

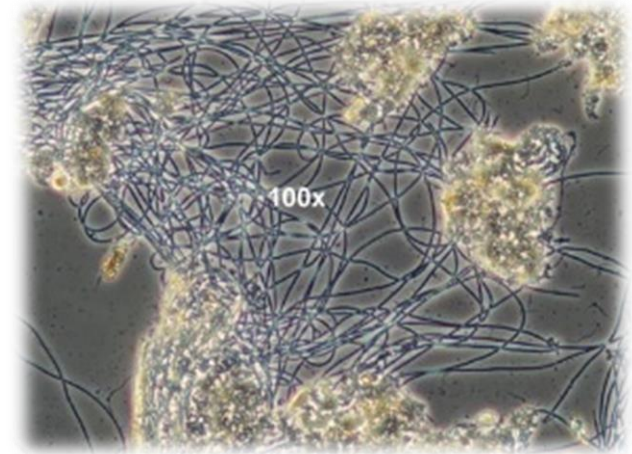


WISCONSIN WASTEWATER
OPERATORS' ASSOCIATION

Case Studies

Common Issues In Municipal WWTPs

WWOA Annual Conference
Grand Geneva, WI



MCO

Midwest Contract Operations

Presented by: Ryan Hennessy
Midwest Contract Operations

Proper Environment For Bugs

- ▶ 1) pH (7–9)
- ▶ 2) Alkalinity (>100 mg/L)
- ▶ 3) Time (HRT and SRT)
- ▶ 4) Temperature
- ▶ 5) Dissolved Oxygen
- ▶ 6) Nutrients
- ▶ 7) FOGs (limited)
- ▶ 8) Septicity (limited)

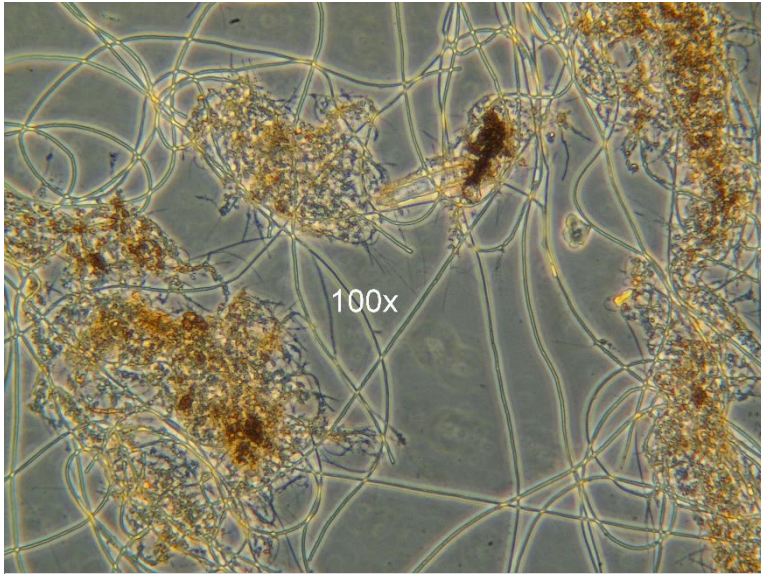


Presentation Outline

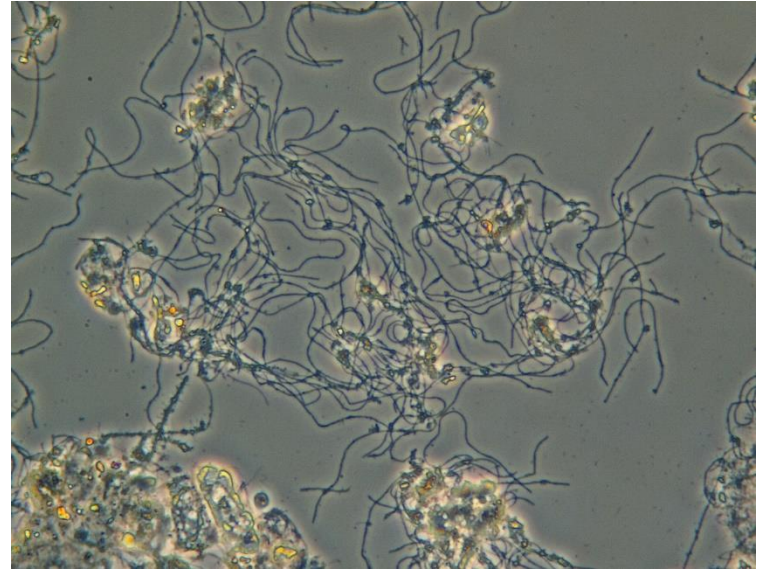
- ▶ Filamentous bulking explained
- ▶ Filamentous bacteria causes
- ▶ State Point Analysis
- ▶ Nocardia case study
- ▶ Septicity filament case study
- ▶ Loss of nitrification case study
- ▶ Pin floc case study
- ▶ Nitrogen gas entrapment (denitrification)
- ▶ Nightmare plant



