



Fountain Lake Sustainable Management

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Introduction

- Prema is full service water/wastewater engineering and contracting firm.
- Services:
 - Water/Wastewater Engineering/Design Services
 - Integrated Lagoon Management
 - Including cloud based 24/7 water quality reporting
 - Dredging and Dewatering
 - Integrated Business Solutions



Project Understanding

Short Term:

- Aeration
- Algae Control
- Odor Control
- Marine Life
- Integrated Water/Air Quality Management

Long Term:

- Sludge Management
- Liner Integrity



Aeration Methods

- Fountains
- Floating Surface Aerators
- Paddlewheel Aerators
- Fine Bubble Aeration (ceramic diffuser)
- Ultra-Fine Bubble Aeration (in combination with Biologics)



Aeration: Ultra-Fine Bubble Aeration

- PREMA ultra-fine bubble process increases critical dissolved oxygen levels much more rapidly and to higher concentrations than micro bubble aeration from diffusers, air stones or paddle-wheels. Its bubbles do not rise and escape, but remain available to maintain DO levels for extended periods through Brownian Motion.
- Conventional aeration methods introduce ambient air with an oxygen content of 21%. PREMA UFB process injects 90-95% pure oxygen through the use of oxygen generators.
- University and independent testing has shown PREMA's Process to have over a 90% gas transfer efficiency.
- Over time dissolved oxygen levels can be raised 8 ppm or lot more.



Ultra-Fine Bubble Technology

- Ultra-fine bubbles (UFB's) are extremely small, measuring less than 100 nanometers or 0.1 micron in diameter, and invisible to the naked eye or microscope.
- UFB's are negatively charged and are under extremely high pressure. Accordingly, these bubbles move horizontally in solution (Brownian movement) remaining available to implode, as needed, to maintain maximum gas levels in the solution over time.



Different Types of Bubbles

bubble behaviour



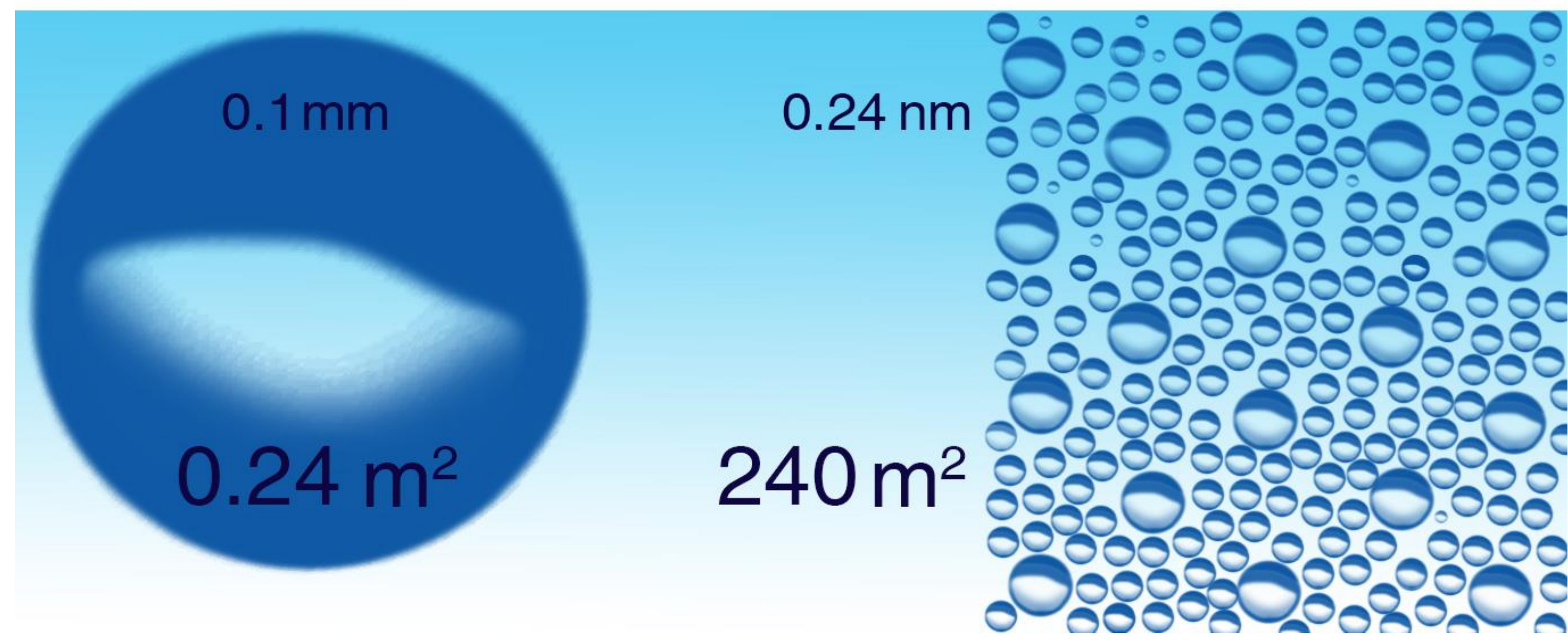
Ultra-Fine Bubble Science

- Surface contact area of UFB's is exponentially greater than larger sized bubbles of similar gas volume.
- Gas pressure inside UFB's is much higher than in larger sized bubbles. For this reason, gas from the imploding bubbles dissolves into solution more rapidly and efficiently than is possible with larger bubbles.
- The increase in the contact area enhances i.e. the aerobic bacteria activities in the liquid by using oxygen gas



