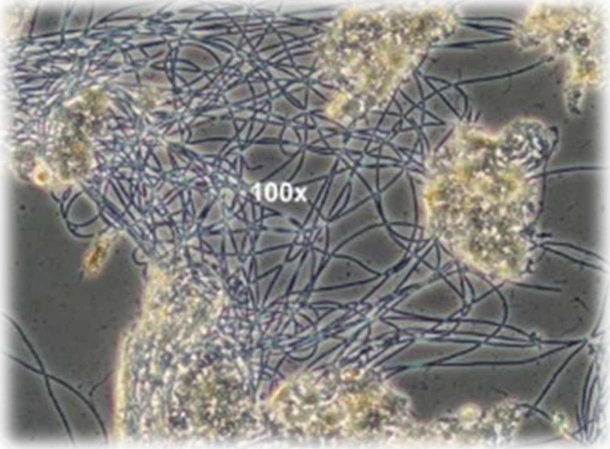
Wisconsin Wastewater Operators' Association

Case Studies

Common Issues In Municipal WWTPs

WWOA Annual Conference
Grand Geneva, WI



Presented by: Ryan Hennessy
Midwest Contract Operations

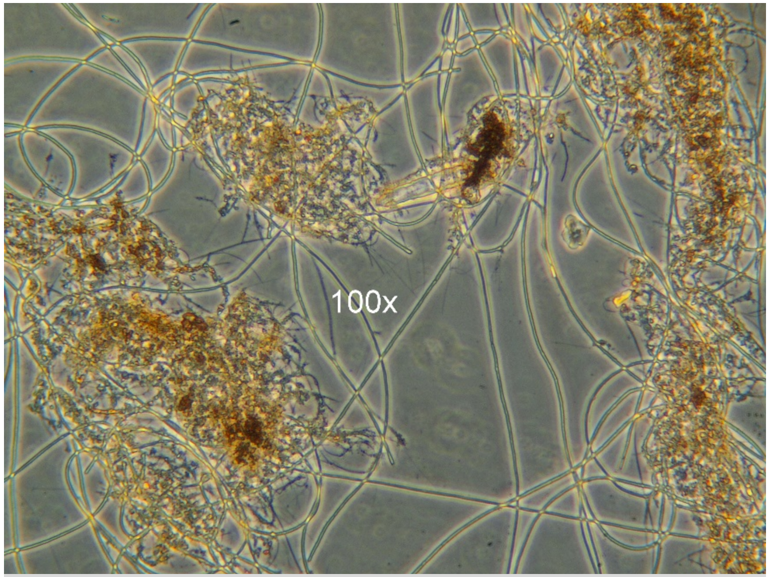
Proper Environment For Bugs

- 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)

