



# Evaluating Optical Measurements to Distinguish Organics Present in Wastewater and Natural Water



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## Introduction to Potable Reuse

Due to increased water demands and drought, water utilities are considering using highly-treated recycled wastewater for potable use. Potable reuse is achieved by further treating wastewater effluent with a multi-barrier advanced treatment train, as shown in Figure 1.

The main advantage of potable reuse over conventional water treatment is conservation of water. This is especially true in areas suffering from drought and increased population, such as California.

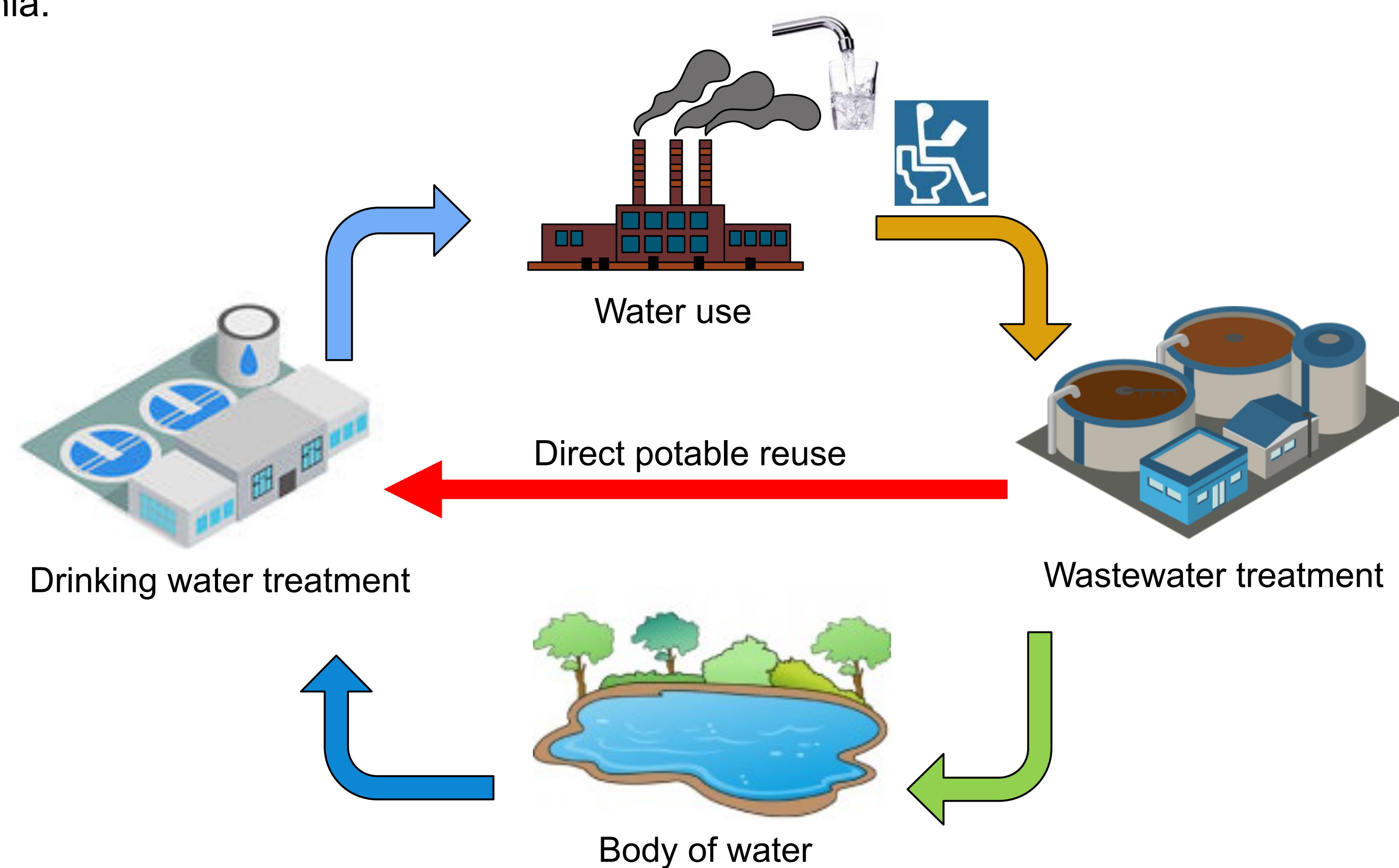


Figure 1. Conventional water treatment processes compared to direct potable reuse.