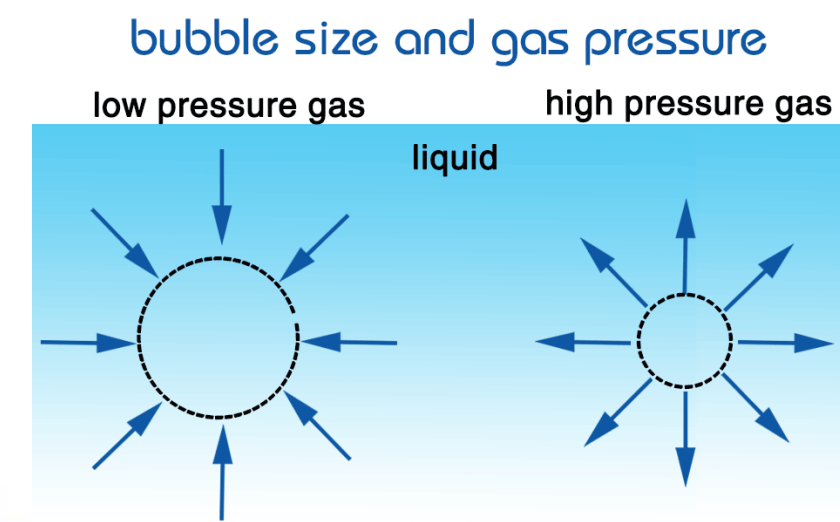
Ultra-Fine Bubble Science

1000x times more surface / ml



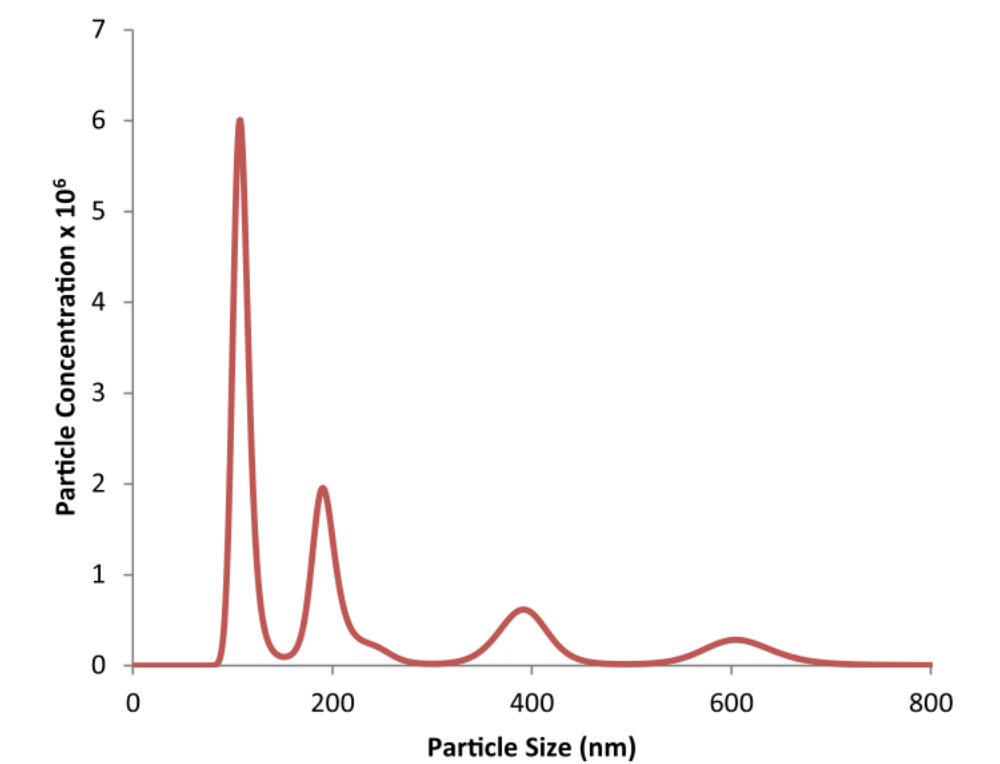
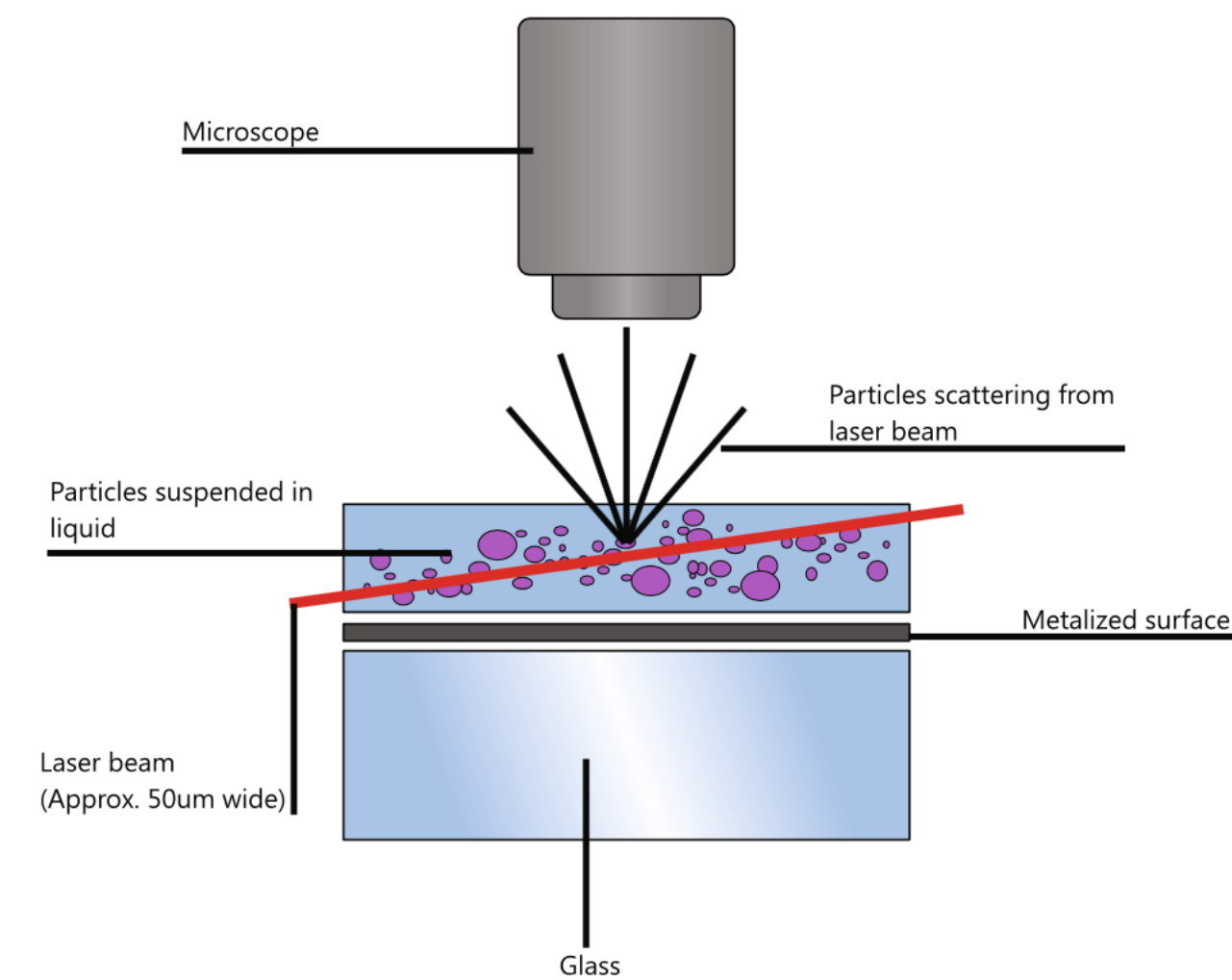
Ultra-Fine Bubble Science

- The gas pressure inside a small bubble is higher than in a large bubble, therefore the surface tension of a small bubble is higher as well. For this reason the gas of a small bubble dissolves quicker than that of a large bubble.
- Small bubble rise slower than large bubbles to the top of the water surface, because of this extra time the gas transport from bubble to liquid is more efficient.
- Small bubble coalescence less (stick less together) than large bubbles, this is beneficial because when bubbles get bigger they raise quicker to the surface giving them less time for gas transport.



Ultra-Fine Bubble Detection

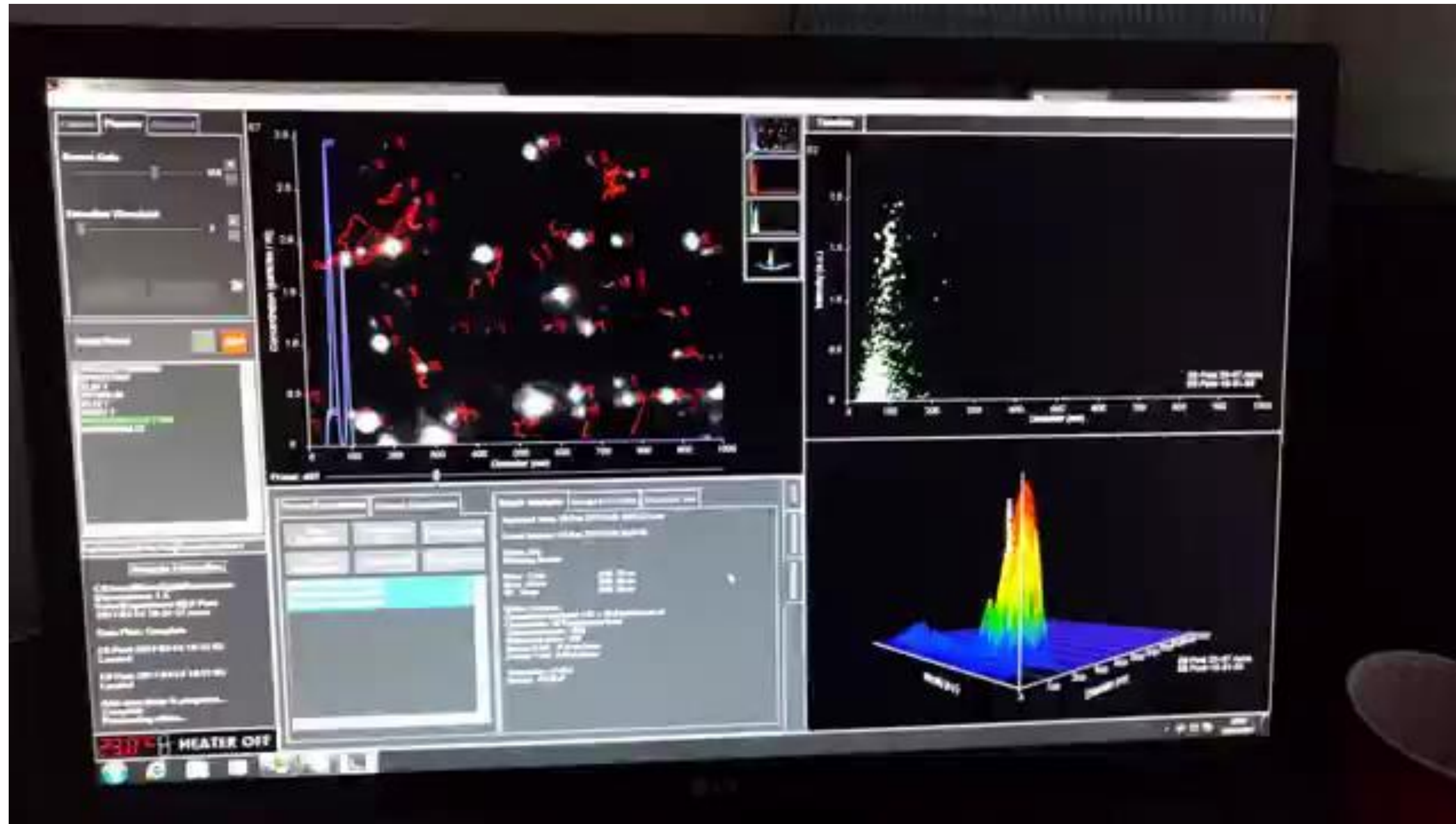
- With particle tracking analysis method using NTA (Nano Tracking Analysis) technology, the Brownian motion of nano particles in liquid can be observed in real time. Because the speed of particle depends on the diameter, the particle size distribution graph of diameter and number of particles can be obtained by measuring the Brownian motion pattern.



Graph of a sample with distinct peaks at 100 nm, 200 nm, 400 nm and 600 nm.



