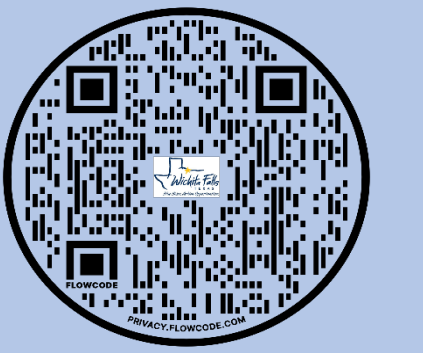


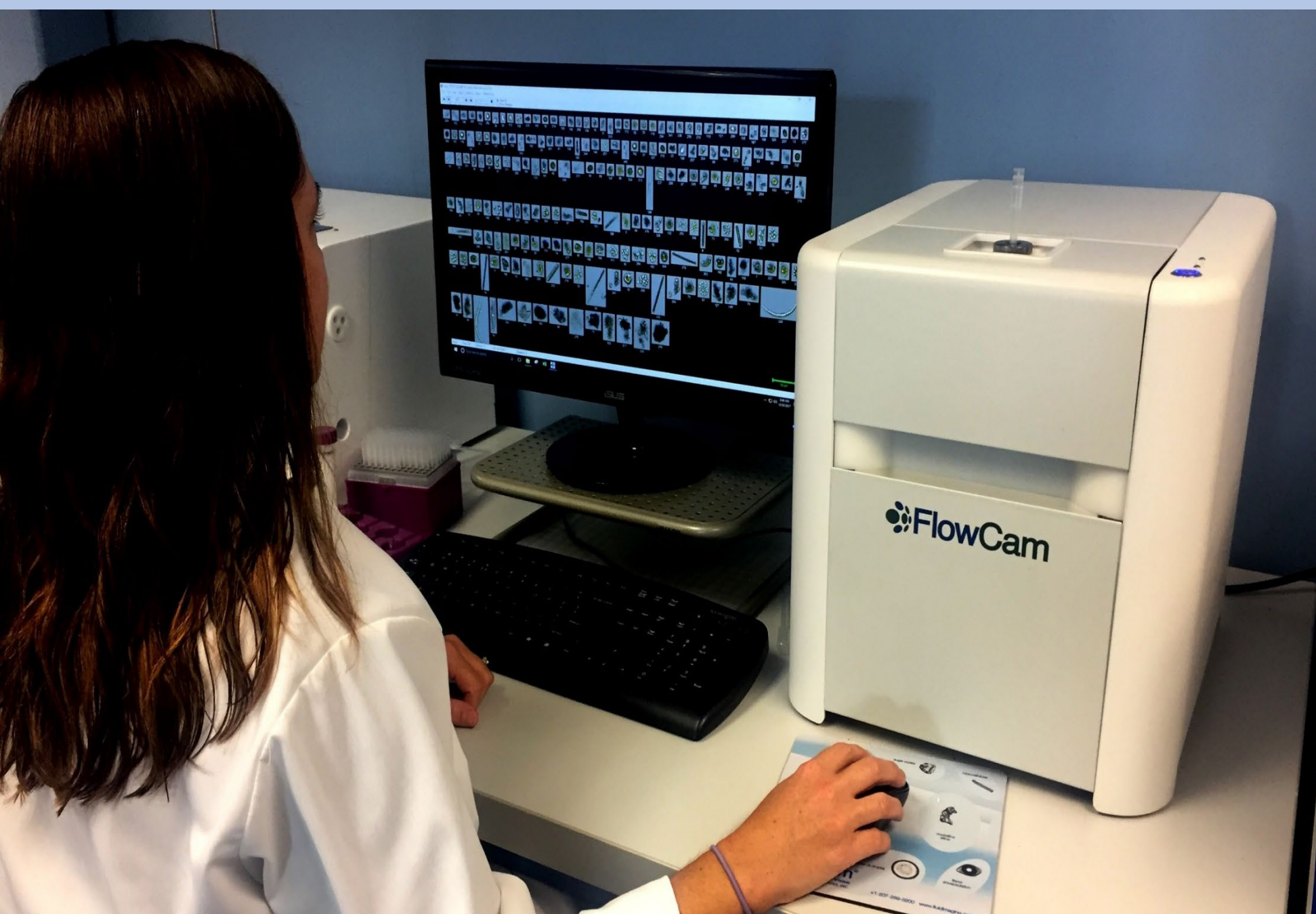
# An Integrated and High-Speed Approach to Monitoring Algae and Cyanobacteria in Lakes, Reservoirs and Finished Drinking Water