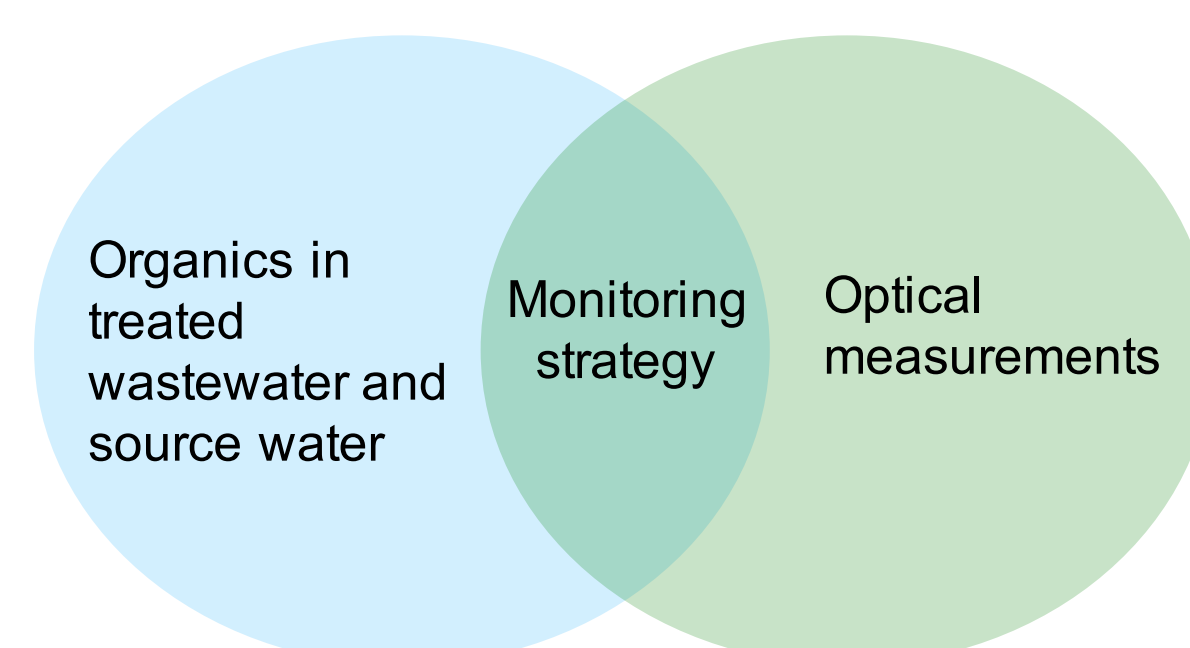
## Motivation

Currently, there is no accepted method to monitor the quality of organic matter present in potable reuse product water. Investigating changes in organic matter characteristics would provide a better understanding of the fate of organic matter in potable reuse trains and could lead to the development of a monitoring strategy to assure safe and reliable potable water from potable reuse trains.

## Research Objectives

This study characterizes the optical properties of organic matter (OM) at various treatment steps in potable reuse treatment trains and develop methods to monitor for any organic matter-driven negative changes in water quality. The purpose of this research is to:

- Better understand the organics present in a potable reuse system
- Evaluate the ability of optical measurements to distinguish wastewater-derived organic matter from organic matter present in natural source water
- See how treatment processes impact the optical measurements of organic matter present in the system.



## Sample Collection

- Samples were collected from the South Platte and Aurora Reservoir treatment train located at the Binney Water Purification Treatment facility, Aurora Colorado. A sampling schematic is shown in Figure 2.
- Organics entering the Aurora Reservoir treatment train are from natural origin, referred to as natural organic matter (NOM).
- The South Platte river is impacted by treated wastewater, therefore, organics entering the the South Platte Treatment train are a mixture of NOM and effluent organic matter (EfOM).
- A water quality analysis was performed on collected samples.

