



**Date:** 11/7/2019

**To:** City of [REDACTED] NY WWTP

**Sample(s):** AT2-2, AT4-2

**Date Received:** 11/7/2019

**Date(s) Analyzed:** 11/7/2019, 11/8/2019

**Sample Analyzed By:** Dan McKeaton, Chemist; Aquafix

**Objective:** Perform microscopic observations of the [REDACTED] sample and make recommendations where needed.

### Microscopic Observations: AT2-2



Figure 1, 100x magnification (m): Most floc in the [REDACTED] AT2-2 sample appeared to be medium in size. A significant number of smaller flocs which may have difficulty settling were also observed. Rotifers were abundant, and several tardigrades (arrow) were observed indicating a high sludge age.

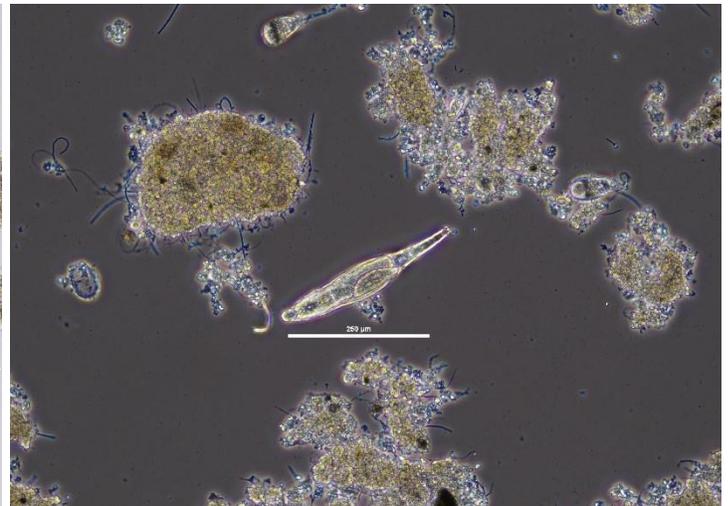


Figure 2, 100x (m), Phase contrast: Occasional filaments were observed extending from floc. Some free bacteria were observed in the bulk liquid. Occasional black spots were observed in floc indicating the presence of septic compounds.

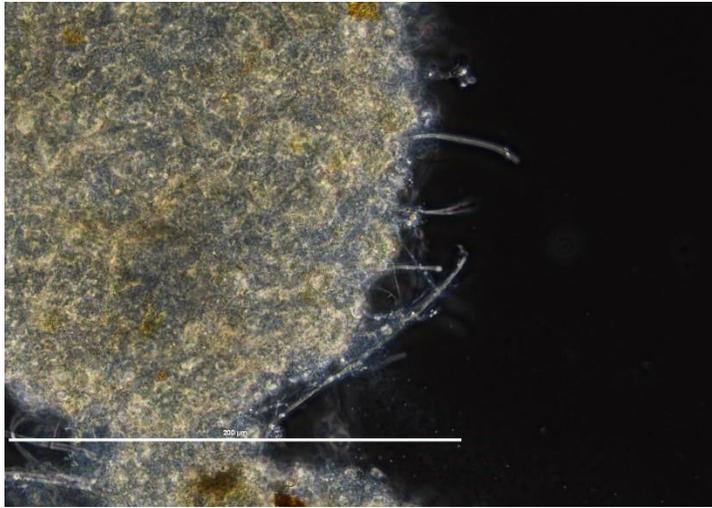


Figure 3, 400x (m), Phase contrast: Floc appeared to be tan to light brown in color under phase contrast, indicating floc contain medium levels of extracellular polymer substances density is high enough for good floc formation, and adequate (EPS) in the AT2-2 sample. EPS levels appeared adequate oxygen penetration throughout floc. for effective floc formation.

