Kevin McClurg, Business Development
YSI Inc. - Integrated Systems & Services

COST-EFFECTIVE AUTOMATED WATER QUALITY MONITORING SYSTEMS PROVIDING HIGH-RESOLUTION DATA IN NEAR REAL-TIME

Agenda

1. High Resolution Data
2. Sensors
3. Monitoring Systems
4. Scenarios / Case Studies

SECTION ONE

High-Resolution Data

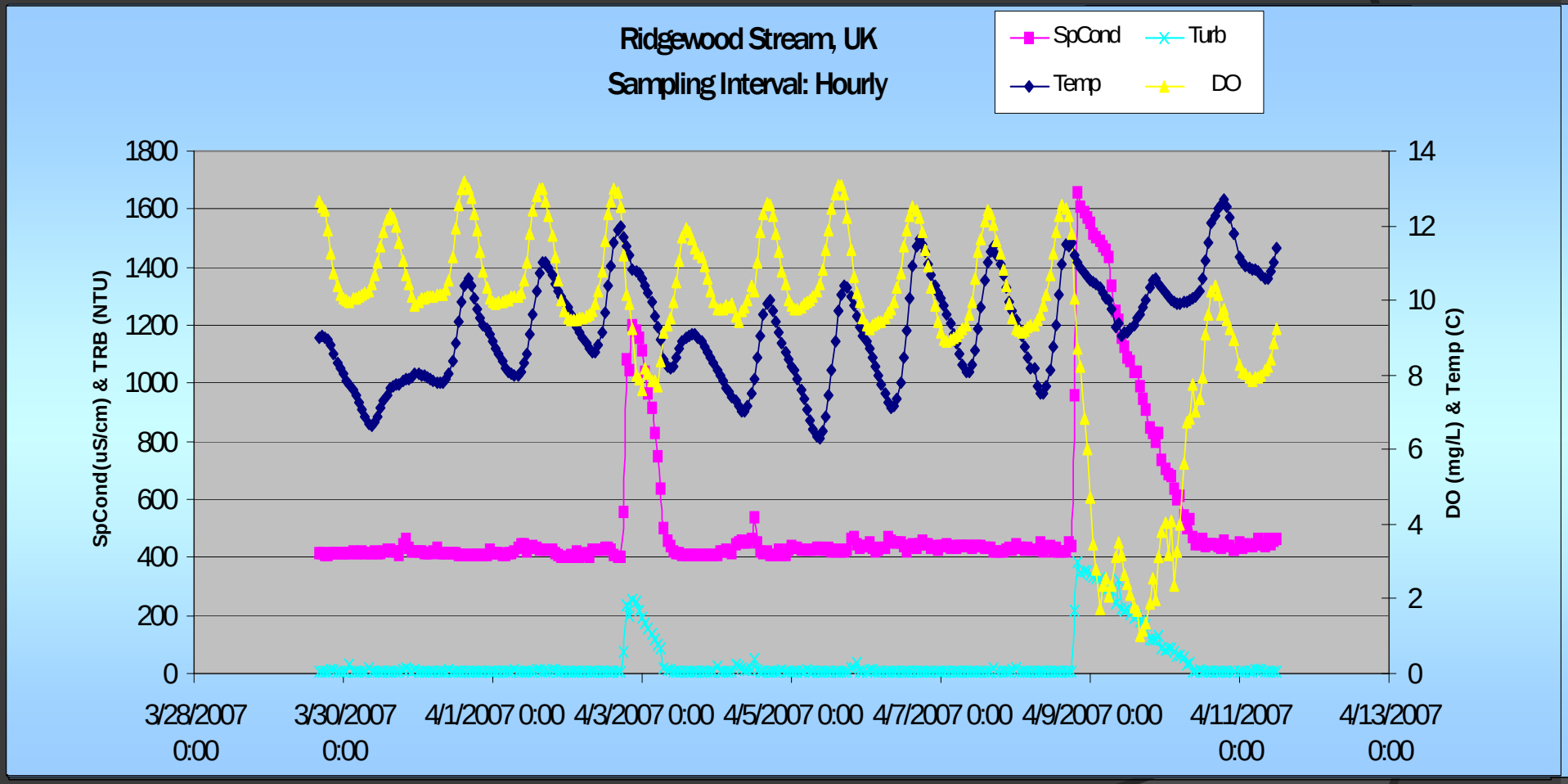
Why High Resolution Data? (Temporal & Spatial)

1. Data Quality
   - Improved Understanding of the Environment
   - Increases accuracy

2. Improved Management Decisions
   - Early Warning
   - Detect ‘events’
   - Identify point sources, trends, anomalies
   - Measure the impact of restoration, land management, and development
   - Data for forecasting & modeling