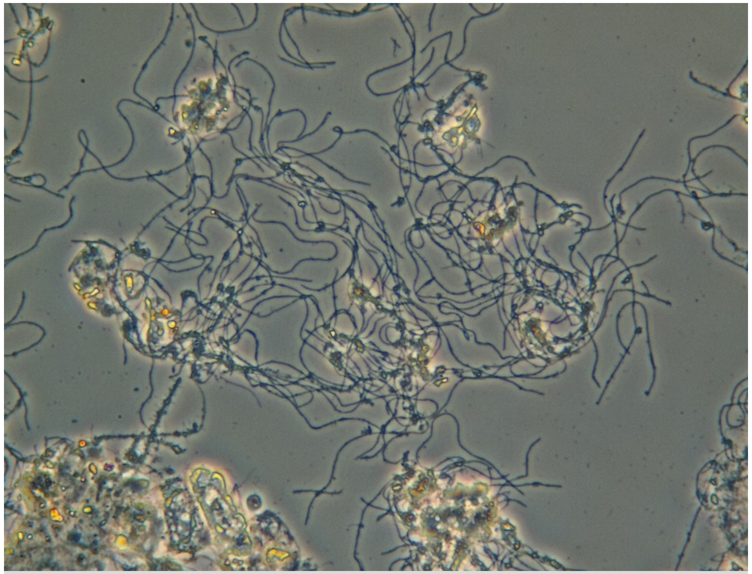
Presentation Outline

- 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



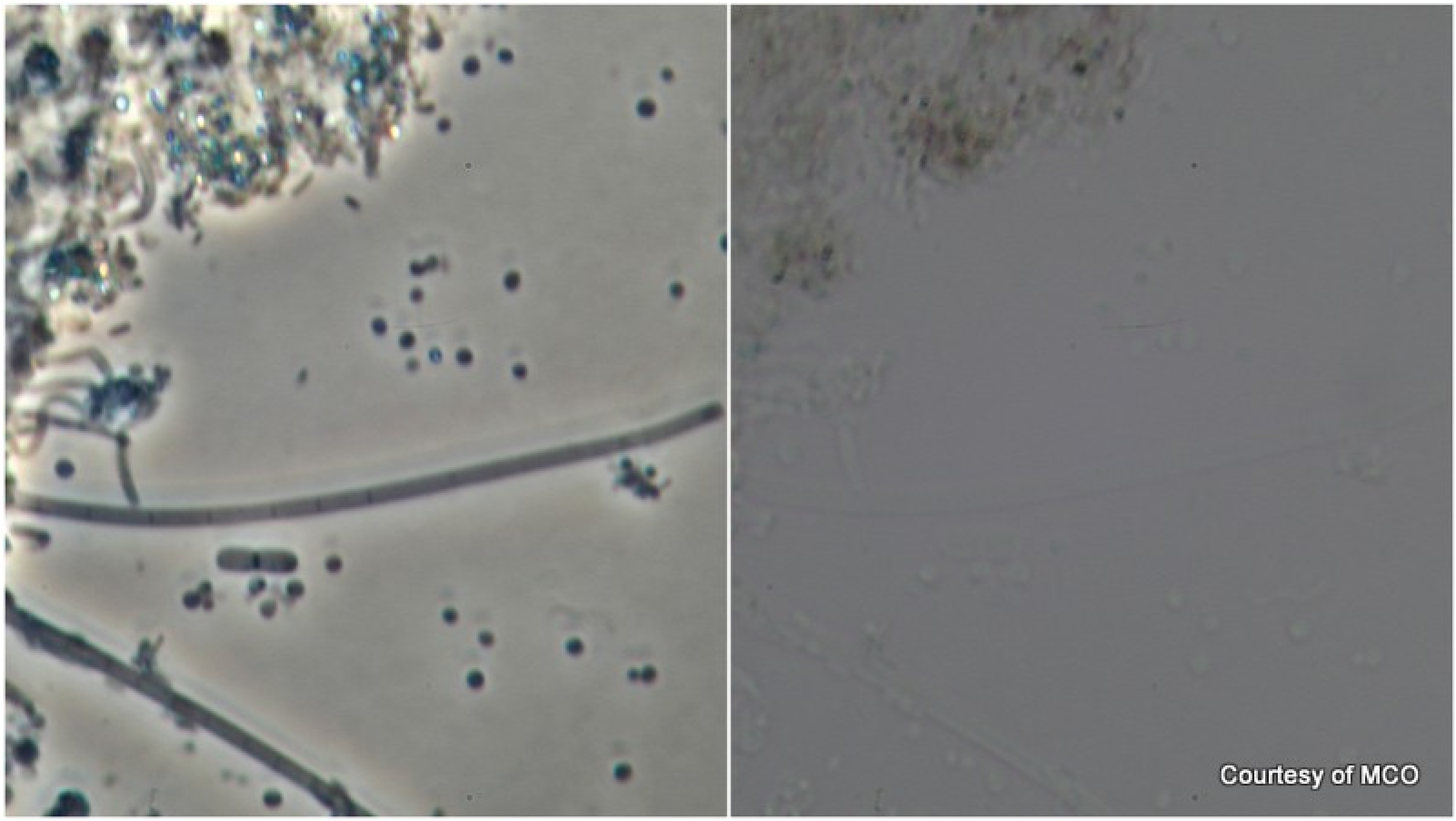
Bridging

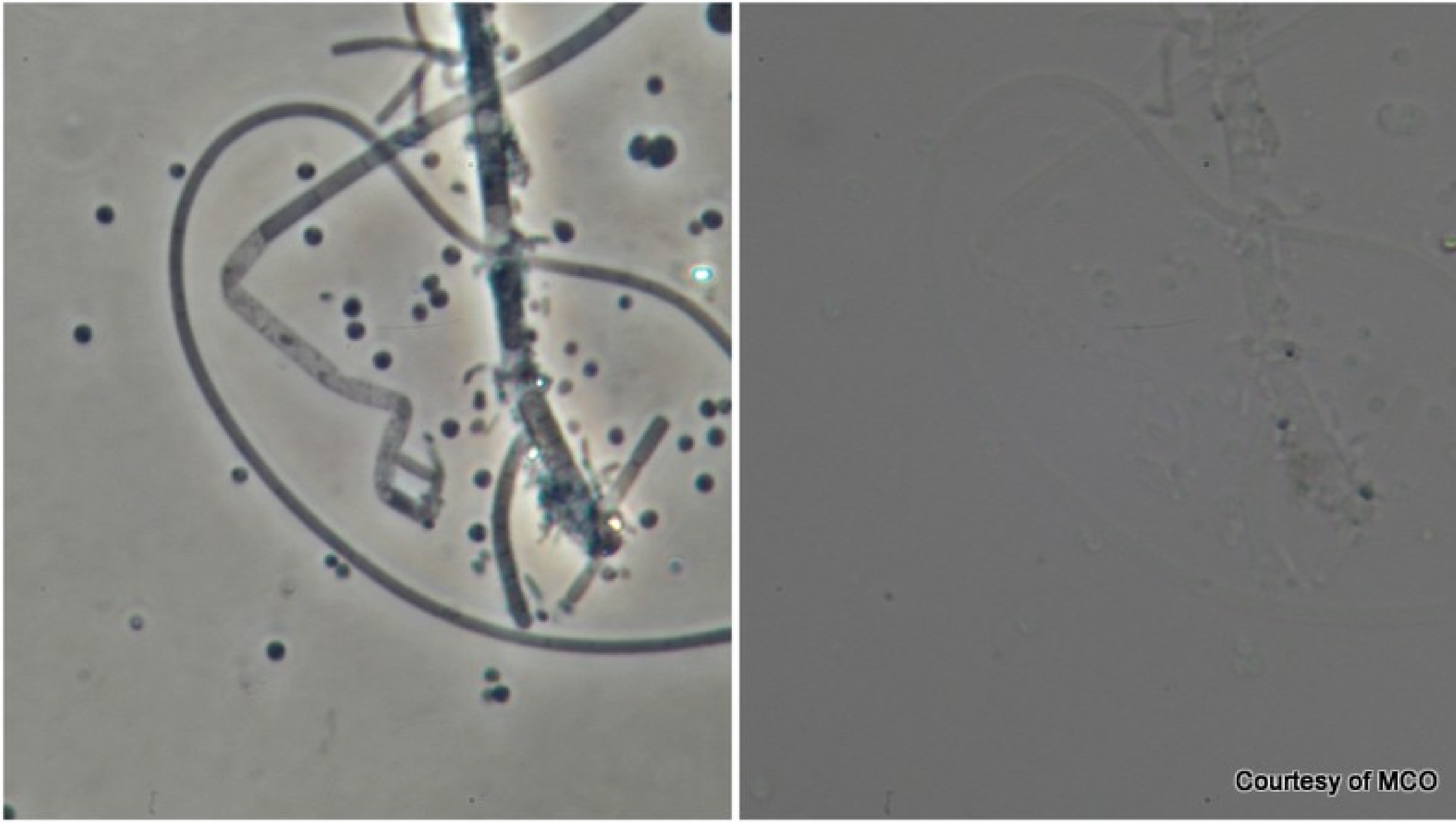


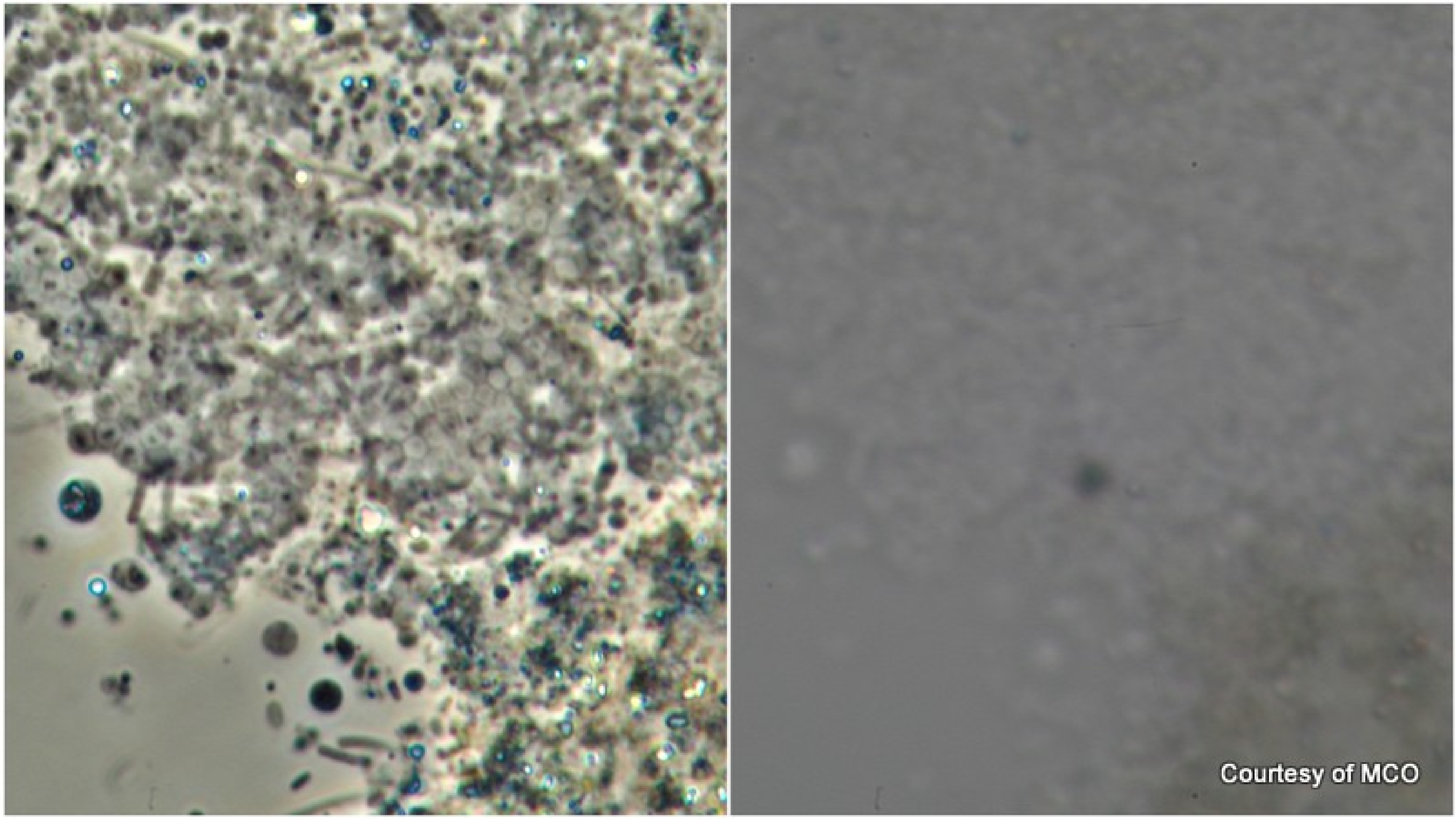
Open- Diffuse flocs

Filament Identification

Why Phase Contrast?