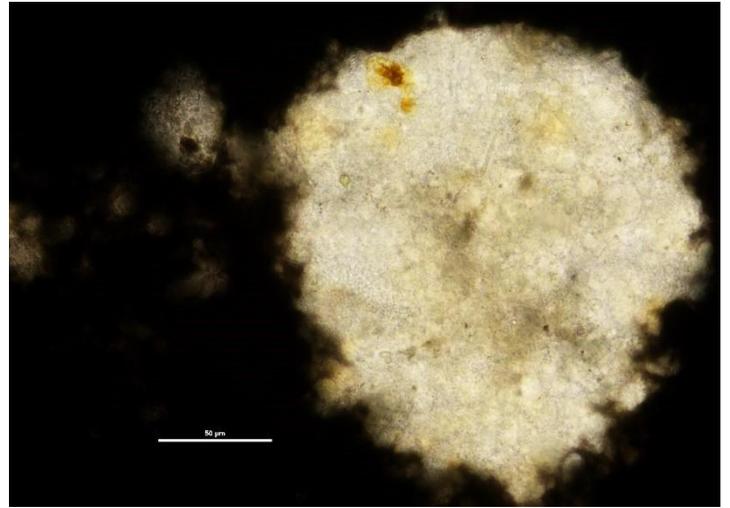


Figure 4, 400x (m), India ink stain: Floc present appeared to contain medium levels of extracellular polymer substances density is high enough for good floc formation, and adequate (EPS) in the AT2-2 sample. EPS levels appeared adequate oxygen penetration throughout floc. for effective floc formation.

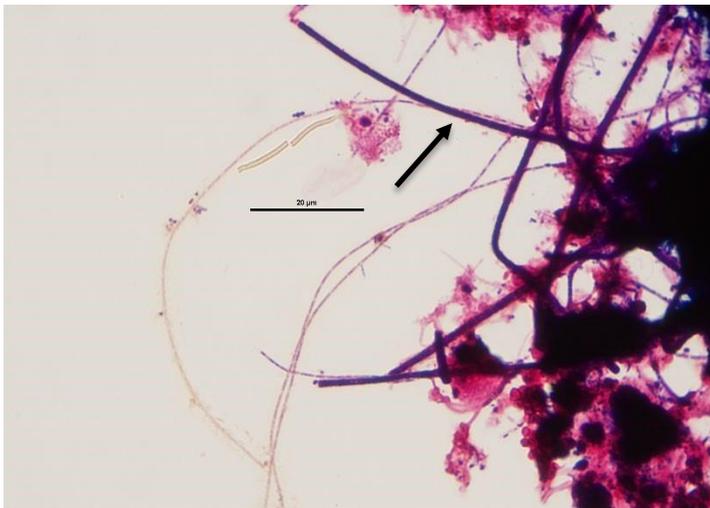


Figure 5, 1000x (m), Gram stain: Low Levels of Type 0041/0675 were observed after Gram staining (arrow).

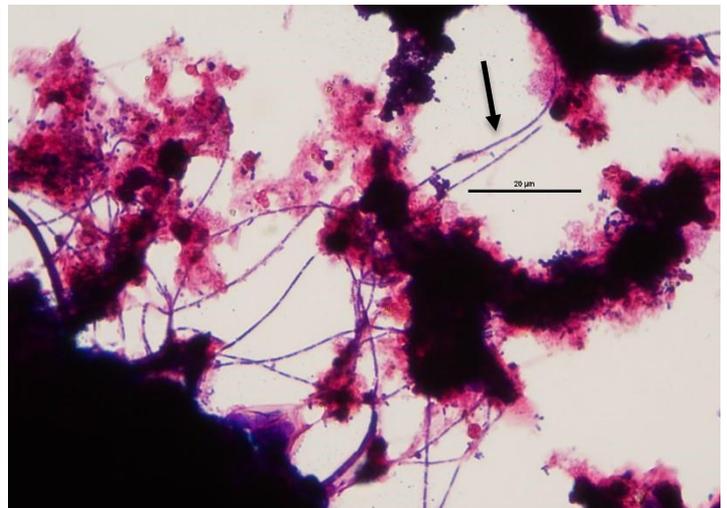


Figure 6, 1000x (m), Gram stain: Low to moderate levels of Type 1851 (arrow) was observed in the AT2-2 sample.