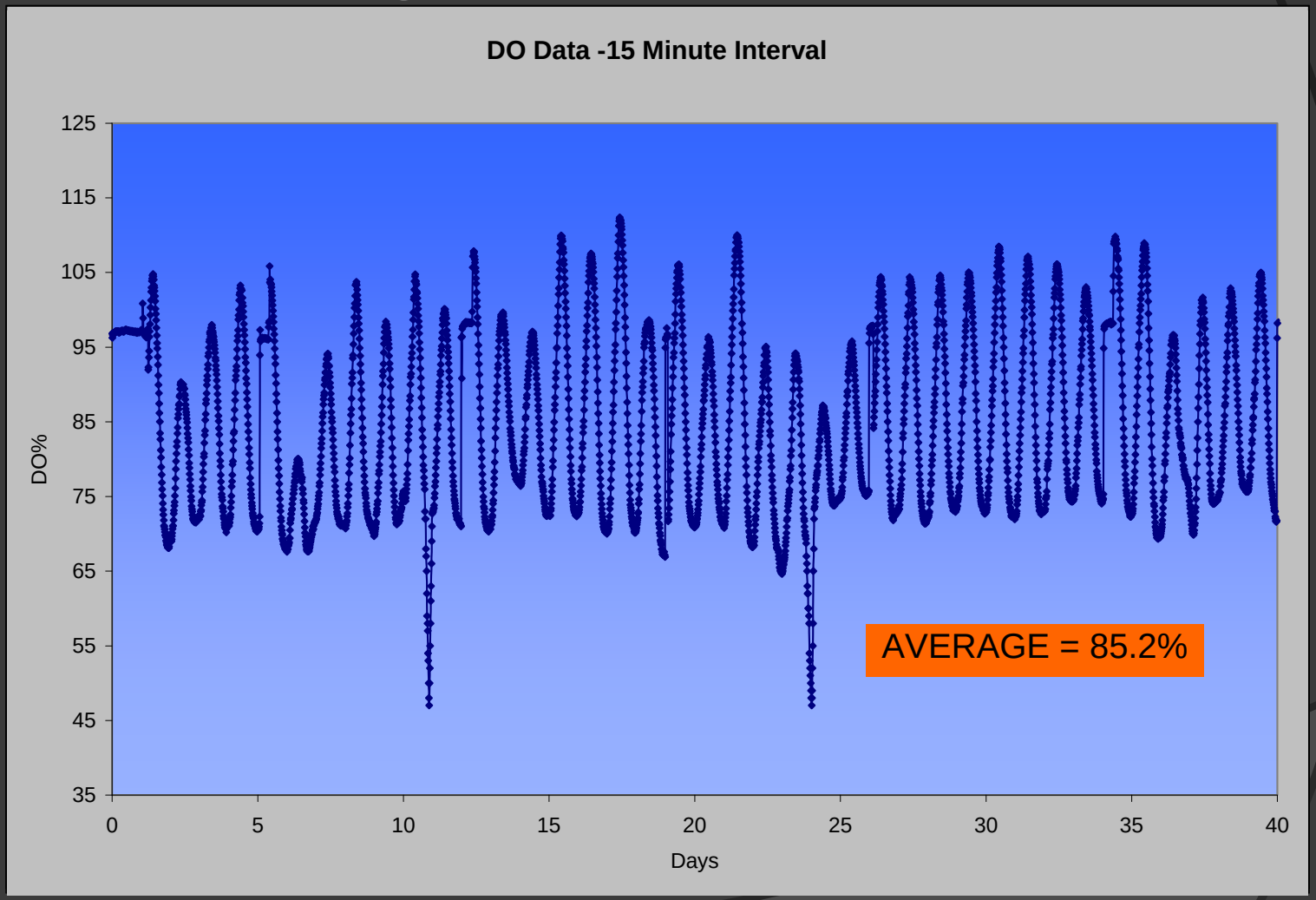
Temporal Data

The under-sampling problem

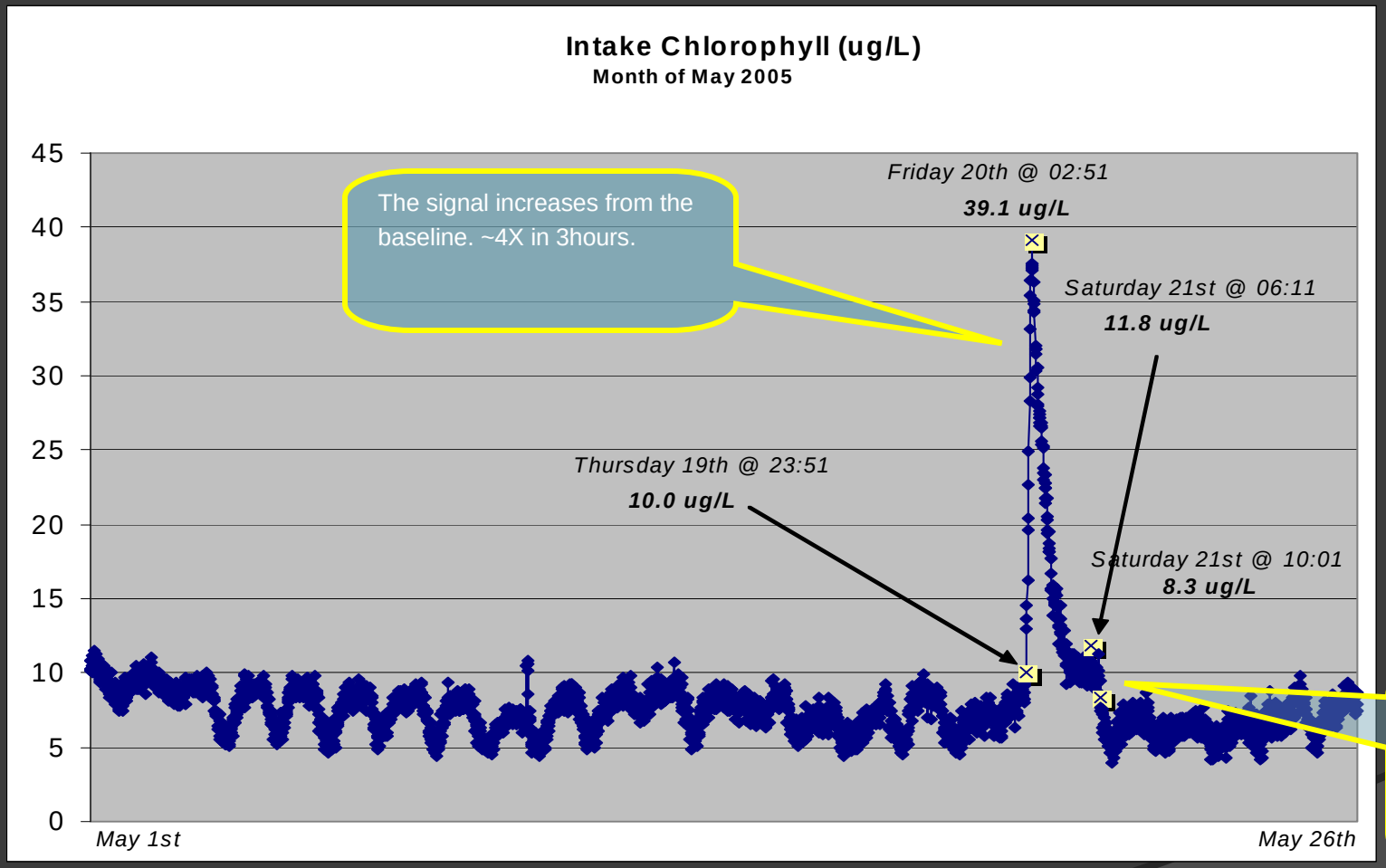


Data Accuracy

The under-sampling problem



Short Term Events



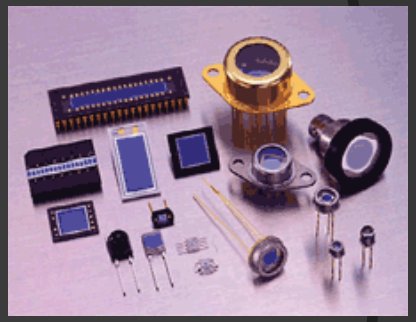
Chlorophyll spike in the raw water in May 2008 that was tied to customer taste and odor calls in the finished water distribution system.

