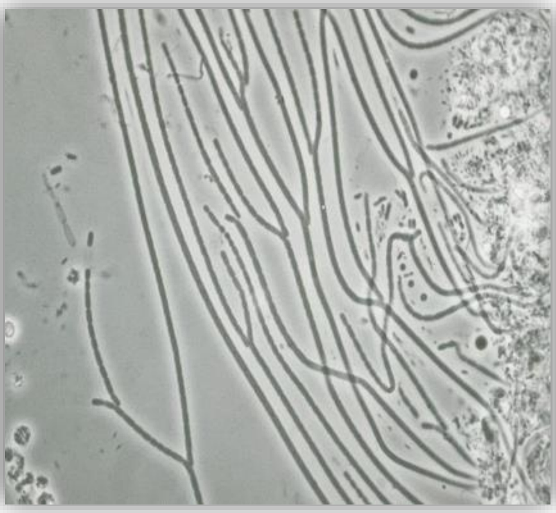


Nocardia

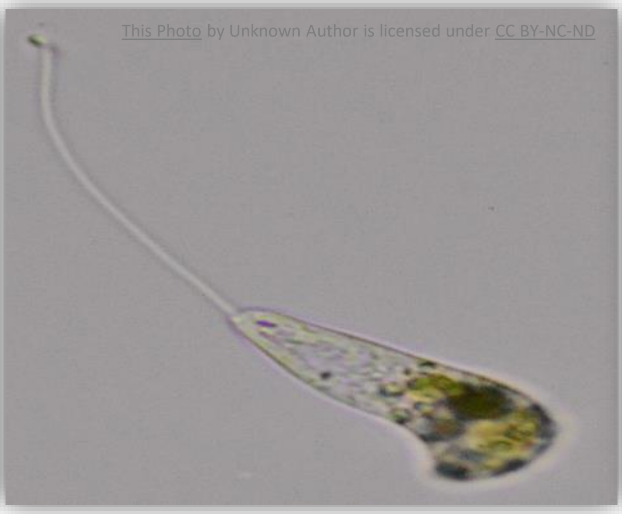
Wastewater Microbiology Examples

Nematode

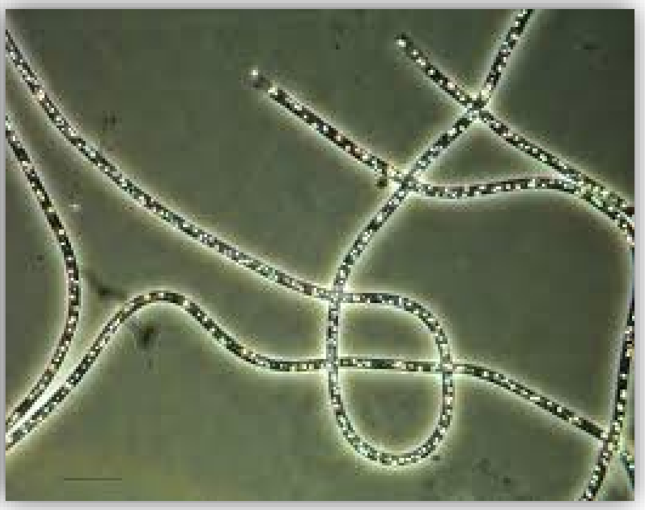
S. natans



