How Anti-Fouling Works

Principles and Practice in Water Quality Monitoring

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Curtis Butler, Application Specialist

BACKGROUND

- 14 years at YSI
- Started in Repair and Technicial Support Departments
- Now an Application Specialist, supporting sales and customers
- Maintains sites in coastal environments

Kerry Hubbard, Outdoor Water Monitoring Specialist

BACKGROUND

2 years at YSI as a Product Specialist for Outdoor Water Quality

>10 years of field experience with water quality and flow monitoring

Maintains a site in freshwater urban environment

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We'll try to answer as many as we can during the presentation

Chat
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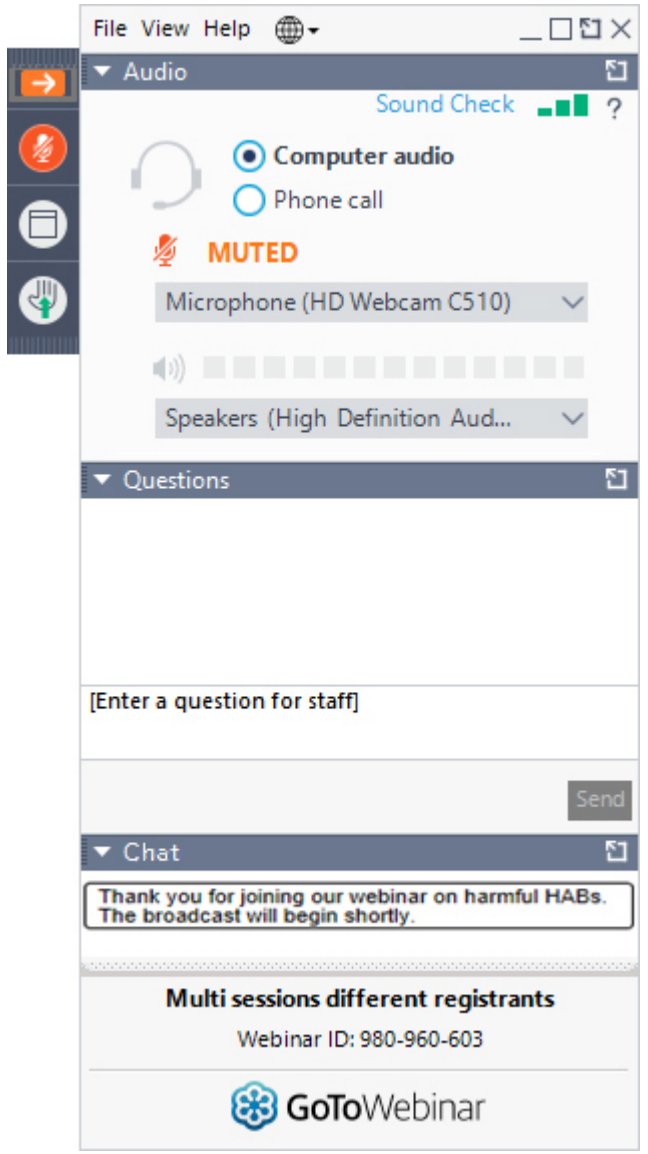

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Please Ask Questions!

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Agenda

- Freshwater Fouling
- Marine Fouling
- Evolution and Principles of Antifouling Technology
- Recommended Cleaning Procedures

Which environment do you work in?

Freshwater Fouling

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Fouling Types

Fouling will change dependent on site:

- Soils
- Leaves/Debris
- Fish/Invertebrates
- Algae
- “Urban Scum”

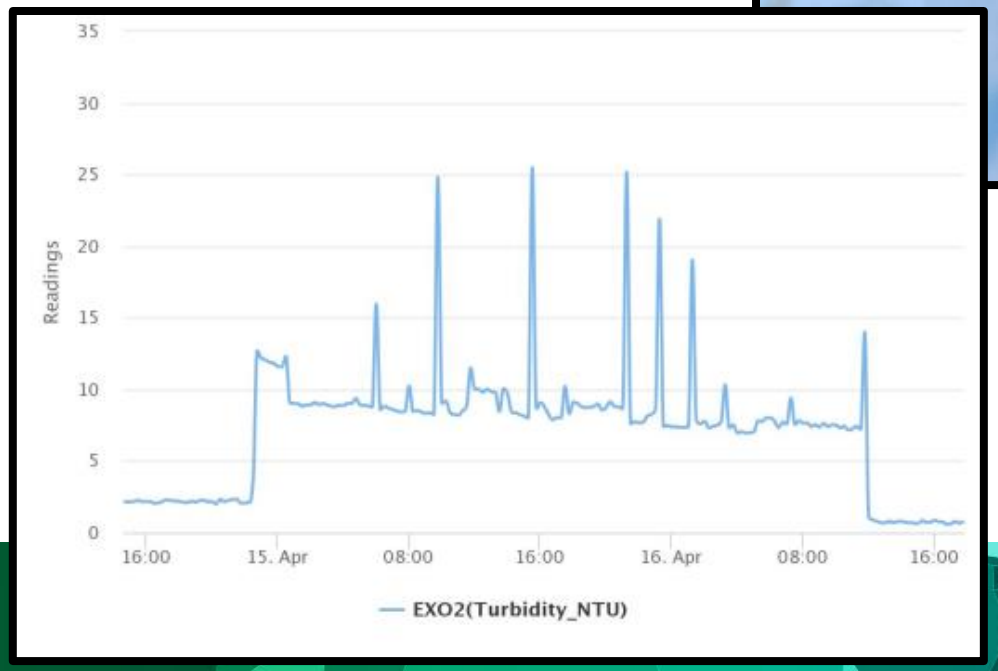
Each fouling source can have a different effect on data!

Fouling Type: Soils

- Sands, Silts, Clays
- Different types suspended depending on flow
  - Storms have higher velocity → carry larger particles
  - Baseflow has lower velocity → carry smaller particles
- Some soils can “stain” sensors causing erroneous readings

Fouling Type: Leaves & Debris

- Caused by:
  - Storm Flow
  - Season Change
- Predominantly affects optical sensors but can affect all sensors if sonde guard is full