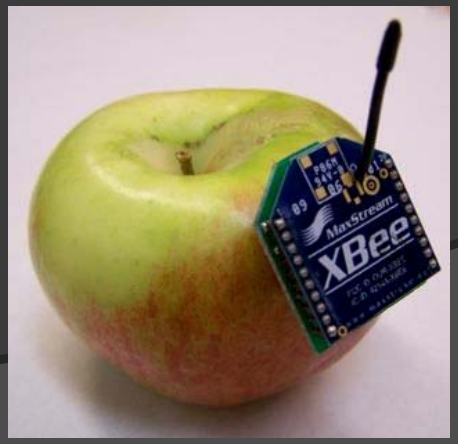
SECTION TWO

SENSORS

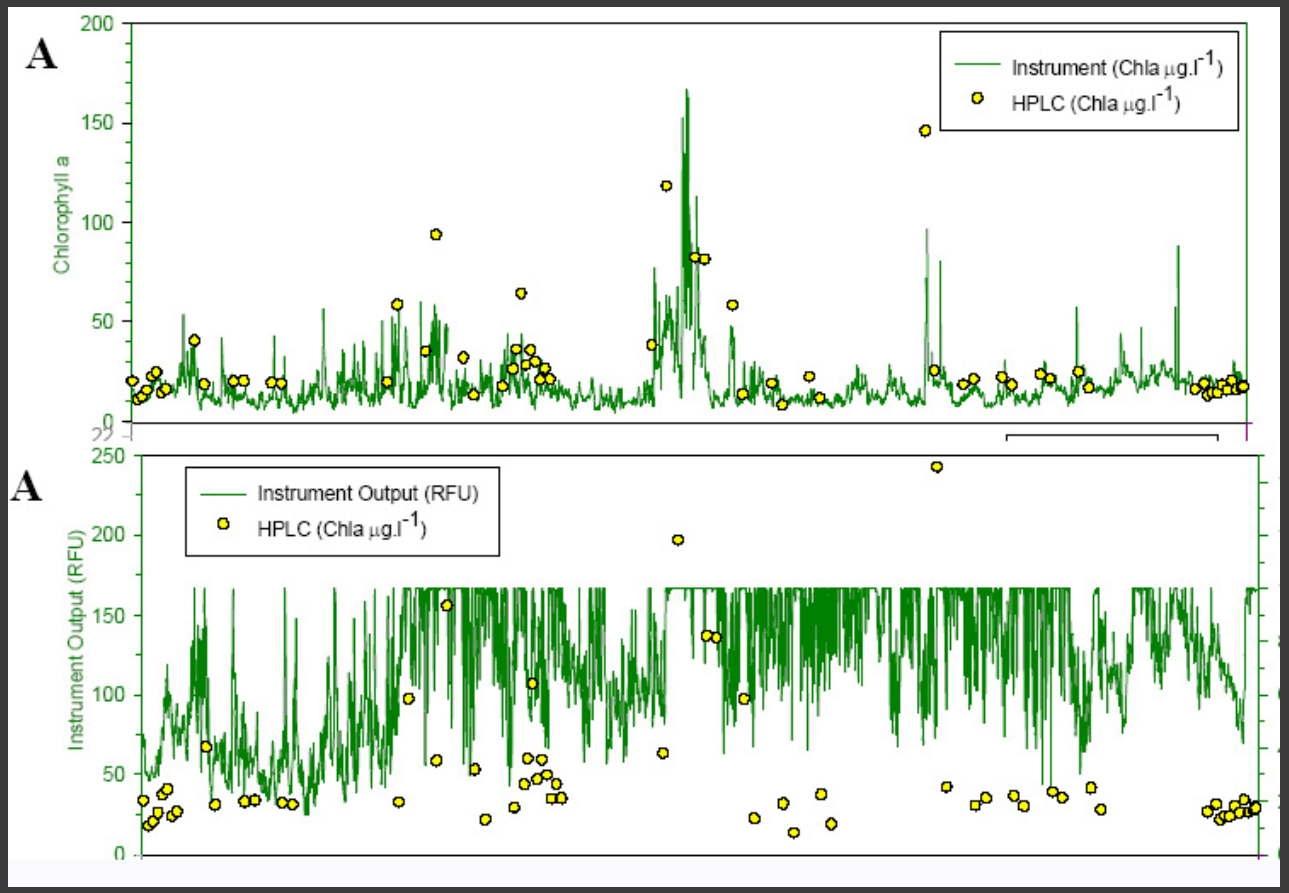
Evolution of Technology

- Low power sensors & electronics
- Smaller electronics
- More stable sensors
- Anti-fouling systems
- Low cost real-time communication





Sensors for Real-World Conditions



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30-day deployment – Severe Conditions

With anti-fouling

Without

30-day deployment – Severe Conditions

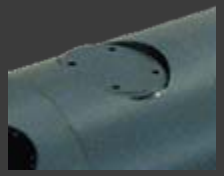
With anti-fouling

Without

Water Quality Sensors

Physical Property & Electrochemical Sensors

Temperature
Conductivity



Depth

PAR

pH & ORP (Redox)

Optical Sensors

Optical DO

Blue-Green
Algae

Turbidity

Chlorophyll

Additional Sensors

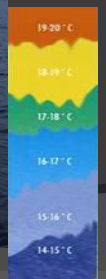
In addition to a water quality sonde, additional sensors are integrated into the DCP to provide one, consolidated data stream

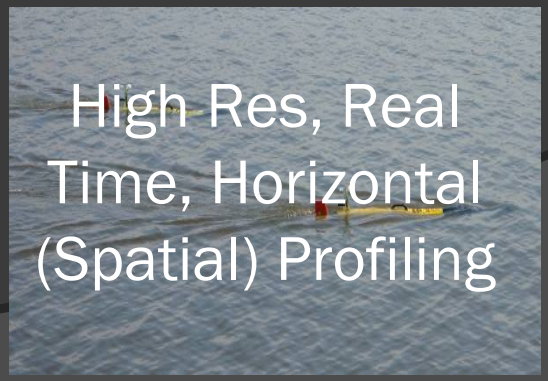
- MET (wind speed/direction, barometer, humidity)
- Nitrate Analyzer
- Multi-Nutrient Systems
- Hydrocarbons