Flagellate

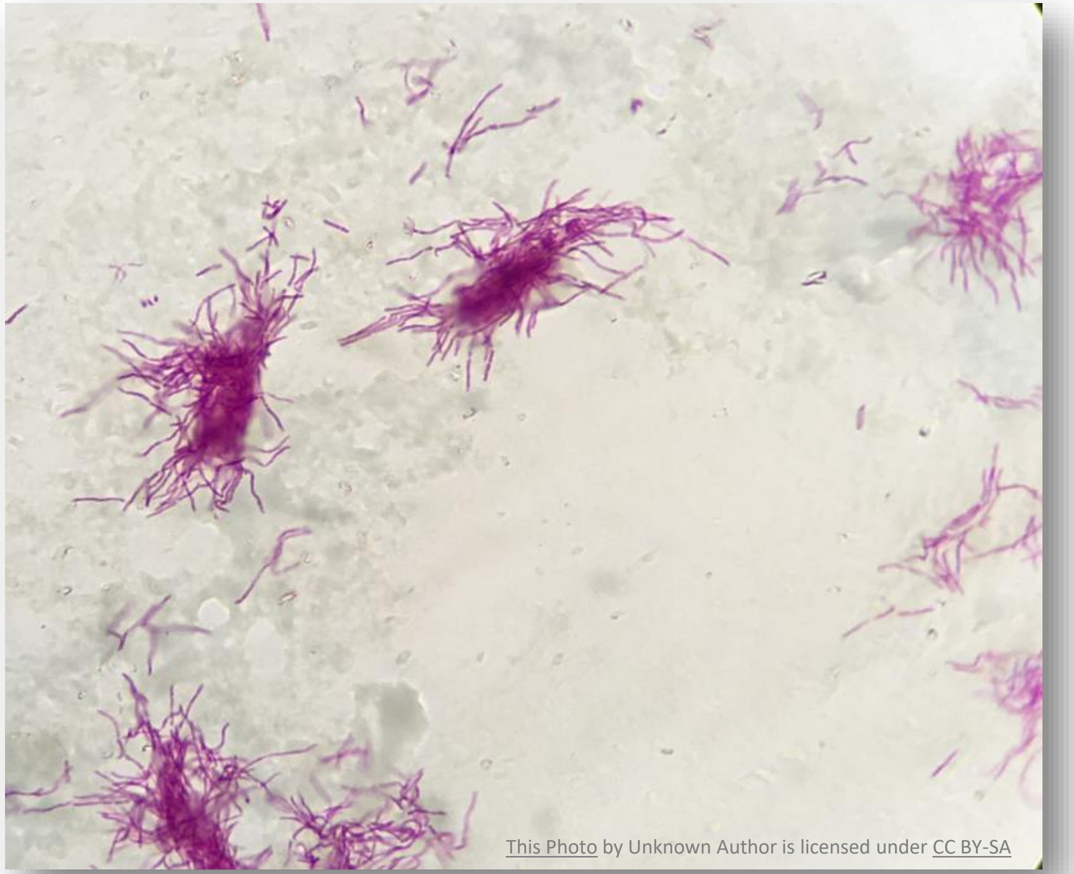


Beggiatoa



For Example…

Nocardia



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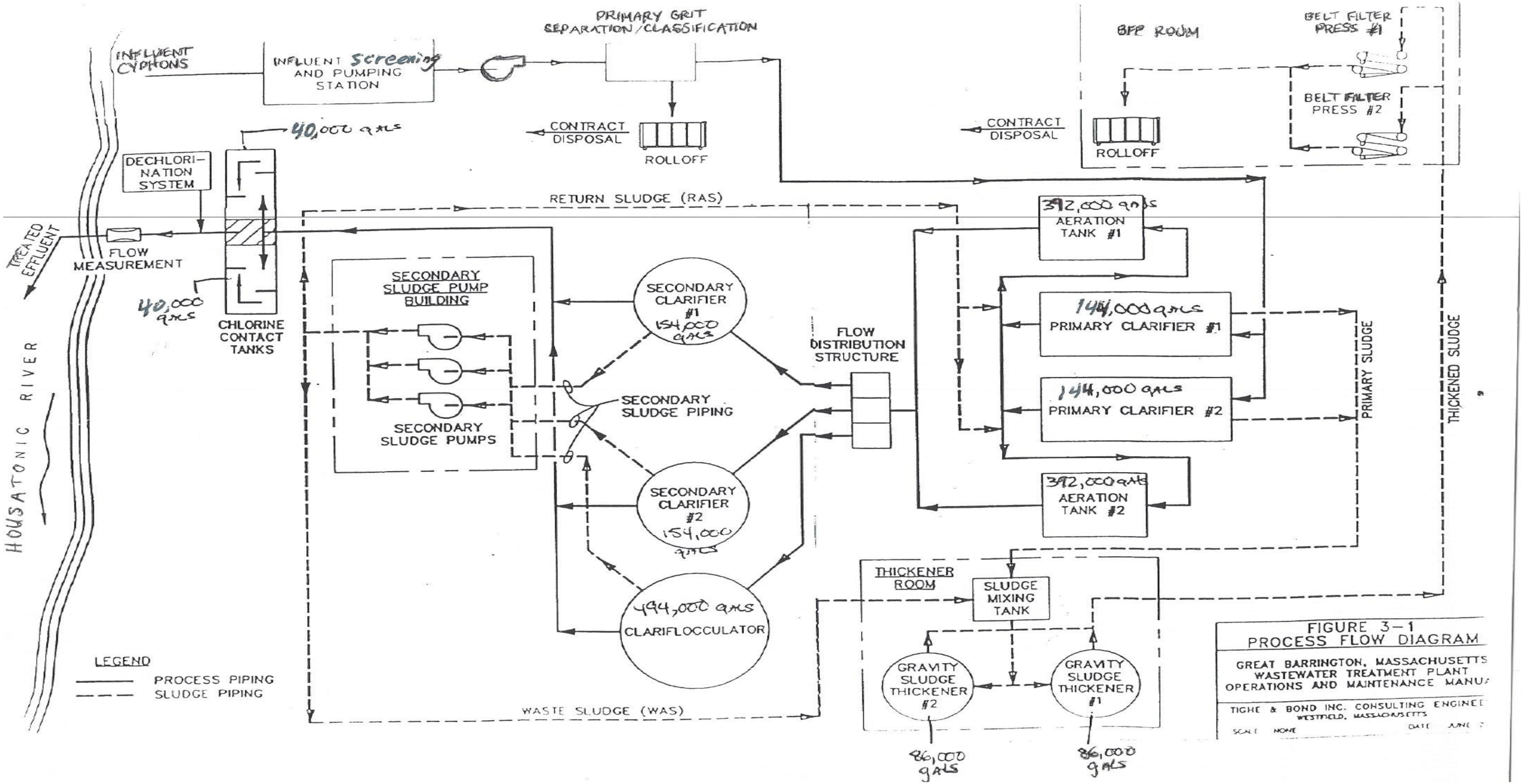
Foaming