Filamentous Bulking



Bridging

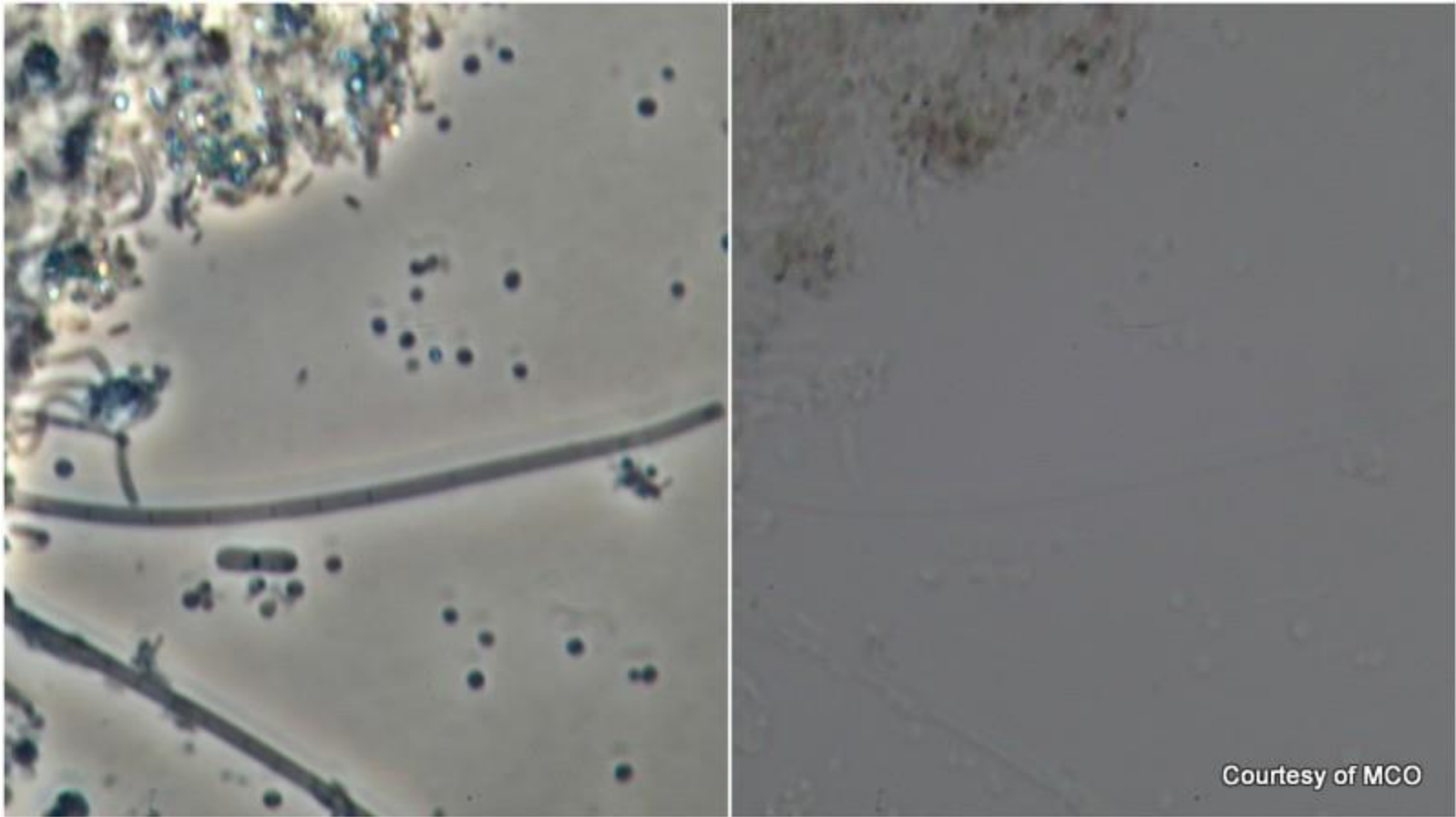


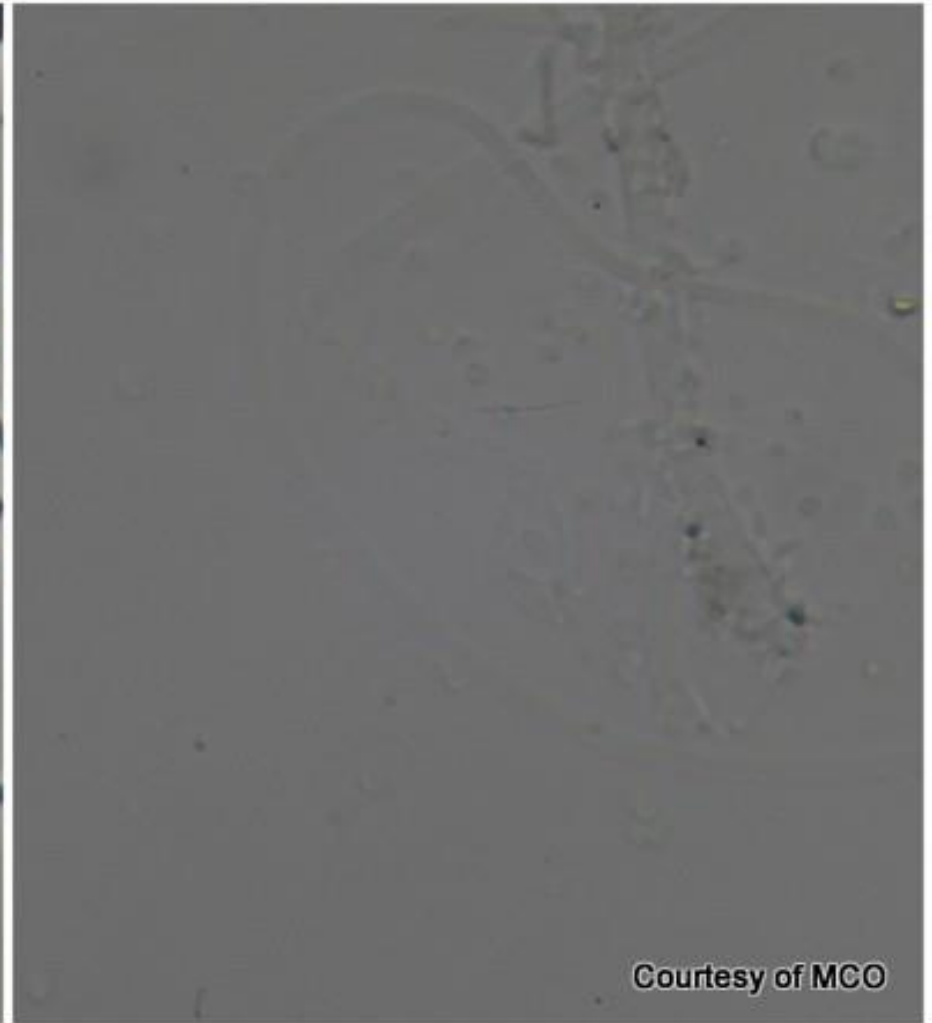
Open- Diffuse flocs

Filament Identification

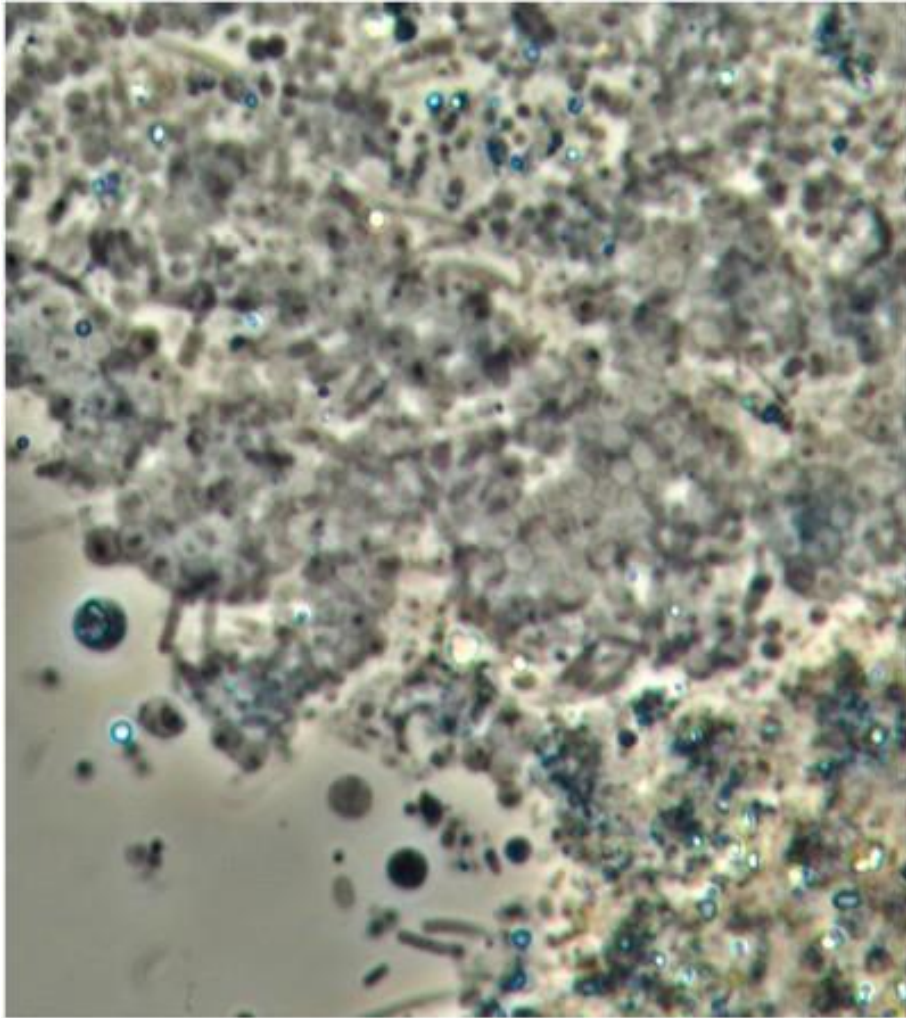


Why Phase Contrast?





Courtesy of MCO

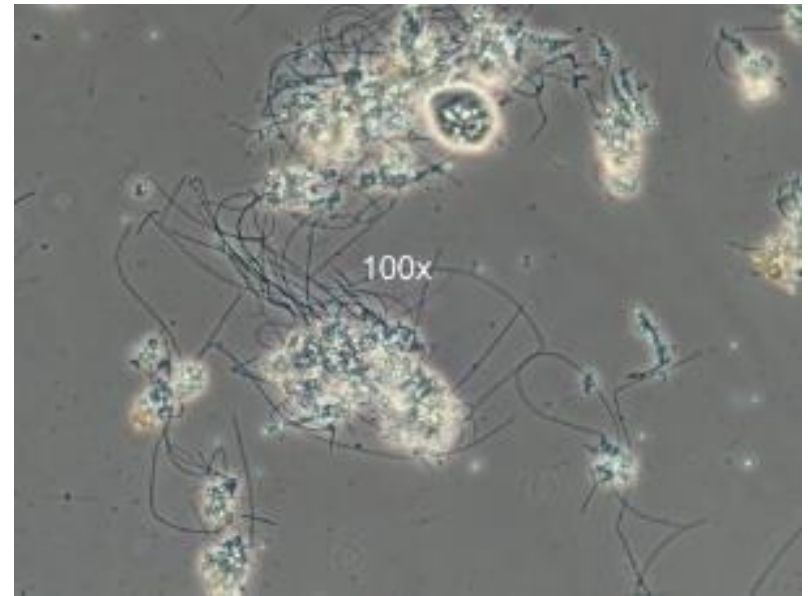
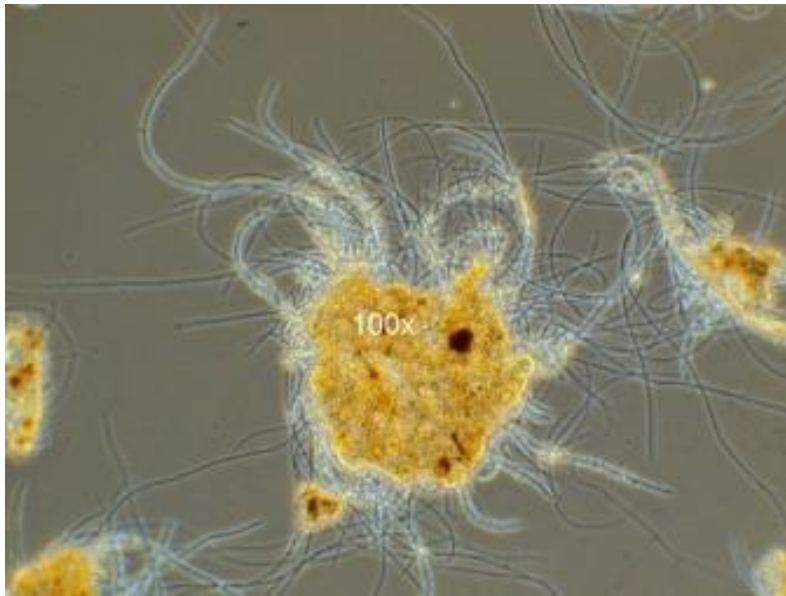


