Real Time Water Monitoring and the Shift to a Digital Water Archive

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Outline

- Why Real Time WQ Monitoring
- Traditional versus Spectroscopic Methods
- Overview of s::can technology
- Fingerprint and the Digital Water Archive

Why Real Time WQ Monitoring?

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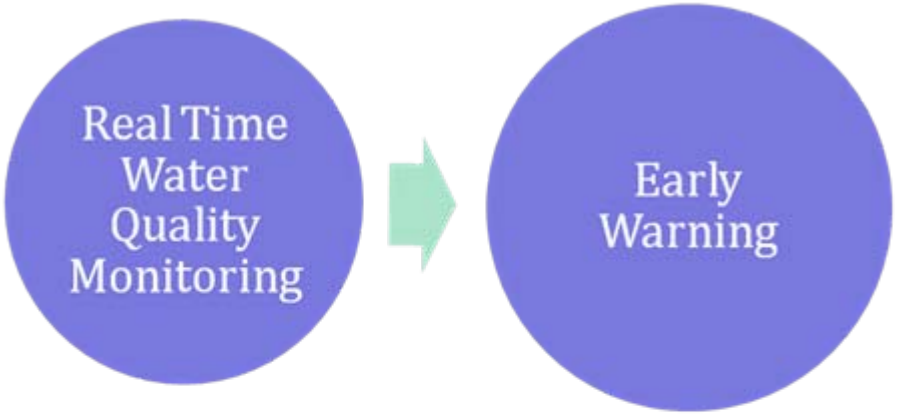
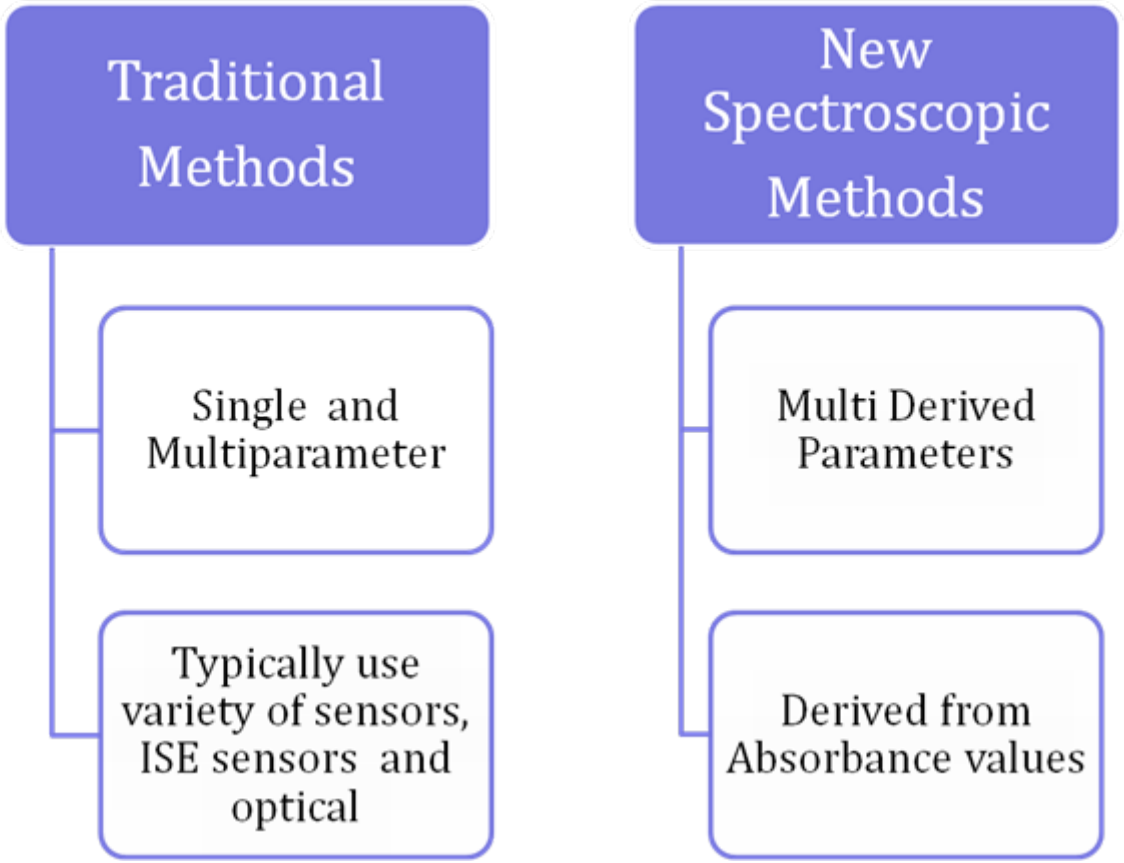


- Watershed changes
- Parameter Exceedance
- Event Detection
- Trigger Autosampler

Why Real Time WQ Monitoring?