Evaluating Microbiology at Great Barrington WWTP (MA)

Key Plant Stats:

- Built in the mid-1970's
- Massachusetts Grade 5 plant with a design capacity of 3.2 million gallons per day (MGD)
- Activated sludge
- Chemical precipitation for phosphorus
- Sludge processed through gravity thickening and belt filter presses



INFLUENT CYPHONS
INFLUENT Screening AND PUMPING STATION
PRIMARY GRIT SEPARATION/CLASSIFICATION
CONTRACT DISPOSAL
ROLLOFF
BFP ROOM
BELT FILTER PRESS #1
BELT FILTER PRESS #2
CONTRACT DISPOSAL
ROLLOFF
40,000 gals
DECHLORI-NATION SYSTEM
TREATED EFFLUENT
FLOW MEASUREMENT
40,000 gals
CHLORINE CONTACT TANKS
RETURN SLUDGE (RAS)
392,000 gals
AERATION TANK #1
SECONDARY SLUDGE PUMP BUILDING
SECONDARY CLARIFIER #1 154,000 gals
FLOW DISTRIBUTION STRUCTURE
144,000 gals
PRIMARY CLARIFIER #1
144,000 gals
PRIMARY CLARIFIER #2
PRIMARY SLUDGE
THICKENED SLUDGE
SECONDARY SLUDGE PIPING
SECONDARY SLUDGE PUMPS
HOUSATONIC RIVER
SECONDARY CLARIFIER #2 154,000 gals
392,000 gals
AERATION TANK #2
THICKENER ROOM
SLUDGE MIXING TANK
494,000 gals
CLARIFLOCCULATOR
LEGEND
PROCESS PIPING
SLUDGE PIPING
WASTE SLUDGE (WAS)
GRAVITY SLUDGE THICKENER #2
GRAVITY SLUDGE THICKENER #1
86,000 gals
86,000 gals
FIGURE 3-1
PROCESS FLOW DIAGRAM
GREAT BARRINGTON, MASSACHUSETTS
WASTEWATER TREATMENT PLANT
OPERATIONS AND MAINTENANCE MANU
TIGHE & BOND INC. CONSULTING ENGINEE
WESTFIELD, MASSACHUSETTS
SCALE NONE
DATE JUNE

<u>The problem</u>: Solids bulking and solids loss

The culprit: Sphaerotilus (S.) natans

What causes S. natans growth?

- Low dissolved oxygen
- Low nutrient concentrations

The solution: Chlorinating returned sludge and maintaining healthy DO and nutrient levels in secondary treatment

Cl_2

NaOCl Dosage Calculation for Filamentous Control

$$\mathbf{Cl_2\,feedrate\ (lbs./day)} = \frac{\mathbf{(desired\ dosage\ (lbs./day))/(1,000\ lbs.\ MLVSS))(1\ lb.\ MLVSS)}}{\mathbf{1,000\ lbs\ MLVSS}}$$

$$\mathbf{NaOCl\,feedrate\ (gal./day)} = \frac{\mathbf{(Cl_2\,feedrate\ (lbs/day))(\frac{0.83\ gal.\ NaOCl}{1\ lb.\ Cl2})}}{\mathbf{1,000\ lbs.\ MLVSS}}$$

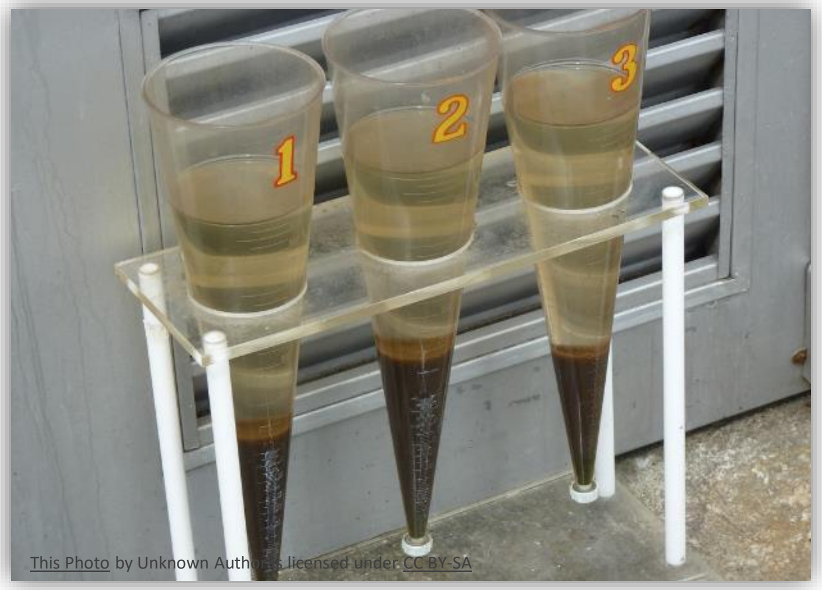
OR

$$\mathbf{NaOCl\,feedrate\ (gal./day)} = \frac{\mathbf{(Cl_2\,dosage\ (lbs/day))(1\ lb.\ MLVSS)(0.83\ gal.\ NaOCl)}}{\mathbf{1,000\ lbs.\ MLVSS}}$$