Courtesy of MCO

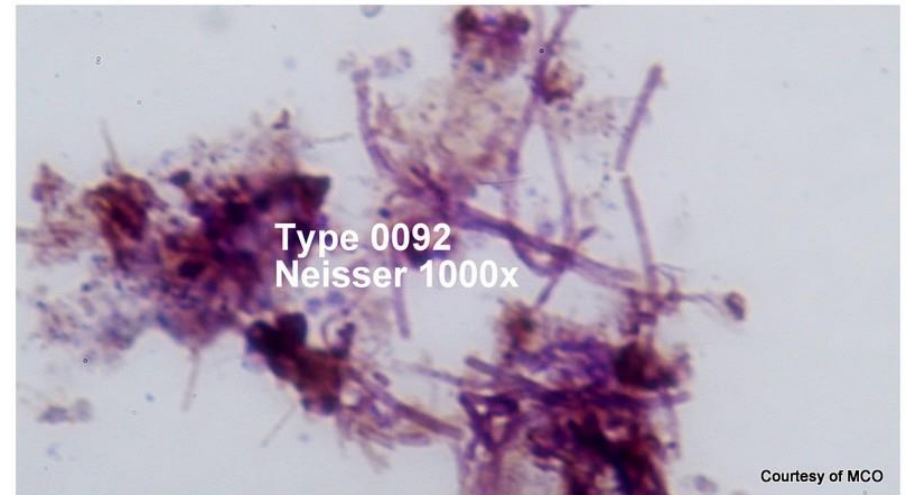
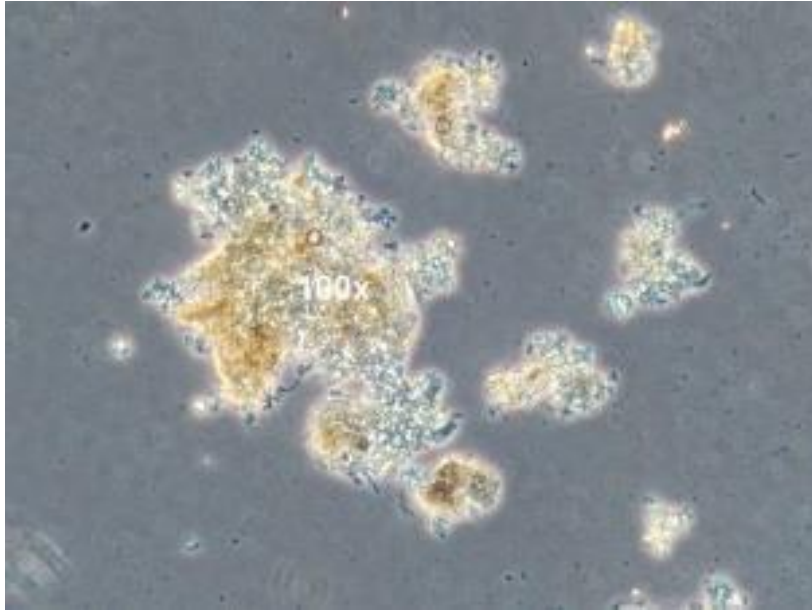
Filament Causes

Cause	Filaments
Low DO	<i>Spaeroltilus natans</i> Type 1701 <i>Haliscomenobacter hydrossis</i>
Low F/M ratio	Type 0041 Type 0675 Type 1851
Septicity	Type 021N <i>Thiothrix</i> I and II <i>Nostocoida limicola</i> I, II, III Type 0411 Type 0961 Type 0581 Type 0092
Oil and Grease	<i>Nocardia</i> spp. <i>Microthrix parvicella</i> Type 1863
Nutrient Deficiency	Nitrogen: <i>Thiothrix</i> I, II, type 021N Phosphorus: <i>N limicola</i> III, <i>H. hydrossis</i> , <i>S. natans</i>
Low pH	Fungi
Source: Dr. Michael G Richard; used with his authorization.	

Factor of Floc Strength



Actually has very common filaments



Big picture: high OAs
but no issues/ no
operational changes

State Point Analysis

This spreadsheet will generate a flux curve given the following inputs (insert value in the appropriate cell between thick lines -- mind your units):

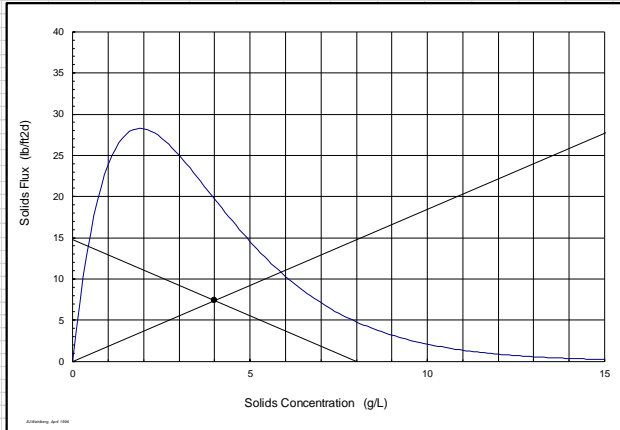
SVISN 160 mL/g
 No. of clarifiers 4
 Area of each 11304 ft²
 MLSS 4 g/L
 Inf. flow 10 mgd
 RAS flow 10 mgd
 Alternate inf. flow mgd
 Alternate RAS flow mgd

Choose desired flux units by placing a "1" in place of the "0" next to desired units:

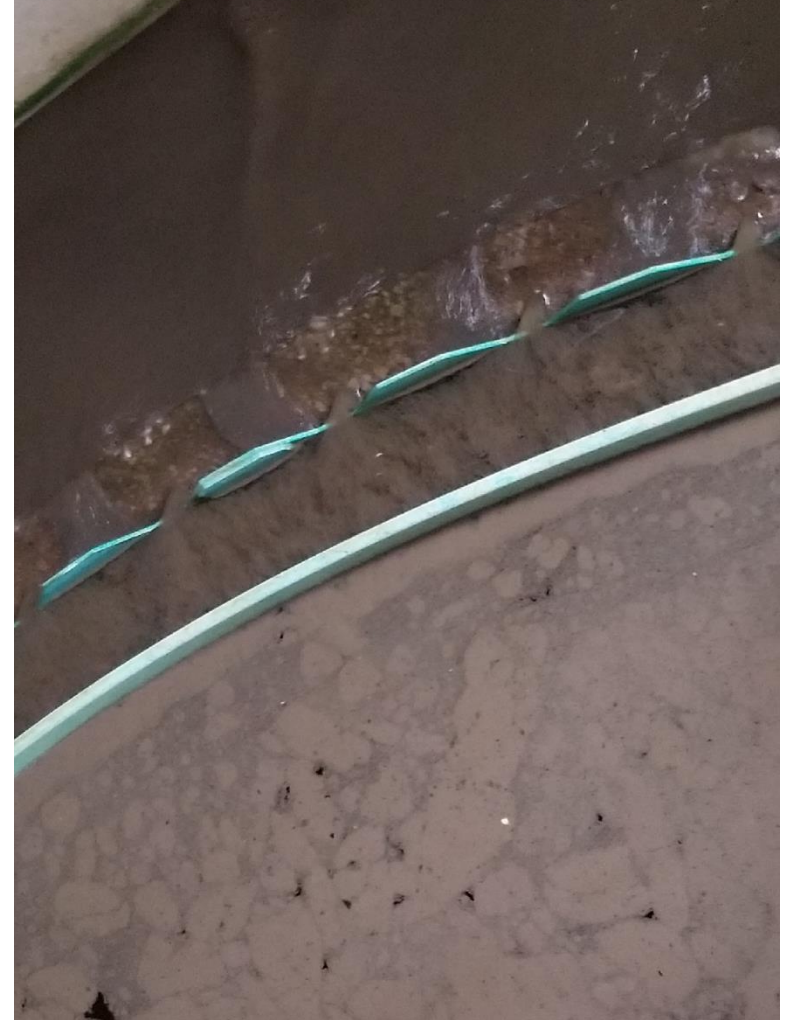
kg/m²h 0
 kg/m²d 0
 lb/ft²d 1

X G
 Solids Cor Solids Flux (lb/ft²d)

0 0
 0.1 3.840602
 0.2 7.287178
 0.3 10.37005
 0.4 13.11745
 0.5 15.5557
 0.6 17.70928
 0.7 19.60097
 0.8 21.25199
 0.9 22.68205
 1 23.90946
 1.1 24.95126
 1.2 25.82326
 1.3 26.54014
 1.4 27.11553
 1.5 27.56204
 1.6 27.89138
 1.7 28.11442
 1.8 28.24117
 1.9 28.28094
 2 28.24232
 2.1 28.13323
 2.2 27.96102
 2.3 27.73245
 2.4 27.45375
 2.5 27.13067
 2.6 26.76985
 2.7 26.37208
 2.8 25.94599
 2.9 25.49405
 3 25.02028
 3.1 24.52802
 3.2 24.02044
 3.3 23.50038
 3.4 22.97047
 3.5 22.43309
 3.6 21.8904
 3.7 21.34435
 3.8 20.79672
 3.9 20.24911
 4 19.70295
 4.1 19.15955
 4.2 18.62005
 4.3 18.08548
 4.4 17.55675
 4.5 17.03469
 4.6 16.51998
 4.7 16.01325



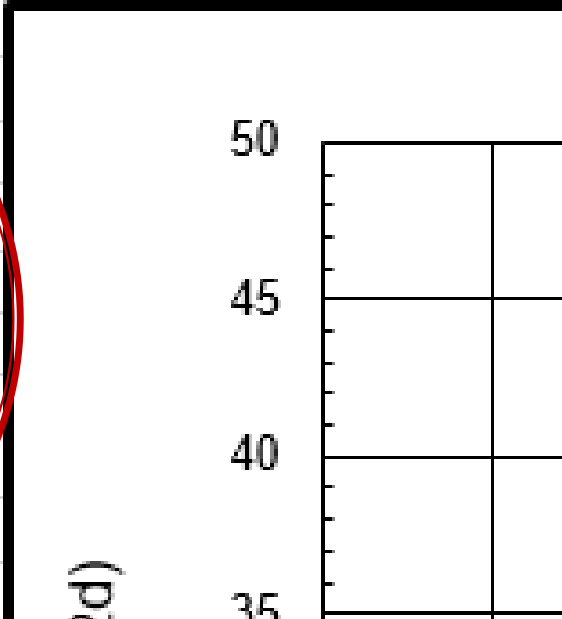
Summary information	
SVISN	160 mL/g
Total Clarifier Surface Area	45216 ft ²
MLSS Concentration	4000 mg/L
Influent Flow	10 mgd
Surface Overflow Rate	221 gal/ft ² d
RAS Flow	10 mgd
Applied Solids Loading*	14.75 lb/ft ² d
RAS SS Concentration*	8000 mg/L
Alternate Influent Flow	0 mgd
Alt. Surface Overflow Rate	0 gal/ft ² d
Alt. Applied Solids Loading*	0.00 lb/ft ² d
Alt. RAS SS Concentration*	0 mg/L
Alternate RAS Flow	0 mgd
Alt. Applied Solids Loading*	0.00 lb/ft ² d
Alt. RAS SS Concentration*	0 mg/L
BROWN AND CALDWELL	
*Assumes underloaded conditions, check flux curve	