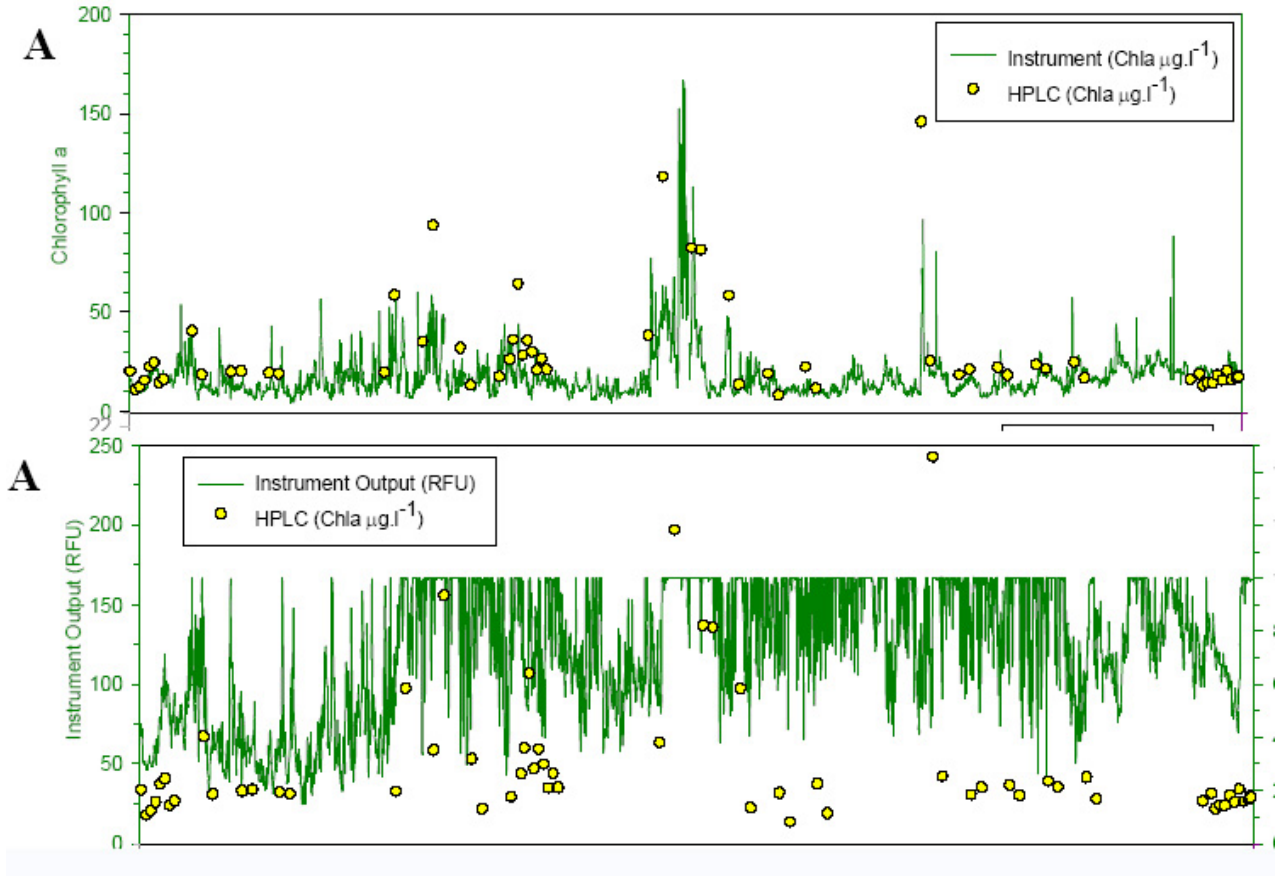


Fouling Type: Animals

- Sonde guard and pipe can be a nice home for many creatures
- Small animals that fit inside cause spikes in optical sensors
- Worms and larvae can fit inside non-wiped conductance sensors
- Birds and mammals can cause spikes when migrating through area

Fouling Type: Algae

- Filamentous algae can attach to sonde guard or deployment tube
- Biofilm can also grow on sensor faces and prevent light from sensors getting through
- Copper keeps organisms from growing



Fouling Type: “Urban Scum”

Urban Scum: Things that come out of a sewer or things that have been improperly disposed.

- Solids like toilet paper or diapers
- Trash like plastics, cans, cigarettes
- Films caused by fats, oils, greases

These items can cause spikes in data or gradually foul sensors causing a slow drift in data.

Marine Fouling

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Fouling Types

Fouling will change dependent on site:

- Barnacles
- Bryozoans
- Animals
- Sea Plants

REMINDER:

Each fouling source can have a different effect on data!

Fouling Type: Barnacles

- As little as 1 minute, conditioning begins!
- As little as 1 hour, biofilms are laid down!
- As little as 1 day, colonization can occur!
- As little as 2 weeks, Barnacle Growth!!

We need to take measures to combat this growth!

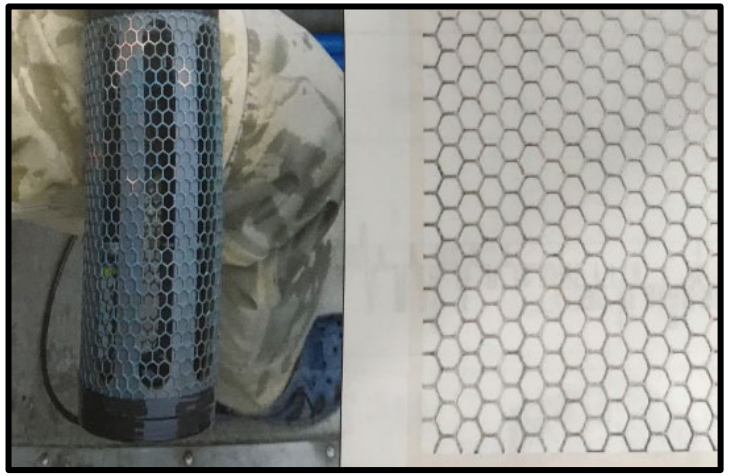
Fouling Type: Bryozoans

The EXO Central Wiper has done well against this Bryozoan:

Fouling Type: Animals

- Fish, crabs, and other sea creatures might seek the safety of your sensor guard

- You may need to cover the sensor guard with copper mesh



Fouling Type: Sea Plants (Pre-deployment)

Fouling Type: Sea Plants (Post-Deployment)

What is Most Important?