NanoSight Instrumentation



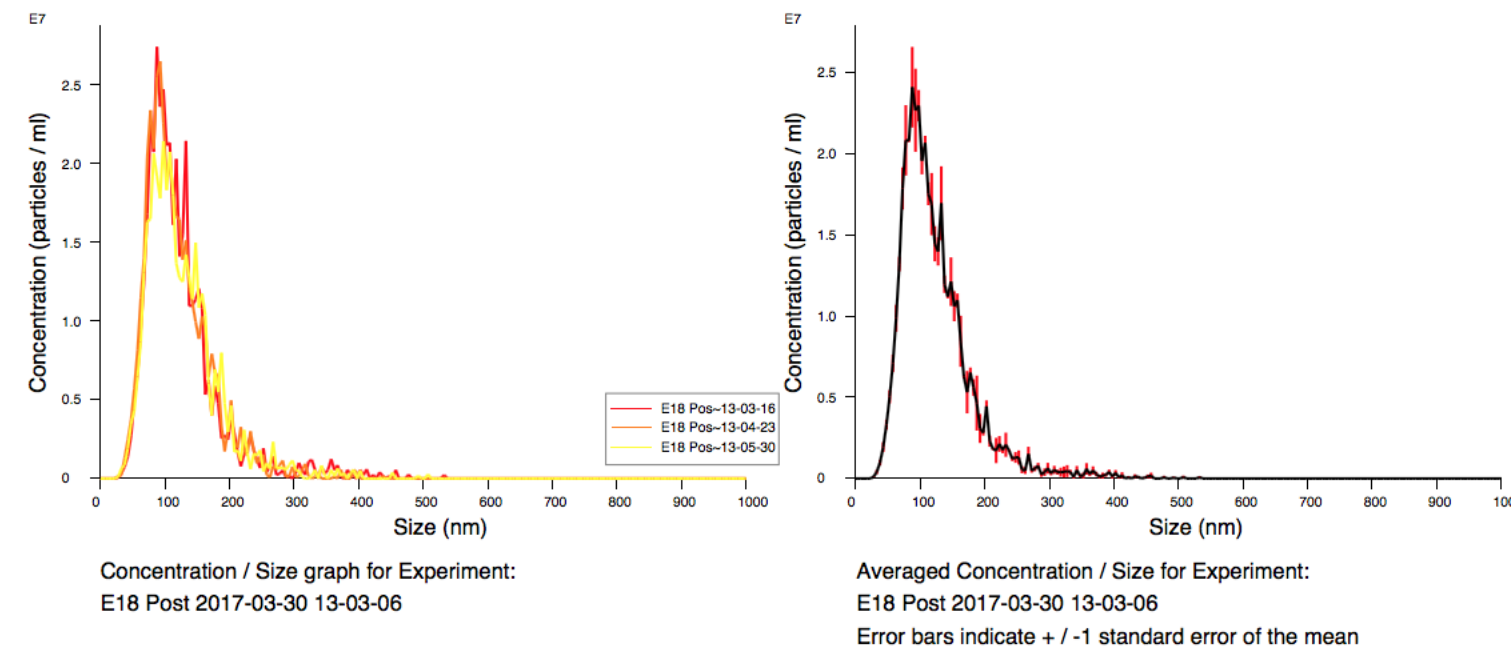
Video showing ultra-fine bubbles measured by a NanoSight particle analyzer detecting an average size of 100 nm (0.1micron) or less.