SECTION THREE

SYSTEMS

Evolution of Monitoring Systems





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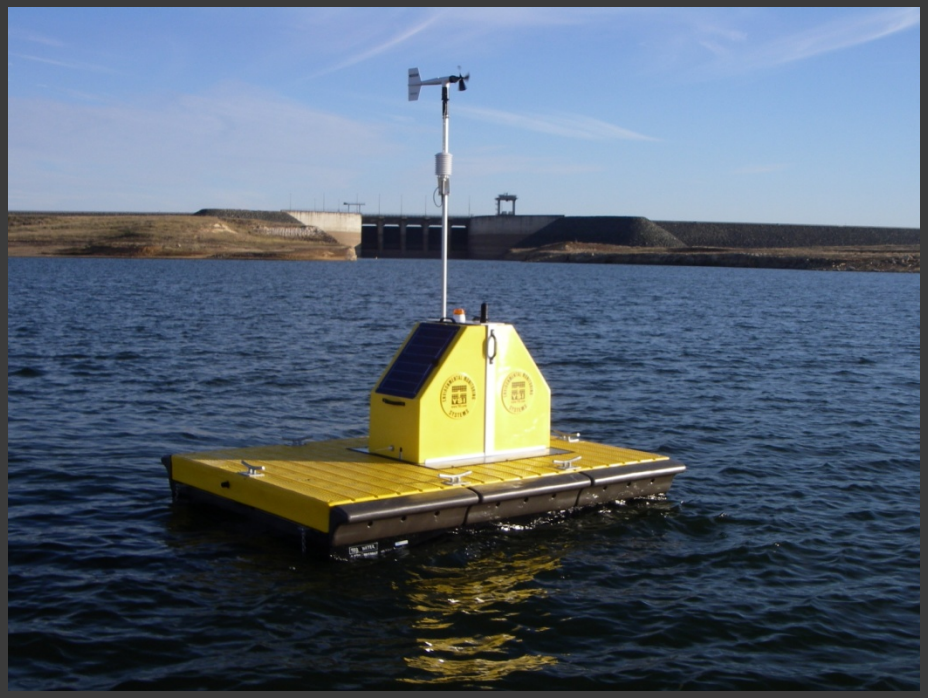
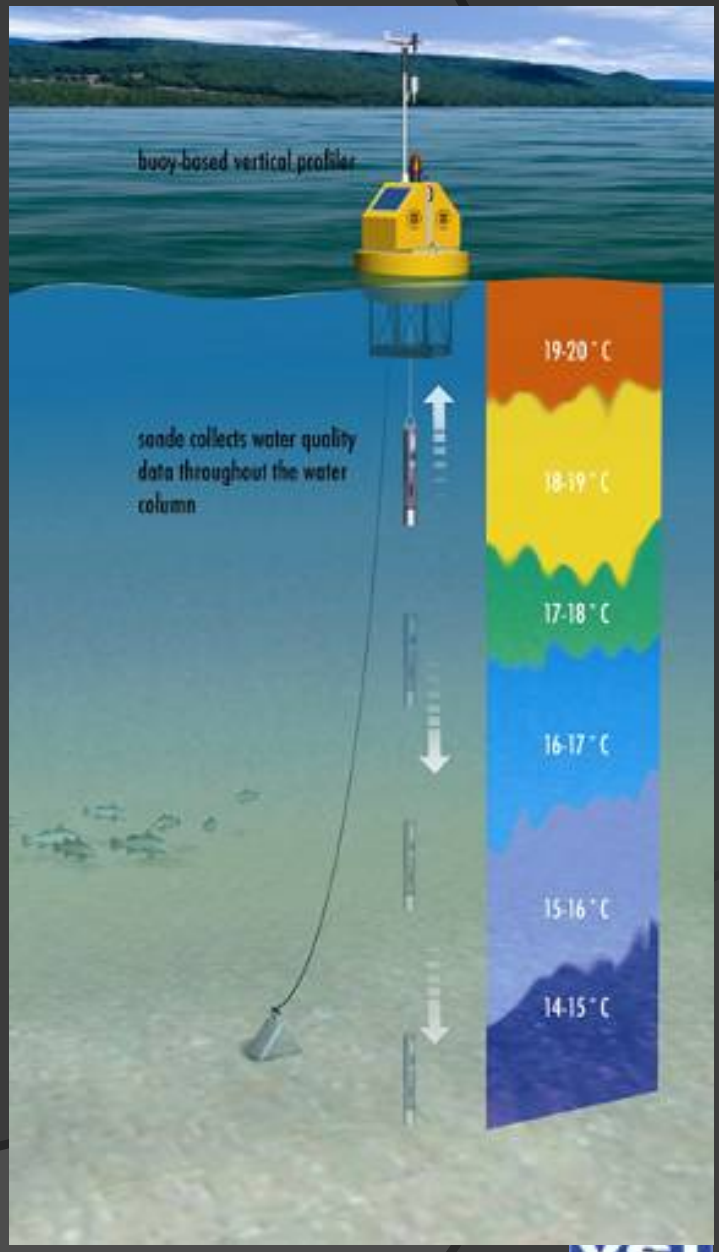
Vertical Profilers



Automated Vertical Profiling

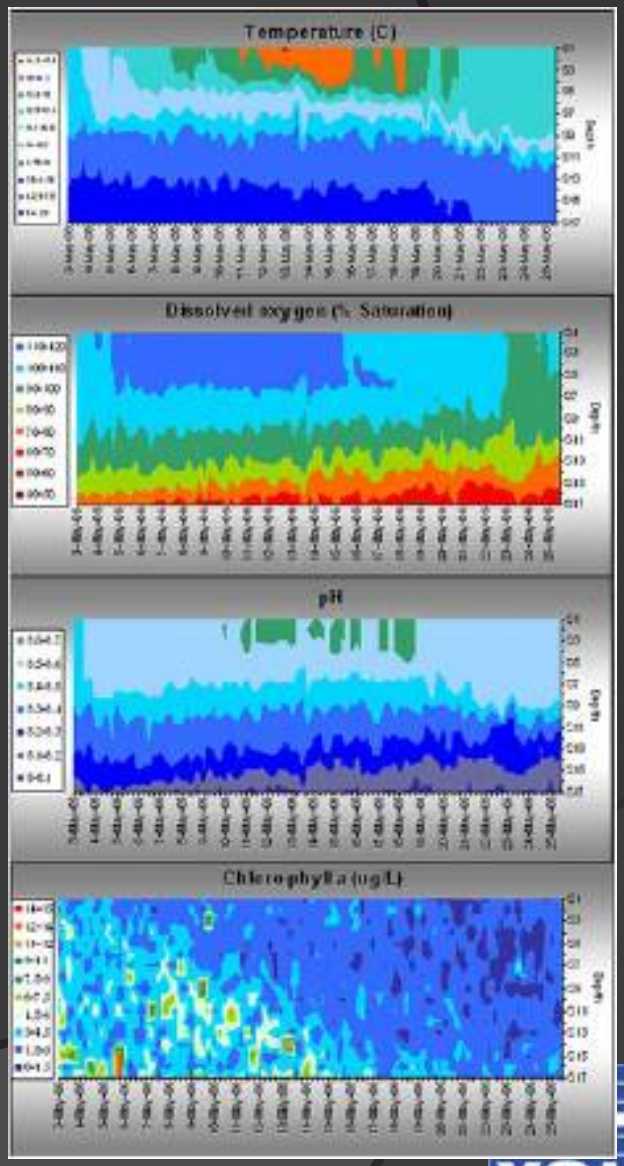
- Variations in temperature, wind, rainfall, sunlight, and salinity cause changes in the vertical structure of a water column, varying from highly stratified to well-mixed

- The Vertical Profiler collects data continuously to shed light on the impacts of the physical environment of the water body.