What's needed

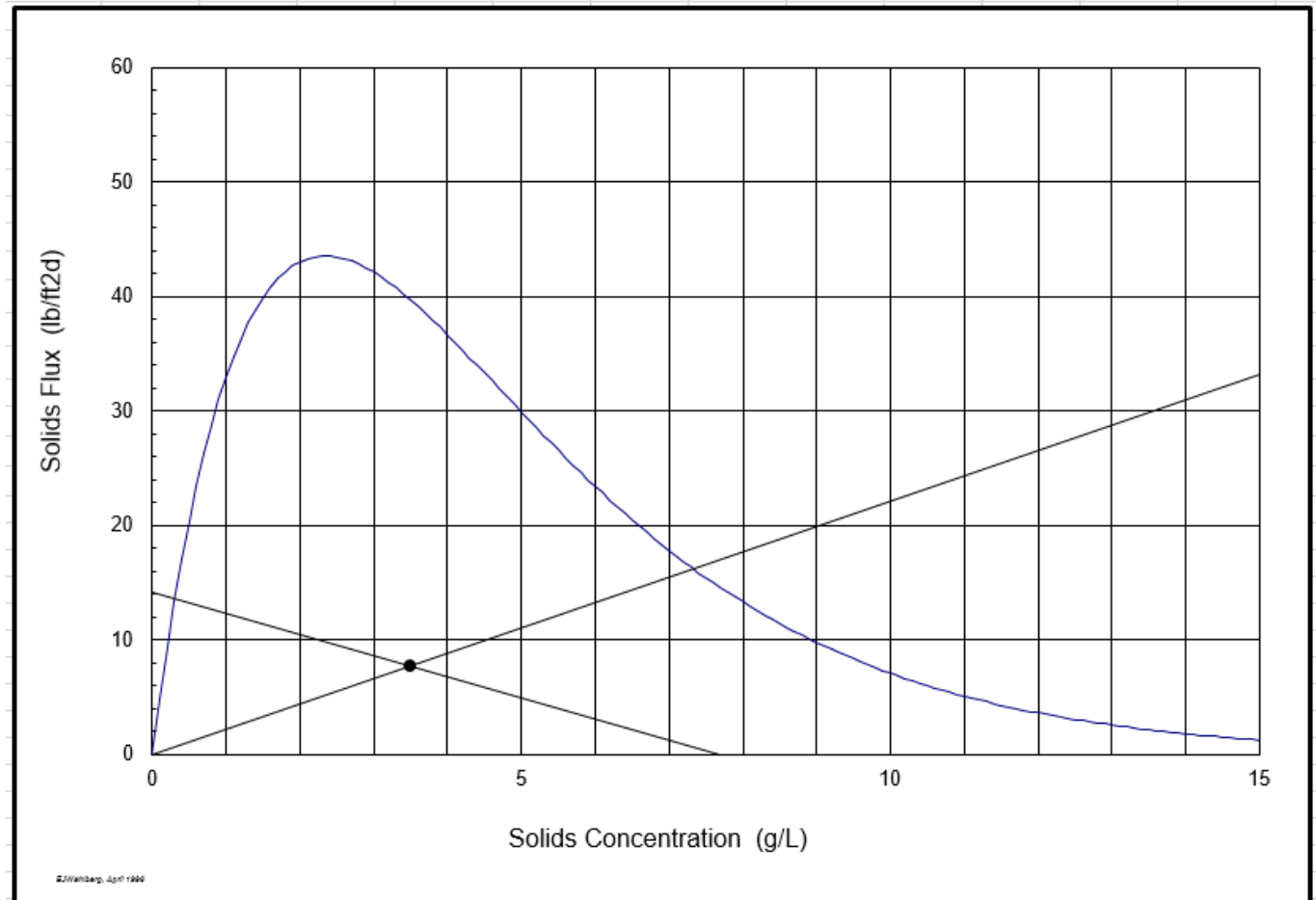
This spreadsheet will generate a flux curve given the following inputs (insert value in the appropriate cell between thick lines -- mind your units):

SVISN	120 mL/g
No. of clarifiers	4
Area of each	11304 ft ²
MLSS	3.5 g/L
Inf. flow	12 mgd
RAS flow	10 mgd
Alternate inf. flow	mgd
Alternate RAS flow	mgd