Authors: Polly Barrowman<sup>1</sup>, Hunter Adams<sup>2</sup>

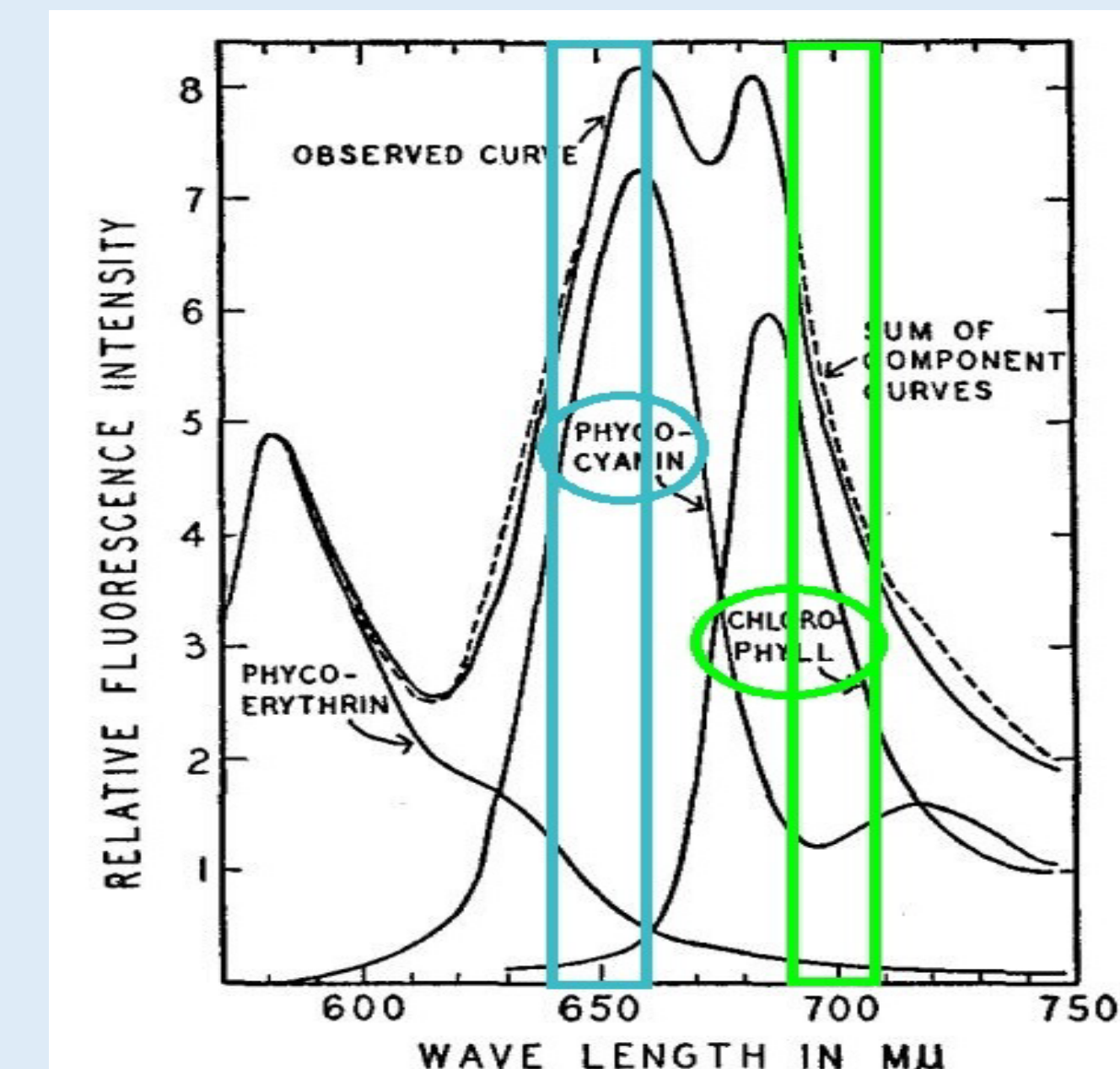
<sup>1</sup>Yokogawa Fluid Imaging Technologies, <sup>2</sup>City of Wichita Falls Cypress Environmental Laboratory



Introduction: FlowCam Cyano is a high throughput, semi-automated alternative to manual microscopy and has been successfully implemented into many HAB monitoring programs by utilities across the United States and worldwide. The technology can be utilized to rapidly identify and enumerate algae particles by imaging each particle as it flows through a flow cell. This has allowed water utility managers to see and react to algal blooms in their nascent stages.