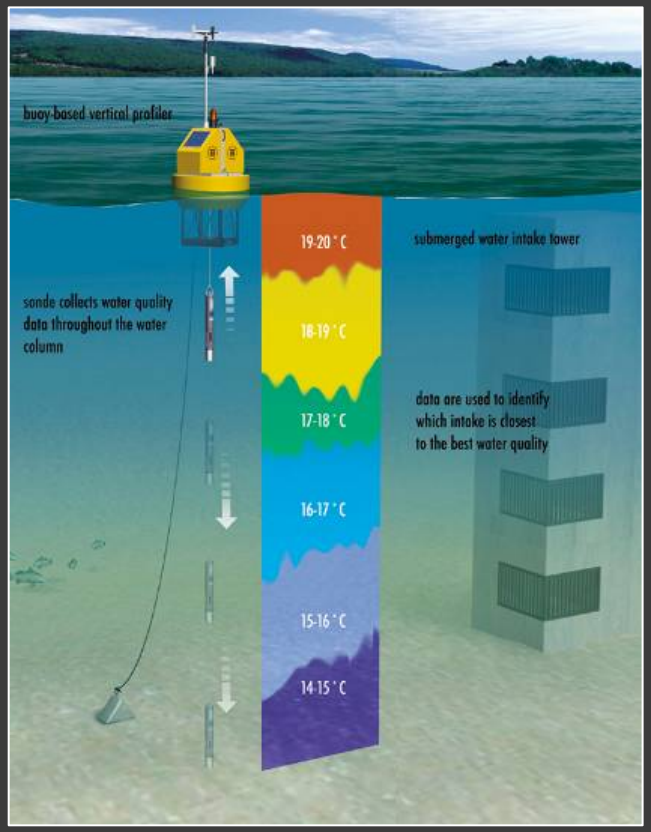


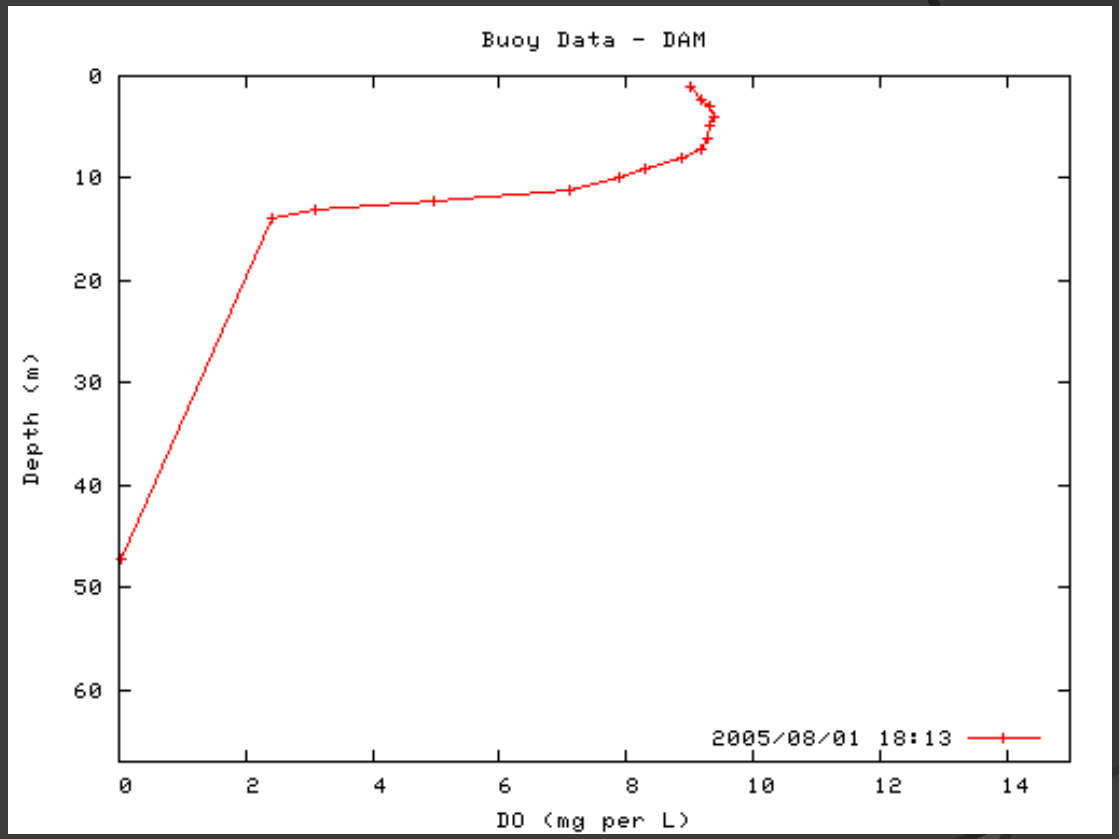
Vertical Profiling Applications

- Monitor changes in stratification
- Track vertical distribution of phytoplankton and/or blue-green algae populations
- Evaluate the impacts of storms with turbidity sensors
- Monitor dissolved oxygen concentrations and detect onset of low oxygen events
- Generate the most comprehensive baseline water quality record



Profiler Data





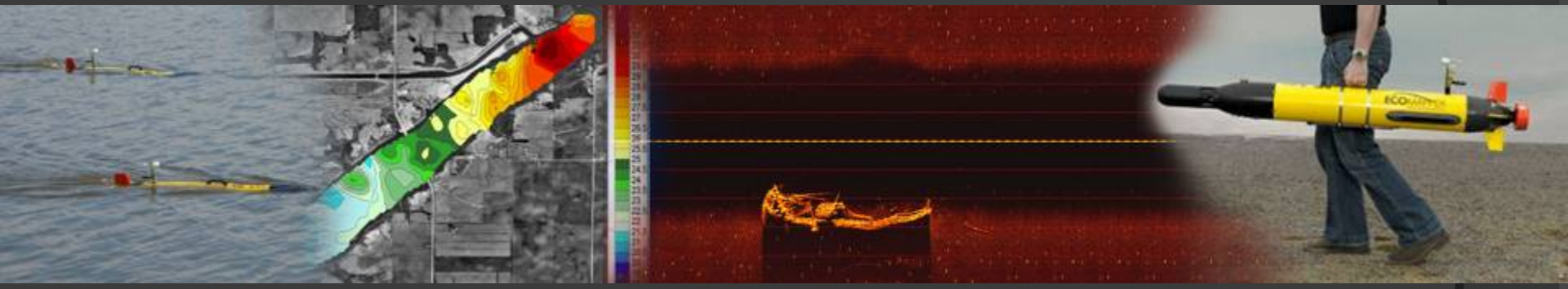
TCEQ

Profiler Animation

YSI EcoMapper

Autonomous Underwater Vehicle

~ A Cost-Effective Water Quality & Bottom Mapping Tool ~



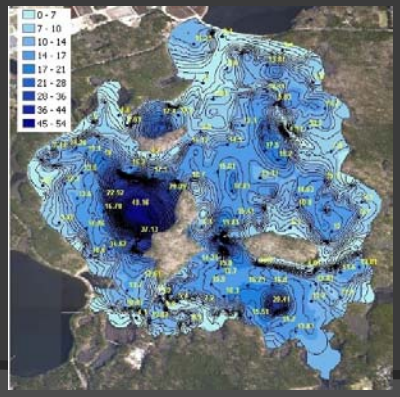
ECOMAPPER

Autonomous Underwater Vehicle

YSI

Autonomous Underwater Vehicle (AUV)

The EcoMapper AUV is a cost-effective tool for quickly and easily collecting high-resolution water quality, bathymetry, and sonar data.