Evolution and Principles of Antifouling Technology

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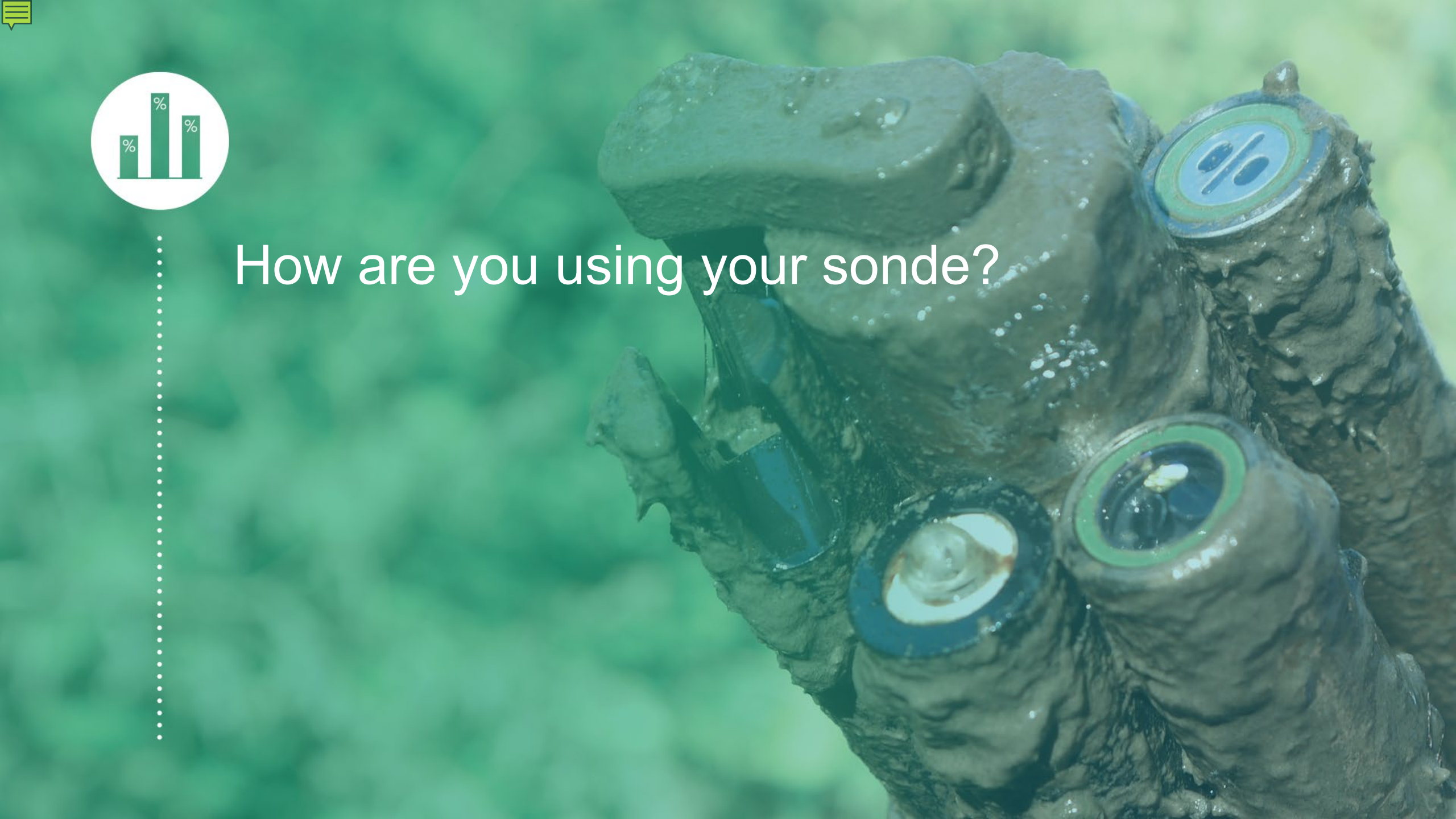
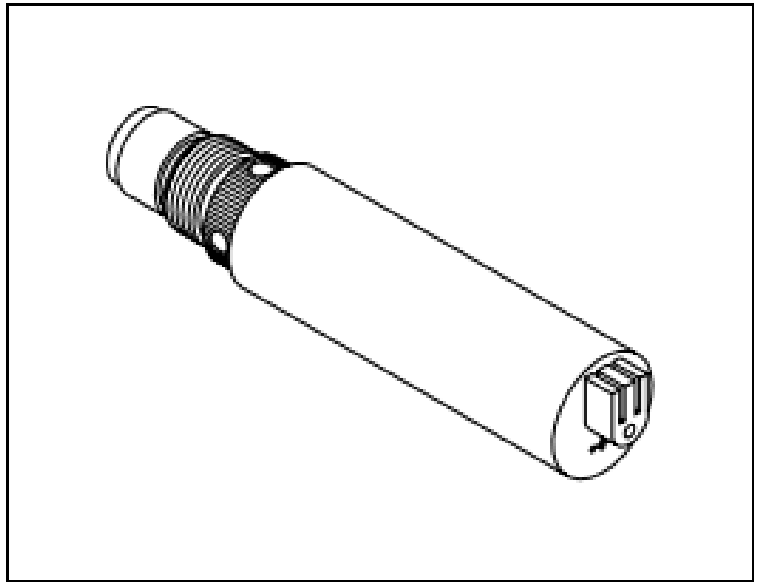
How are you using your sonde?



Early Technology in Continuous Monitoring

YSI 6000 Sonde

- Only wiped sensor: Turbidity
- No other optical sensors
- Required frequent servicing for cleaning



Early Technology in Continuous Monitoring

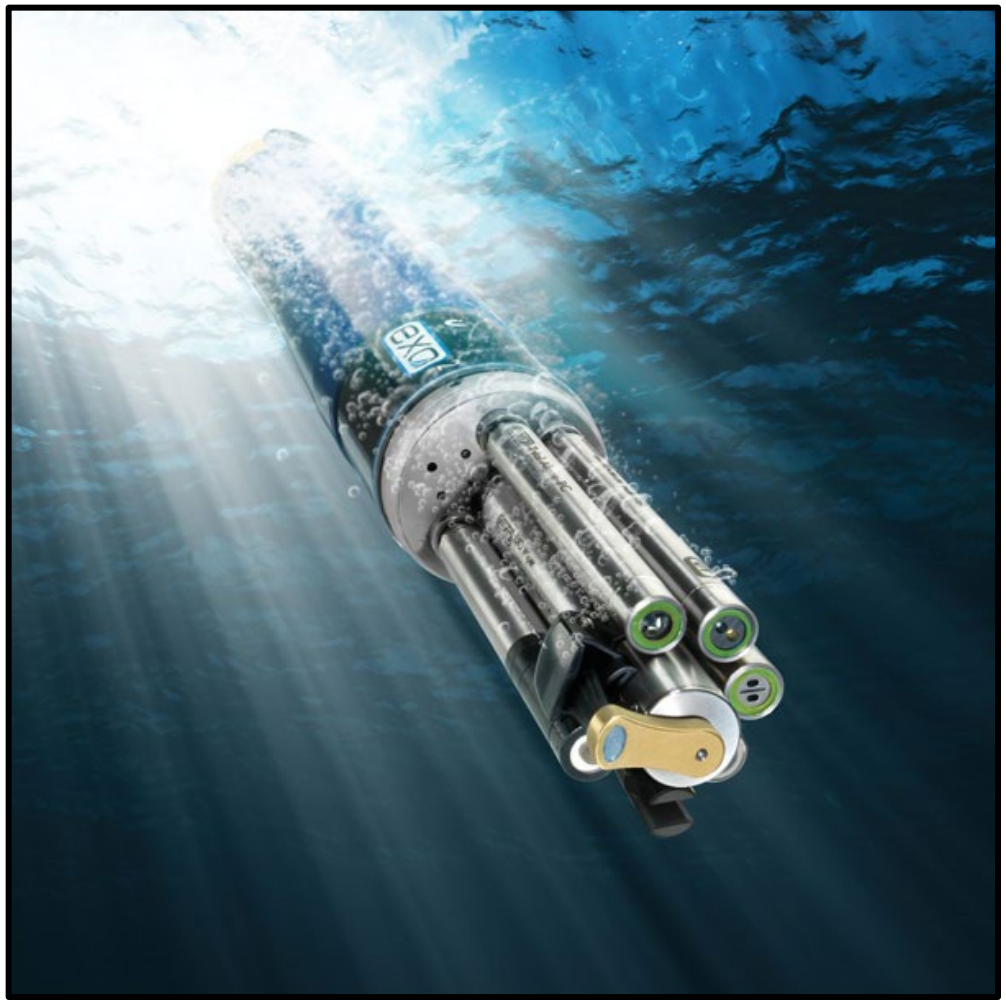
Later: 6-Series Sondes

- More individually wiped sensors
  - Turbidity, Algae, Dissolved Oxygen, Rhodamine
- Addition of copper as antifouling tool
  - Copper sonde guards
  - Copper sensors
  - Organisms have a hard time attaching to copper components and copper is also toxic to some!