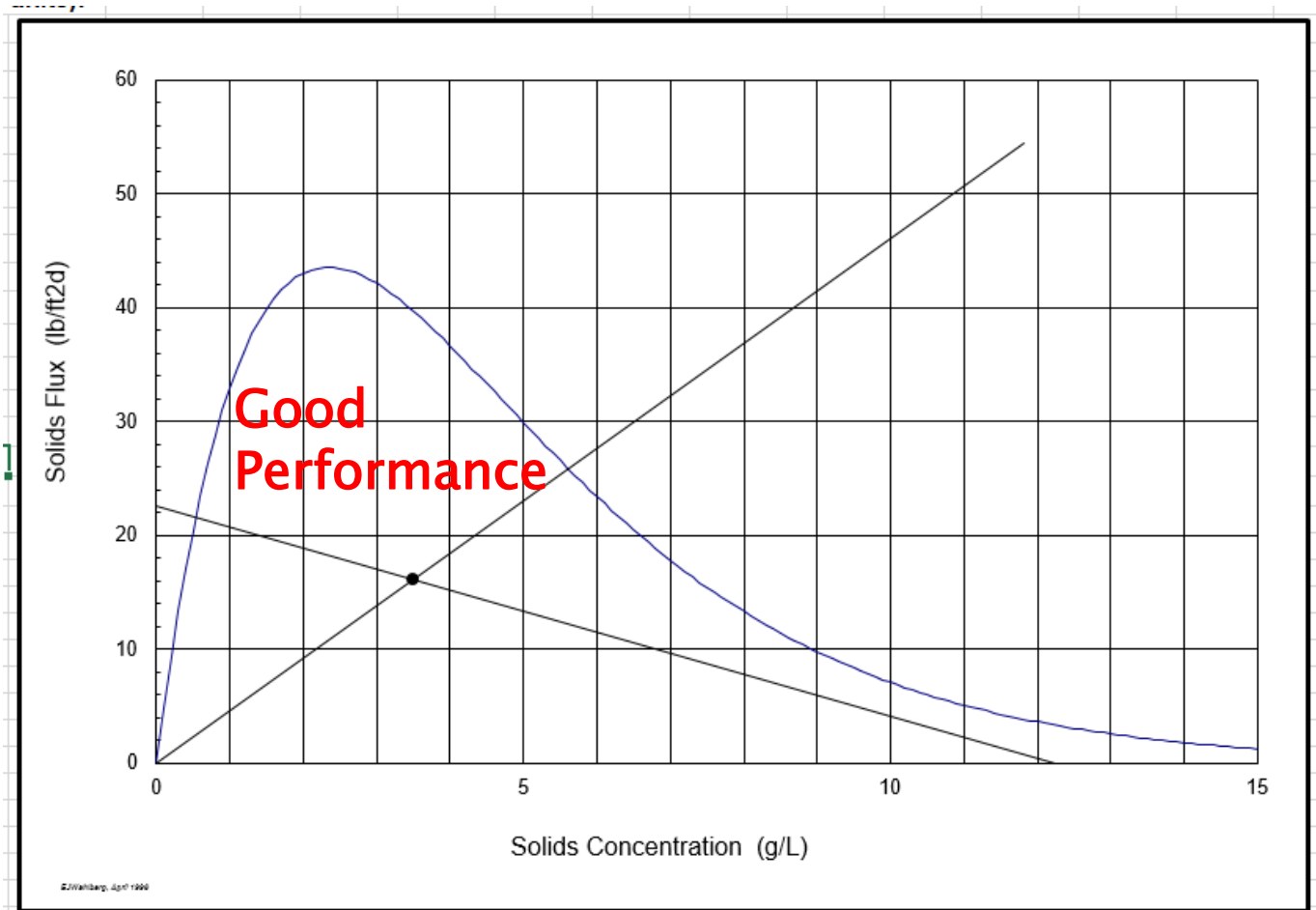
NMSC normal conditions

RAS	10 MGD
SVI	100
MLSS	3500 mg/L
Flow	12 MGD



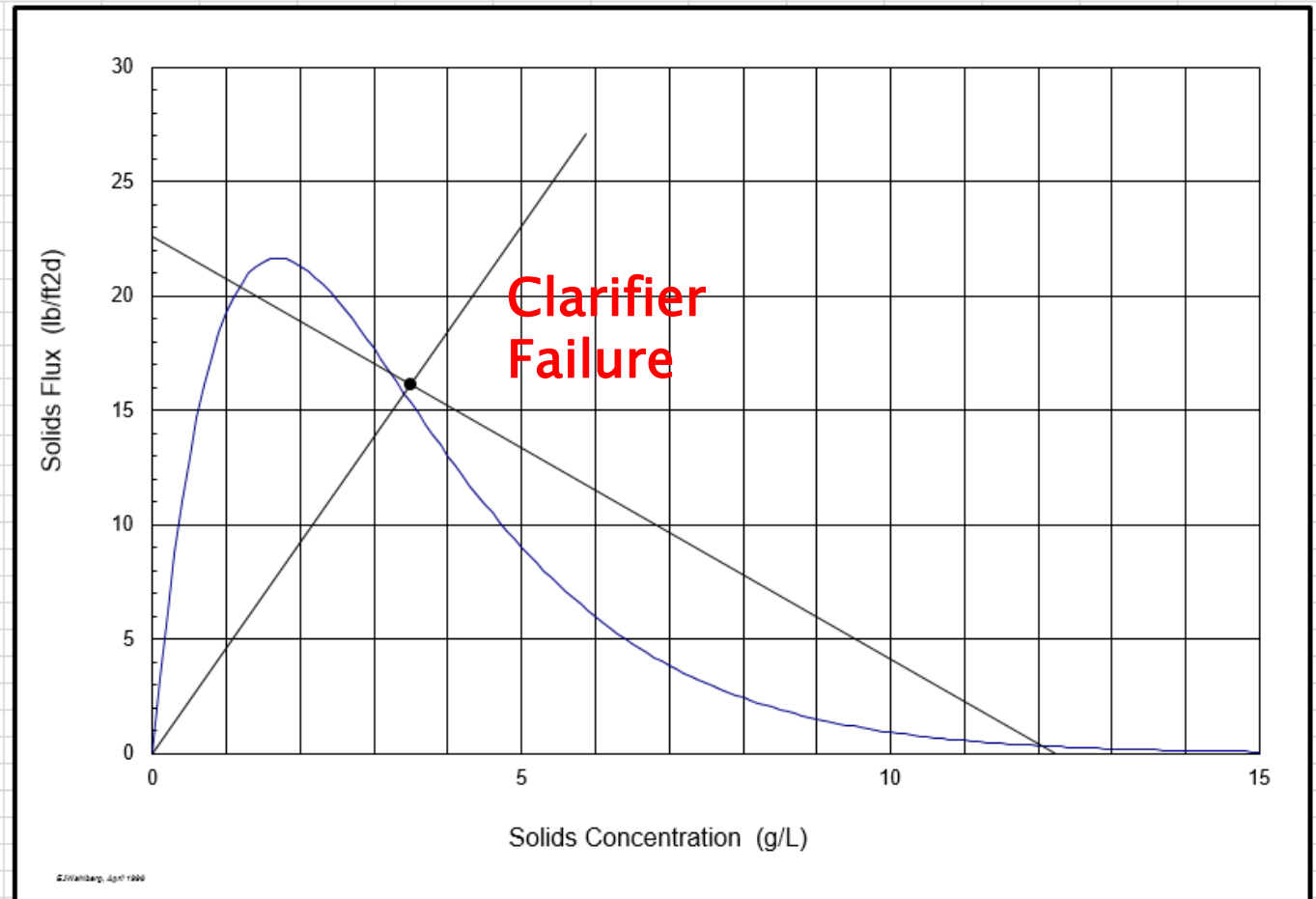
Normal Rain Event

RAS	10 MGD
SVI	100
MLSS	3500 mg/L
Flow	25 MGD



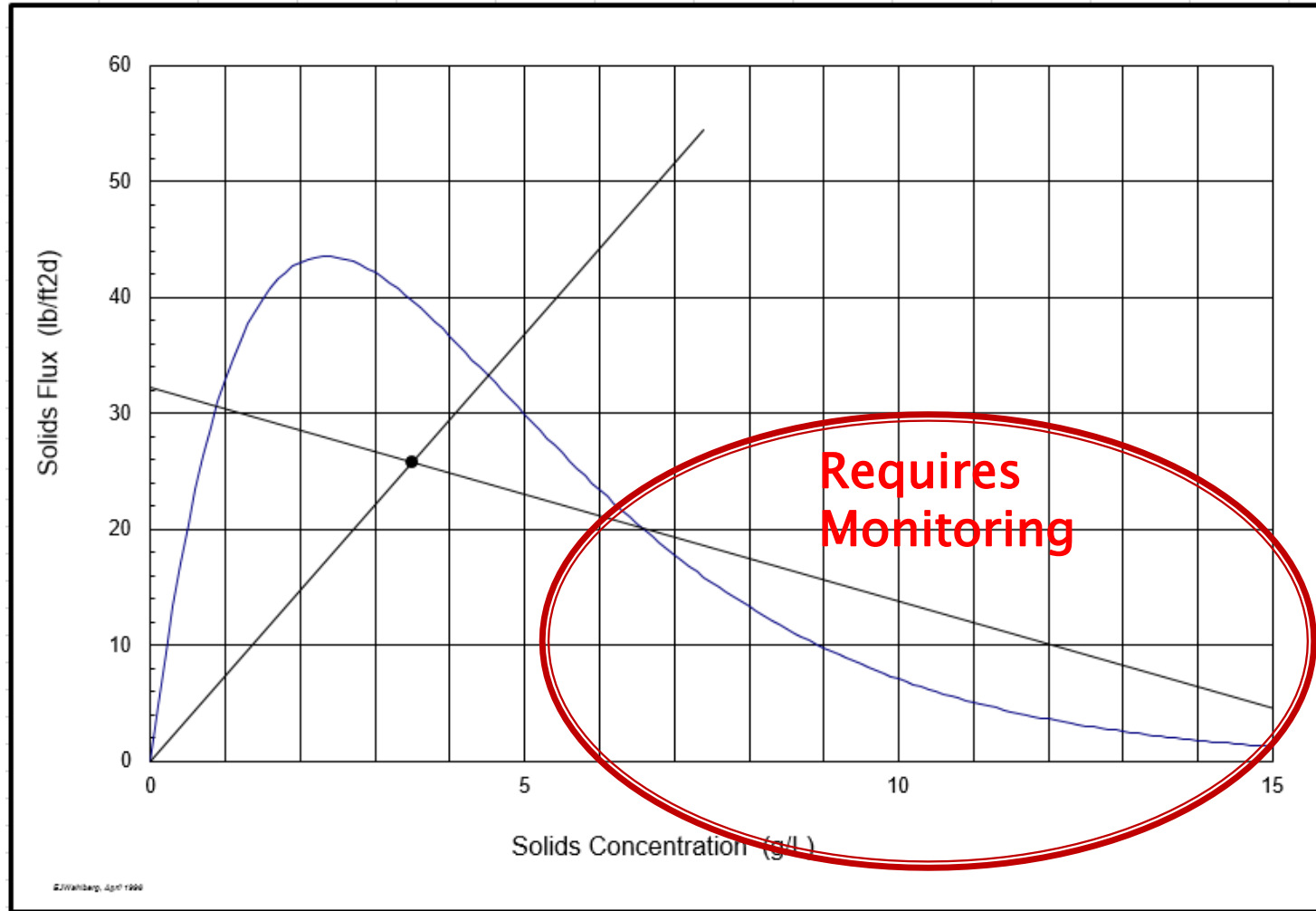
Normal Rain Event/ High SVI