NanoSight Data

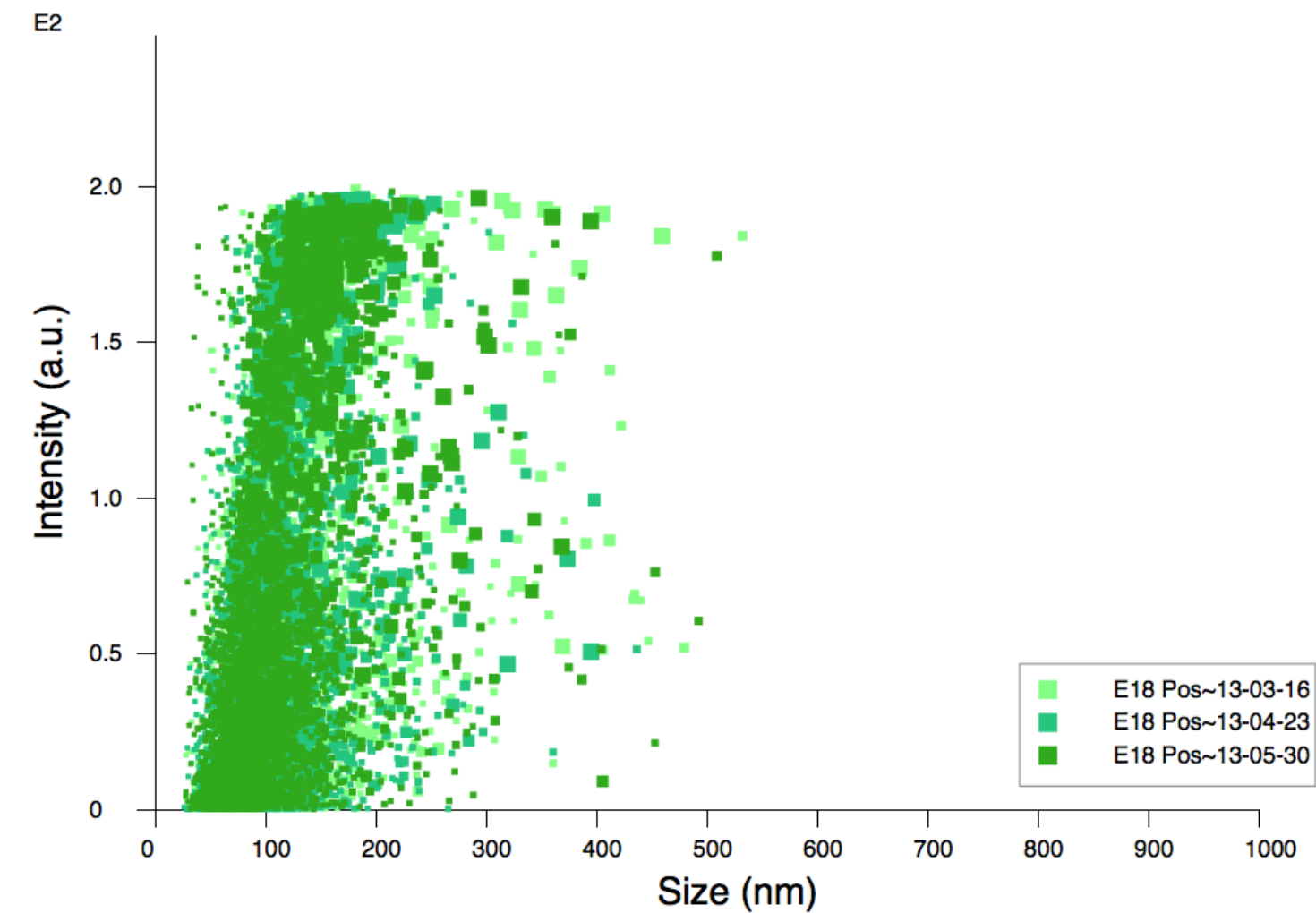
NANOSIGHT

E18 Post 2017-03-30 13-03-06

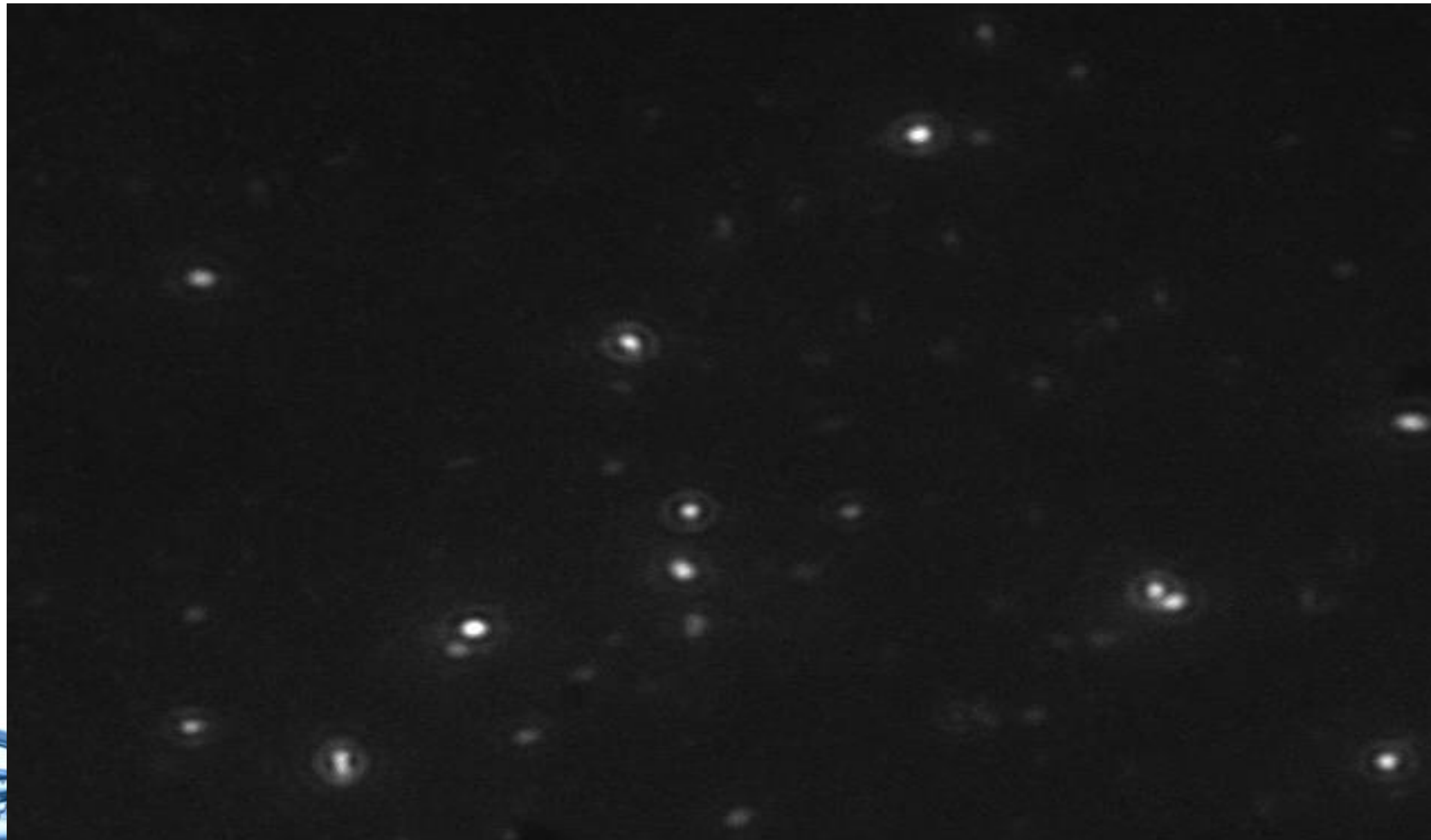


Included Files		Results	
E18 Post 2017-03-30 13-03-16 E18 Post 2017-03-30 13-04-23 E18 Post 2017-03-30 13-05-30		Stats: Merged Data	
Details		Mean:	123.9 nm
NTA Version:	NTA 3.2 Dev Build 3.2.16	Mode:	88.5 nm
Script Used:	Fast Bubbles3x60 No Pump#.txt	SD:	57.1 nm
Time Captured:	13:03:06 30/03/2017	D10:	65.2 nm
Operator:	IH	D50:	105.5 nm
Pre-treatment:		D90:	183.8 nm
Sample Name:	E18 Post	Stats: Mean +/- Standard Error	
Diluent:	DISTILLED WATER	Mean:	124.0 +/- 2.1 nm
Remarks:	E18 Post TANK VALVE O2 0.5 LPM 10 PSI	Mode:	92.3 +/- 2.8 nm
Capture Settings		SD:	56.9 +/- 2.9 nm
Camera Type:	sCMOS	D10:	65.1 +/- 0.8 nm
Laser Type:	Blue405	D50:	105.6 +/- 1.6 nm
Camera Level:	15	D90:	183.7 +/- 2.8 nm
Slider Shutter:	1206	Concentration (Upgrade):	4.26e+008 +/- 9.33e+006 particles/ml
Slider Gain:	366		74.6 +/- 1.2 particles/frame
FPS:	25.0		78.1 +/- 0.4 centres/frame
Number of Frames:	1498		
Temperature:	25.7 - 25.7 °C		
Viscosity:	(Water) 0.874 - 0.875 cP		
Dilution factor:	Dilution not recorded		