Current Technology in Continuous Monitoring

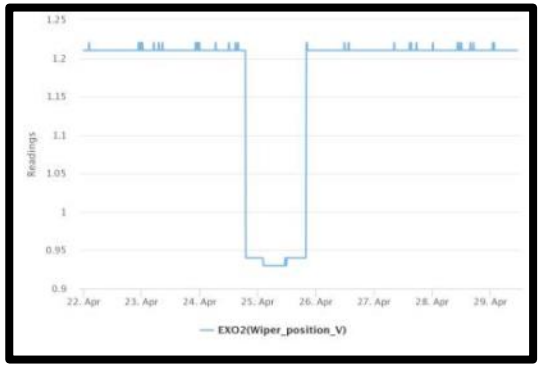
EXO Series Sondes

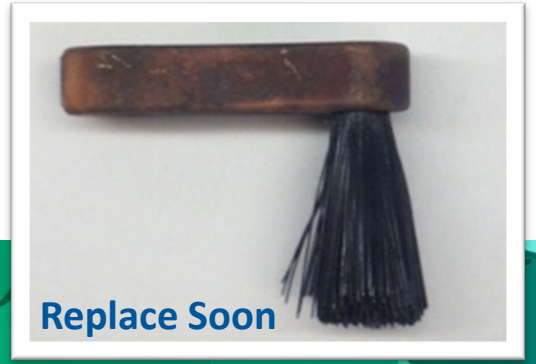
- Powerful central wiper
  - Wipes ALL sensors
- Sensors specifically designed to be wiped
  - All sensors on same plane
  - Wiped CT
  - Unguarded pH/ORP and ISE's
- Old and new antifouling tools
  - Antifouling sleeves for sonde and sensors
  - Copper tape
  - Copper sonde guards



EXO Central Wiper Brush

- Wipes all sensors to remove fouling
- Parks in a “Parking Garage”
  - Monitor wiper position
  - Wiper position should be around 1.20V
- Wiper brush may need replaced!
  - Fray caused by:
    - General wear wiping sensors
    - Sediment entrapment
    - Biological growth





Other Technology Used for Antifouling

Flow-Through Chamber:

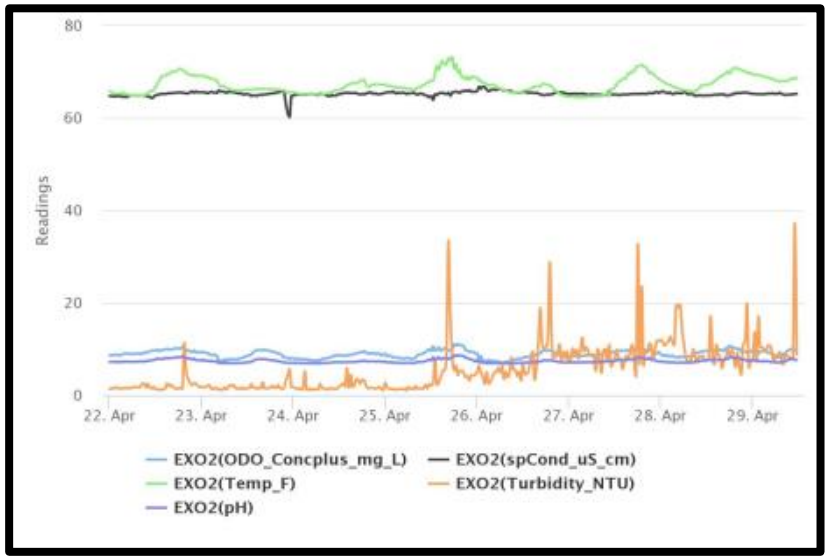
- Pump water into flow cell or tub from body of water
- Strainer on end of tubing in water

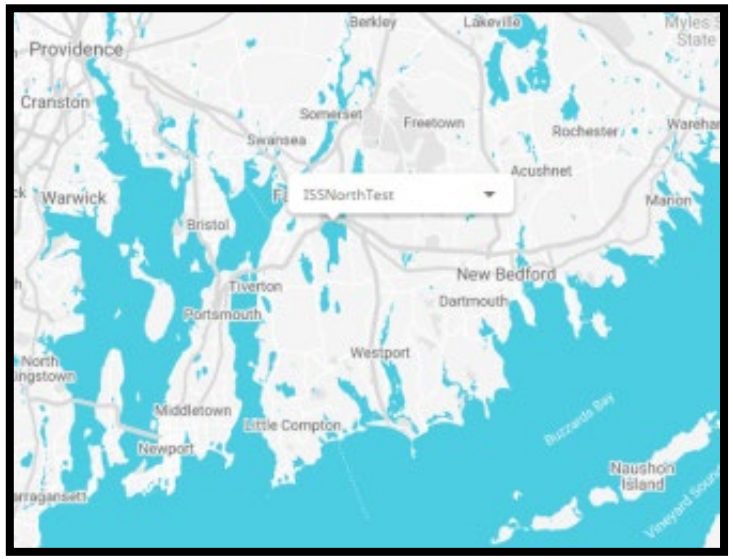
Other Technology Used for Antifouling

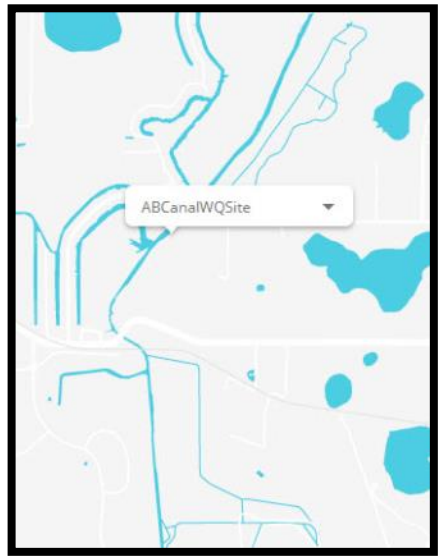
Equipment provided by third party manufacturers:

- Ultraviolet light
- Air burst

Remote Monitoring







Data available *anywhere* and *anytime*, 24/7

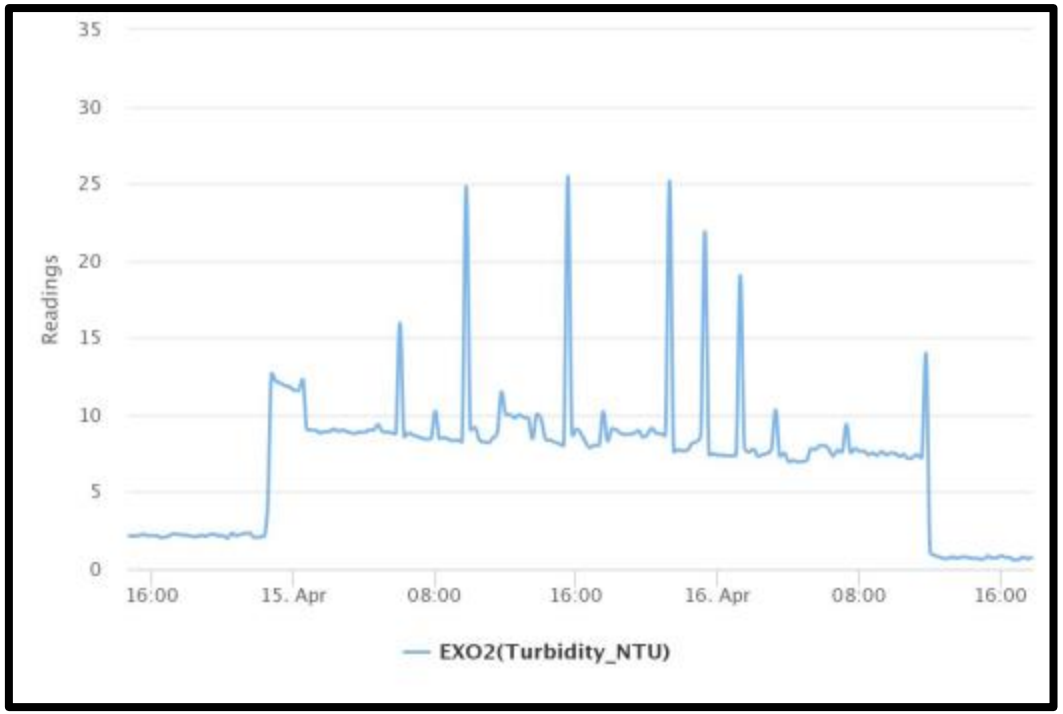
Easy connection to telemetry system

Real-time data assistance:

- Alarms warn if a threshold is met
- Alerts let you know if a site stops transmitting

Remote Monitoring Example: Alarm for Fouling

- Turbidity fouling at this site is typically anything greater than 3 FNU
- Set an alarm for:
  - Turbidity greater than 30% of average of last 96 samples
  - AND Water Level less than 1.95 feet



Recommended Cleaning Procedures

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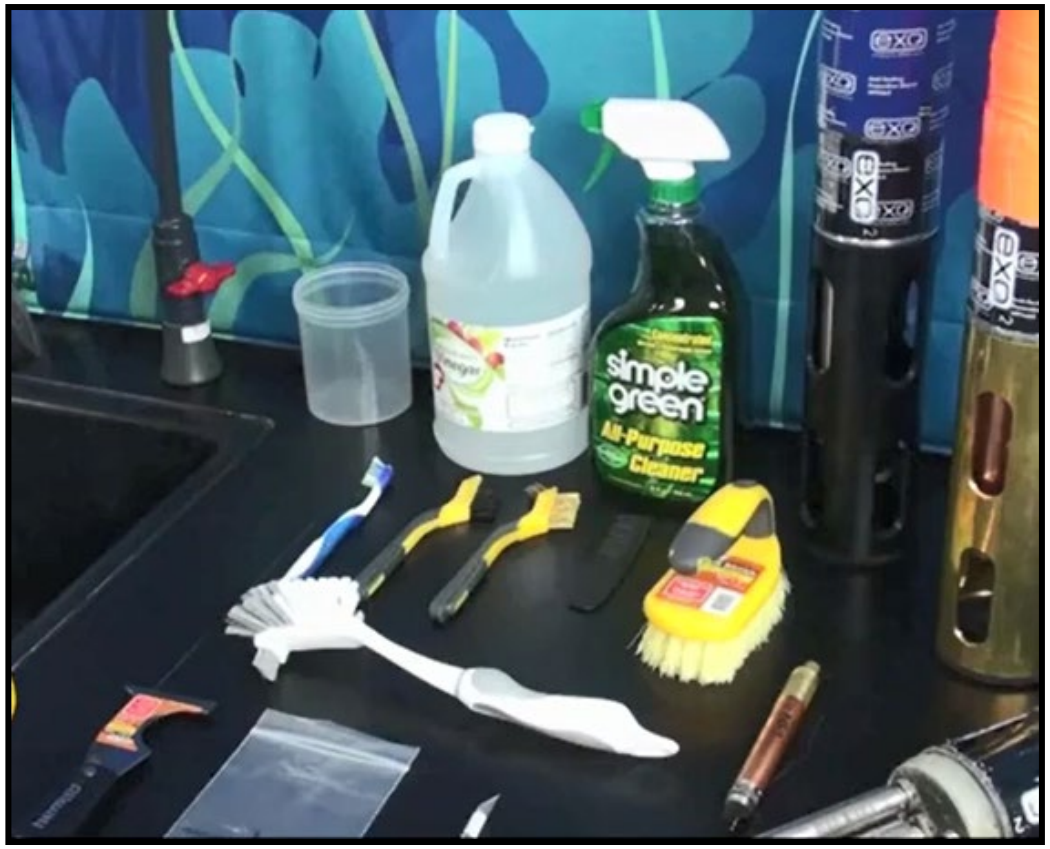
What is your typical deployment length before servicing your sonde?

Fouling Field Kit

Common items found in a field trip kit:

- Lint free cloths
- Sponges
- Hard bristle brushes and/or toothbrushes
- Toilet bowl brush
- Scraping tool for hard growth
- Cotton swabs
- Brush kits that come with sensors
- Mild soap and clean water
- Spare O-rings and Krytox grease
- Sonde & sensor sleeves/duct tape/copper tape
- Sensor wrenches