## AT4-2

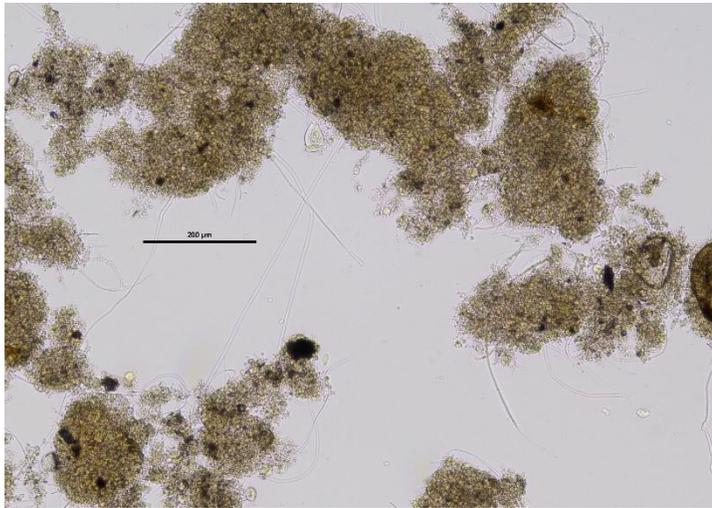


Figure 7, 100x (m): Floc in the AT4-2 sample appeared to be condensed and irregular in shape and mostly large in size. Filamentous bacteria were observed extending from floc into the bulk liquid. Filament abundance appeared somewhat higher than the AT2-2 sample.

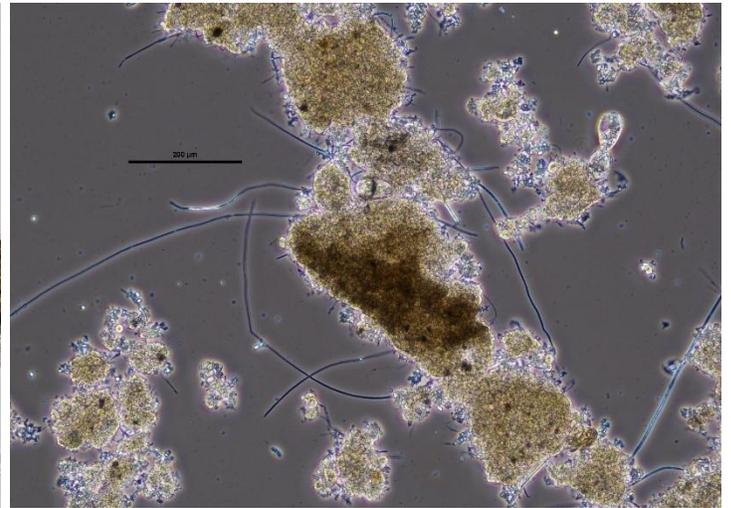


Figure 8, 100x (m), phase contrast: Floc in the AT4-2 sample appeared to be relatively dense based on brown color under phase contrast. This typically indicates good floc forming qualities. Some darker areas in floc indicated the presence of septic compounds.

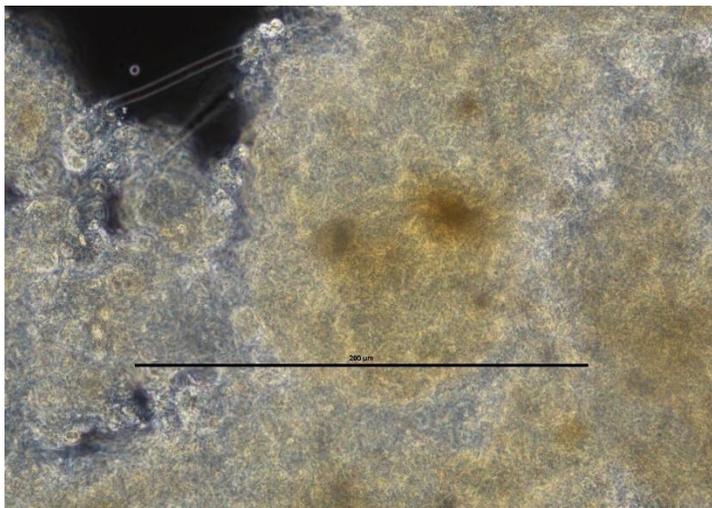


Figure 9, 400x (m), phase contrast: Floc appeared to be mostly tan to light brown in color under phase contrast. Occasional darker areas were present within floc. Overall, oxygen penetration into floc appeared adequate at this time.