RAS	10 MGD
SVI	200
MLSS	3500 mg/L
Flow	25 MGD



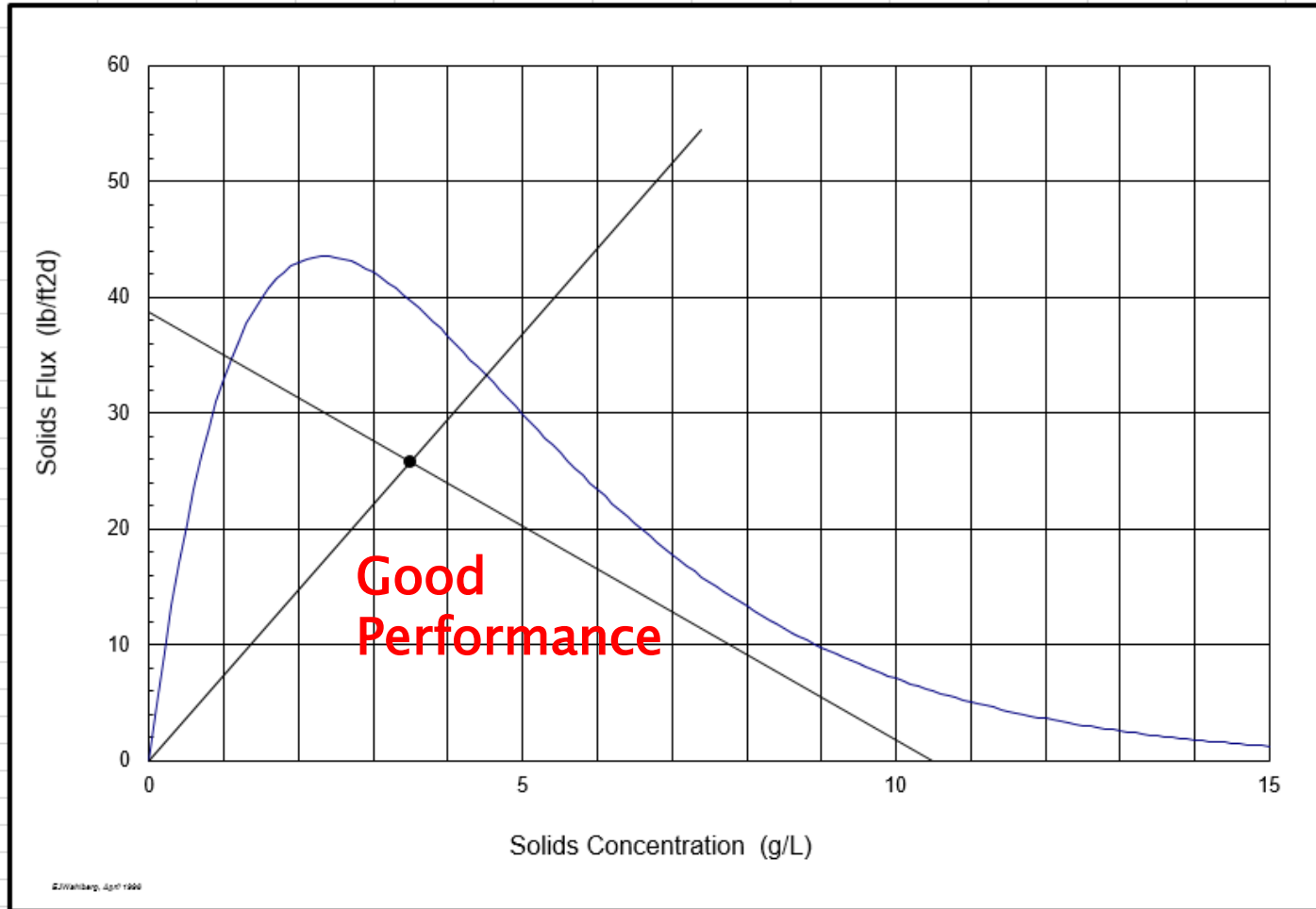
Major Storm/ I & I

RAS	10 MGD
SVI	100
MLSS	3500 mg/L
Flow	40 MGD

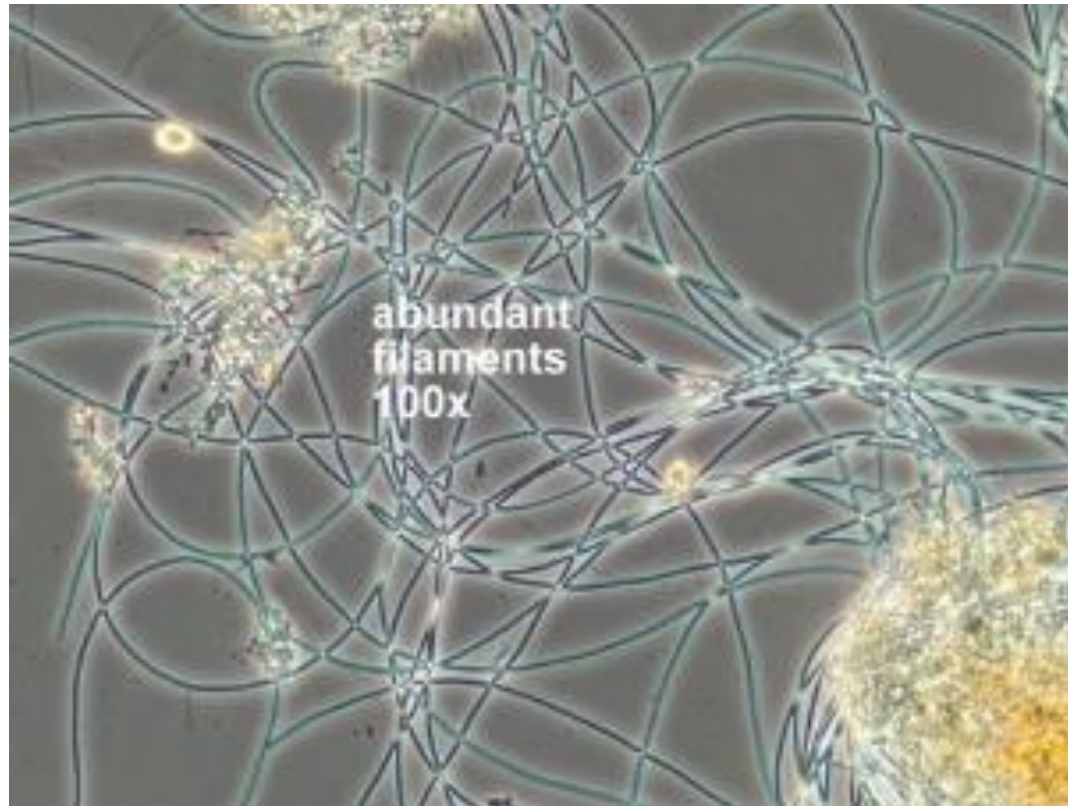


RAS adjusted to 20 MGD

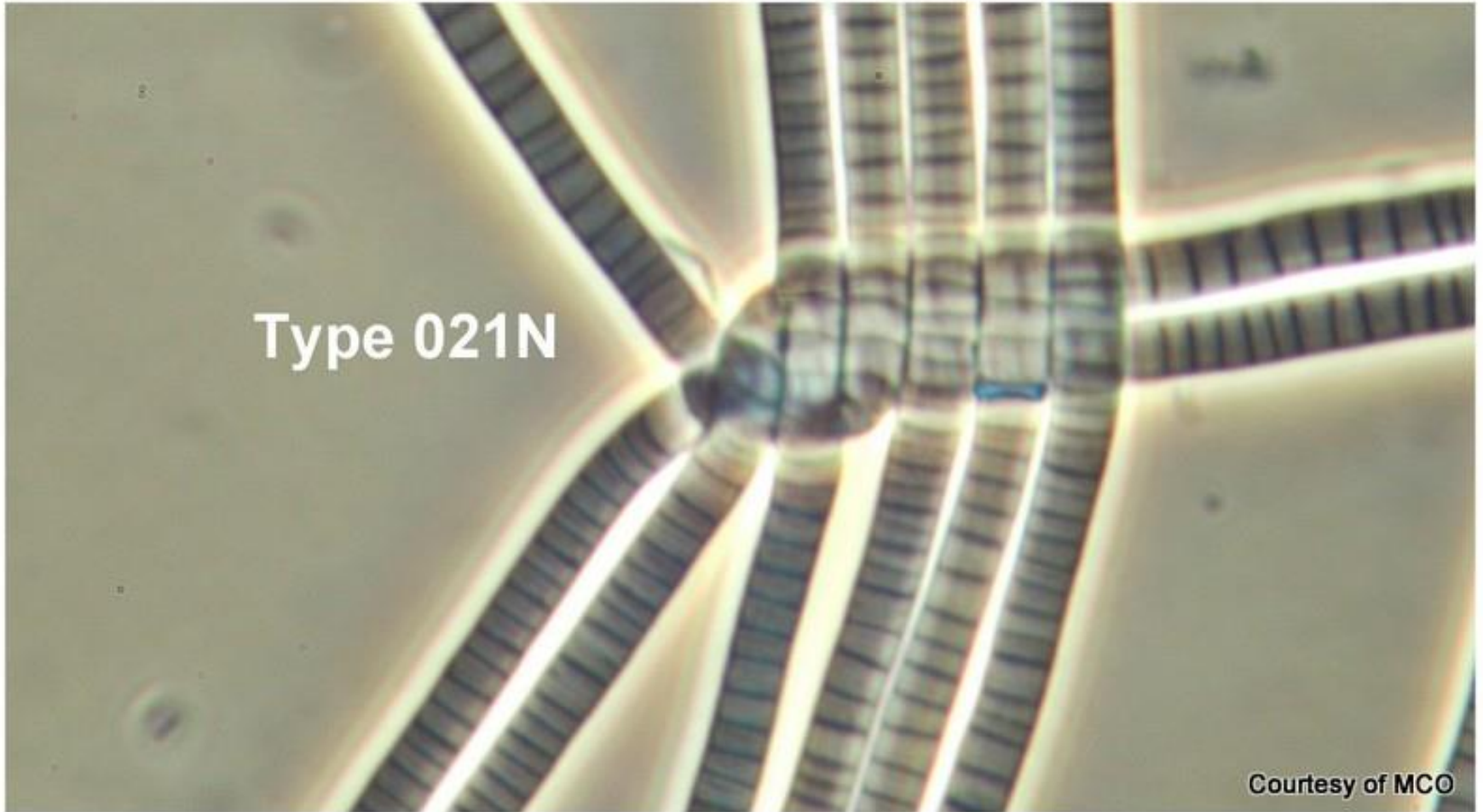
in units.