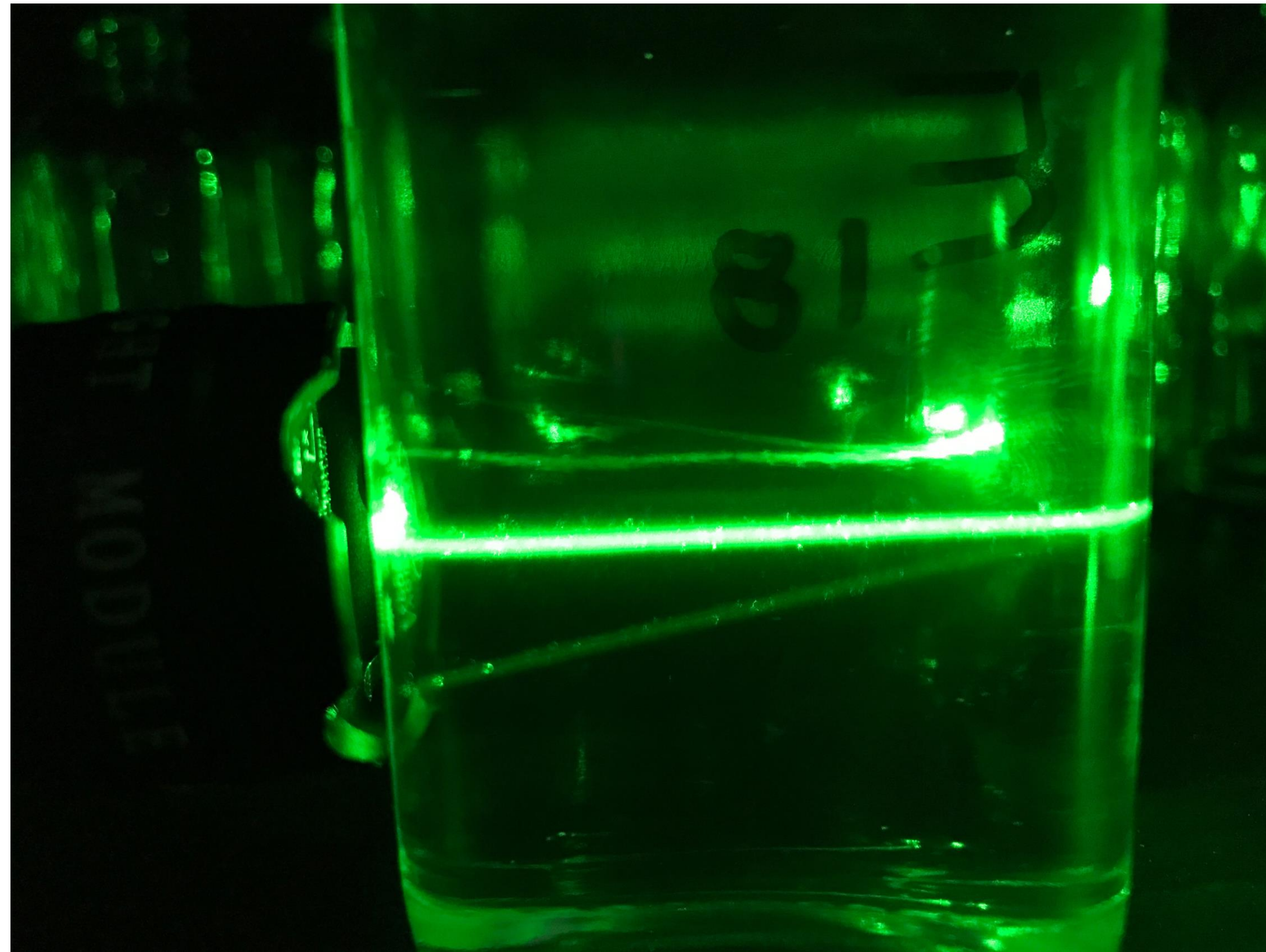
NANOSIGHT







Ultra-Fine Bubble Video



Ultra-Fine Bubble



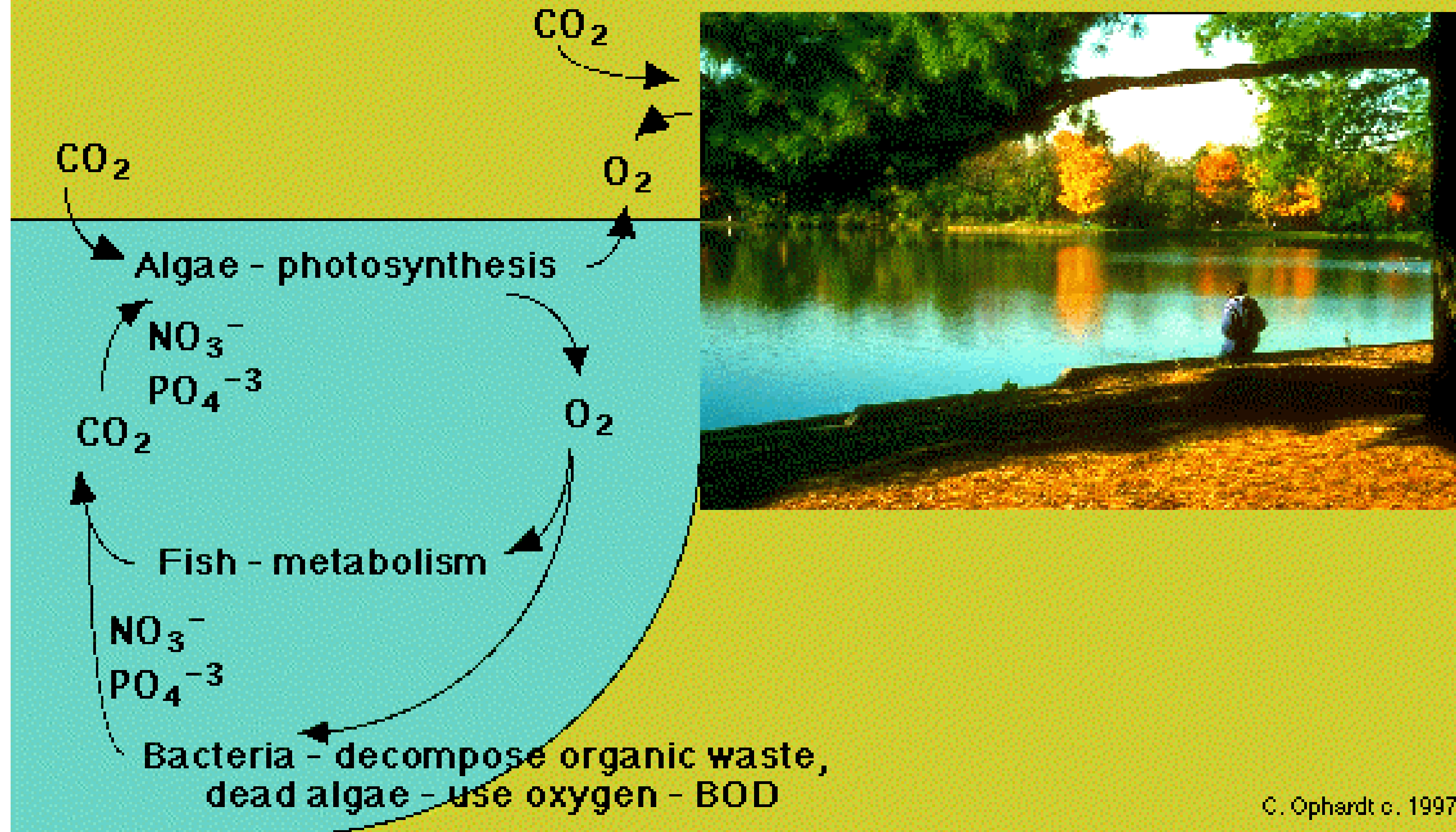
Applications for Ultra Fine-Bubble Technology

Industry	Problems/Opportunities	Solution
 <p>Agriculture</p>	<ul style="list-style-type: none"> • Crop yield maximization • Plant health to resist pathogens • Elimination of detrimental insects 	<ul style="list-style-type: none"> • Increase oxygen at plant roots by delivering ultra-fine bubbles through irrigation systems • 15% to 25% more yield from healthy plants less susceptible to pathogens. • Eliminate harmful insects with foliar ultra-fine CO2 bubble application.
 <p>Swimming Pools</p>	<ul style="list-style-type: none"> • Chemical use/maintenance costs • Algae control • Swimmer experience/health 	<ul style="list-style-type: none"> • Ultra-fine bubble oxygenation reduces the need for supplemental oxidation chemicals • pH control with ultra-fine bubble CO2.
 <p>Aquaculture</p>	<ul style="list-style-type: none"> • Fish stress from low dissolved oxygen • Reduce energy & oxygen costs necessary to support oxygen demand • Increase weight of harvests 	<ul style="list-style-type: none"> • Increase DO levels with ultra-fine bubble oxygenation systems to levels where fish thrive and grow. • Efficient ultra-fine bubble injection reduces energy and costs over alternative technologies.
 <p>Pond Remediation</p>	<ul style="list-style-type: none"> • Algae and Milfoil build up • Odors • Low dissolved oxygen for wildlife 	<ul style="list-style-type: none"> • Increase oxygen levels with long lasting ultra-fine bubbles, naturally mitigating algae and milfoil and eliminating the odors their decomposition causes.