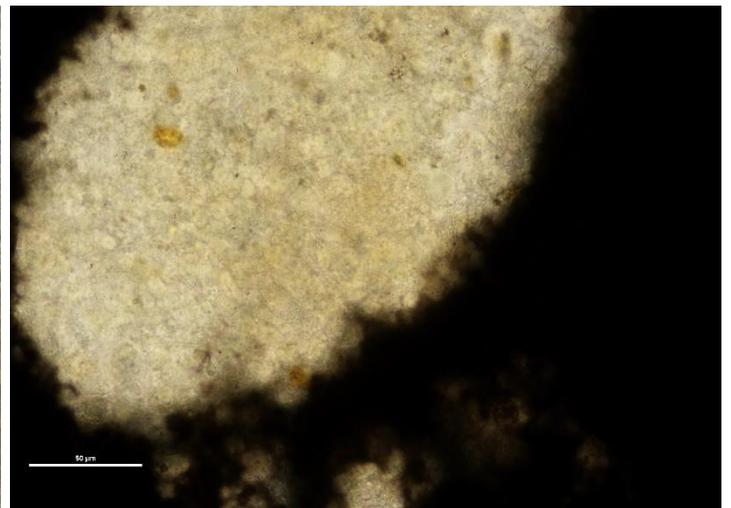


Figure 10, 400x (m), India ink stain: Floc in the AT4-2 sample appeared to contain moderate levels of EPS. EPS was not observed diffusing from floc in significant levels in the AT4-2 sample.

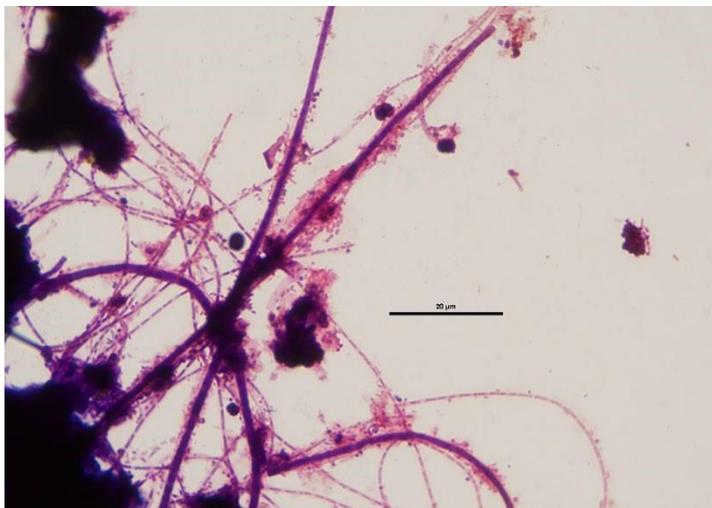


Figure 11, 1000x (m), Gram stain: Moderate levels of Type 0041/0675 were observed after Gram staining as well as levels of Type 1851. Both filaments tend to thrive in