Removing Hard Growth

- Use scrapers to remove growth as needed
- Soak equipment in vinegar, if needed

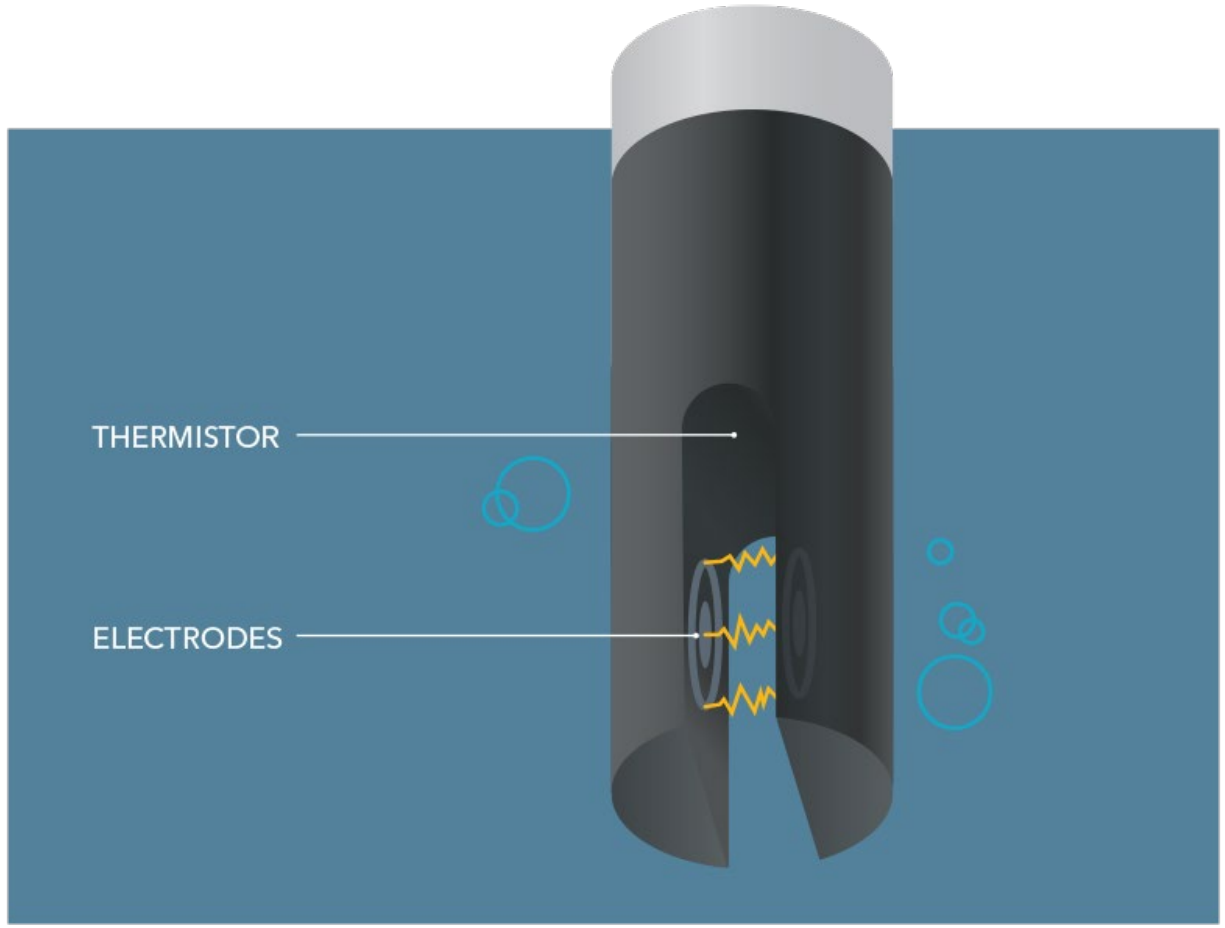
Curt's Favorite Tool: Putty Knife!

Removing Sediment and Staining

- Rinse off with fresh water
- Use mild soap cleaners
  - Ex. Scrubbing Bubbles, Magic Erasers, Simple Green
- Make sure to clean between all sensors

Sensor Specifics: Wiped Conductance

- Important to stop conductance fouling because salinity is also used for depth and DO
- Wiped conductance sensor can be wiped by central wiper, unlike standard sensor
- Fouling on electrode only
  - Remove with Scotch Brite cleaners

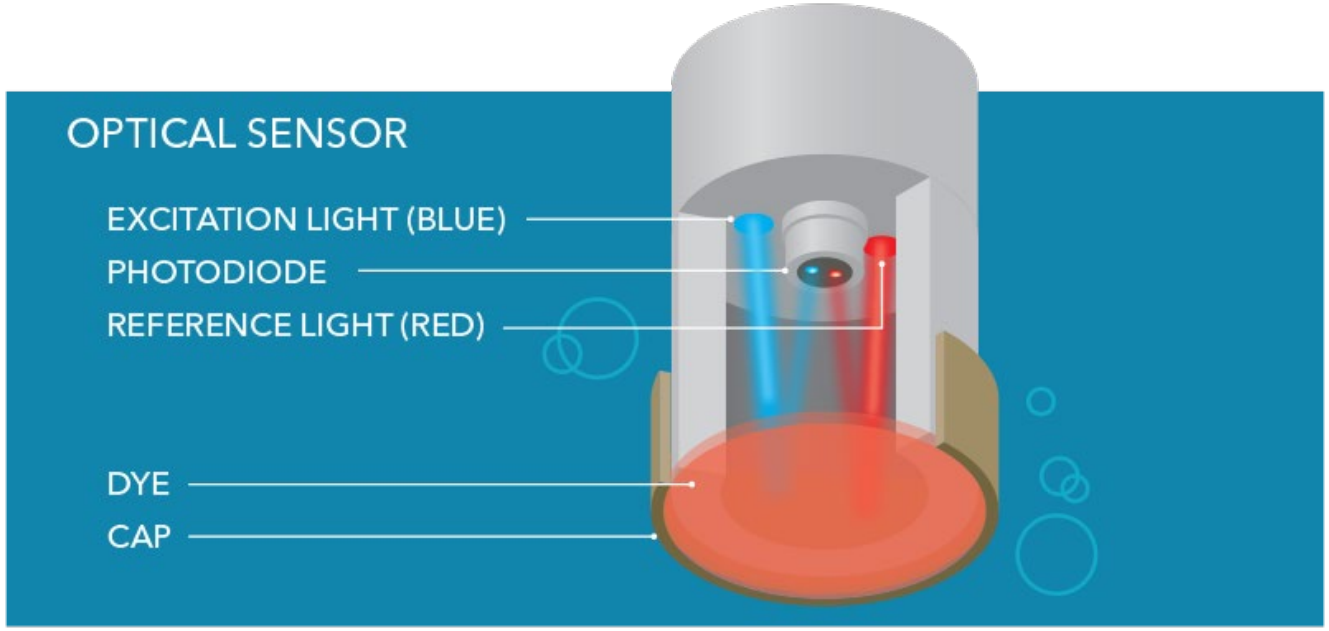


Sensor Specifics: pH/ORP/ISE's

- Make sure you choose unguarded sensor if using a sonde with a wiper brush
- Be careful to not damage glass bulb or membrane
- ISE Sensors:
  - Gently use lint free cloth
  - Use DI water or alcohol rinse
- pH Sensors:
  - Swirl in soap and water
  - Soak in 1M HCl
  - Soak in 1:1 mix of bleach and water