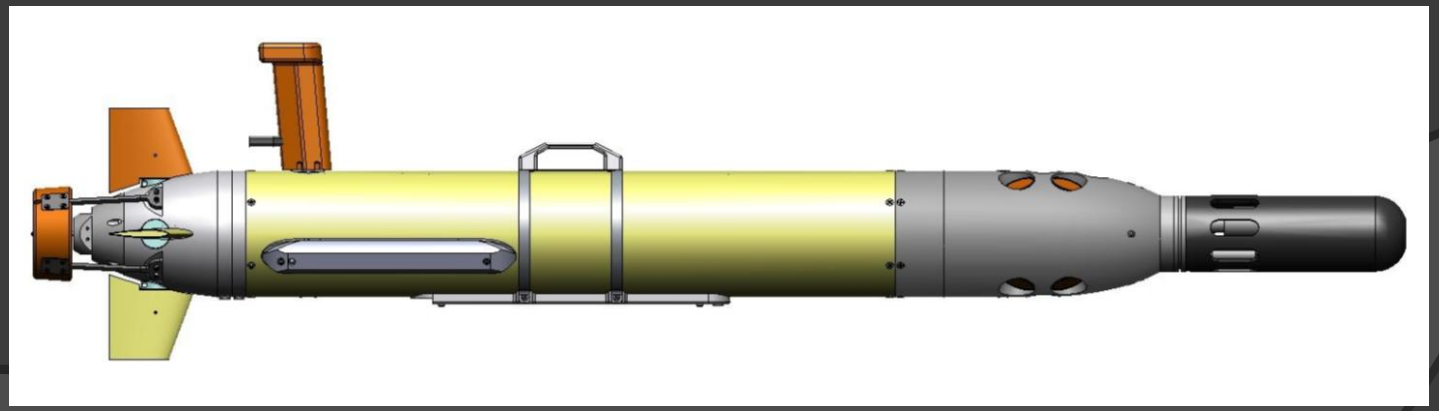


Key Features

- Small, portable, lightweight (~50lbs)
- Single Person-deployable
- Autonomous (self-navigating)
- Easy and fast mission planning
- Large sensor payload (18 parameters)
- Long Endurance (9 hours run time)
- Quick Recharge (3 hours)
- Expansion Capability

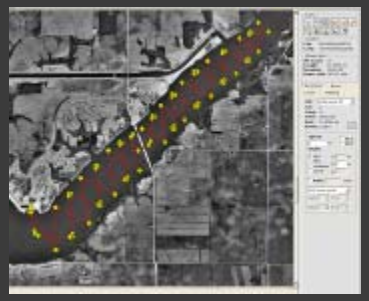
EcoMapper Components

1. **Electronics / Processor-**
   - Low Power processor running Windows XP
2. **Power -**
   - Rechargeable Lithium-ion Batteries
3. **Communications – (wireless)**
   - Wi-fi
   - Radio (optional)
   - Cellular (optional)
4. **Propulsion / Control -**
   - Four independent control fins
   - DC motor with propeller
5. **Navigation –**
   - GPS - when on the surface
   - DVL – bottom/water track when below the surface
6. **Expandable Payload –**
   - 10 YSI sensors (18 param)
   - Altimeter
   - Doppler Velocity/Currents



5 Steps to an EcoMapper Mission

1 → 2 → 3 → 4 → 5



Vector Map
Point and click mission planning onto a geo-referenced map

UVC Software
Start EcoMapper with key fob Load mission in EcoMapper UVC Software

Start Mission
Place vehicle in water and start mission

Remote Control
When EcoMapper is on the surface and within range, view data and monitor progress or take manual control

Retrieve EcoMapper
at planned PARK location and download data via Wi-Fi link

EcoMapper Animation

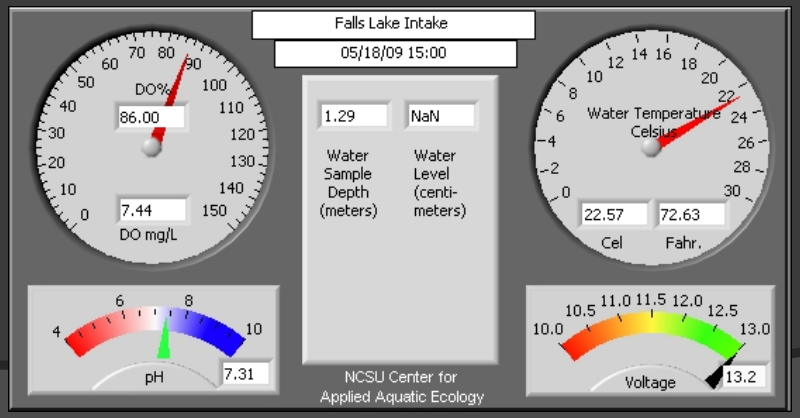
SECTION FOUR

SCENARIOS

1. Source Water Protection
2. Ecosystem restoration
3. Source Water Management
4. Environmental Impact

Source Water Protection

Water level at Falls Lake on Sept. 1 2004.



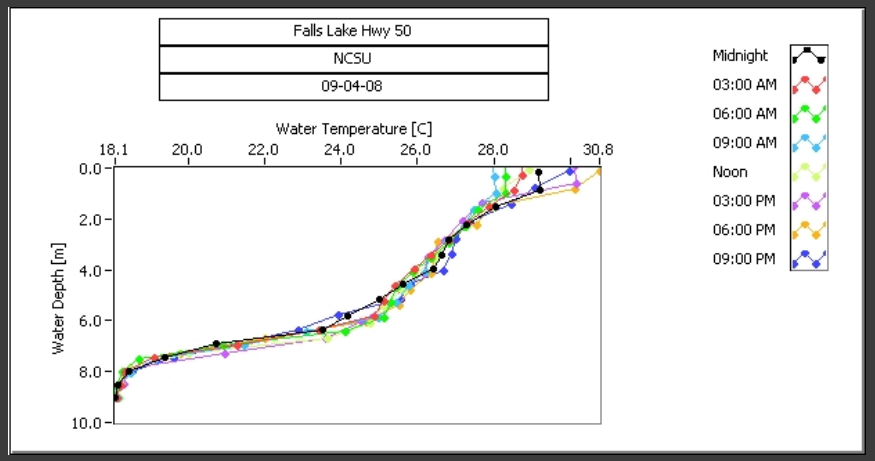
Falls Lake

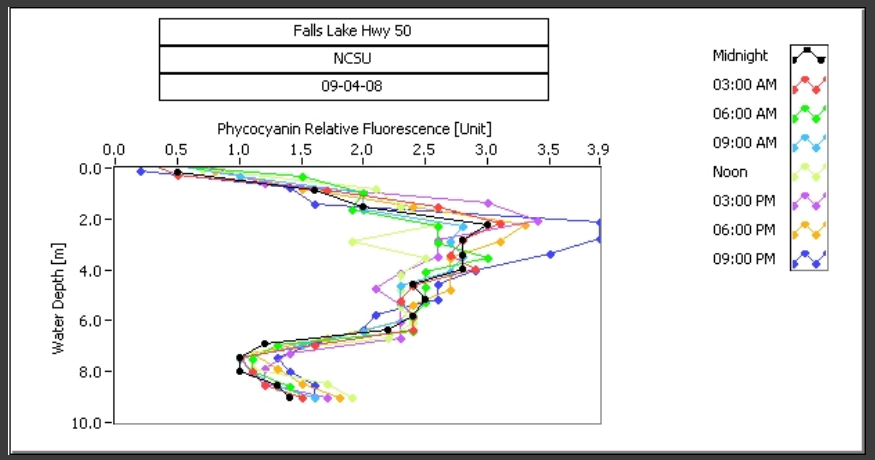
North Carolina, USA

Problem:

- Falls Lake is a primary drinking water source for the Triangle area. Blue-green algae can cause taste-and-odor problems in water supplies. Some species also produce toxins that can negatively impact human health.