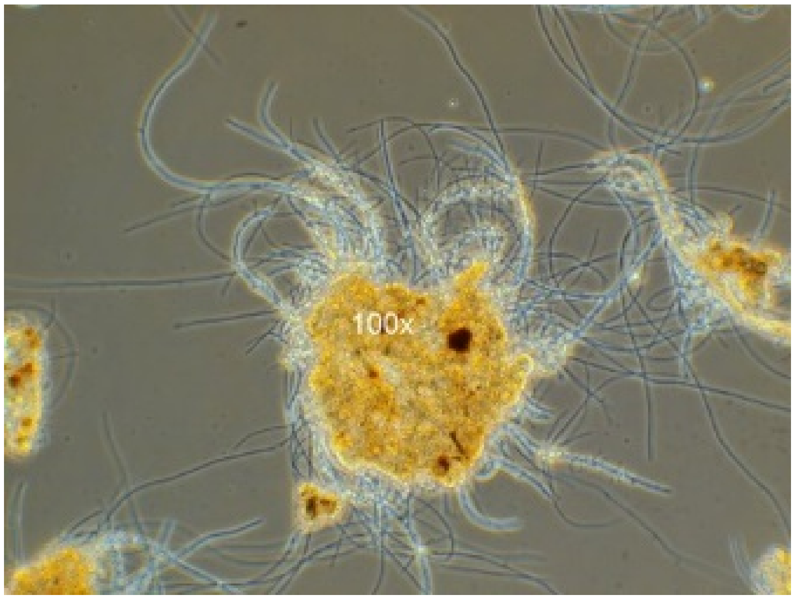

Courtesy of MCO

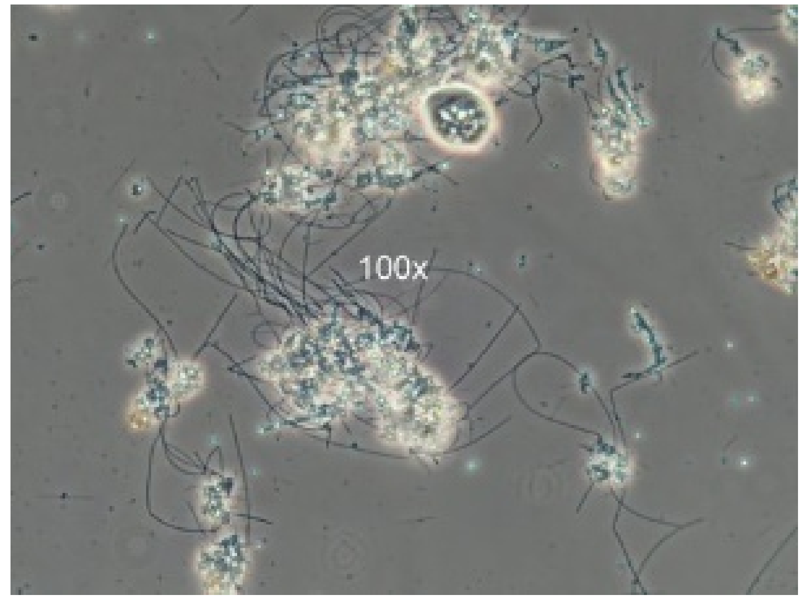

Courtesy of MCO

Filament Causes

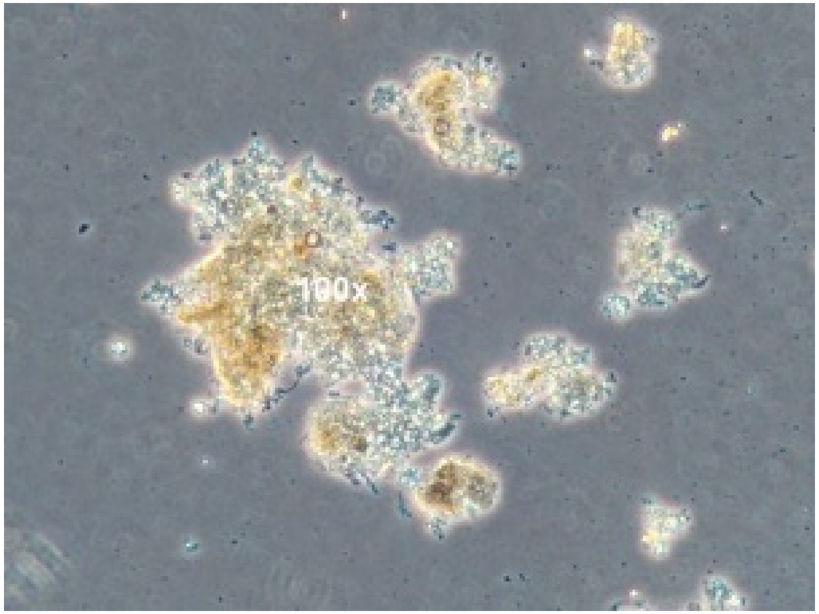
Cause	Filaments
Low DO	*Spaeroltius natans* Type 1701 *Haliscomenobacter hydrossis*
Low F/M ratio	Type 0041 Type 0675 Type 1851
Septicity	Type 021N *Thiothrix* I and II *Nostocoida limicola* I, II, III Type 0411 Type 0961 Type 0581 Type 0092
Oil and Grease	Nocardia spp. *Microthrix parvicella* Type 1863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

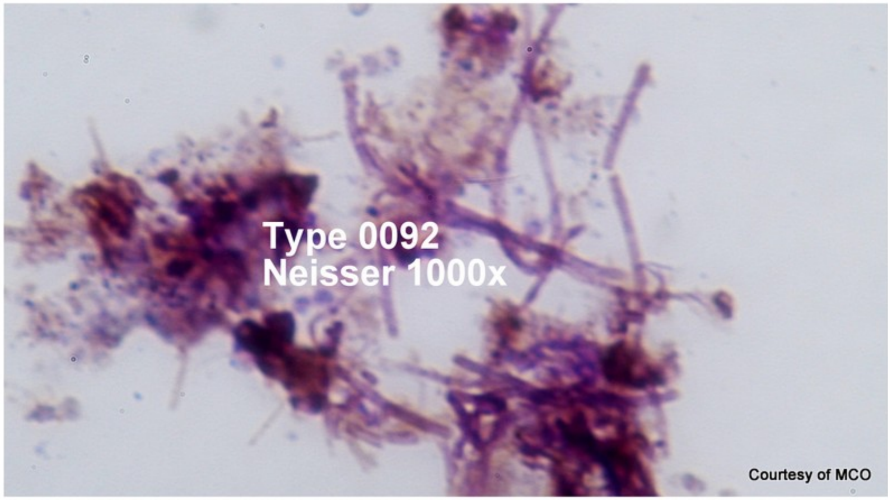
Factor of Floc Strength





Actually has very common filaments





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

State Point Analysis

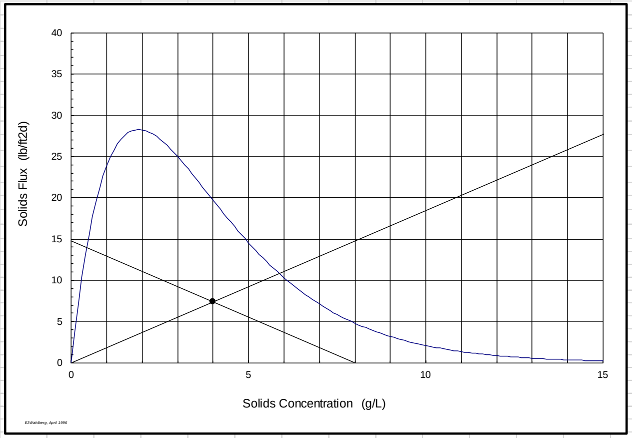
This spreadsheet will generate a flux curve given the following inputs (insert value in the appropriate cell between thick lines -- mind your units):

SVISN	160	mL/g
No. of clarifiers	4	
Area of each	11304	ft^2
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/m^2h	0
kg/m^2d	0
lb/ft^2d	1

X	G
Solids Co	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	26.7685
2.7	26.37208
2.8	25.9459
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

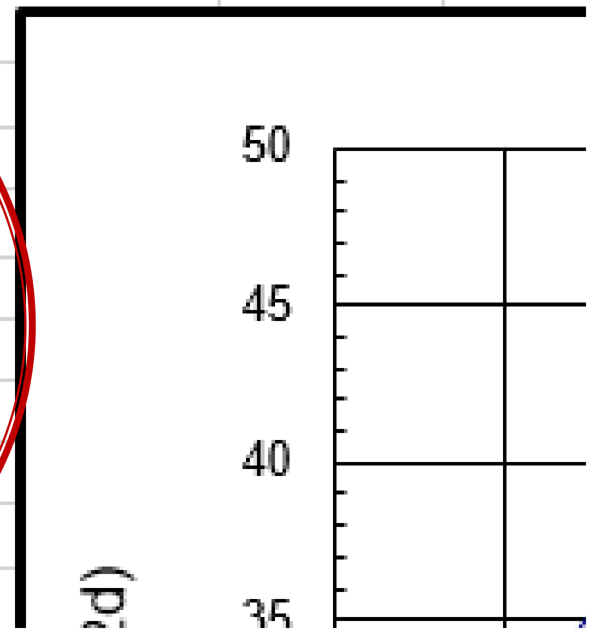


Summary Information		
SVISN	160	mL/g
Total Clarifier Surface Area	45216	ft^2
MLSS Concentration	4000	mg/L
Influent Flow	10	mgd
Surface Overflow Rate	221	gal/ft^2d
RAS Flow	10	mgd
Applied Solids Loading*	14.75	lb/ft2d
RAS SS Concentration*	8000	mg/L
Alternate Influent Flow	0	mgd
Alt. Surface Overflow Rate	0	gal/ft^2d
Alt. Applied Solids Loading*	0.00	lb/ft2d
Alt. RAS SS Concentration*	0	mg/L
Alternate RAS Flow	0	mgd
Alt. Applied Solids Loading*	0.00	lb/ft2d
Alt. RAS SS Concentration*	0	mg/L
BROWN AND CALDWELL		
**Assumes underloaded conditions;check flux curve*		