Lake and Lagoon Management



Natural Biochemical Cycles

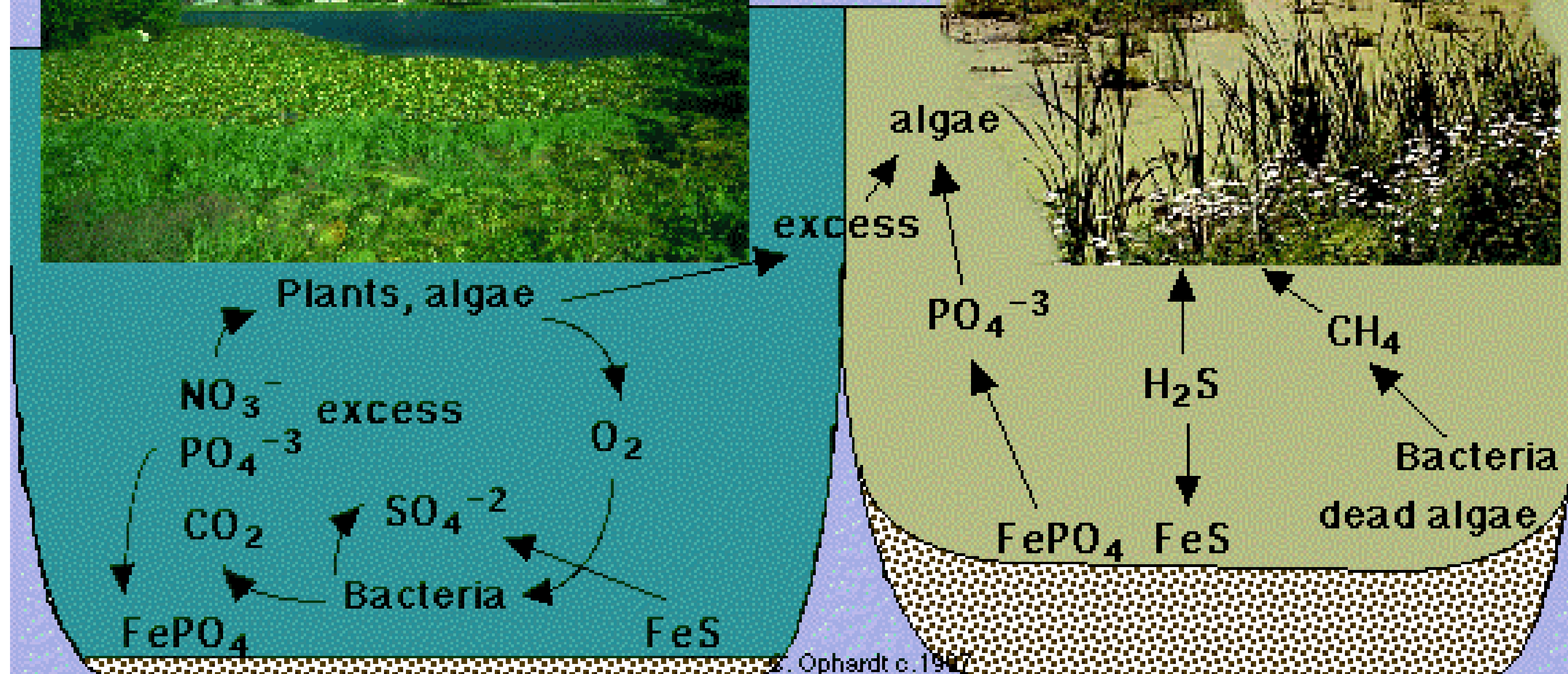


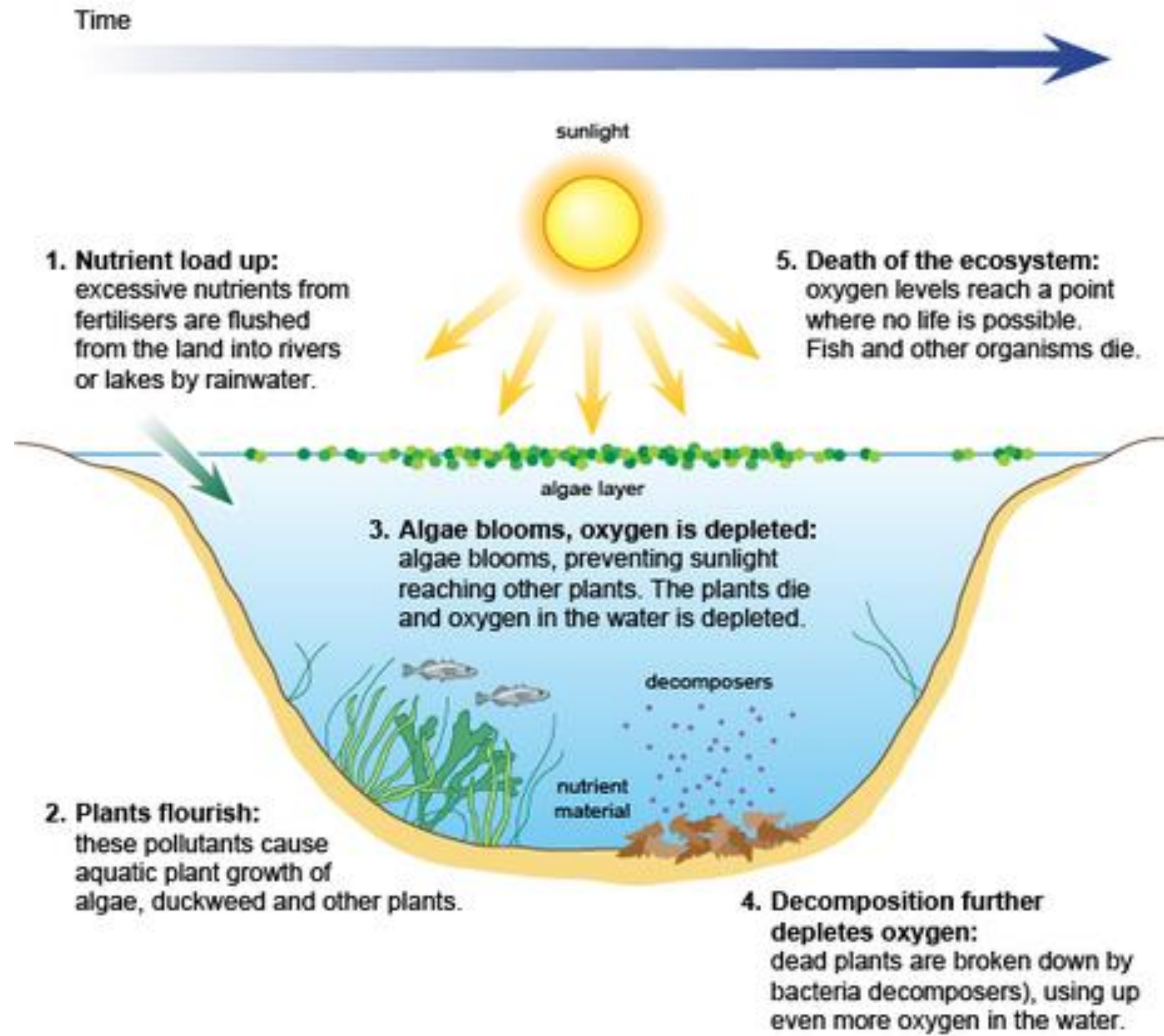
Eutrophication

Aerobic - oxygen



Anaerobic - No oxygen





Advantages of Ultra Fine Bubble Generators

- Customized Approach
 - Biologics
 - Oxygen based on demand
- Plug and Play System
 - Small footprint
 - Low maintenance
 - Solar unit option if applicable
- Chemical Free
 - Assist nature in returning the body of water to a natural ecological balance



Examples of Field Equipment



Projects Utilizing UFB Technology



Spider Lake Springs, Qualicum British Columbia



- Four connecting lakes
- Community fishing & swimming
- Milfoil & algae buildup



Before



After



Lake Ida Anne, Langford, British Columbia



- Low oxygen levels
- Major algae bloom
- Fertilizers, contaminants
- Bear Mountain waterways



Before



After



Lake Apopka, Florida

- Two tests were conducted in 2016 to show effectiveness of technology
 - 500,000 gallon lake water pond
 - Increased dissolved oxygen from 2 ppm to 15 ppm
 - Decreased muck level by 4 feet in 2 months
 - No loss of marine life
 - Open canal test
 - Increased dissolved oxygen in areas up from 4-5 ppm to 15 ppm



Lake Apopka, Florida



Lake Apopka, Florida



Lake Apopka, Florida



Plant City, Florida



Plant City, Florida



Chandler, Arizona



Sludge Management using Microbes

- The health of surface waters is damaged by run-off containing fertilizers, effluent, toxic chemicals, and invasive plants causing an imbalance in the biome.
- Introduction of the appropriate microbes, over time, assist nature in returning the body of water to a natural ecological balance. Biologics restore the natural biome of the aquatic environment.
- Negative effects of phosphates, nitrates and other chemicals are ameliorated.
- The unhealthy non-contributing sediment becomes a part of the successful transition to a healthy biome.

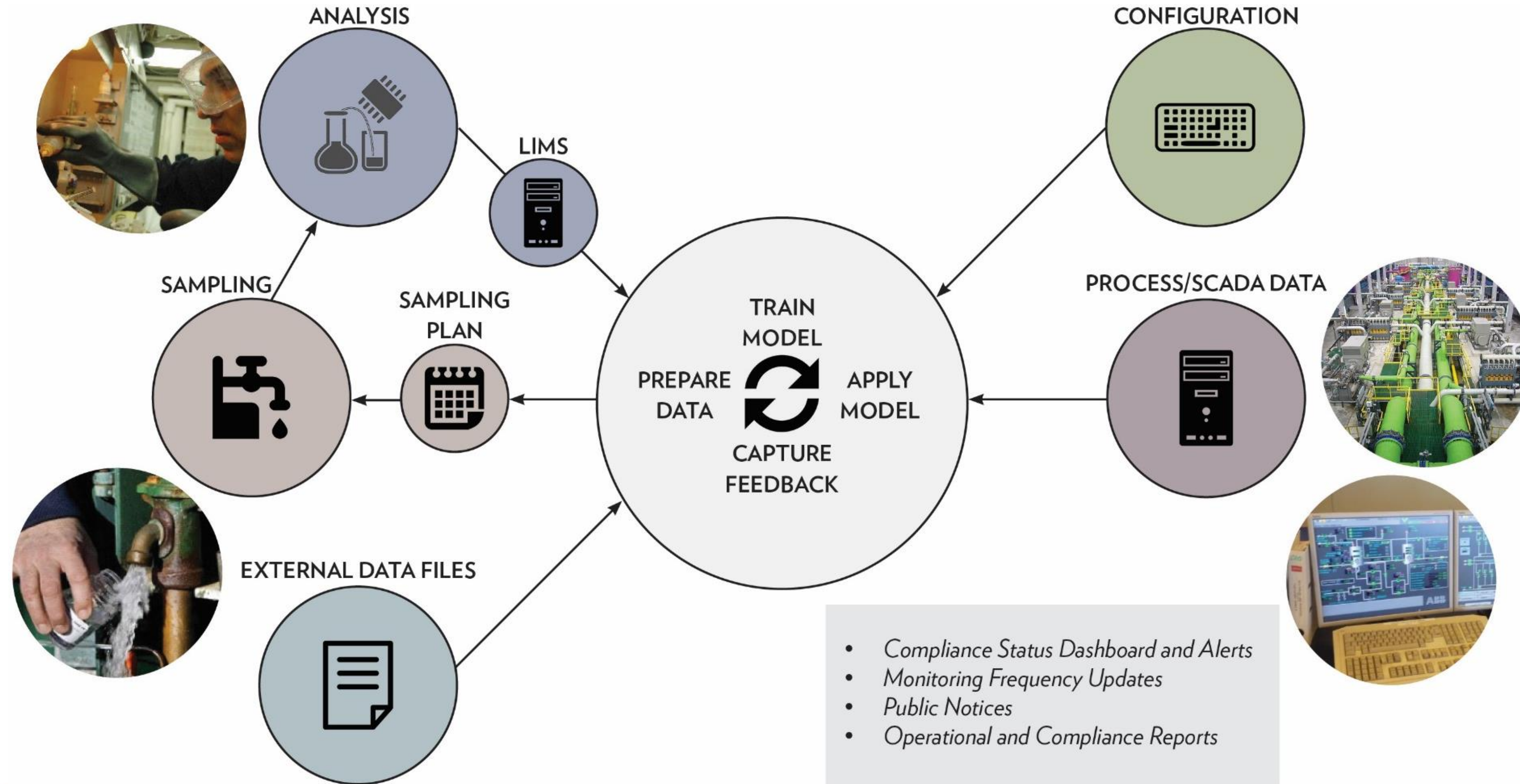


Sludge Management using Microbes

- Oxygen treatment of ponds and lakes with UFB technology will eliminate algae and other invasive plant materials and will improve water clarity. The odor caused by decaying materials will disappear as the oxygenated water encourages beneficial microbe growth.
- Oxygen combined with inoculation of appropriate customized biologics hastens the repair of damaged surface water. Aerobic bacteria need oxygen to thrive and multiply. UFB's oxygenation technology maximizes the impact of customized biologics.