***Chlorine dosage should start low with 2 to 3 lbs. Cl_2 per day per 1,000 lbs. MLVSS. More, up to 5 to 6 lbs. Cl_2 per day per 1,000 lbs., may be necessary for heavy filamentous growth.**

Process control monitoring going forward:

- ✓ Continue microscope observations
- ✓ Sludge volume index (SVI) monitoring
- ✓ DO and nutrient monitoring




Questions

Using Process Control to Overcome Challenges

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POLL QUESTION: High Sludge Volume Index (SVI) may indicate:

a) Young sludge
b) Old sludge
c) Filamentous bacteria
d) A or C
e) B or C

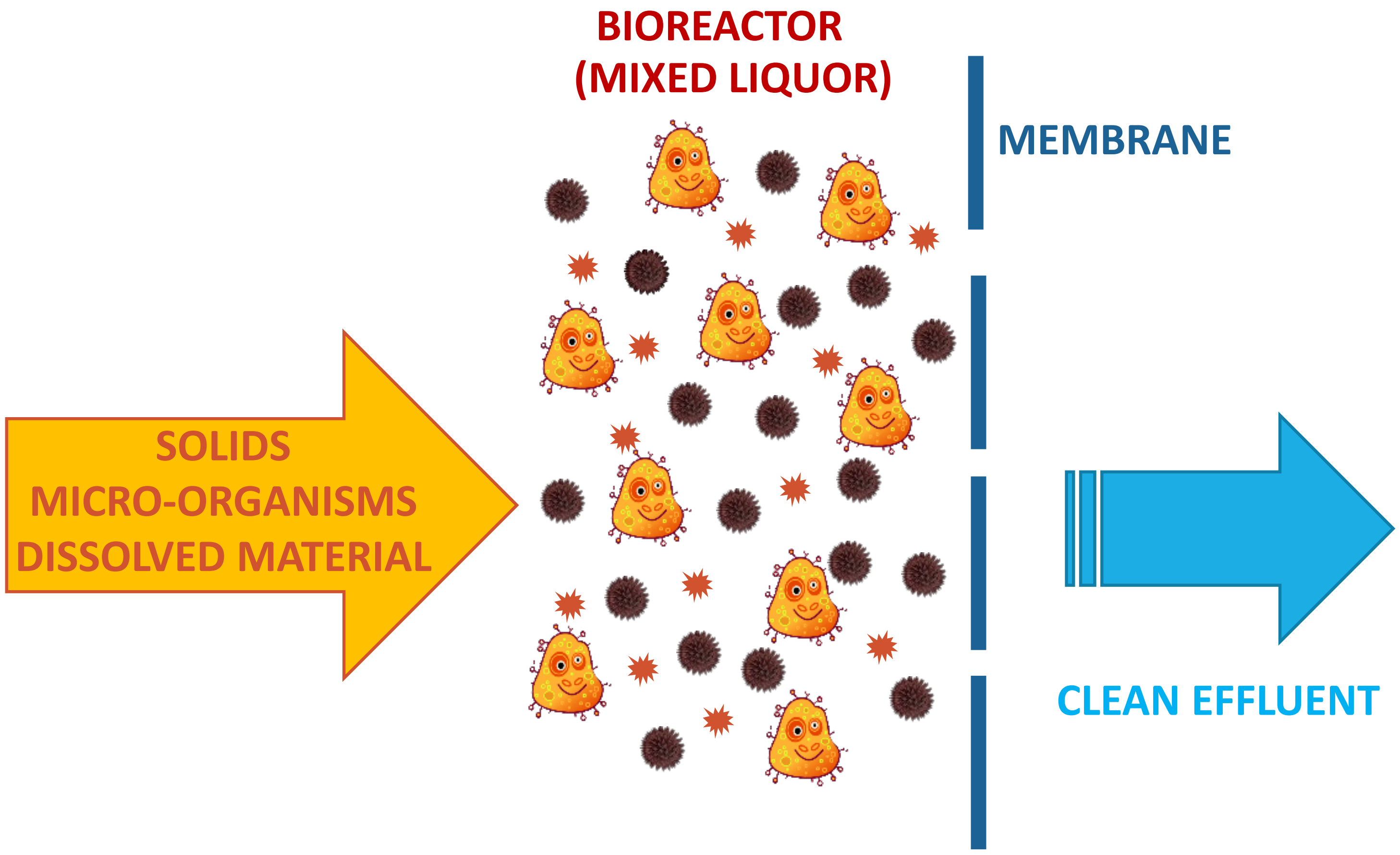
Wastewater treatment facilities are not always perfectly designed.