Source Water Protection





Falls Lake

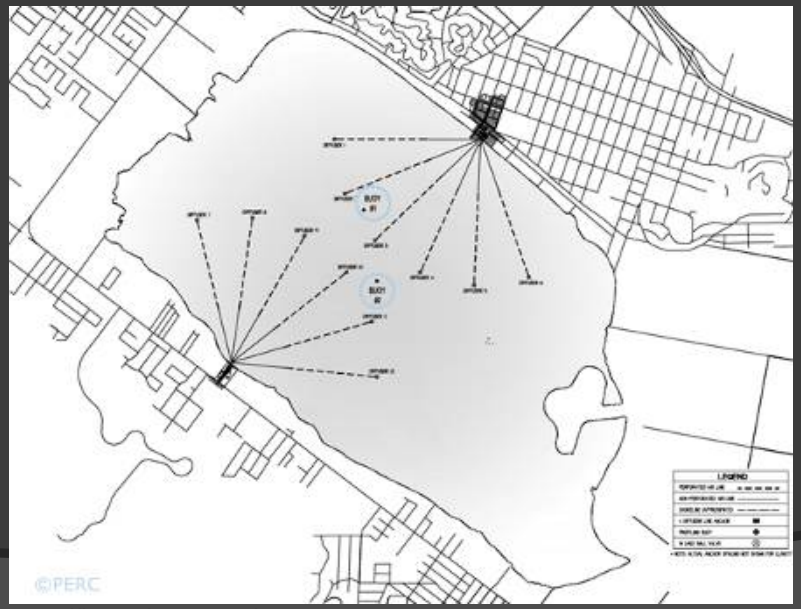
North Carolina, USA

Solution:

- Continuous vertical profiling system monitors algae levels
- $ Early warning of possible taste and odor or toxin events
- $ Reduce trips to field for sampling and analysis
- $ Improve water quality and PR

http://www.ncsu.edu/wq/RTRM/dp14profiler.html

Ecosystem Restoration



Lake Elsinore
California, USA

Problem:

- Need to improve poor water quality by efficiently operating aeration system to replenish oxygen and reduce fish kills and algal blooms

Ecosystem Restoration

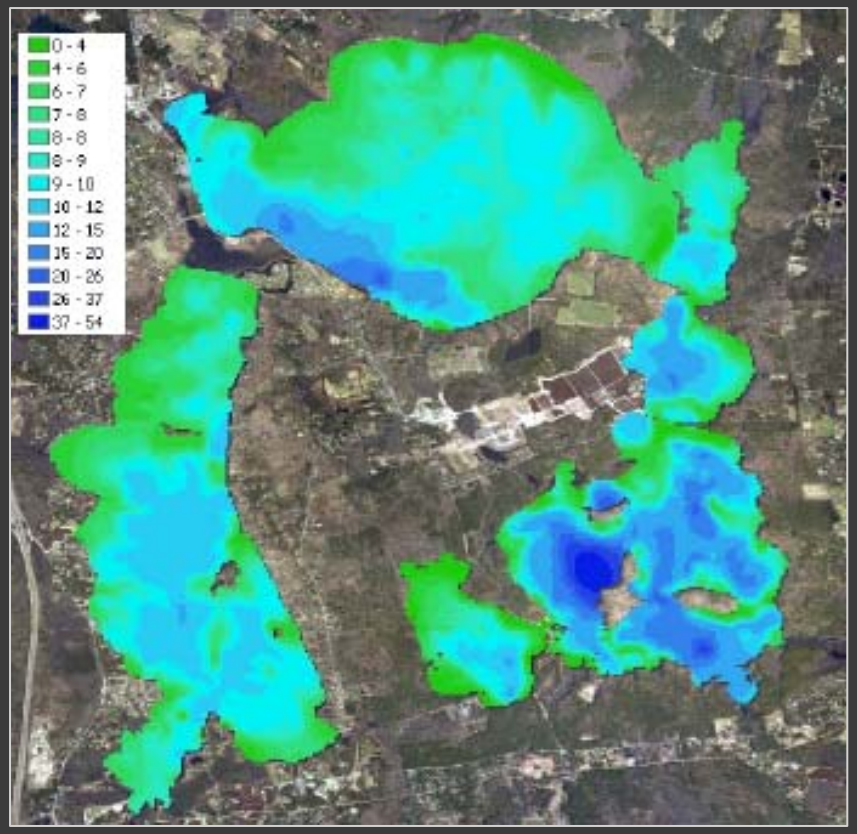
Lake Elsinore
California, USA

Solution:

- Continuous vertical profiling system monitors DO levels
- $ Real-time data optimizes use of aerator
- $ Reduces energy usage by 50% (saves >$13K/year per aerator)

PACE

Source Water Management



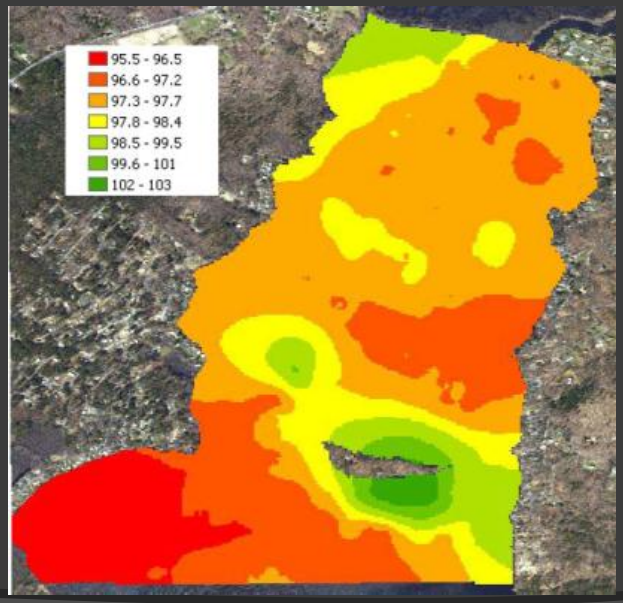
Drinking Water Reservoir Survey

New Bedford, MA

Problem:

- The City of New Bedford did not have accurate data on the volume of drinking water in their reservoirs. They were searching for a cost-effective means of collecting this data in their large and complex reservoir system

Source Water Management



Dissolved Oxygen(% Sat)

Drinking Water Reservoirs

New Bedford, MA

Solution:

- Automates water quality and bathymetry mapping
- $ Low overhead, 2 operators, 1 small boat
- $ Reduce survey time through use of multiple vehicles
- $ Collect bathymetry and water quality data simultaneously

Source Water Management

Pond	Date	AUV	Mission Hours	Sample Points	Surface Area (acres)	Volume (cubic feet) (millions)	Gallons Water (billions)	Gallons Water/inch (millions)
Little Quittacas	05/15/08	4	8:30:45	30,550	297	84.5	0.6	8
Great Quittacas	08/07/08	3	12:31:26	44,840	1,128	641	4.8	31
Assawompset	08/21/08	3	15:18:53	61,135	2,091	811	6.1	57
Pocksha	09/19/08	1	2:41:22	9,647	563	226	1.7	15
Long	10/10/08	3	10:09:49	36,432	1,721	627	4.7	47
Total		**14**	**49:12:15**	**182,604**	**5,800**	**2389**	**17.9**	