- Toxicity Upset detection
- Parameter exceedance
- Determination of loading values


Traditional Methods
Single and Multiparameter
Typically use variety of sensors, ISE sensors and optical
New Spectroscopic Methods
Multi Derived Parameters
Derived from Absorbance values

A Few Examples of In-Situ Inc. Monitoring Equipment

Aquatroll 100 and 200

- Conductivity, level and Temperature
- 6 cell conductivity sensor
- Titanium housing
- 2 million datapoint internal datalogger
- Communicates via multiple methods including SDI 12

A Few Examples of In-Situ Inc Monitoring Equipment

In-Situ Troll Link Telemetry System

- ***TROLL Link 100*** – GSM/GPRS modem
- ***TROLL Link 102 –*** CDMA modem
-
- ***TROLL Link 101 –*** GSM/GPRS modem w/ Data Center link
-
- ***TROLL Link 201*** – Iridium satellite modem with Data Center link

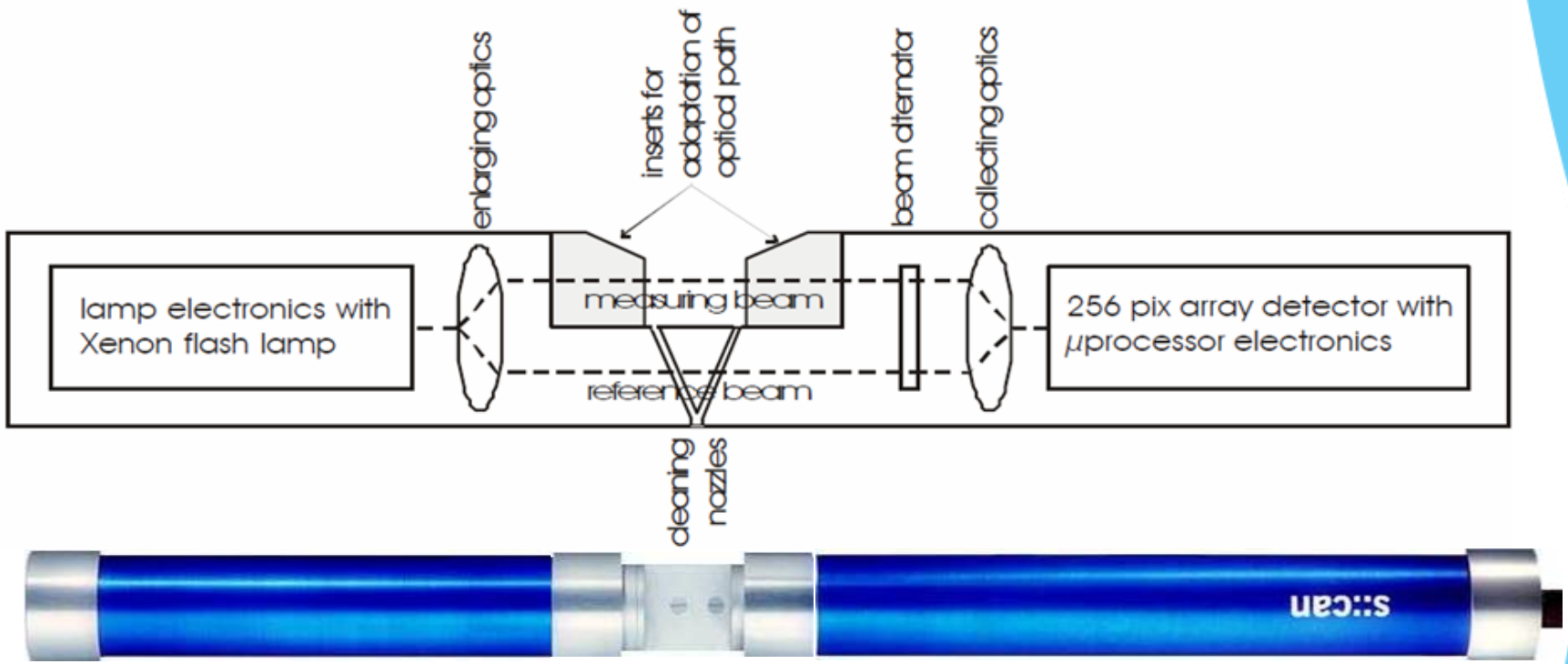
The Innovation: The Submersible mobile field probe