- Fluctuations in population and flow
- Industry
- New or changing permit requirements
- Design and equipment challenges

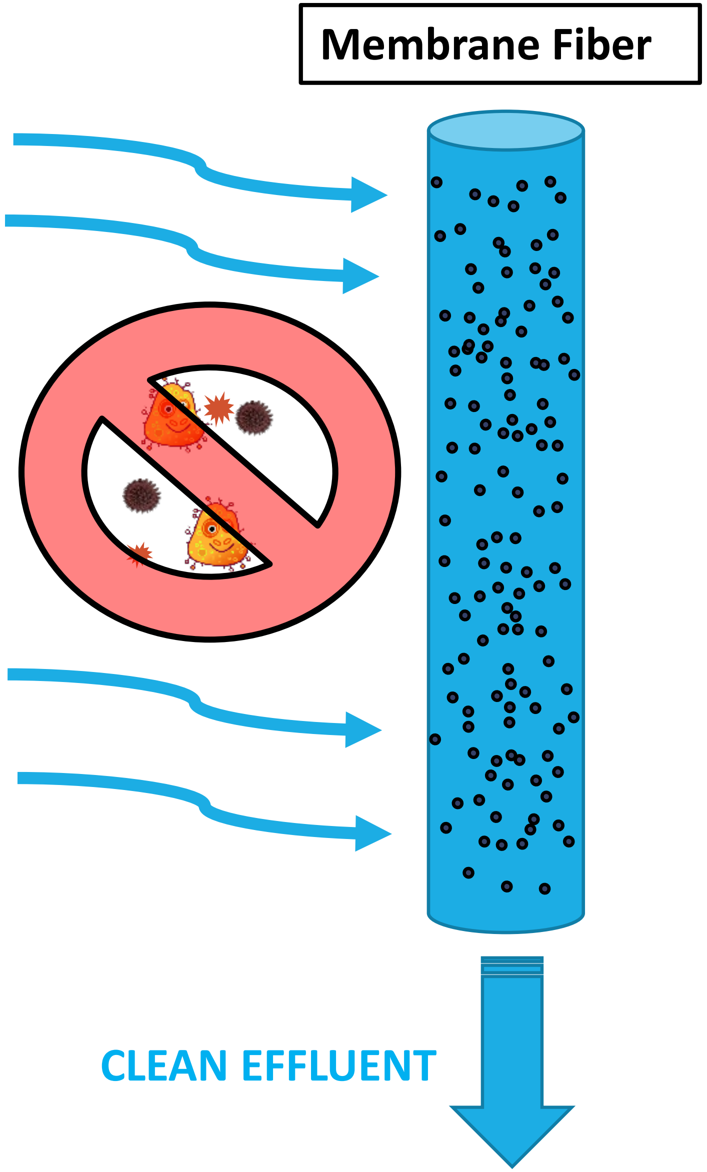
How can a vigilant process control program help?

- Create a historical trend of plant performance
- Identify issues before they become failures
- Help operators learn and adapt and compensate in less than ideal situations
- Inform decision-making for long-term solutions

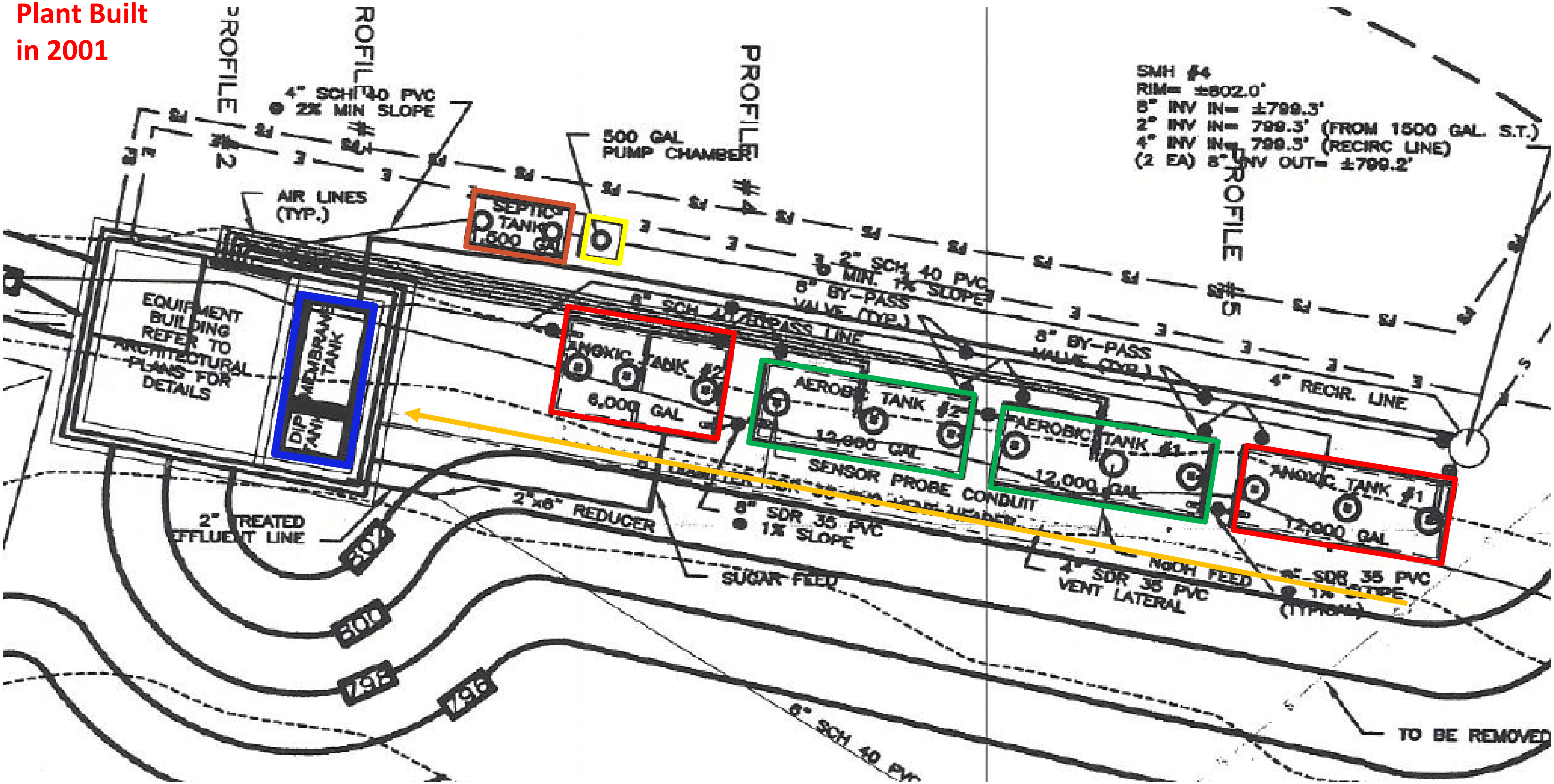
Overcoming Design Challenges at a Small New England MBR Plant