Environmental Impact/Mapping

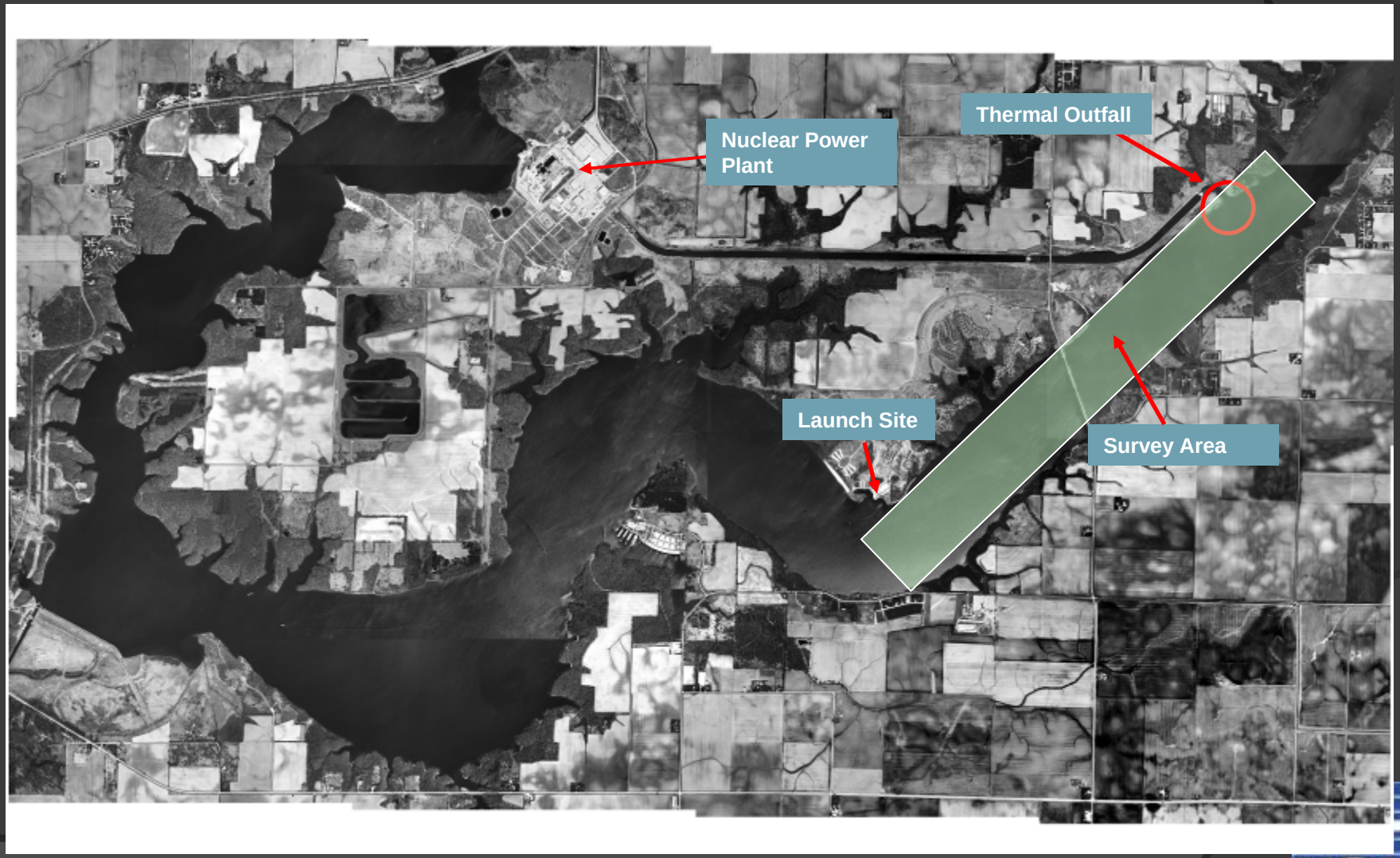
Lake used for Thermal Cooling

Midwest State, United States

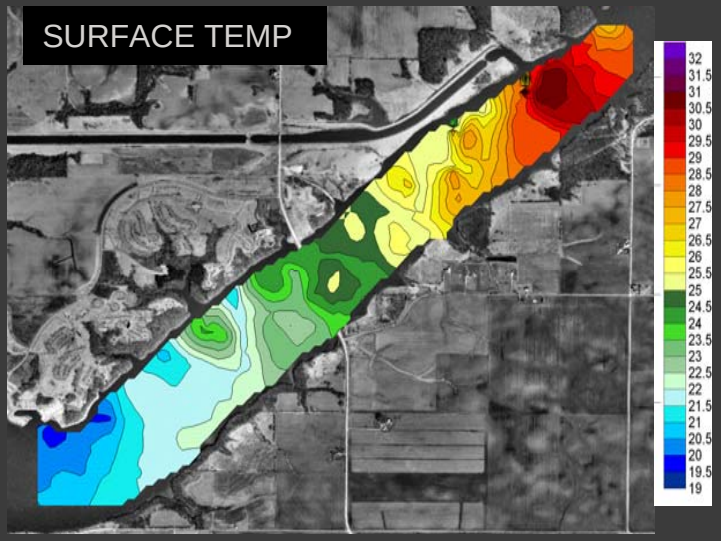
Problem:

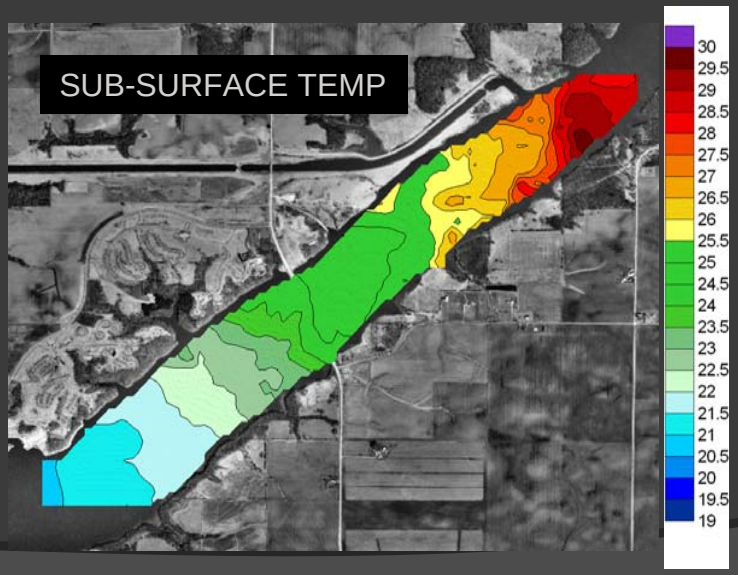
- Power generation company uses important recreational lake for cooling reactor water. State requires environmental impact assessment of hot water discharge. Plant wants to determine if increase discharge to increase production.

Environmental Impact/Mapping



Environmental Impact/Mapping





Midwest Lake, US

Solution:

- Automates water quality and bathymetry mapping at multiple depths
- $ Low overhead, 2 operators, launch from shore
- $ Eliminate need for remote sensing
- $ Meet regulatory requirements
- $ Maximize production

Spatial Data

Questions?

IMPORTANT LINKS

http://www.youtube.com/user/YSIinc

http://truecostofdata.com/index.php

EcoMapper Animation

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