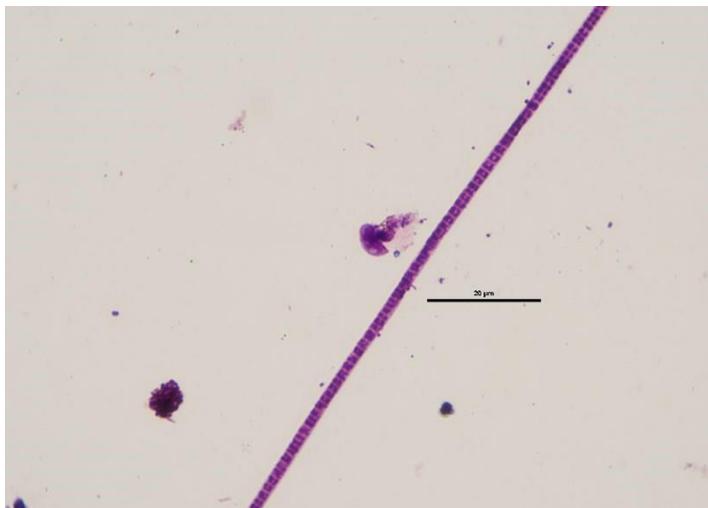


Figure 12, 1000x (m), Gram stain: *Thiothrix*/Type 021N were observed after Gram stain. Filaments appeared to contain medium many Gram-positive granules. low F:M conditions.

### Summary:

Overall, the [REDACTED] aeration samples appeared to be relatively healthy at this time. Sludge age appeared to be somewhat higher than ideal, but not high enough to cause issues with the settling properties of the [REDACTED] mixed liquor.

Floc in both [REDACTED] samples appeared to be medium to large in size. Floc appeared to range from spherical to irregular in shape with high floc density. Generally high density, medium flocs are unlikely to have any issues settling and maintaining low effluent TSS levels.

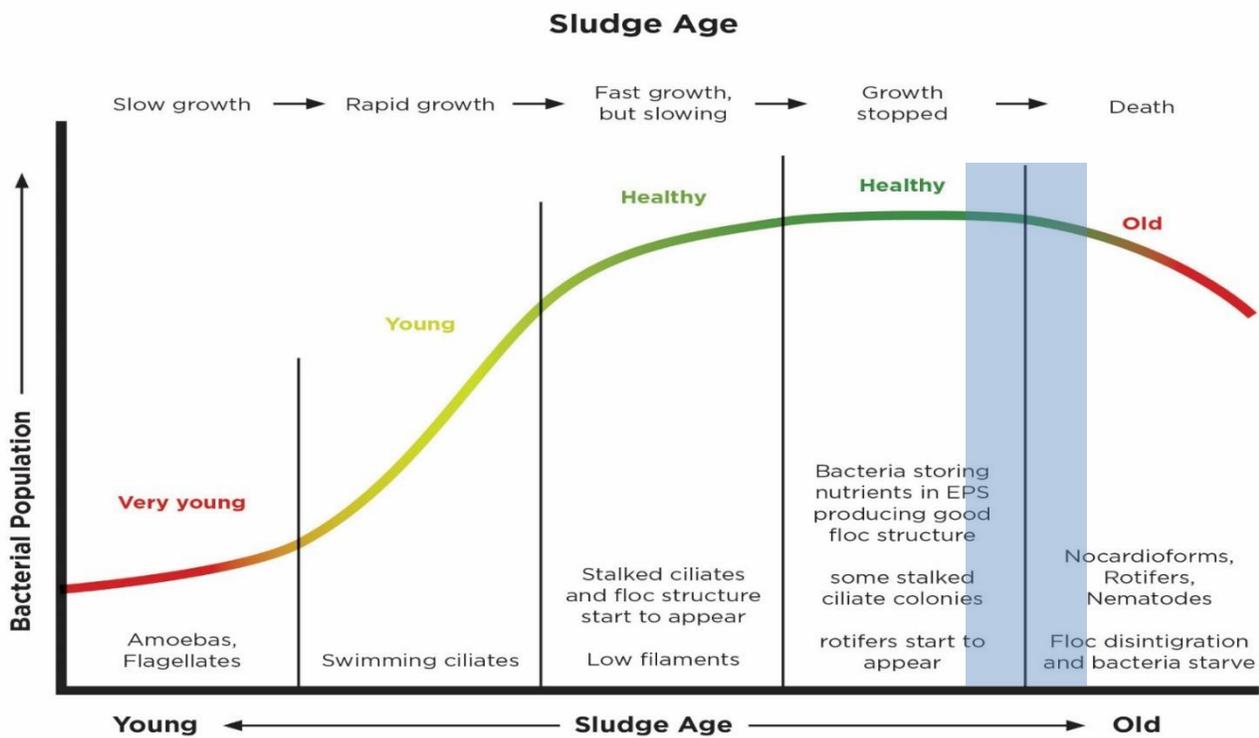
Some smaller spherical floc as well as free bacteria were observed in both AT2-2 and AT4-2 samples. These floc and free bacteria are unlikely to settle well in the [REDACTED] final clarifier and may contribute to effluent turbidity and high TSS. Levels of small floc and free bacteria appeared to be unlikely to cause any effluent issues. It is likely levels of small floc and free bacteria will increase, if sludge age in the City of [REDACTED] sample increases further.