What's needed

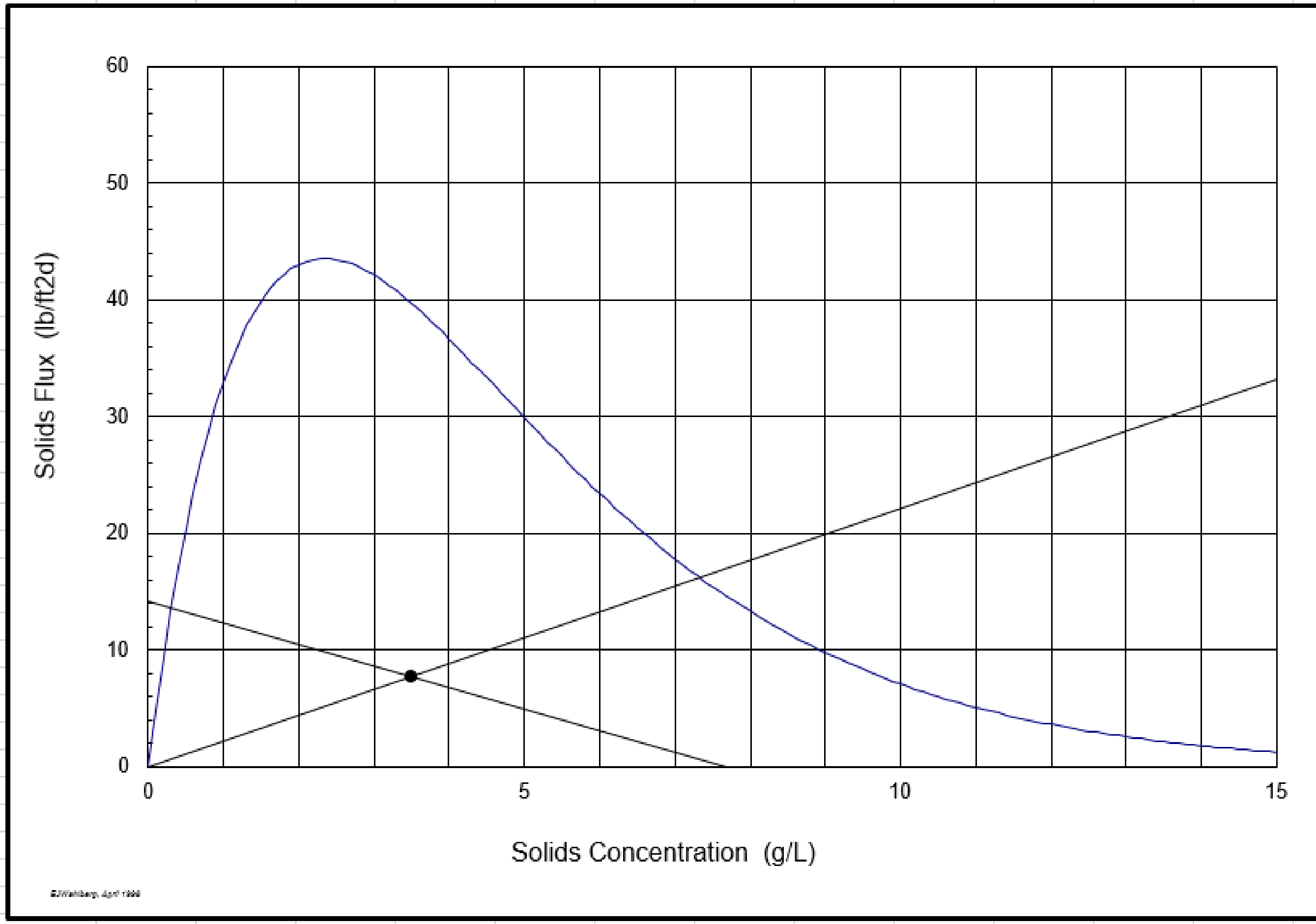
This spreadsheet will generate a flux curve given the following inputs (insert value in the appropriate cell between thick lines -- mind your units):