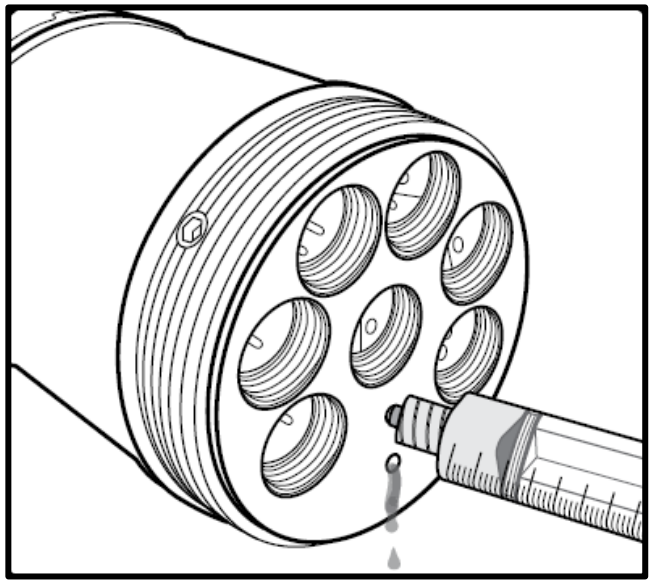
Sensor Specifics: Dissolved Oxygen

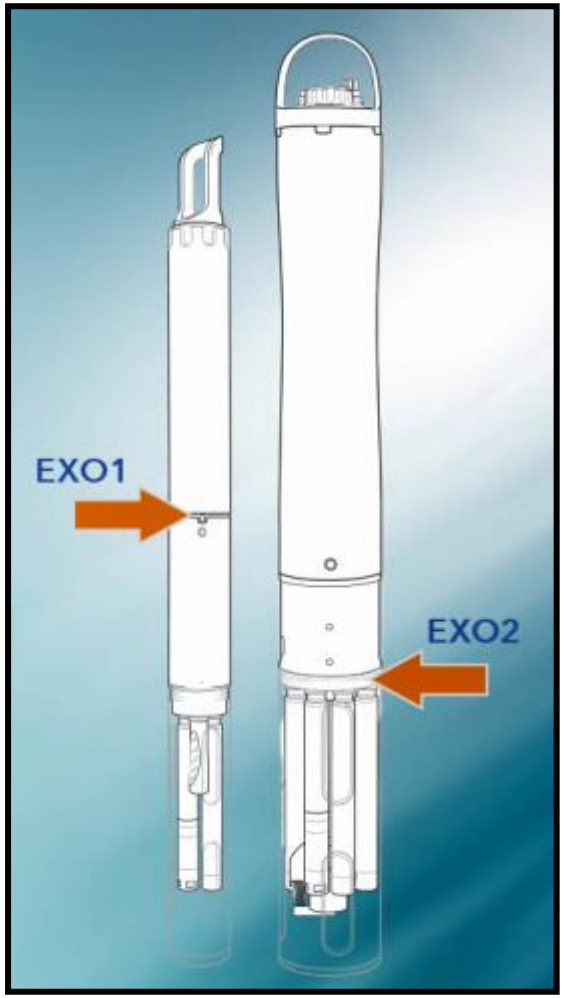
- Do not use any types of alcohol on the membrane cap. It will eat the paint layer.
- Use soap and water
- Replace membrane cap if >25% of paint layer is missing



Sensor Specifics: Depth

- Do NOT stick things inside the depth sensor
- Use a plastic syringe and squirt water into depth sensor holes to loosen debris





Inspect Accessories

Verify integrity of:

- Sonde cable connectors
- Sonde cable
- Sonde bail
- Chain carabiner

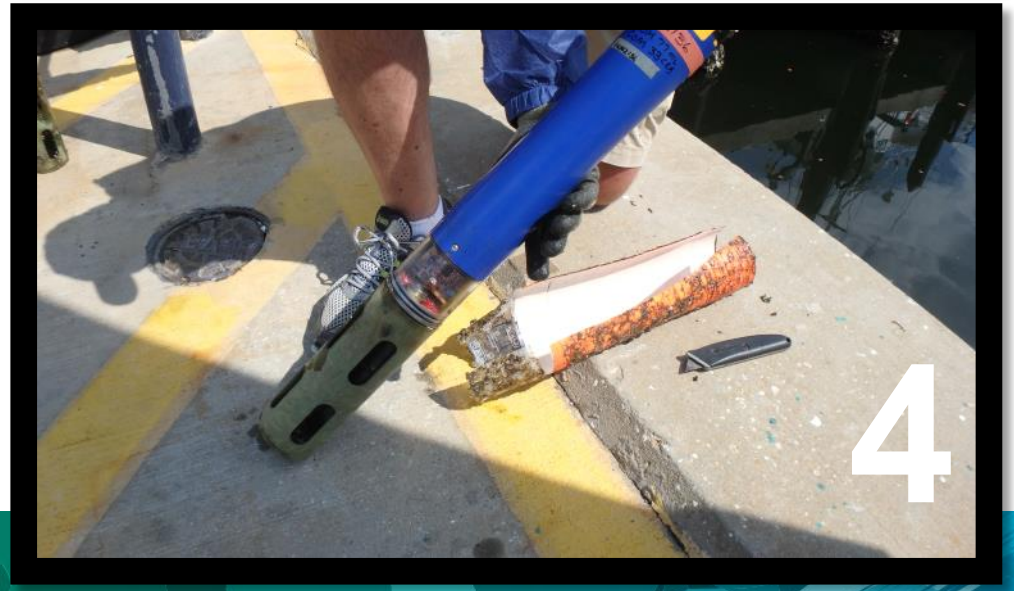
Make sure you clean your deployment tube!!

Applying Sonde Sleeves

- Slide sonde into sleeve
- Use heat source (like hair dryer or heat gun) to shrink sleeve to sonde
- Wrap duct tape around sonde sleeve
  - Duct tape provides additional protection for sonde