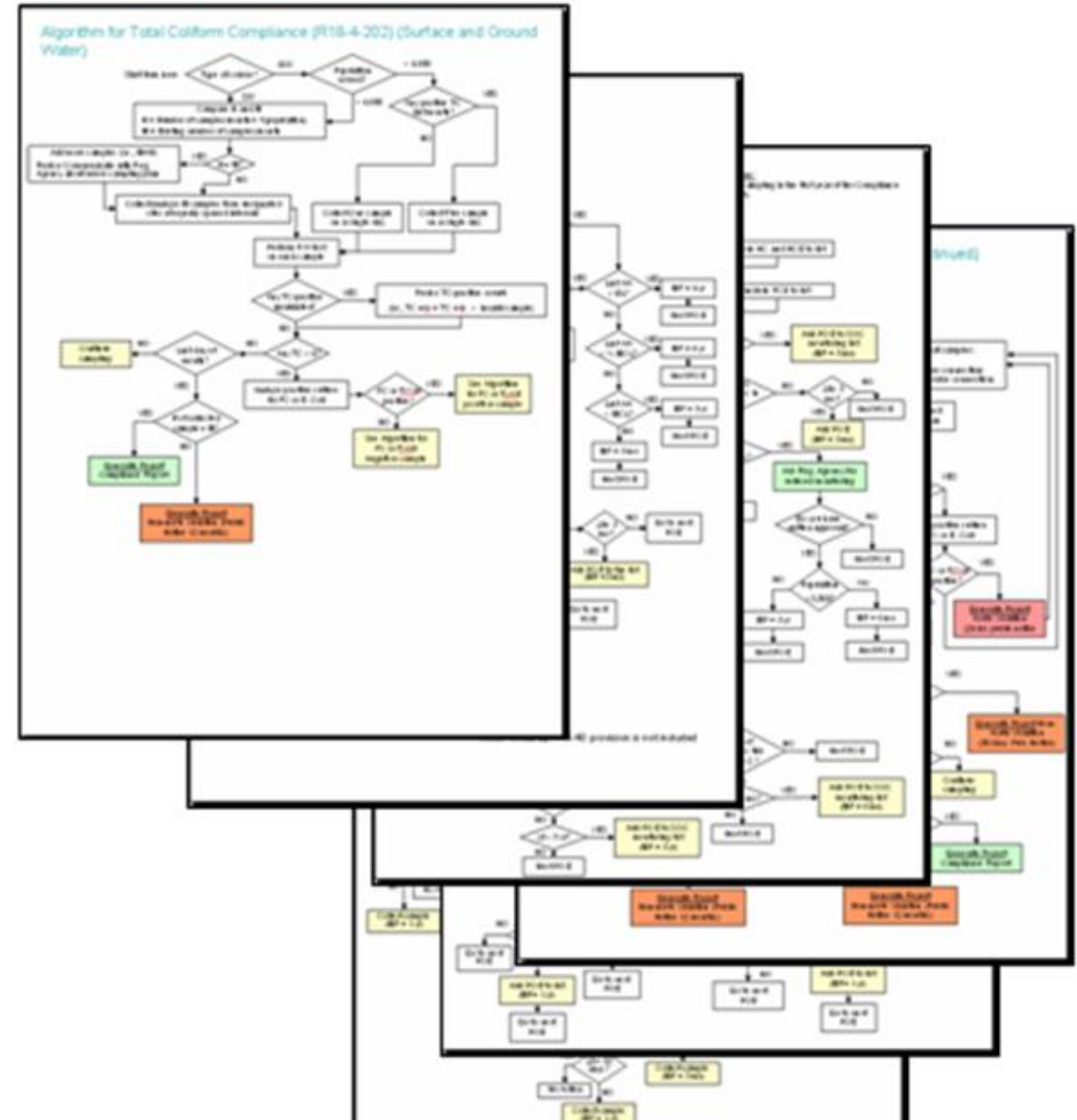
Water Quality Management



Water Quality Management

Drinking water regulations:

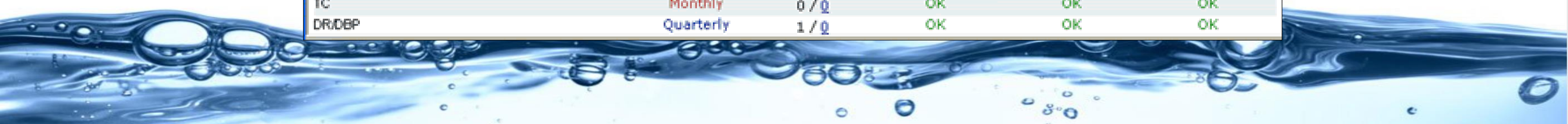
- Total Coliform (R18-4-202)
 - Inorganic (R18-4-206)
 - Asbestos(R18-4-207)
- Nitrate (NO₃⁻) (R18-4-208)
- Nitrite (NO₂⁻) (R18-4-209)
 - VOC (R-18-4-212)
- Vinyl Chloride (R18-4-213)
 - SOCs (R18-4-216)
 - Radiochemicals
 - IESWTR
 - D/DBPs (R18-4-214.02)
- Disinfection Residual @ POE (R18-4-303)
 - MRDLs (R18-4-214.02)
- TOC Removal (R18-4-301.02)
- Lead and Copper(R18-4-310)



Water Quality Management

SYSTEM DASHBOARD

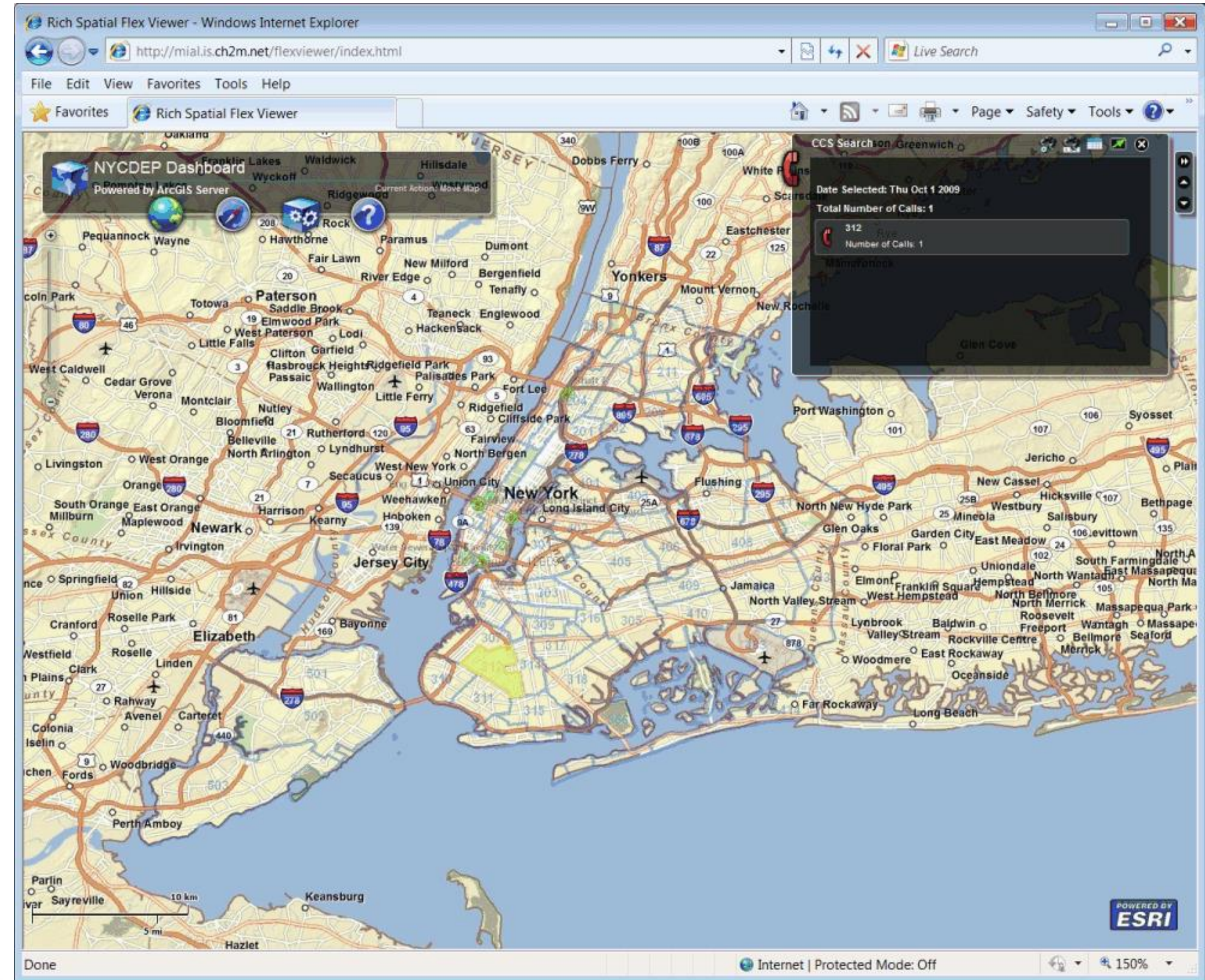
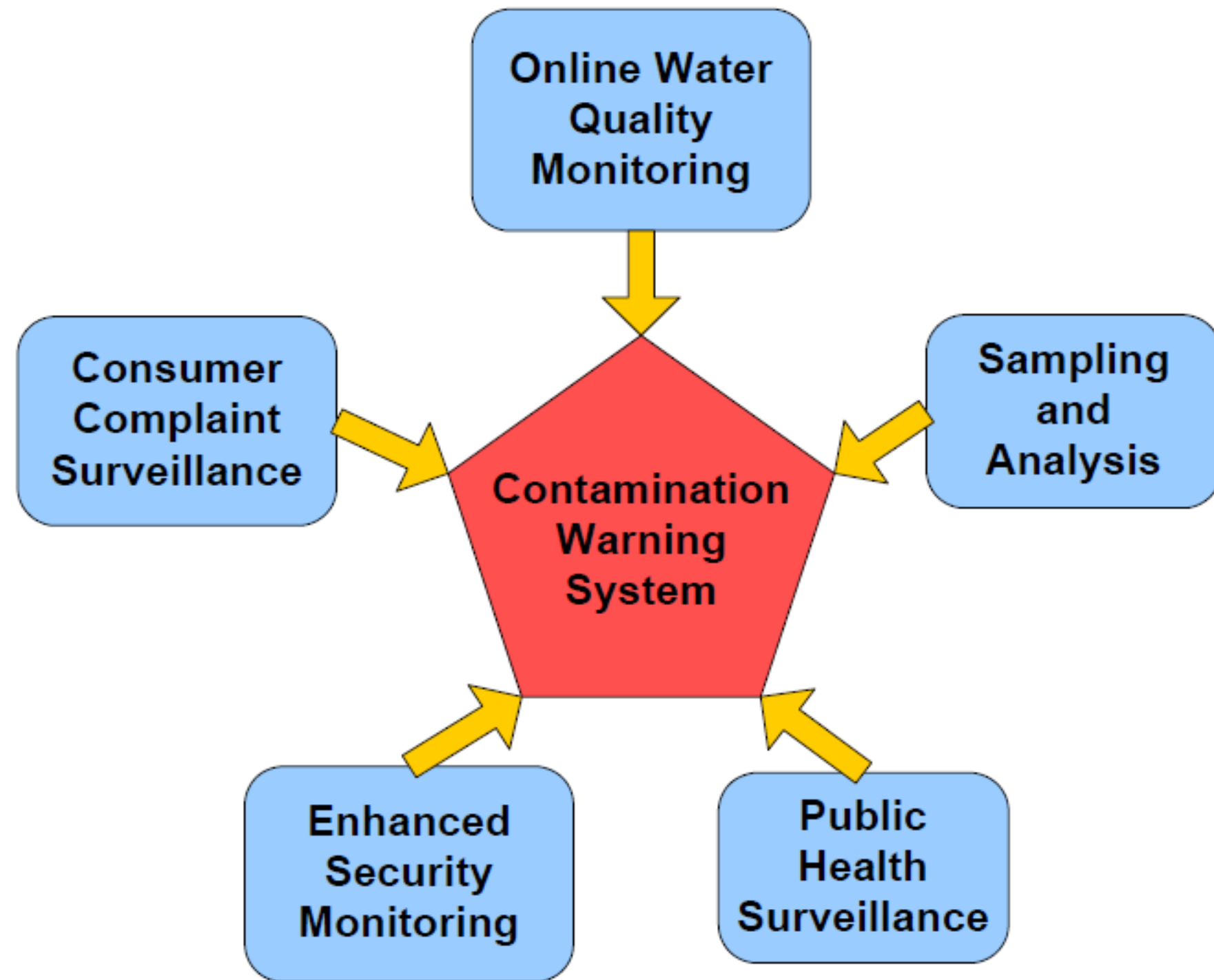
Monitoring Reporting Administration External Links Logout					
Compliance Summary: Dec 2005 Select Month					
Phoenix Municipal					
Regulation	Tracking Frequency	Sampling Tracking	Monitoring Compliance	MCL/TT Compliance	Reporting Compliance
DR@POE	Monthly	NA	OK	OK	OK
L&C	Monthly	0 / 0	OK	OK	OK
MRDLs	Monthly	0 / 0	OK	OK	OK
SMTR/MESWTR	Monthly	NA	OK	OK	OK
TC	Monthly	0 / 0	OK	OK	OK
TOC	Monthly	0 / 0	OK	OK	OK
Asbestos	Quarterly	1 / 0	OK	OK	OK
DR/DBP	Quarterly	48 / 0	OK	OK	OK
Inorganic	Quarterly	13 / 3	OK	OK	OK
Nitrate (NO3-)	Quarterly	1 / 1	OK	OK	OK
Nitrite (NO2-)	Quarterly	1 / 0	OK	OK	OK
Radio-α	Quarterly	0 / 0	OK	OK	OK
Radio-β	Quarterly	0 / 0	OK	OK	OK
SOCs	Quarterly	34 / 0	OK	OK	OK
VOC/VOC	Quarterly	21 / 0	OK	OK	OK
Rigby Childers					
Regulation	Tracking Frequency	Sampling Tracking	Monitoring Compliance	MCL/TT Compliance	Reporting Compliance
L&C	Monthly	0 / 0	OK	OK	OK
TC	Monthly	0 / 0	OK	OK	OK
DR/DBP	Quarterly	1 / 0	OK	OK	OK