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



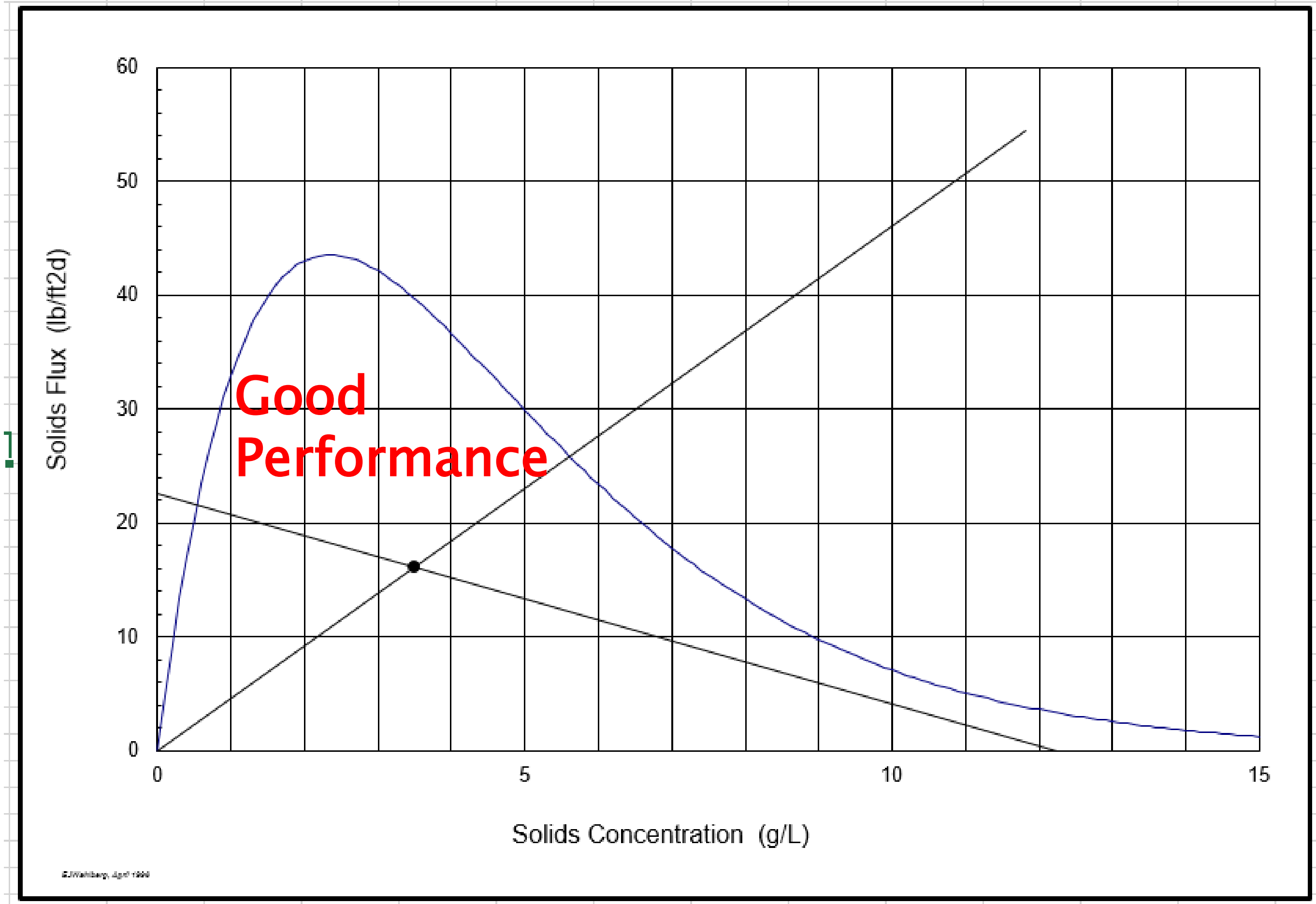
NMSC normal conditions

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



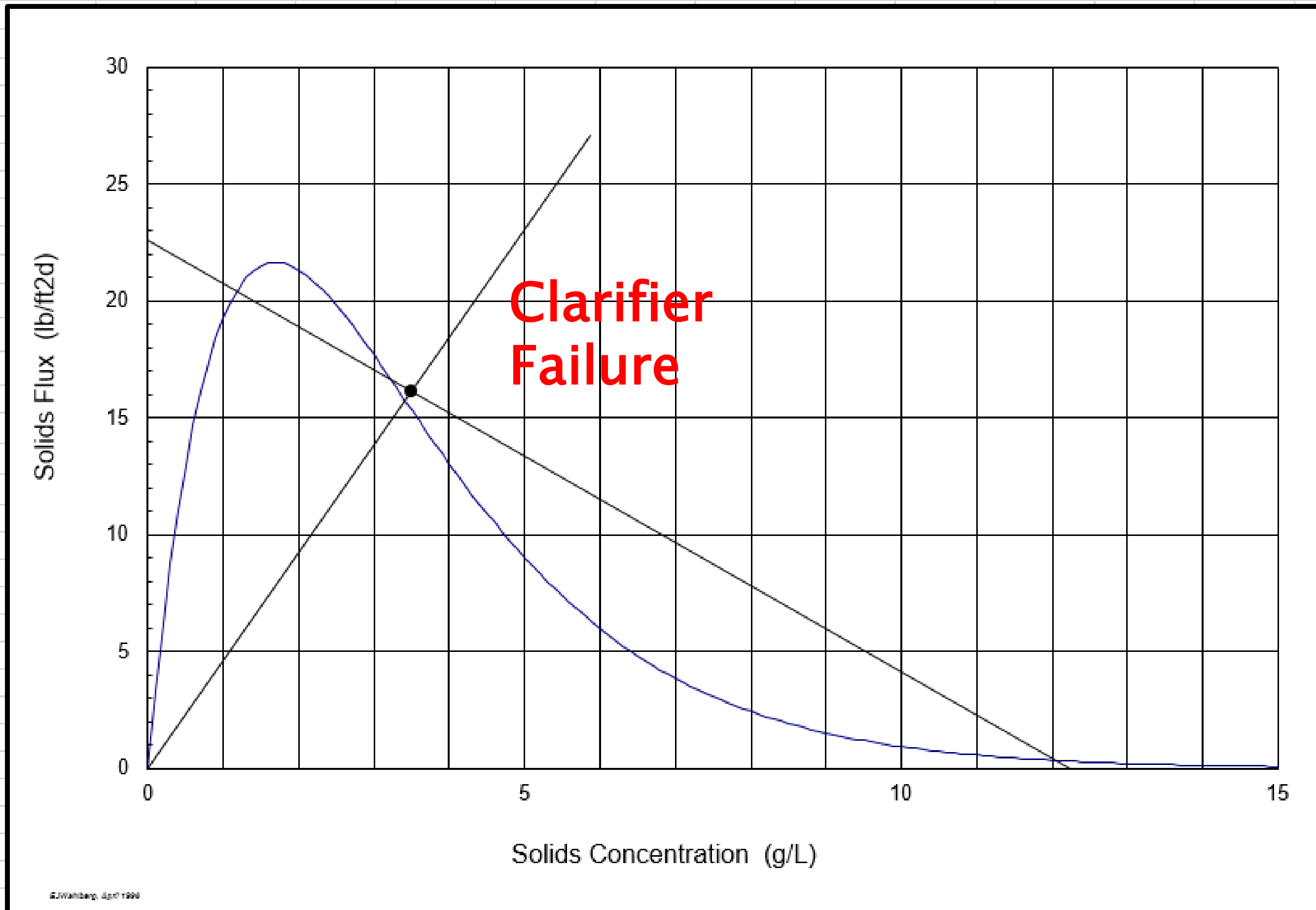
Normal Rain Event

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



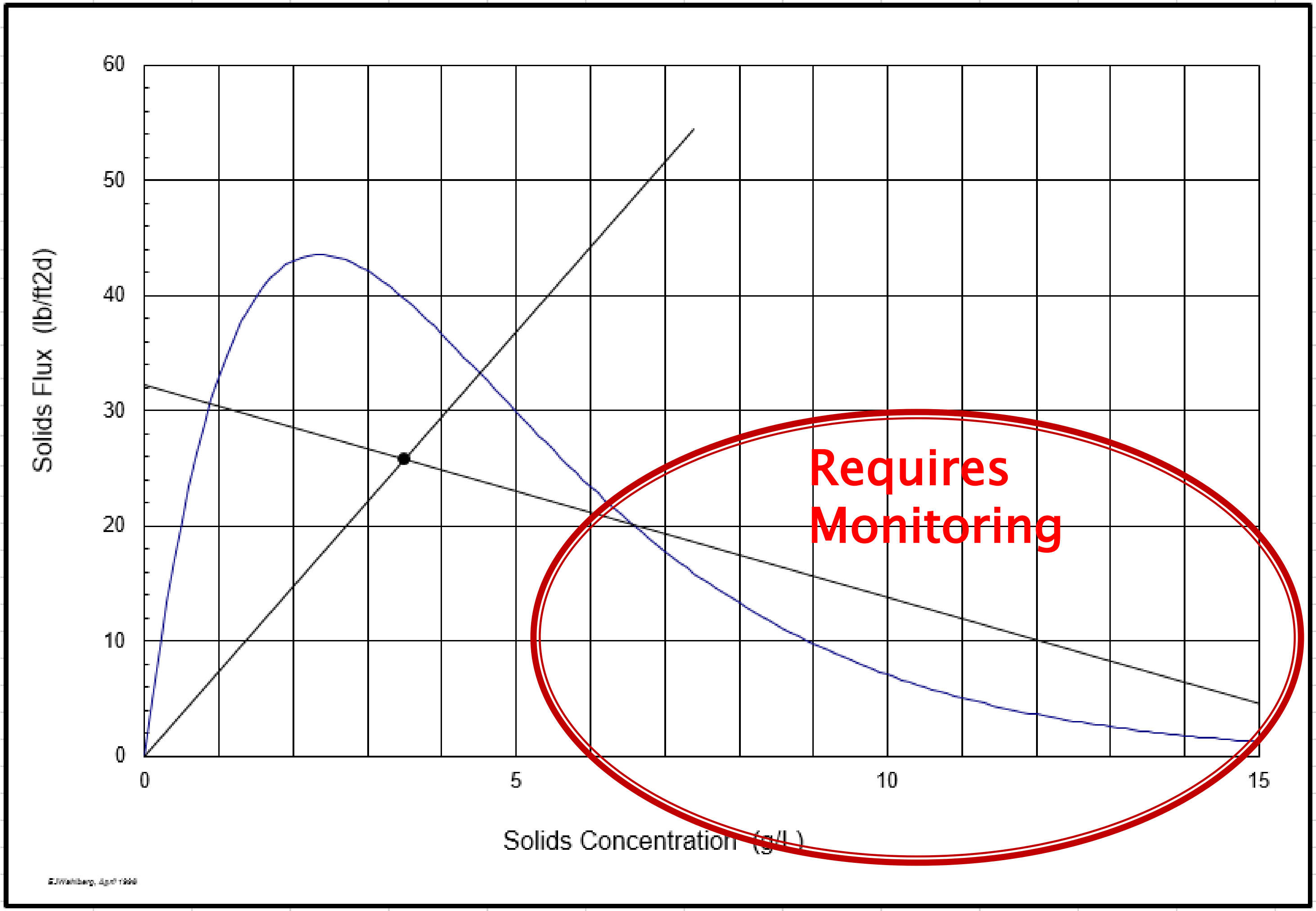
Normal Rain Event/ High SVI