- ❖ FlowCam Cyano will image and enumerate algae and cyanobacteria.
- ❖ Classify into desired categories, including:
  - Genus
  - T&O-producing algae and cyanobacteria
  - Toxin-producing cyanobacteria
  - Filter-clogging algae
  - Green algae
  - Detritus



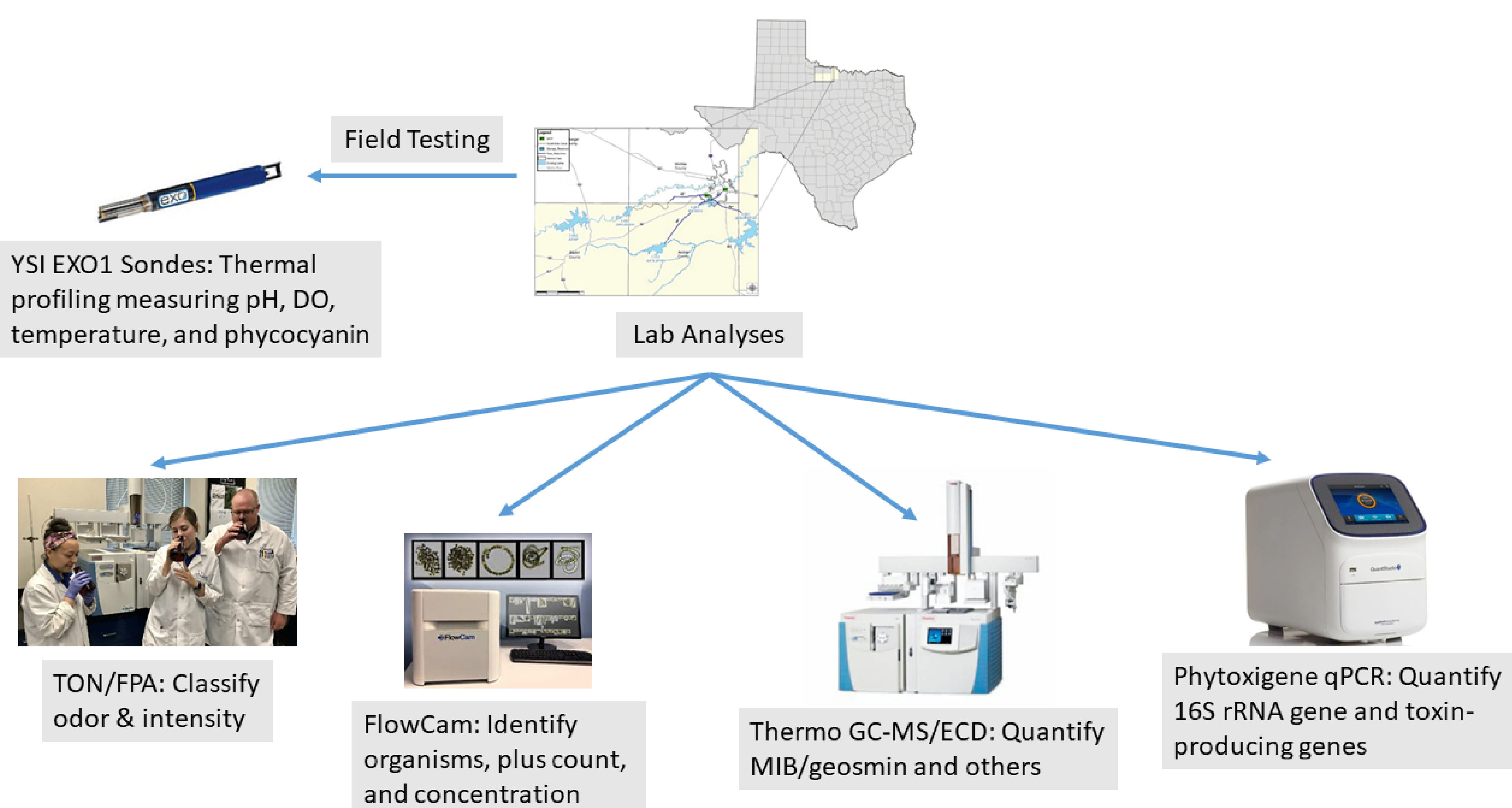
- ❖ Differentiate and quantify cyanobacteria from other algae (pigment analysis)
- ❖ Enabled with 633 nm laser
- ❖ Includes 2 fluorescence channels:
  - Ch 1: 700nm  $\pm$  10nm (detects Chlorophyll)
  - Ch 2: 650nm  $\pm$  10nm (detects Phycocyanin)
- ❖ Ratio of Ch 2/Ch 1 enables differentiation (since cyanobacteria can contain chlorophyll)