Application and Removal of Copper Tape

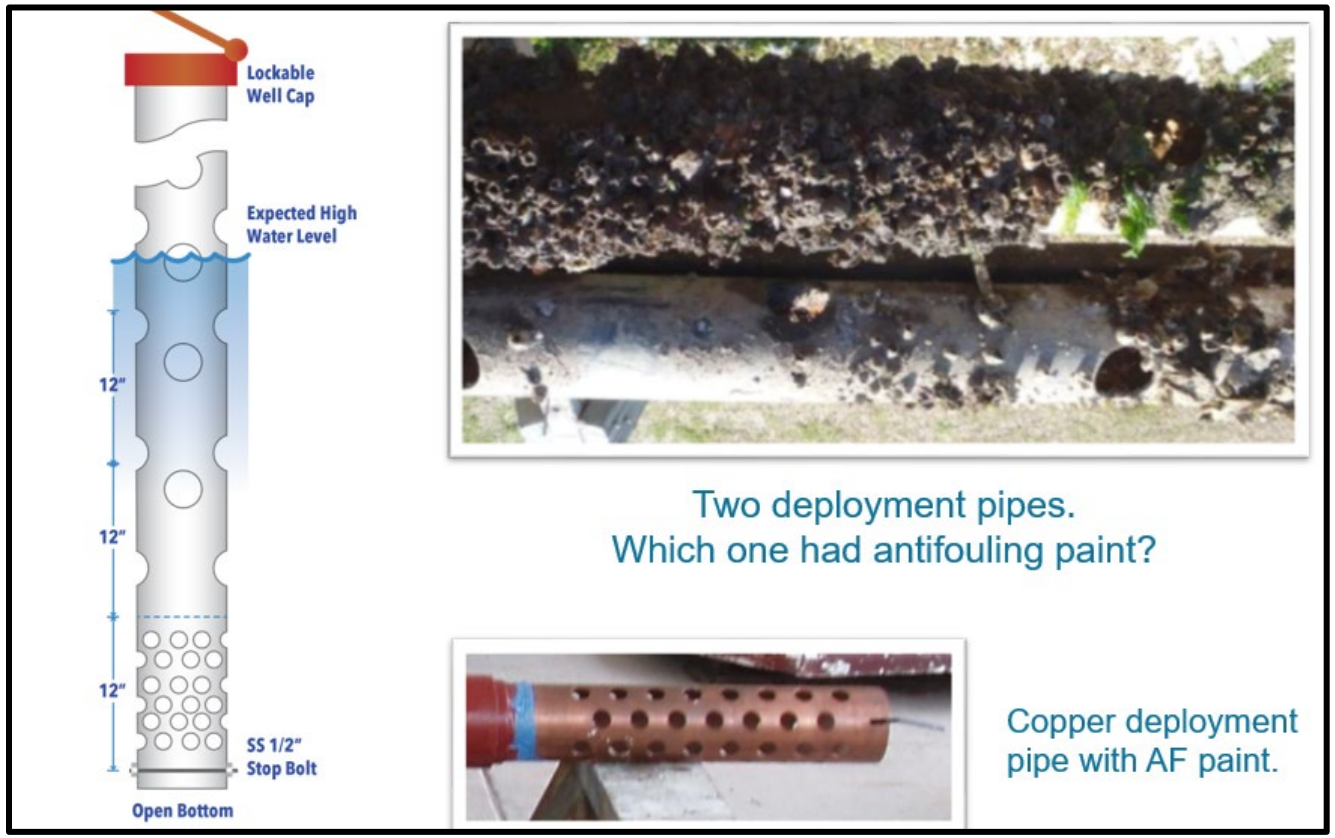
Removing Sonde Sleeves

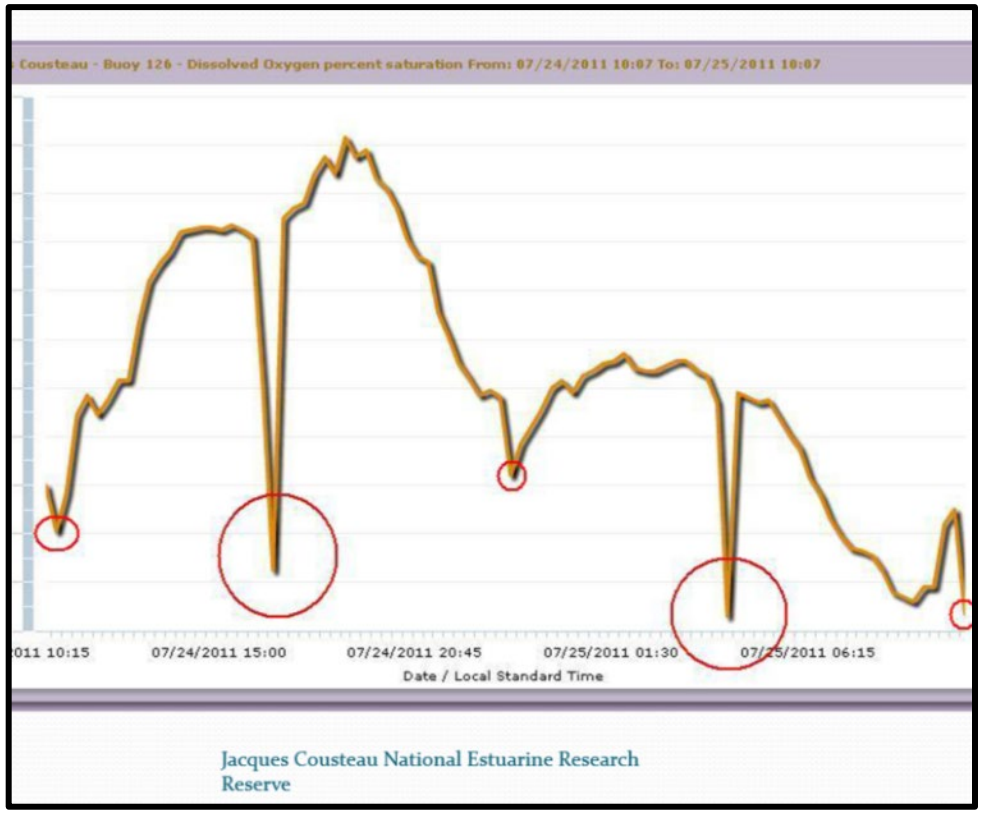


Protecting the Top of the Sonde

Antifouling: Quick, Efficient, Inexpensive

Site Maintenance and Cleaning





PVC Tube Cleaning Tool

R&D Test Site Deployment Tube out for Annual Cleaning

Questions?

Contact us:

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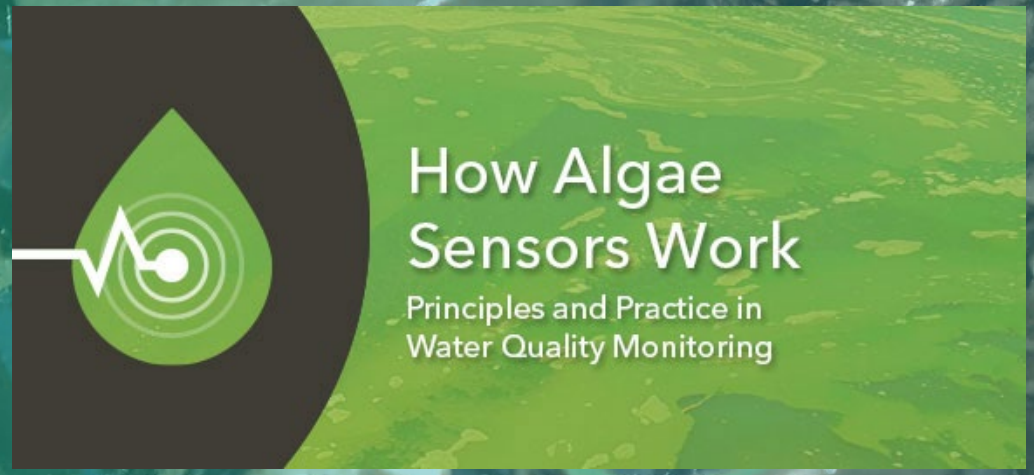
info.apac@xyleminc.com



May 26th / www.xylem-analytics.asia

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