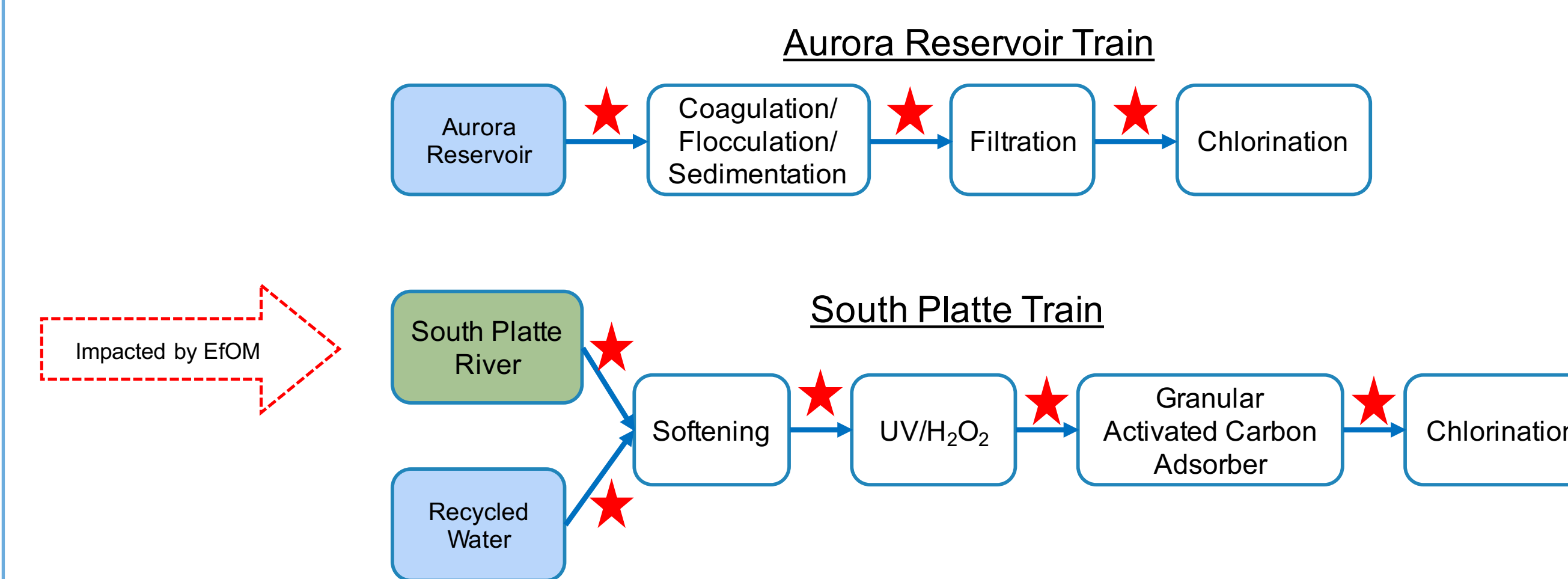


Figure 2. Sampling schematic from Binney Water Purification Treatment facility.

## Sample Analysis

- A fluorometer and UV-vis spectrometer were used to take optical measurements of organic matter present in water samples. An example of a fluorescence excitation emission matrix is presented in Figure 3.
- An intrinsic fluorescence parameter, referred to as the fluorescence quantum yield.