## Case Study: Cypress Environmental Laboratory, Wichita Falls, TX

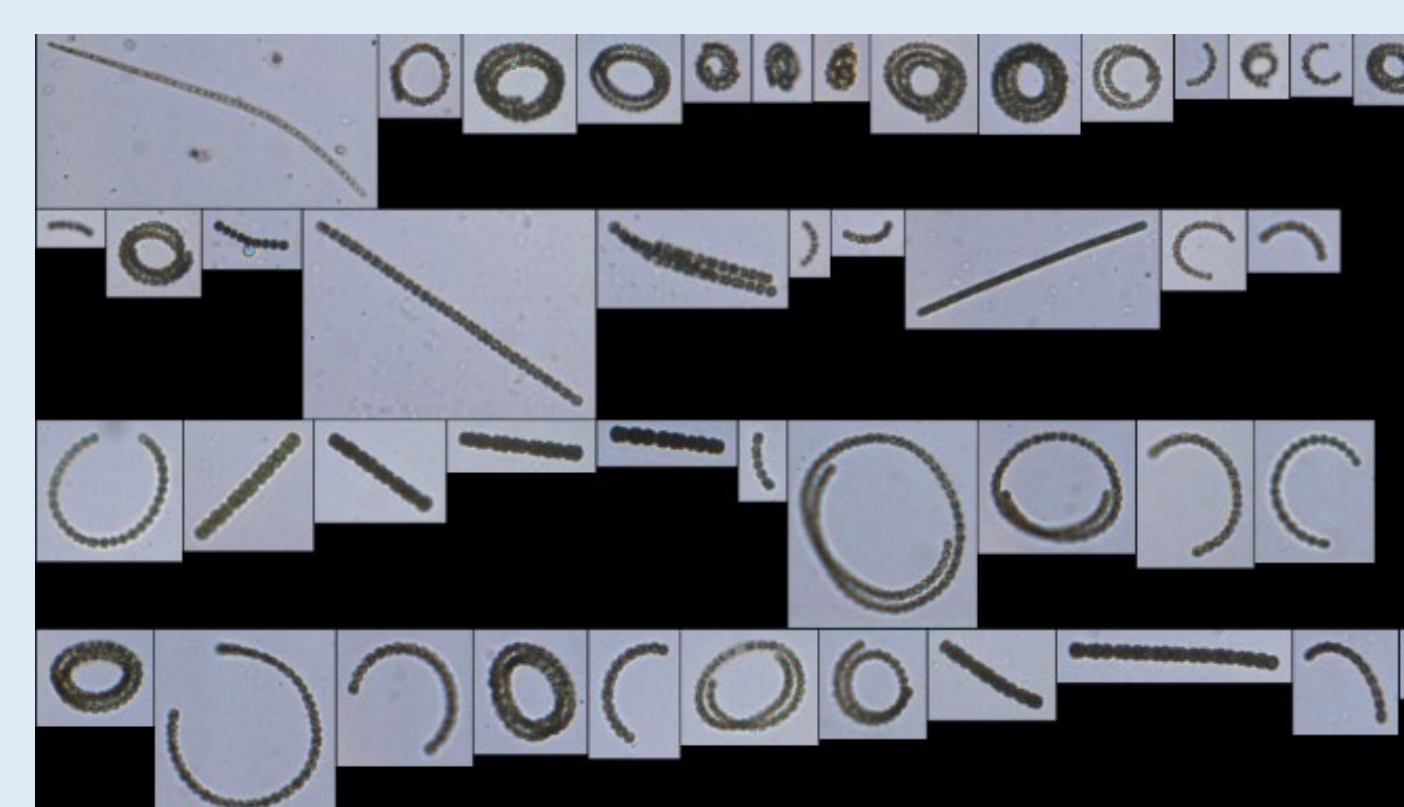
The City of Wichita Falls implemented an integrated monitoring program in 2016 to mitigate some major taste and odor events. Using FlowCam for algae ID and enumeration, they have been able to correlate taste and odor compounds to the organisms that cause them, creating trigger levels and reducing the overall cost of treatment.