Water Quality Management

ALGAE EVENT

SYSTEM DASHBOARD



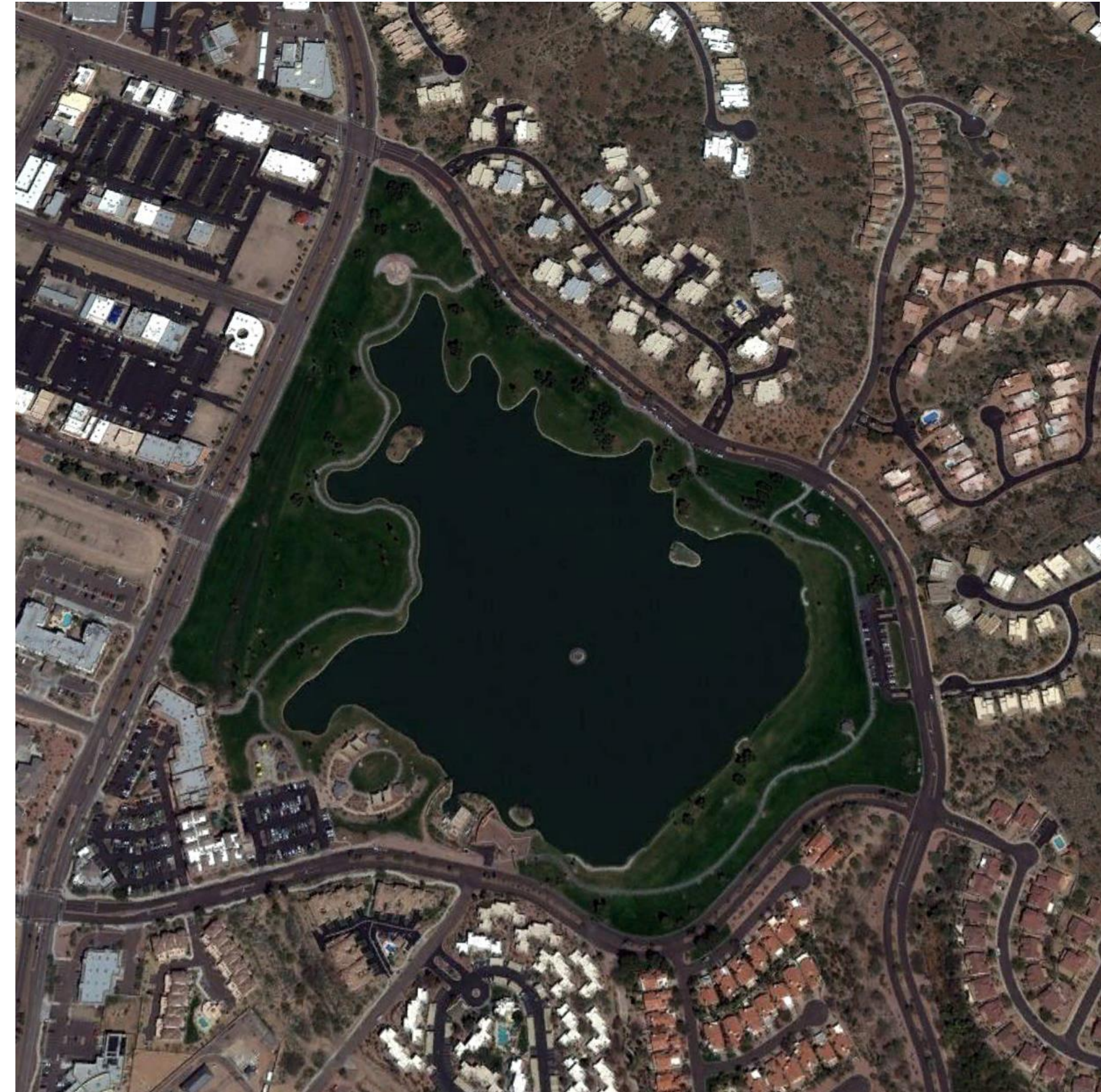
Sludge Management/Liner Integrity

- Dredging Operation: Prema has full service dredging capabilities and have done lined pond dredging in AZ
- Prema could also provide lake liner integrity testing and create a baseline for liner integrity.



Prema Solutions:

- **Study to understand water quality /sludge data including drawdown curve of the fountain**
- **Installing UFB units with pure Oxygen around the Ponds ensuring drawdown zone has positive ORP**
- **Introducing microbes to stabilize the sludge**
- **Installing UFB with Ozone at the lake intake to ensure treatment of incoming reclaimed water**
- **Installing water quality sensors in the lake and air quality sensor around the lake to have 24/7 monitoring of the lake**
- **Study need for dredging and dewatering**





Sustainable Management for Fountain Hills Lake

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