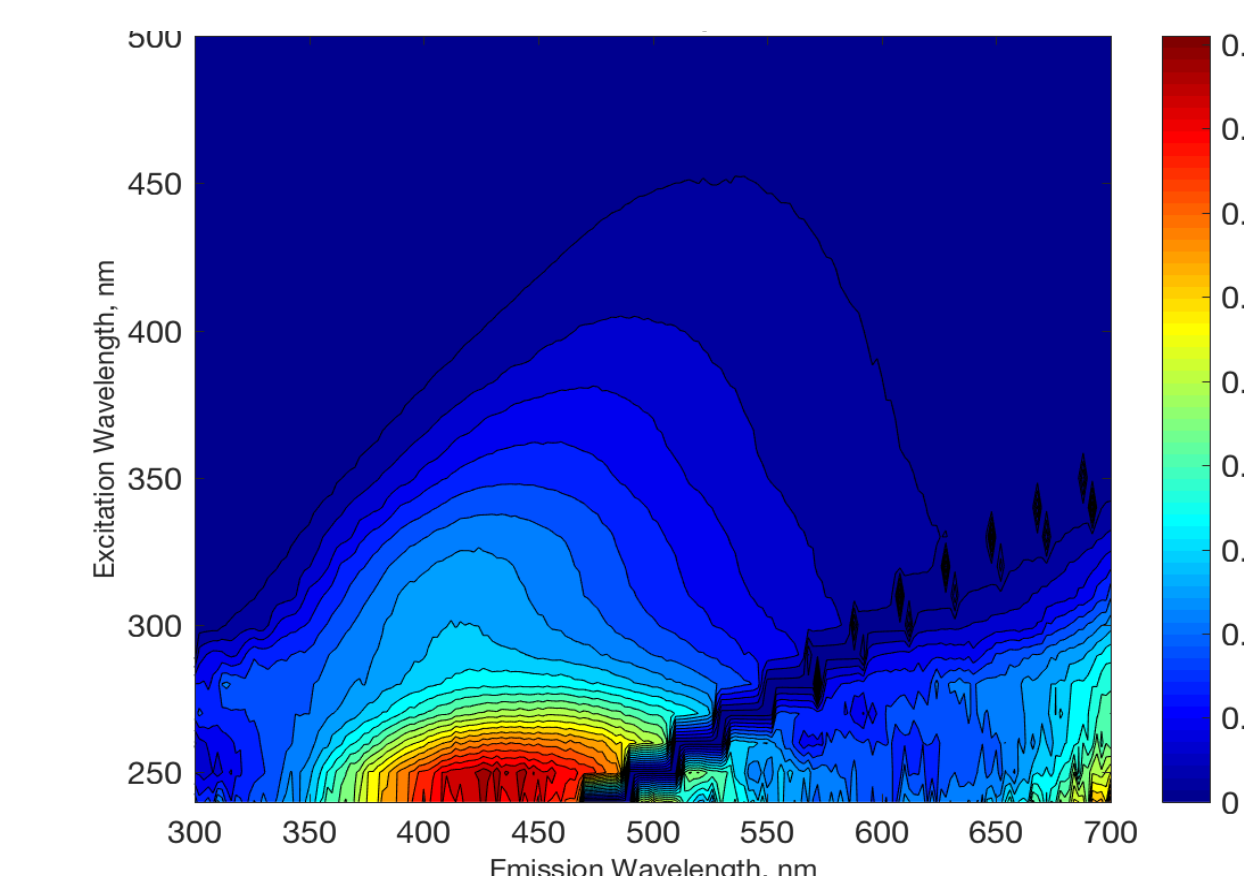
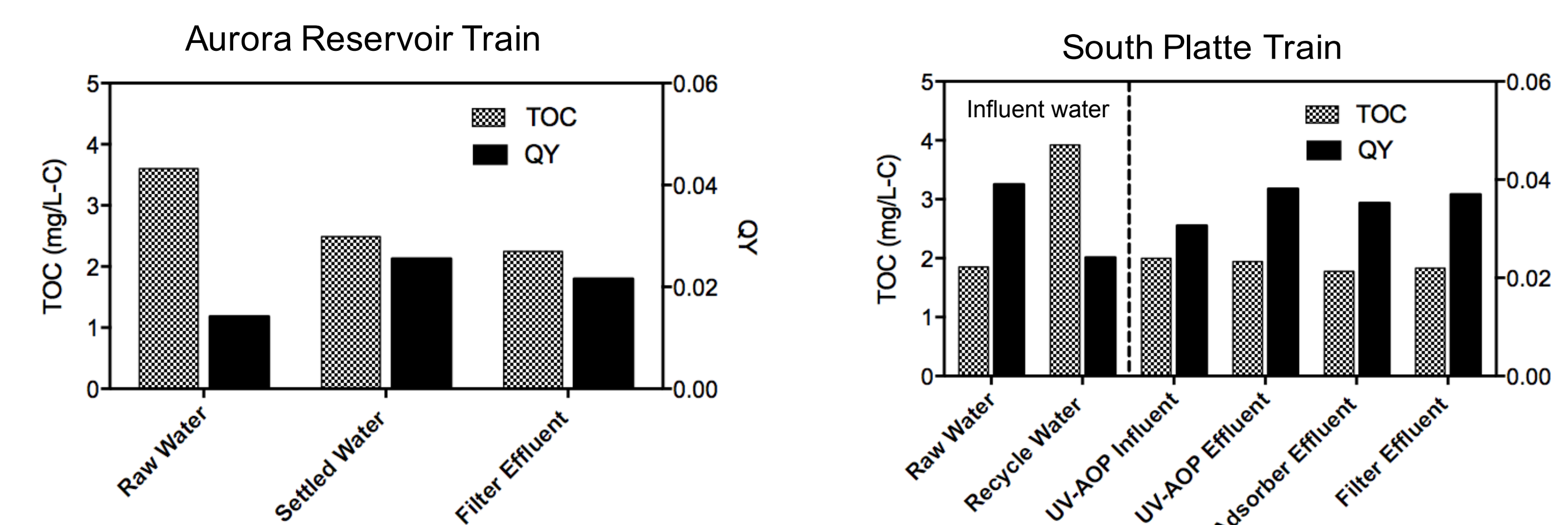


Figure 3. Example fluorescence excitation emission matrix.

## Results



- Quantum yield (QY) values are ~2.8 times higher in the South Platte Train, which is impacted by EfOM, raw water influent when compared to the Aurora reservoir influent water.
- Despite lower total organic carbon (TOC) concentrations in the effluent South Platte treatment train, fluorescence quantum yield was ~1.7 times higher when compared to the Aurora Reservoir treatment train effluent.

## Conclusion

- Results from this study show that fluorescence QY may be a viable surrogate for the detection of effluent organic matter as compared to natural organic matter.
- Fluorescence QY measurements showed no correlation to total organic carbon concentration. Further work would need to be performed to investigate this observation.
- Unit treatment processes were not shown to significantly increase or decrease the QY.

## Continued Work

To further our research on this topic, the following steps would be to:

- Compare different optical measurements to QY for the detection of EfOM.
- Collect more samples from water treatment plants located around the country and perform similar analyses.
- Observe how different treatment processes impact the QY measurements.
- Overall, work towards developing a strategy to better monitor potable reuse systems.

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