## Comprehensive HAB Monitoring Plan

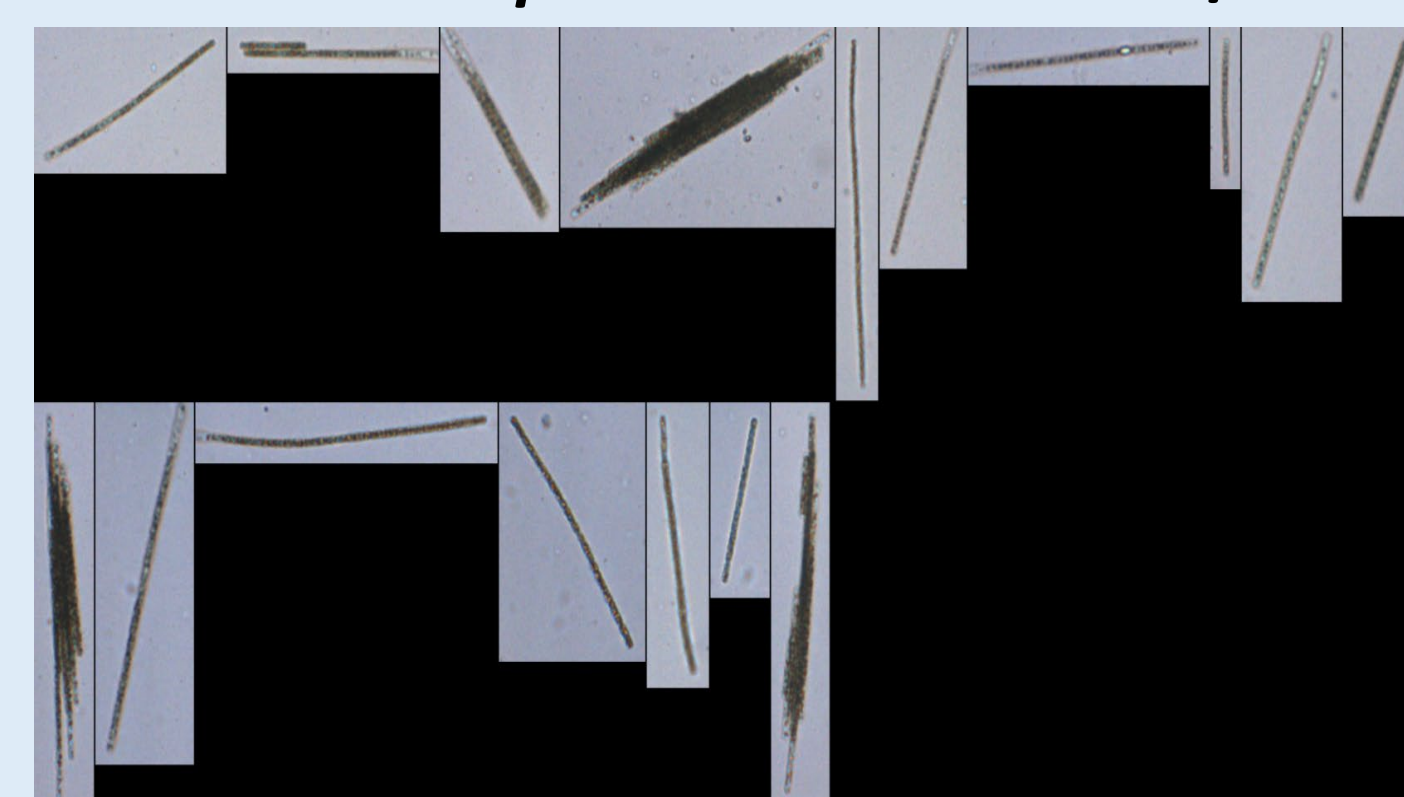
- Sondes trigger a trip to the field. Where samples are collected for analysis.
- FlowCam Cyano results determine the next steps.
  - If taste and odor-causing algae/cyanobacteria are present:
    - TON/FPA and GC-MS/ECD analysis performed to determine T&O compounds present
  - If cyanotoxin-producers are present:
    - qPCR and LC-MS/MS quantify cyanotoxins