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

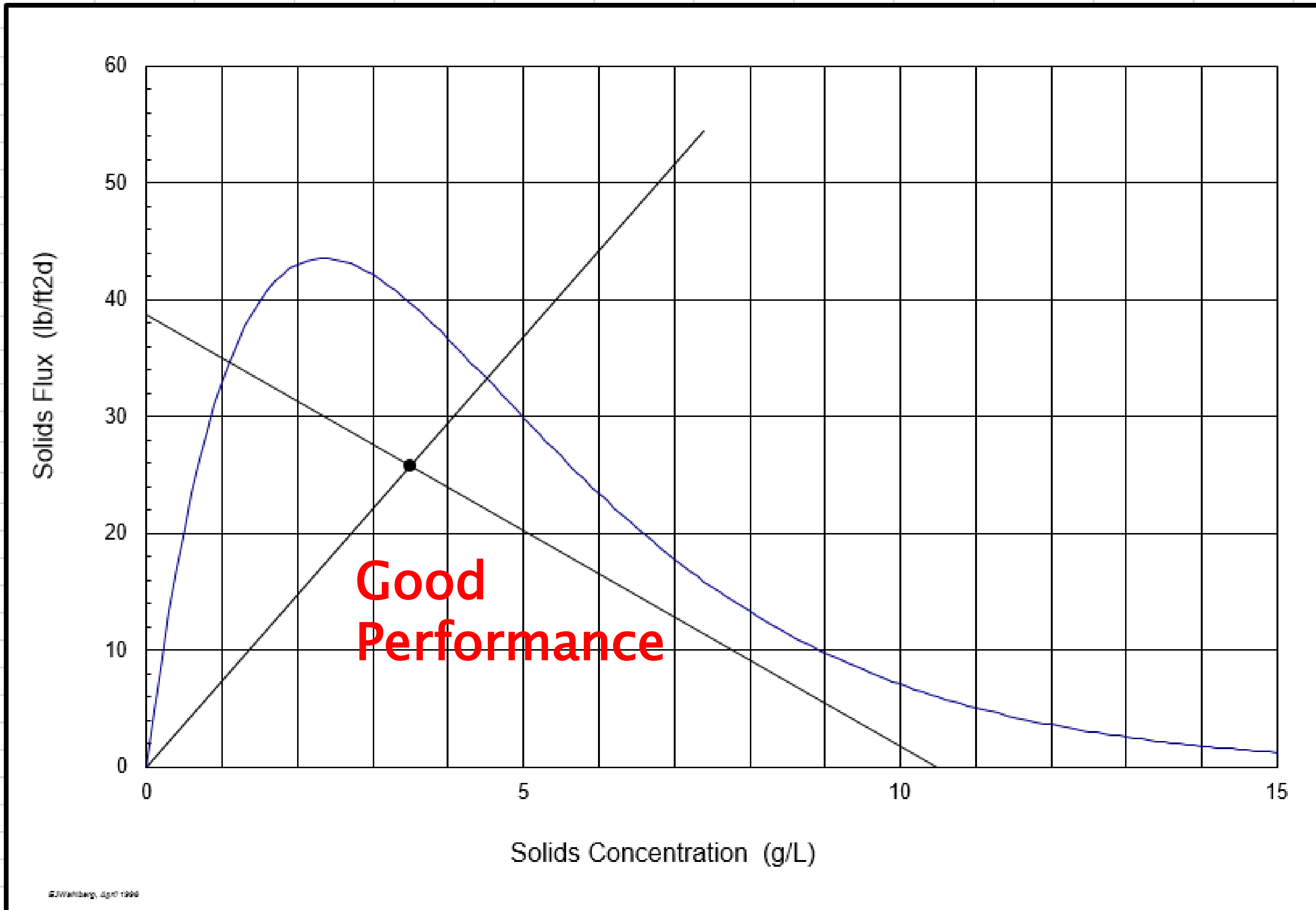


Major Storm / I & I

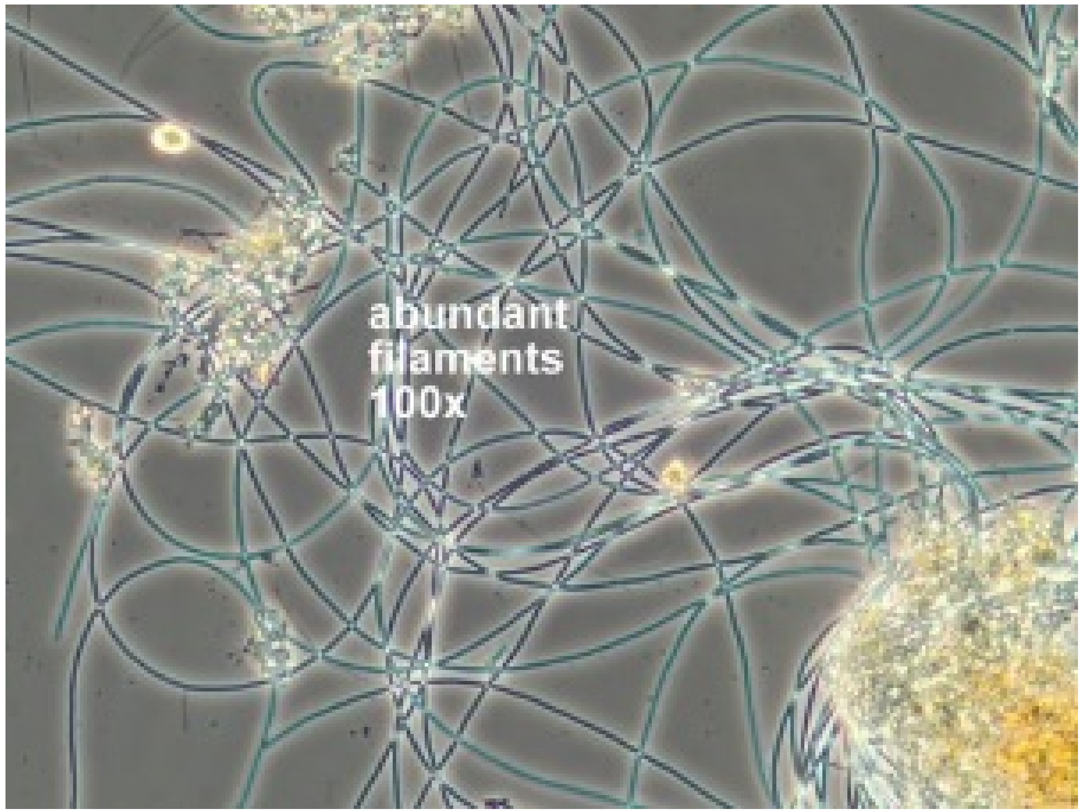
RAS	10 MGD
SVI	100
MLSS	3500 mg/L
Flow	40 MGD



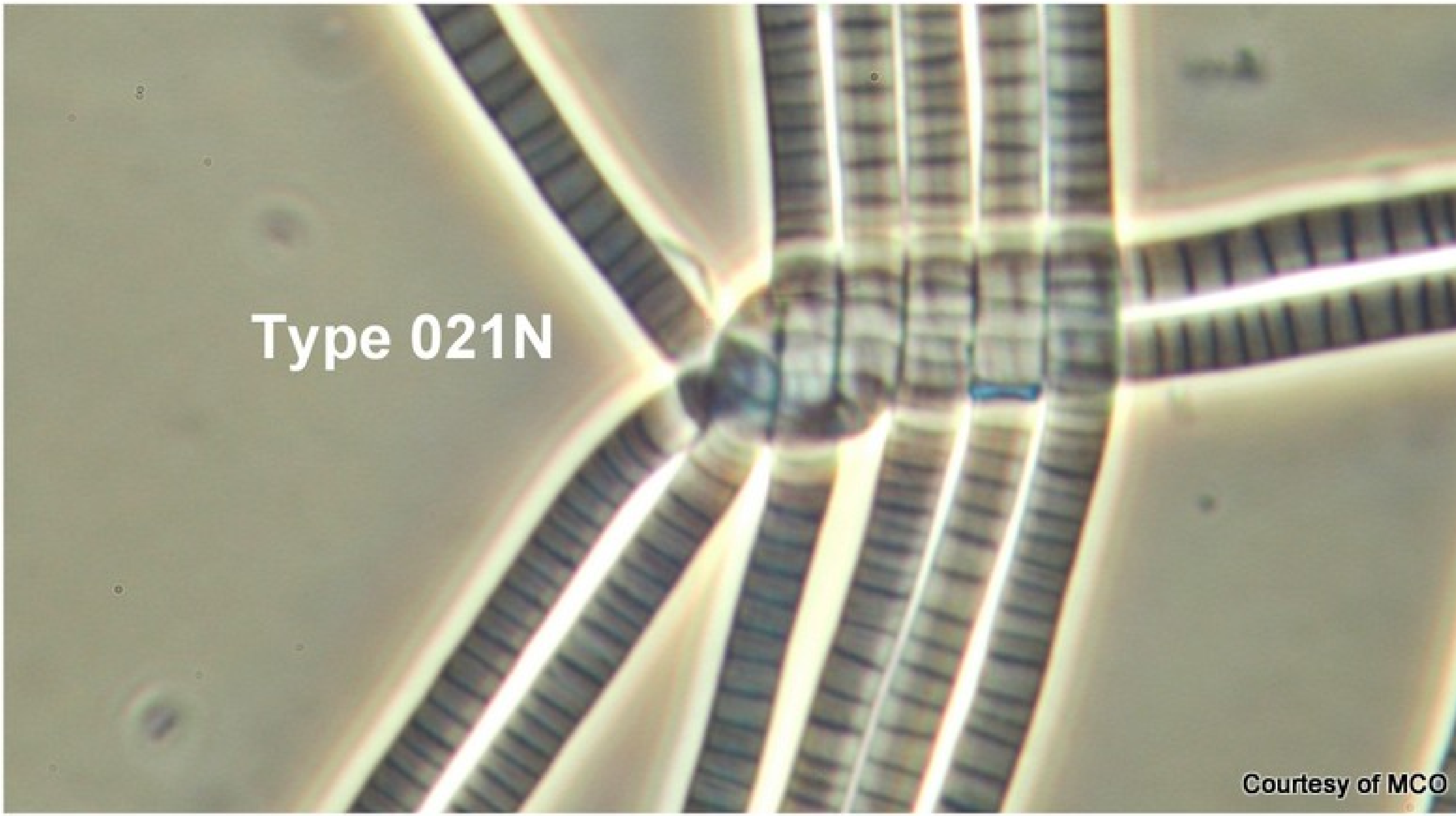
RAS adjusted to 20 MGD



Example 1: Abundant Filaments in plant



The Culprit



Determine if a problem

- Use State Point Analysis
- Factor of cost/ urgency etc.