Membrane bioreactors (MBRs) **are a type of activated sludge process that utilizes membrane filtration to separate mixed liquor suspended solids from the surrounding water.**


Membrane Fiber
CLEAN EFFLUENT

Plant Built in 2001



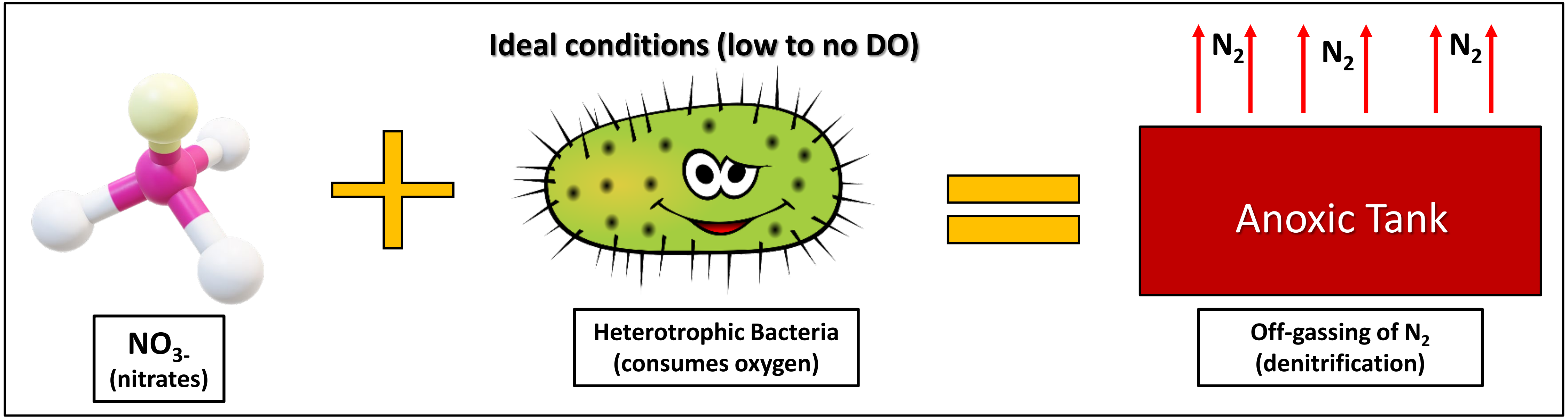
Process Control Considerations

Alkalinity Control
(Sodium Hydroxide)

Carbon Feed
(Granulated Sugar)

Oxygen
(Mechanical Blowers)