Floc appeared to be mostly tan in color under phase contrast (400x). This indicates that while floc density appears to be relatively high, oxygen is still effectively penetrating into floc. Occasional areas of darker color under phase contrast were observed which may be receiving more limited levels of oxygen.

India ink staining results showed that extracellular polymeric substance (EPS) levels appeared adequate in both AT2-2 and AT4-2 samples to produce good floc forming qualities. EPS is a glue-like substance which causes bacteria to adhere together and form floc. Medium levels of EPS contained within floc usually indicates good floc forming properties. Diffused EPS was not observed in significant levels in either sample, indicating settling problems and foaming issues due to excessive EPS are unlikely to be experienced at this time, unless a

change in influent properties occurs. This indicates that nutrient levels in the City of [redacted] samples appeared relatively well balanced at this time.

Levels of metazoa and protozoa indicated a high sludge age in the [redacted] samples. Several tardigrades were observed, as well as large stalked ciliate colonies and rotifers. Crawling ciliates appeared to be abundant as well, but levels of swimming ciliates appeared to be quite low in both samples. High sludge age can become a problem when bacteria no longer receive adequate food to reproduce. Starved bacteria begin to degrade EPS within floc which compromises floc structures and leads to floc disintegration which can lead to high TSS in effluent. No evidence of this occurring was observed at this time, but this will become more likely if sludge age increases further in the system



The blue rectangle on the diagram above indicates the current microbial sludge age of the [redacted] samples.

Levels of filamentous bacteria in the [redacted] sample appeared to be low to moderate. Low F:M filaments such as Type 0041/0675 and Type 1851 were observed frequently extending from floc. Levels of these filaments did not appear to be high enough to indicate any immediate issues. Levels of attached growth on these Low F:M

filaments appeared to be relatively low, especially on the ends of the filaments. This can indicate the population of Low F:M filaments may be increasing at this time. *Thiothrix*/Type 021N was observed primarily in the AT42 sample. This filament can grow in response to low DO, or in low nitrogen conditions. Levels did not appear to be high enough to indicate an issue at this time. In this case, *Thiothrix* appeared to be extending mostly from larger floc in the [REDACTED] samples, indicating it may be growing due to low oxygen penetration into occasional larger floc. This indicates the prevalence of *Thiothrix* is unlikely to increase unless oxygen levels in the [REDACTED] basins decrease.

Rank	Filament	Abundance	Cause
1	Type 1851	Low to Medium	Low F:M
2	Type 0041/0675	Low	Low F:M
3	<i>Thiothrix</i> /Type 021N	Low	Low DO, Low N, septic waste

<https://teamaquafix.com/common-wastewater-filaments/#1851>

<https://teamaquafix.com/common-wastewater-filaments/#021N>

<https://teamaquafix.com/common-wastewater-filaments/#0041>

### Recommendations:

- No major changes are necessary at this time as samples indicate the [REDACTED] system is performing well.
- We recommend continued addition of Accelerator VII and other nutritional supplements being used at this time, as nutrient levels did not appear to be causing any issues at this point.
- We recommend increasing wasting somewhat to decrease sludge age. This should help to prevent the growth of new Low F:M filaments and prevent high sludge age issues from occurring.