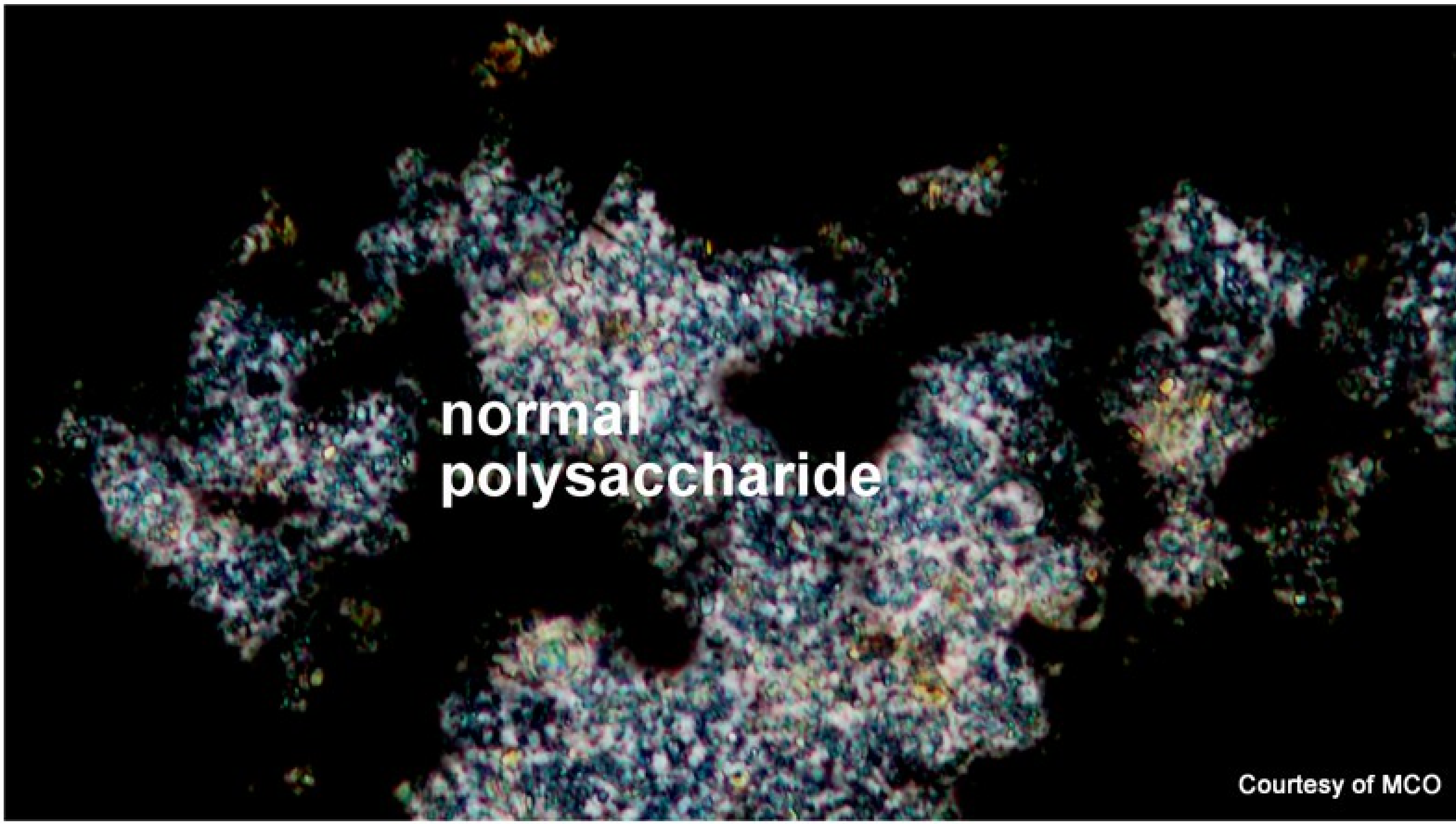
  - In this case yes– clarifier failure risk deemed high

Causes of type 021N

Septicity	Type 021N *Thiothrix* I and II *Nostocoida limicola* I, II, III Type 0411 Type 0961 Type 0581 Type 0092

Nutrient Deficiency	Nitrogen: *Thiothrix* I, II, type 021N Phosphorus: *N limicola* III, *H. hydrossis, S. natans*

Not nutrient deficiency related

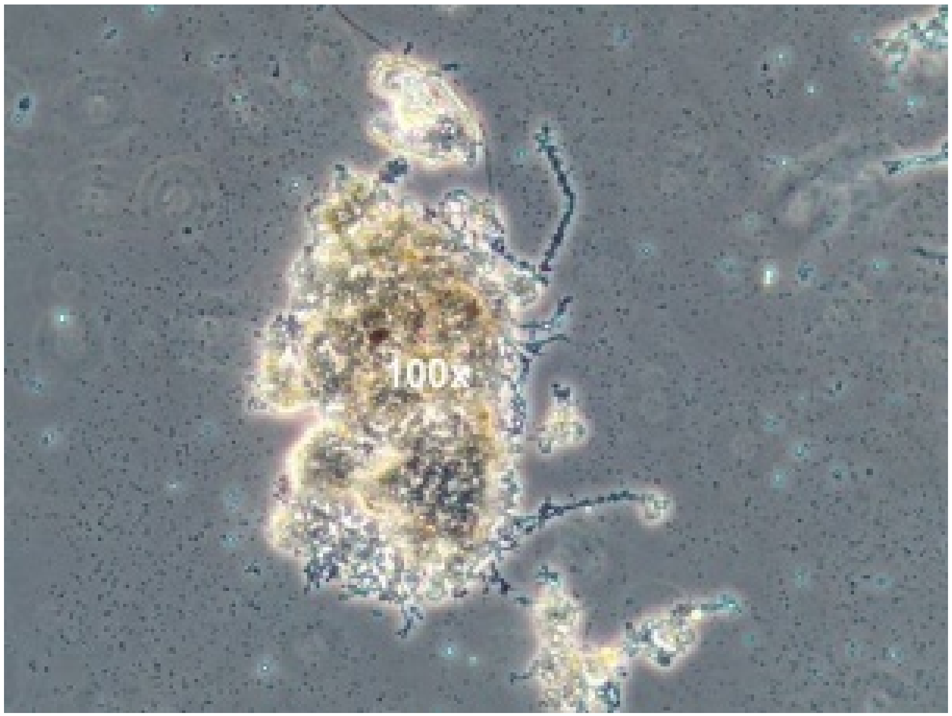


Options

- 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

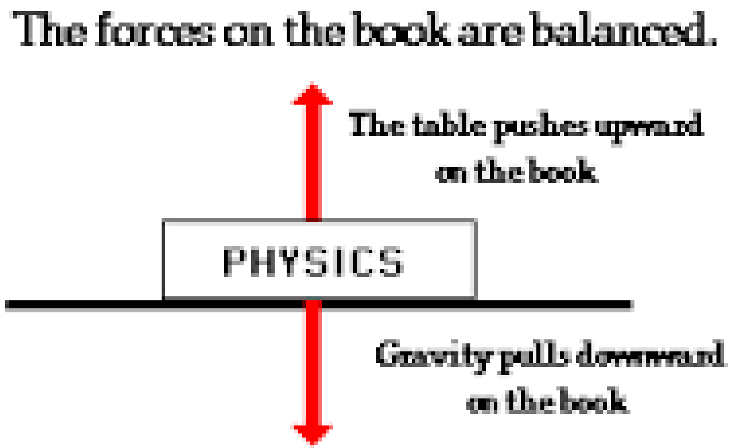
- SVI reduced over 2-3 days at this rate

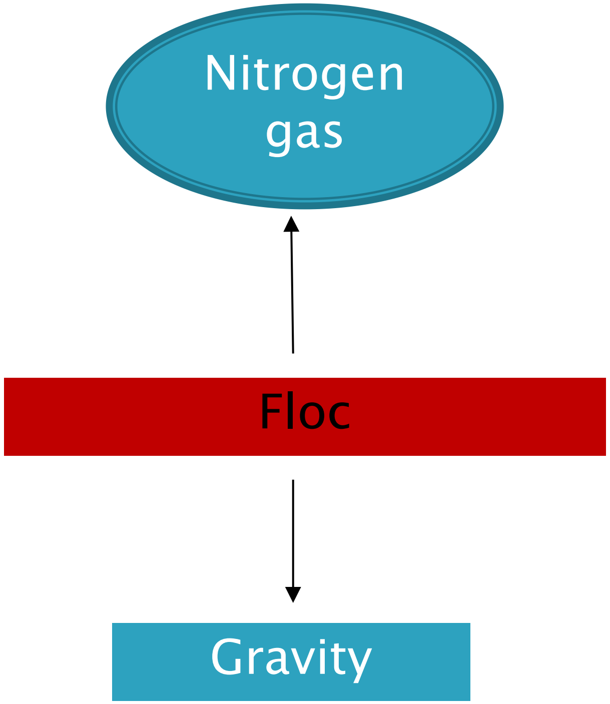
#2 Strong flocs but a settling issue



1000x magnification in floc

Elevated SVI Can Be Denitrification Related



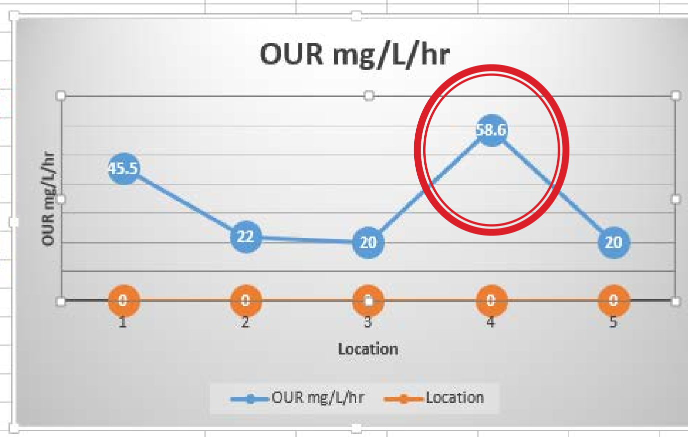


Paddle Test

Conclusion

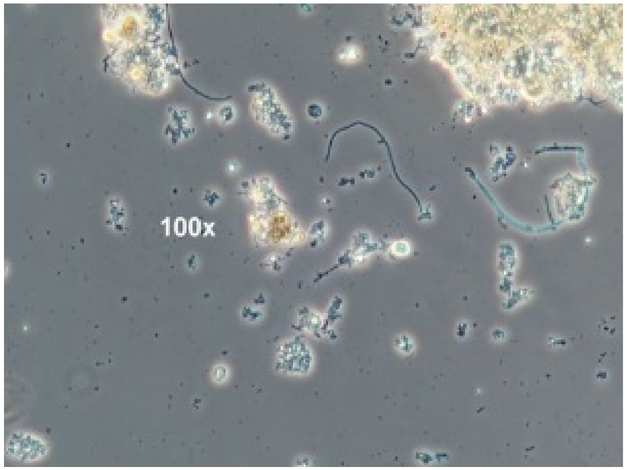
- SVI and 30 minute settling decreased at higher MLSS at this reduced gas entrapment
  - Yes- denitrification can occur within the aeration basin and this is much more common than realized