The Problem: Too much DO for anoxic conditions

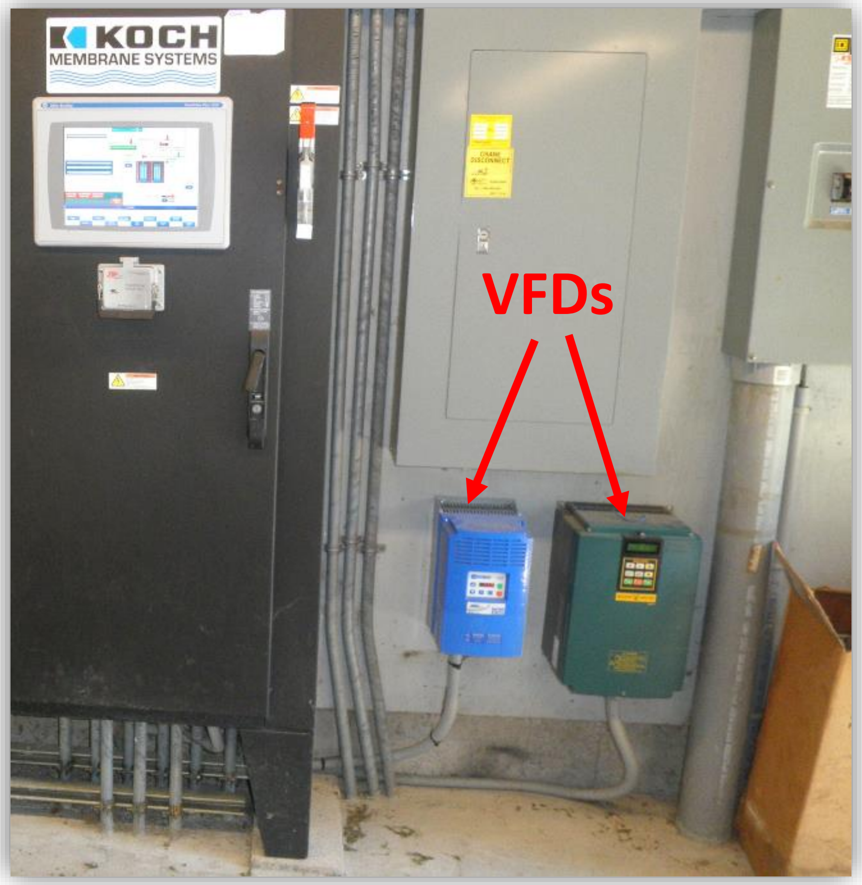


Denitrification requires anoxic conditions of 0.5 mg/L of DO or less.

Anoxic Tank No. 1 DO was too high because of high DO flows from the membrane tank recycle pump, and poor air control in the two aeration tanks resulted in very high DO in the mixed liquor.

Could not denitrify!!

The solution: Better air (DO) control



Variable frequency drives allowed for a wider operational range of aeration (DO) coming from the blowers.

Using Lessons Learned to Inform Solutions

New Plant Upgrades to Include:

- ✓ **Larger anoxic tank to increase detention time**
- ✓ **Remove course bubble diffusers in favor of electric mixers**
- ✓ **Improved tank layout for better treatment**


Questions

Wastewater Workforce Challenges

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POLL QUESTION: Your facility or utility is currently:

A. Appropriately staffed
B. Short-staffed
C. Hiring
D. A and C
E. B and C

Understaffing can be a major contributor to non-compliance

- More reactive than proactive
- Slower decision-making and response times
- Less time for operator enrichment and advancement

Operators are the <u>most important</u> resource to a wastewater utility

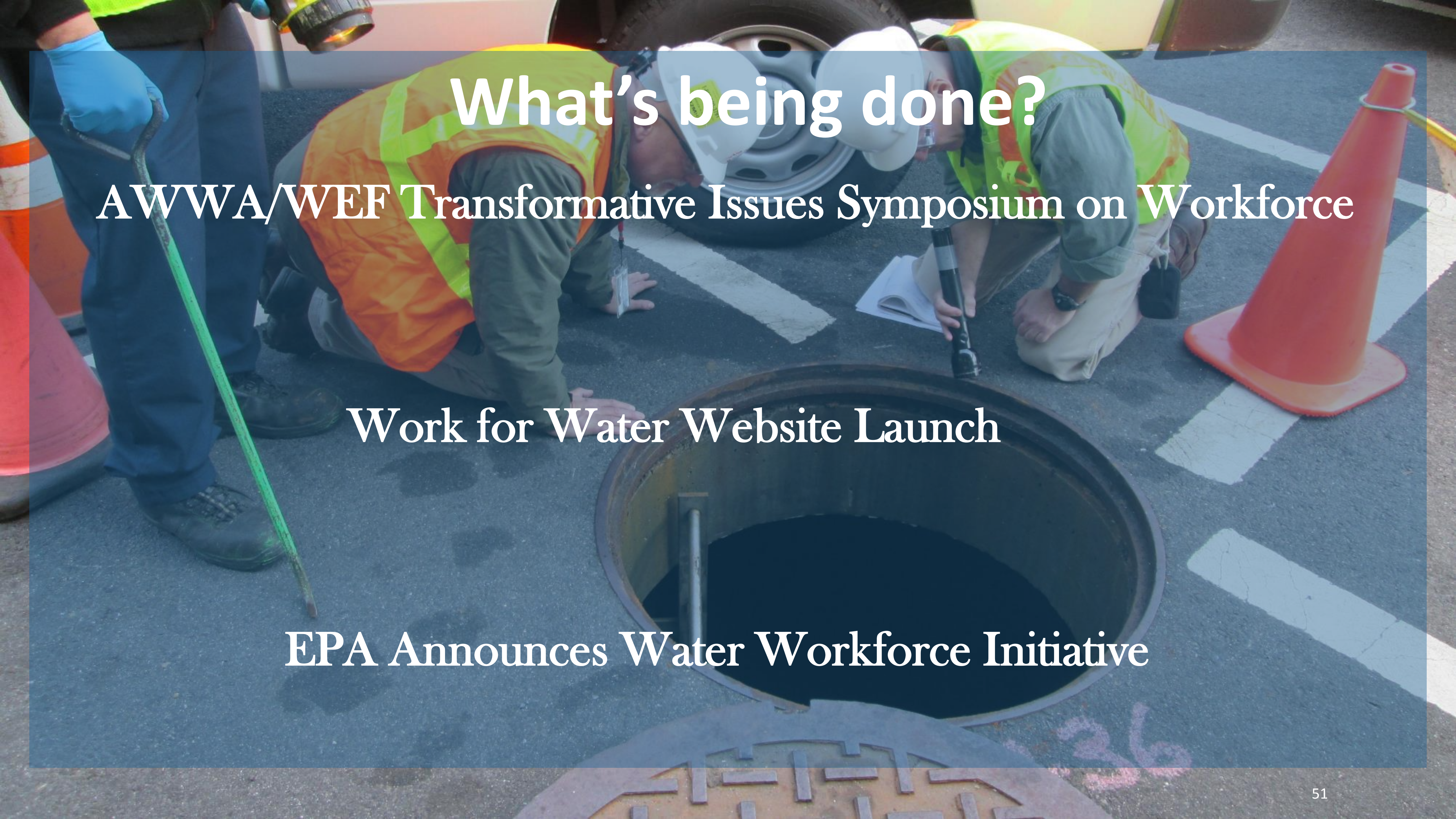
Workforce issues can be attributed to a wide variety of factors