Example 1: Abundant Filaments in plant



The Culprit



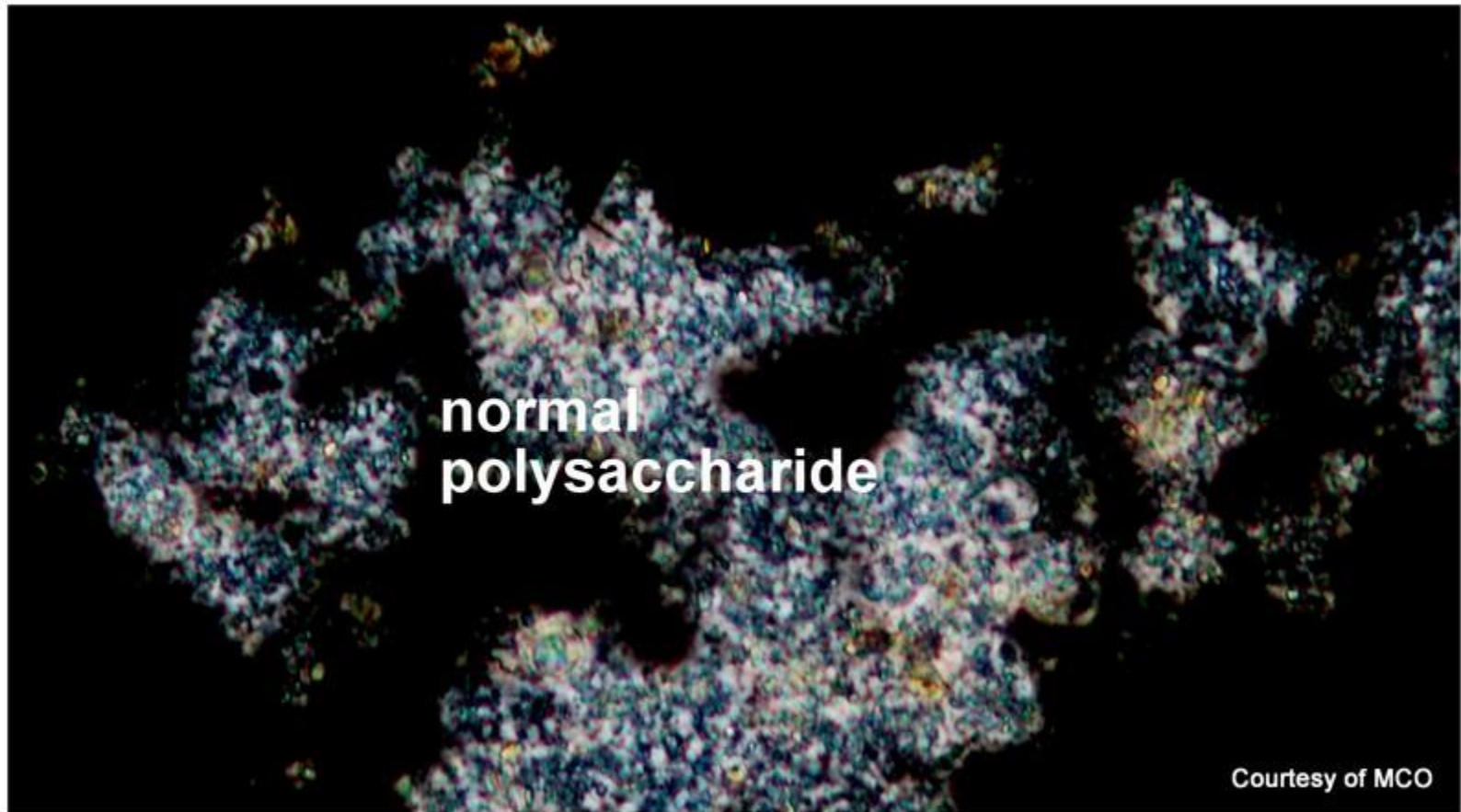
Determine if a problem

- ▶ Use State Point Analysis
 - ▶ Factor of cost/ urgency etc.
-
- In this case yes– clarifier failure risk deemed high

Causes of type 021N

Septicity	Type 021N <i>Thiothrix</i> I and II <i>Nostocoida limicola</i> I, II, III Type 0411 Type 0961 Type 0581 Type 0092
Nutrient Deficiency	Nitrogen: <i>Thiothrix</i> I, II, type 021N Phosphorus: <i>N limicola</i> III, <i>H. hydrossis</i> , <i>S. natans</i>

Not nutrient deficiency related



Options

- ▶ Problem is intermittent
- ▶ Find/eliminate root cause of septicity
 - Sometimes easier said than done
 - Hach TNT872 volatile acids profile
- ▶ Cost analysis
 - RAS Chlorination chosen
 - 4 lbs. chlorine/1000 lbs. MLVSS chosen as starting point



- SVI reduced over 2–3 days at this rate

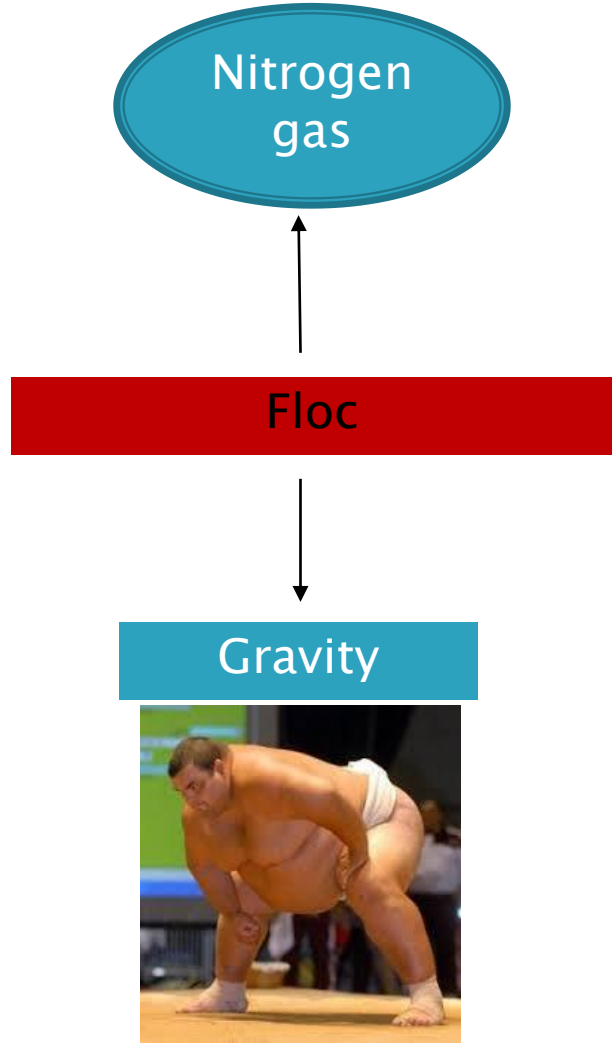
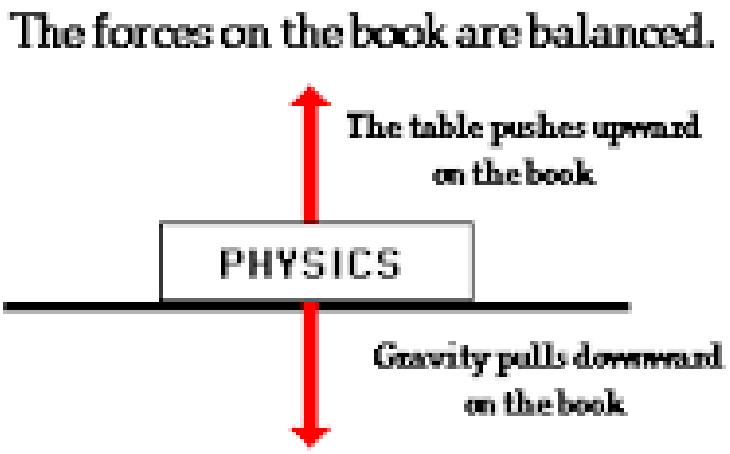
#2 Strong flocs but a settling issue



1 000x magnification in floc



Elevated SVI Can Be Denitrification Related



Paddle Test

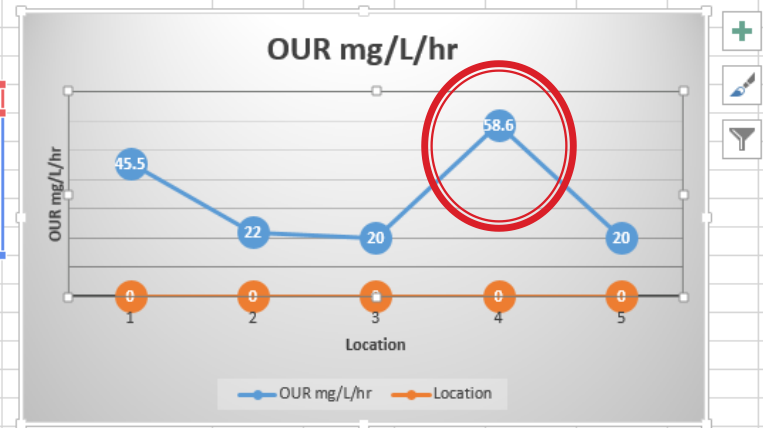


Conclusion

- ▶ SVI and 30 minute settling decreased at higher MLSS at this reduced gas entrapment
 - Yes– denitrification can occur within the aeration basin and this is much more common than realized