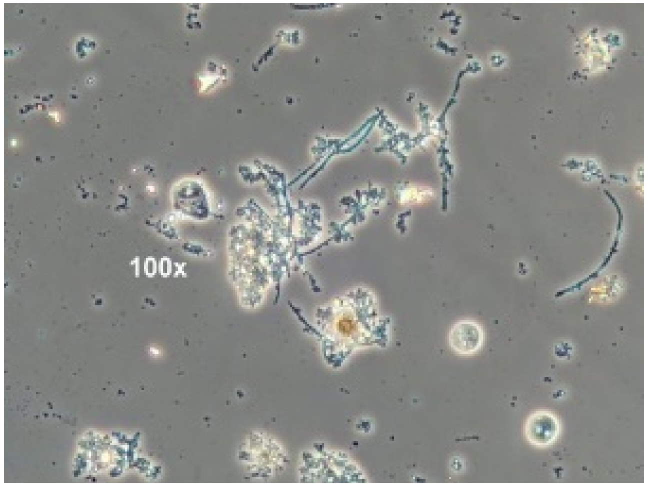
OUR mg/L/hr	Location
45.5	Head of basin
22	1/4 down basin
20	1/2 basin
58.6	3/4 basin
20	end of basin

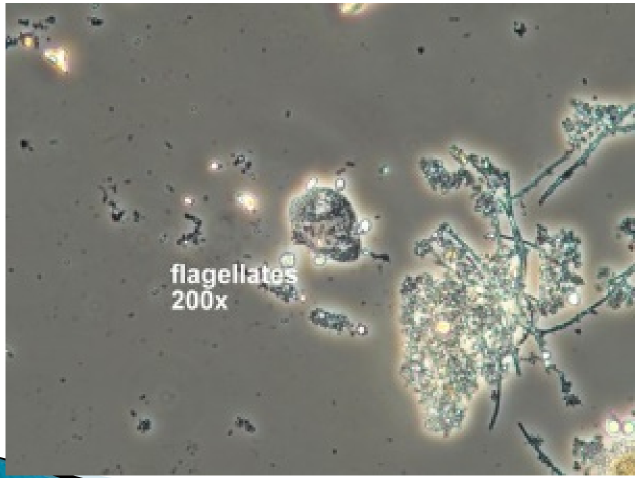


#3 Municipal plant in Indiana

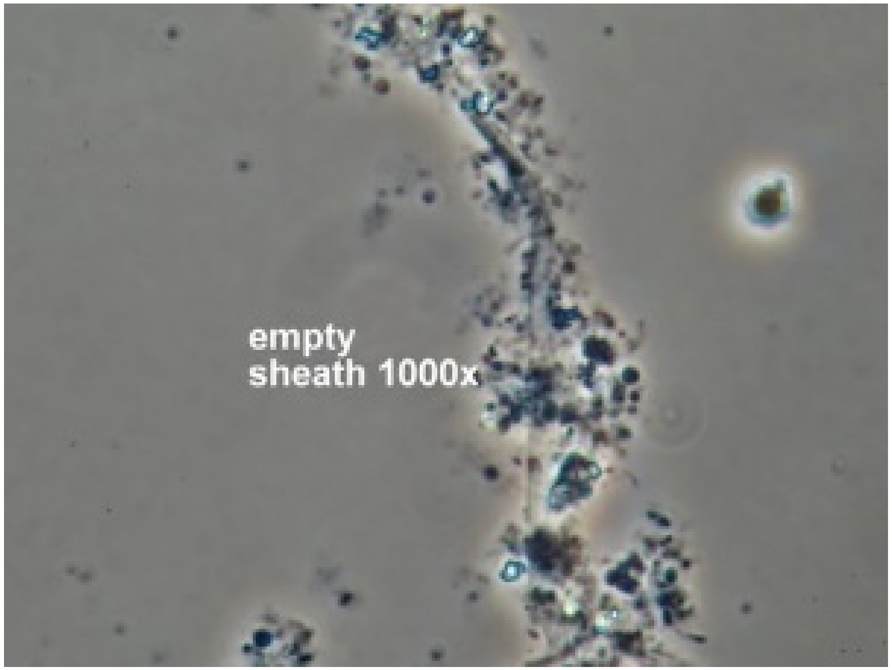
MLSS

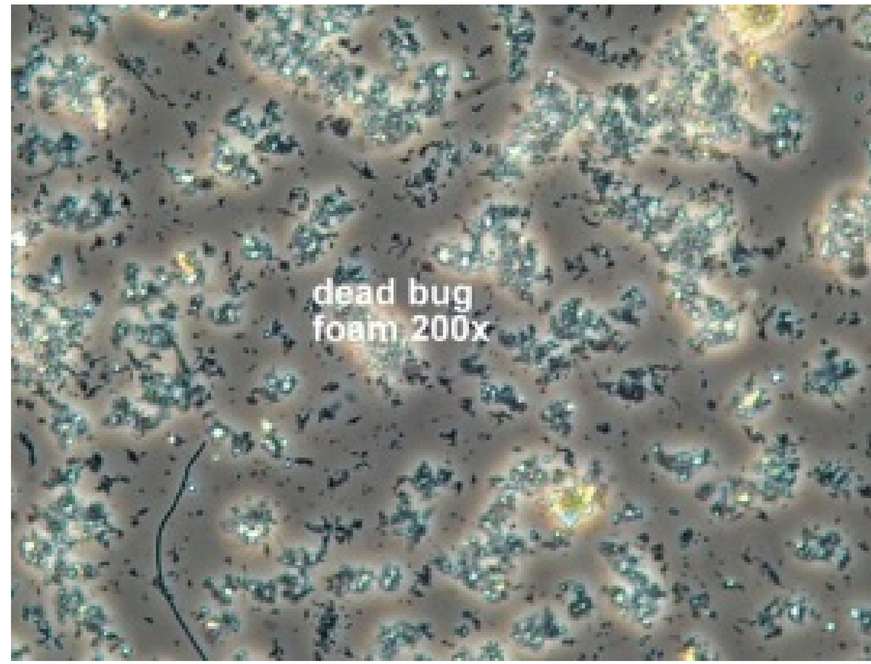






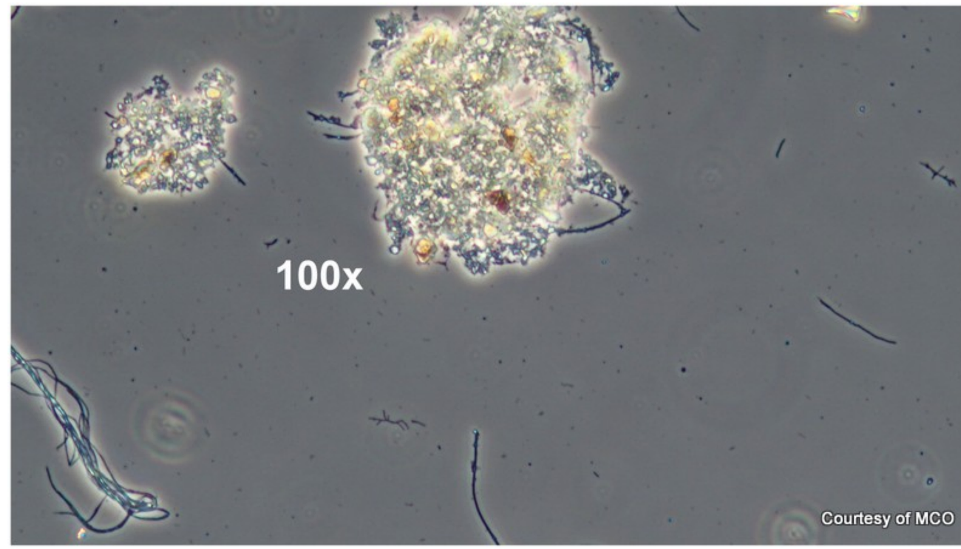
Foam





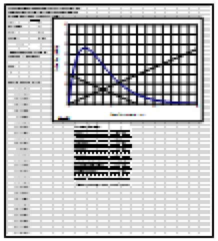
Corrective Actions

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



Take Home Points/ Review

State Point Analysis



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

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

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- 8) Septicity (limited)

Questions?