- Available funding
- Location/available labor pool
- Changing tech and skill requirements
- Utility – union relationships
- Access to training
- Industry awareness and stigma
- Poor management/leadership

By 2028, about 1/3 of the US water sector workforce will be eligible for retirement.

- 2018 Brookings Institute Report
  Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity
  https://www.brookings.edu/research/water-workforce/

Widespread staff shortages in the water sector would almost certainly lead to negative environmental and public health impacts.



What’s being done?

AWWA/WEF Transformative Issues Symposium on Workforce

Work for Water Website Launch

EPA Announces Water Workforce Initiative

Resources

AWWA Career Center
https://careercenter.awwa.org

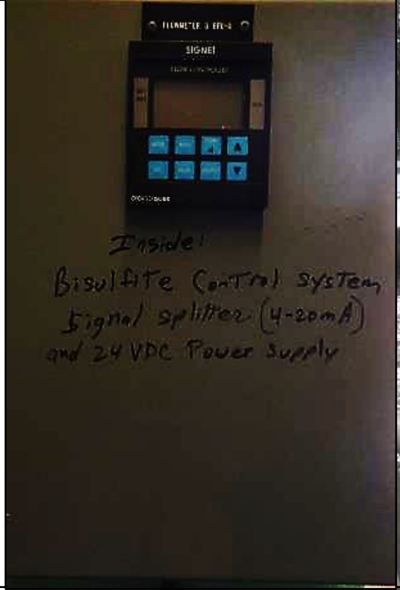
WEF Career Center
https://www.wef.org/jobbank

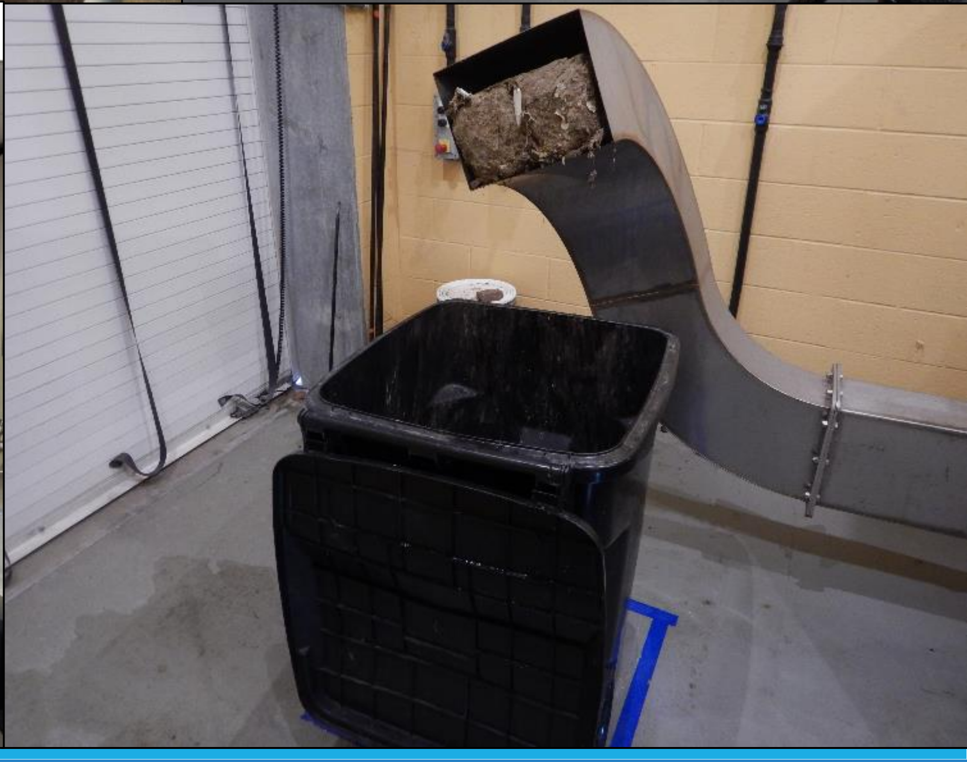
Work for Water
https://www.workforwater.org

What can <u>you</u> do about it?

How do you retain staff and promote an educated and effective workforce?

Examples from Great Barrington WWTP






Questions

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Thank You!