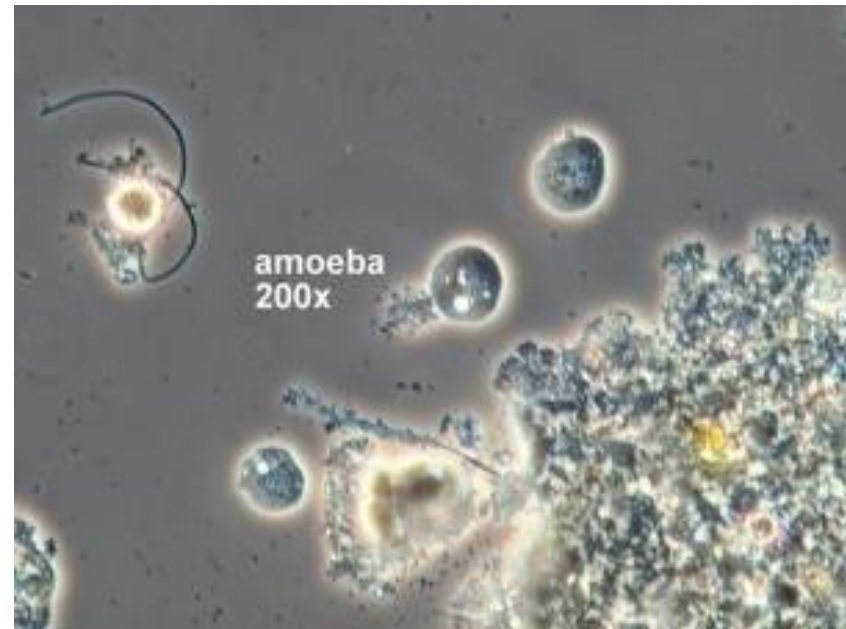
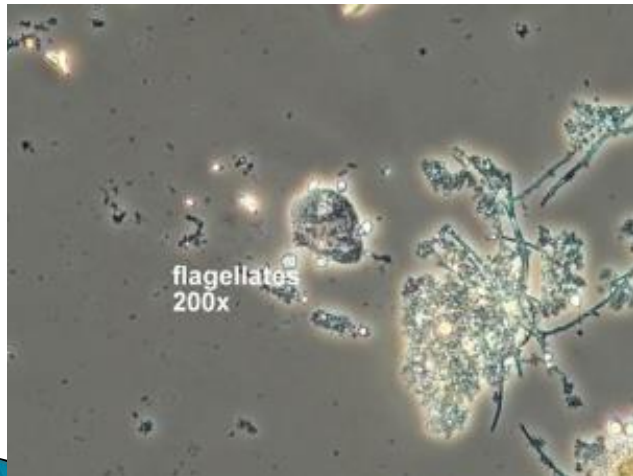
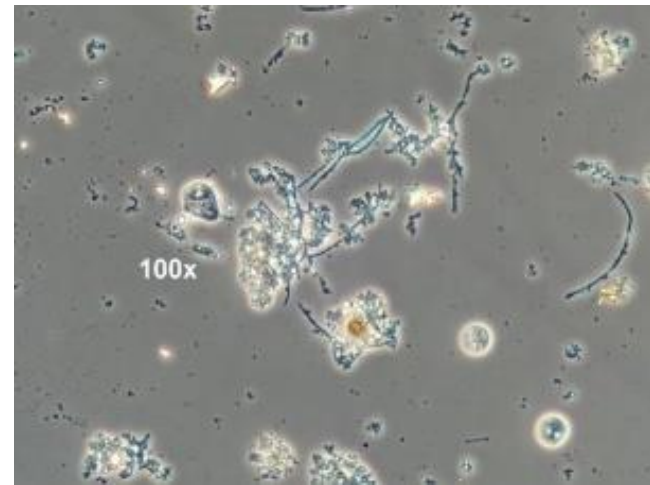
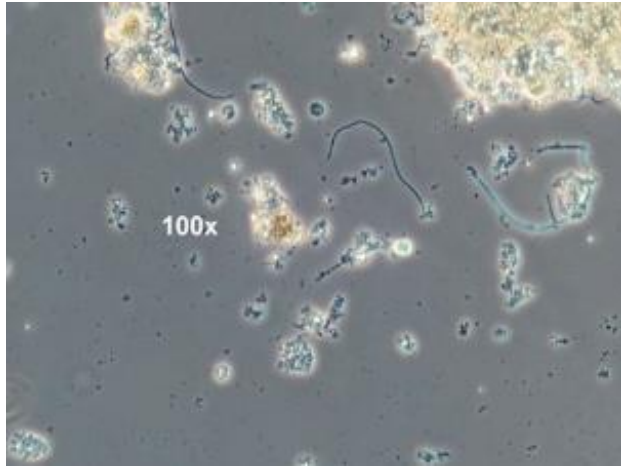
OUR mg/L/hr	Location
45.5	Head of basin
22	1/4 down basin
20	1/2 basin
58.6	3/4 basin
20	end of basin




#3 Municipal plant in Indiana



MLSS

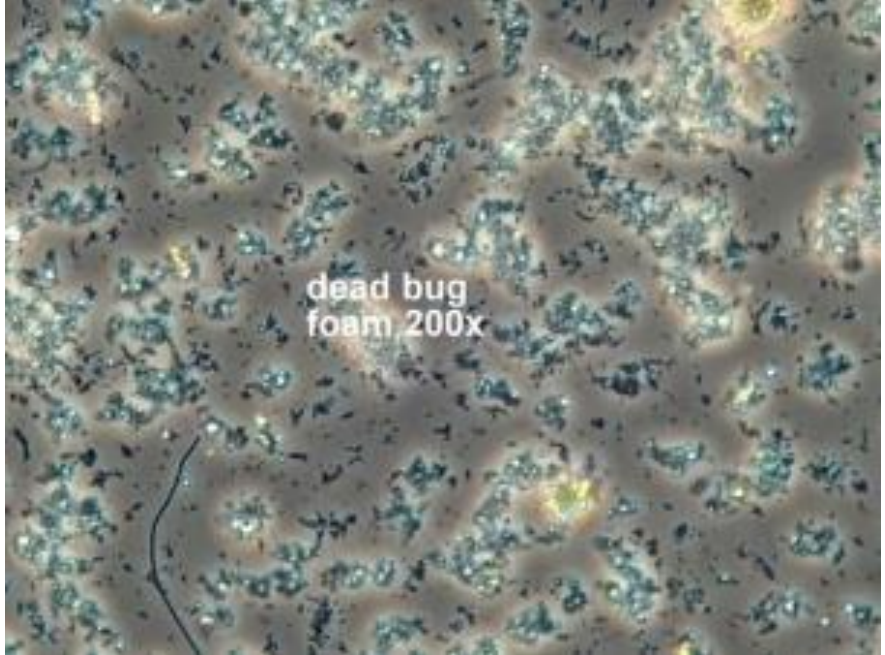


Foam



empty sheath 1000x

This micrograph shows a long, thin, curved structure, likely a sheath, containing a dense cluster of small, dark, granular particles. The background is a light, uniform color. A single, larger, circular structure is visible to the right of the main cluster.

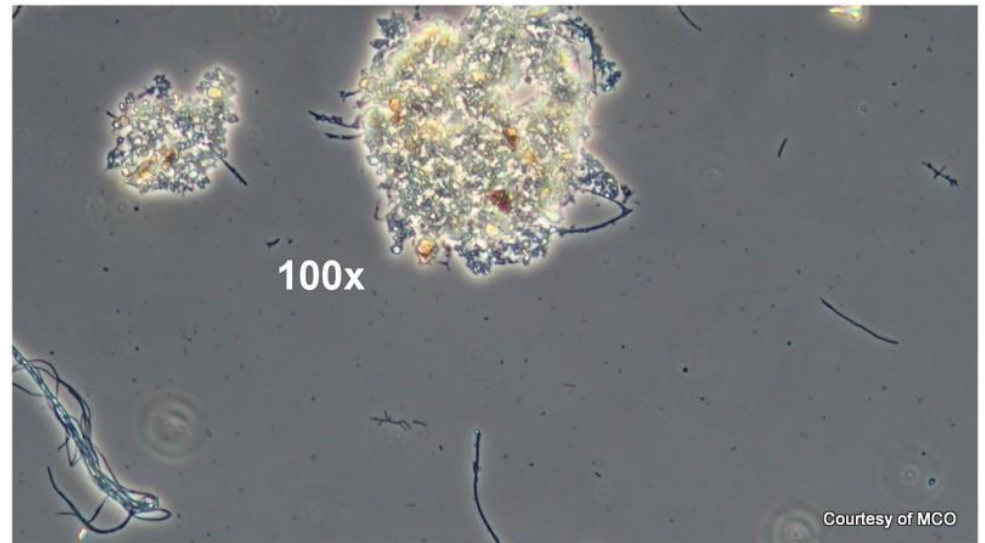


dead bug foam 200x

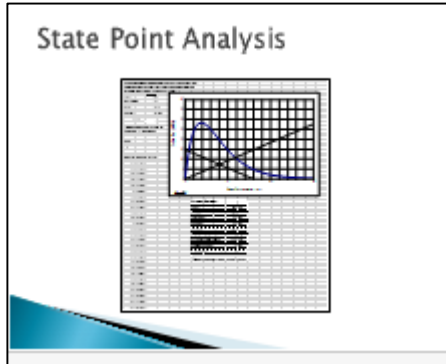
This micrograph shows a dense, textured surface with a mottled appearance. The color is a mix of light brown, tan, and yellowish-green. The texture is irregular and porous, characteristic of foam. There are some darker, more granular areas interspersed throughout the lighter matrix.

Corrective Actions

- ▶ Stopped wasting
- ▶ Seed sludge hauled from nearby plant
- ▶ Within a few days back in compliance
- ▶ Resumed normal operations



Take Home Points/ Review



Cause	Filaments
Low DO	<i>Sphaerotilus natans</i> Type 1701 <i>Haliscamenobacter hydroxys</i>
Low F/M ratio	Type 0041 Type 0675 Type 1851
Septicity	Type 021N <i>Thiothrix</i> I and II <i>Nostocoida limicola</i> I, II, III Type 0411 Type 0961 Type 0581 Type 0092
Oil and Grease	<i>Nocardia</i> spp. <i>Microthrix parvicella</i> Type 1863
Nutrient Deficiency	Nitrogen: <i>Thiothrix</i> I, II, type 021N Phosphorus: <i>N limicola</i> III, <i>H. hydroxys</i> , <i>S. natans</i>
Low pH	Fungi

Source: Dr. Michael G Richard; used with his authorization.



Proper Environment For Bugs

- ▶ 1) pH (7-9)
- ▶ 2) Alkalinity (> 50 mg/L)
- ▶ 3) Time (HRT and SRT)
- ▶ 4) Temperature
- ▶ 5) Dissolved Oxygen
- ▶ 6) Nutrients
- ▶ 7) FOGs (limited)
- ▶ 8) Septicity (limited)



Questions?