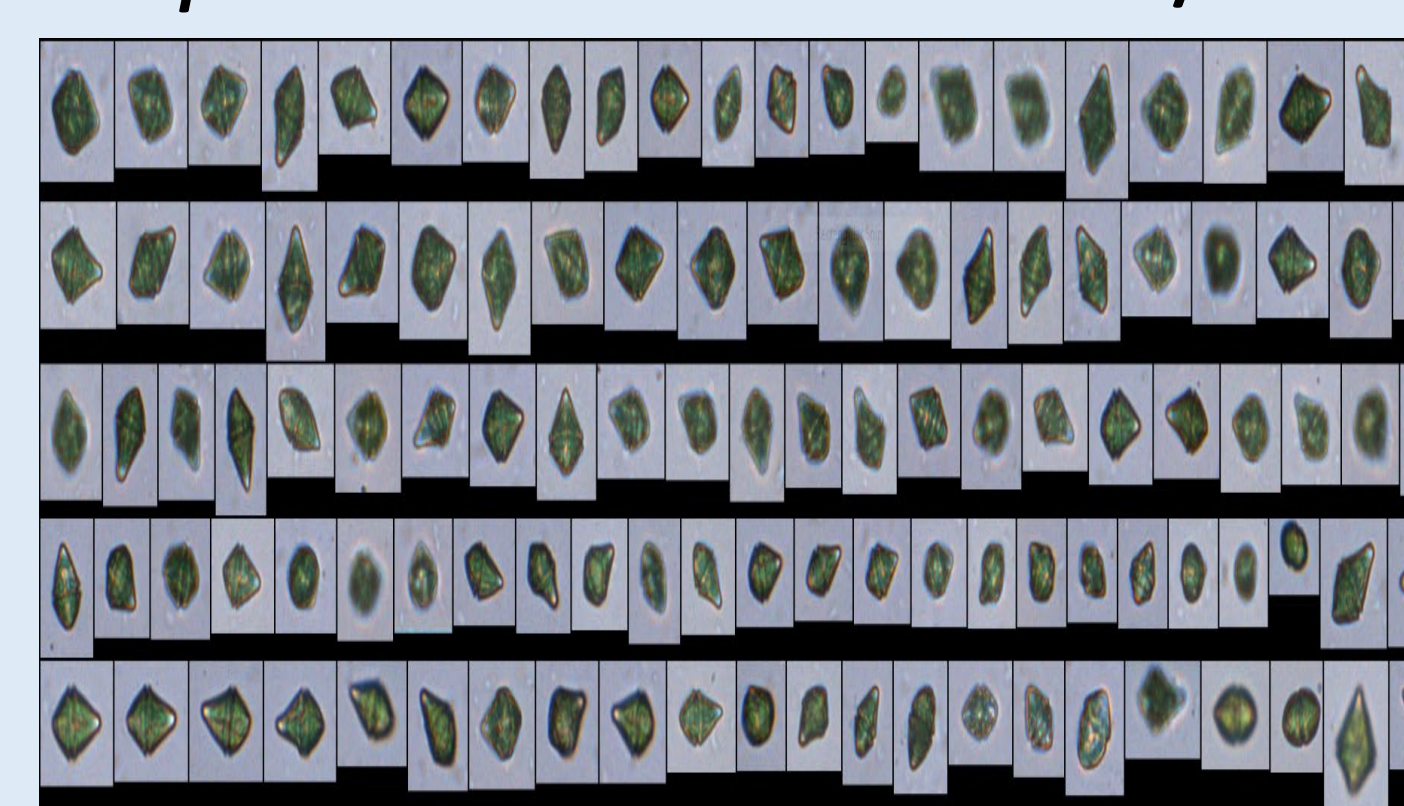
## Trigger Levels Established



*Dolichospermum* > 200/mL



*Aphanizomenon* > 300/mL



*Peridinium* > 500-600/mL

## Lake Arrowhead *Dolichospermum* (formerly *Anabaena*) bloom in 2020

- Reached >11,000 ng/L geosmin within a few days
- Lake treated with copper sulfate and citric acid
- *Dolichospermum* counts immediately declined while geosmin increased as extracellular compounds were released, then fell below detection within a few days