- Better Total Accuracy of Measurement
- Submersible by-pass; direct install in fluid
- Field compatible, (Immediately with regular operator, and with some development by layperson)
- Self cleaning (compressed air, or direct brush method)

- **indirect method, must be parameterized / “Calibration”**

The s::can Spectrometer Probe

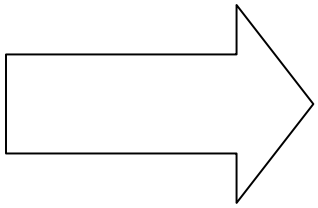
Design & Function

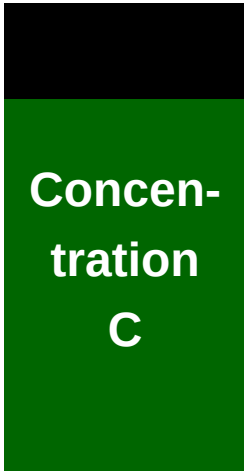


The s::can Spectrometer Probe

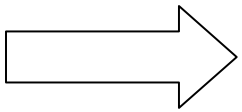
The Measuring Principle – Lambert Beer

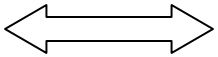
Radiation I_o
Emitted by Light Source





Radiation I
Passing the Sample

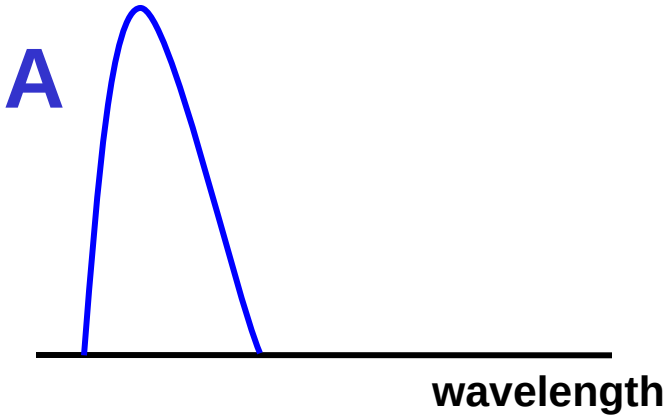


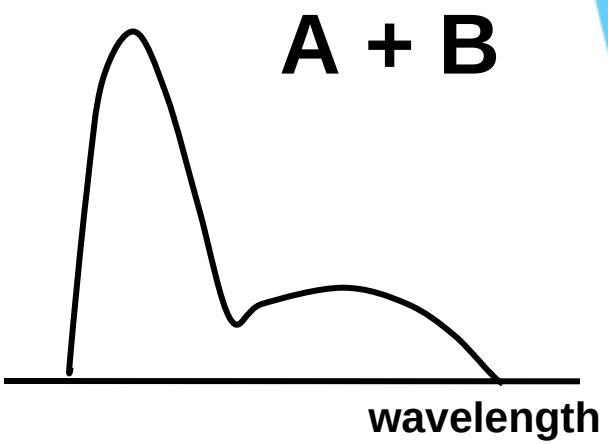


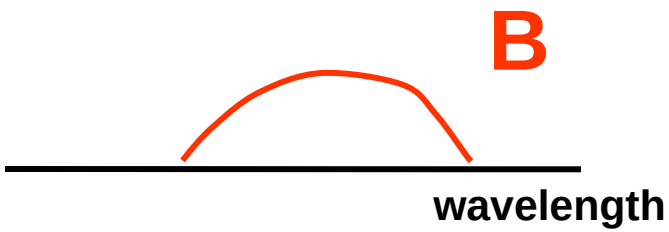
Optical Pathlength OPL

Absorbance Spectra caused by two Substances A & B

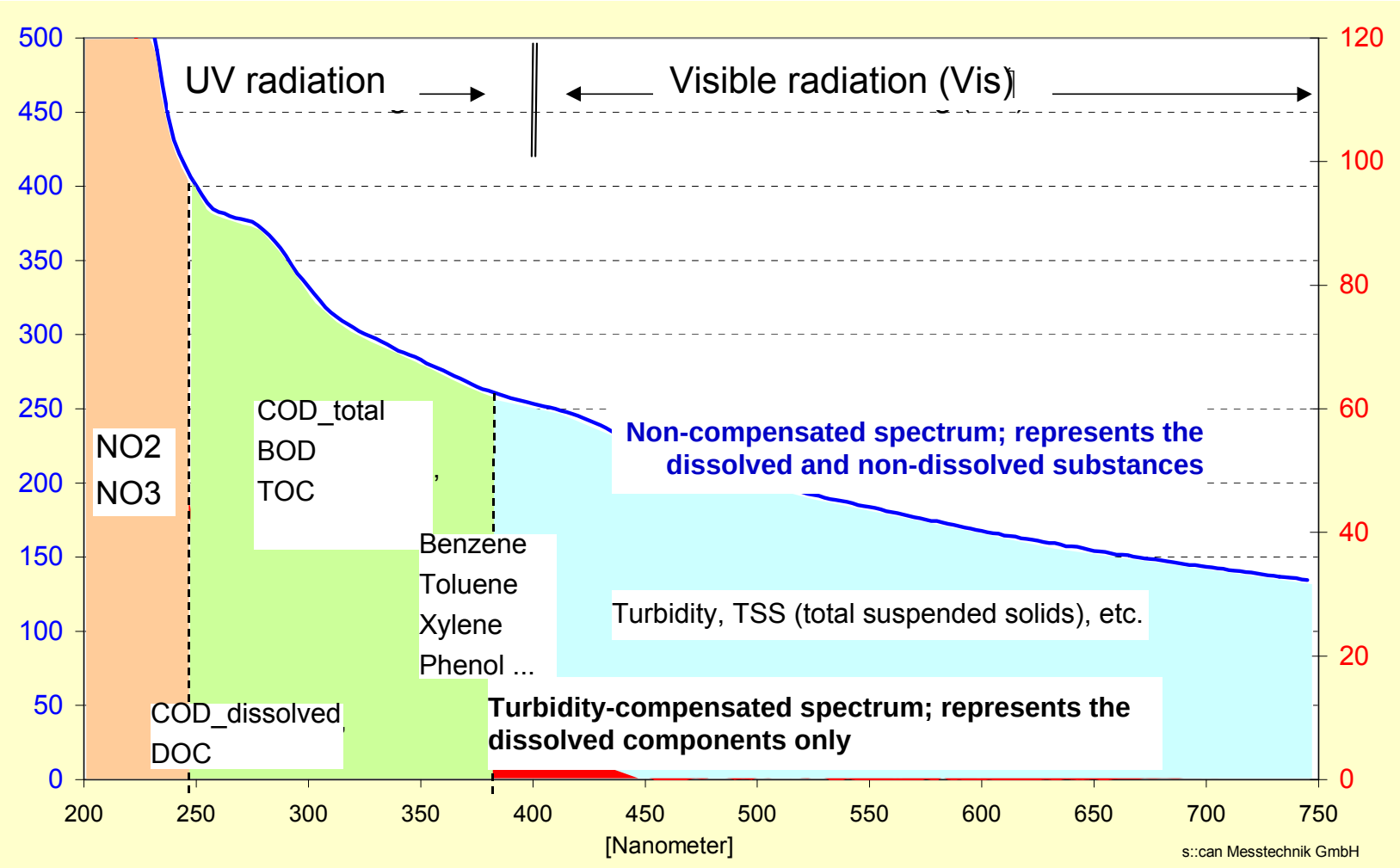
Water monitoring has to deal with a matrix of numerous dissolved and suspended compounds







Full Spectrum Measurement Principle



Absorption fingerprint across multiple wavelengths of light, created using the s::can spectro::lyser

s::can G::Series Spectrometers

Parameter Specific Spectrometers

- UV::lyser – TSS, UV 254, UV254T
- Nitro::lyser – NO3 and Turbidity
- Carbo::lyser - TOC or DOC and Turbidity
- Multi::lyser - TSS, TOC, DOC, UV 254

The s::can Spectrometer Probe

spectro::lyser

- Method: UV-Vis spectrometry; use of the complete absorbance spectrum
- Multiple measurements NO_3 + TOC + DOC + Turbidity and more
- Factory-calibrated
- 100% drift-compensated (*full* 2-beam-design)
- Thus extremely long term stable
- No replacement parts
- Self cleaning, integrated into compressed air system
- Intelligent, many self-diagnosis options
- UV-spectrum can be used to alarm on suspect composition of the water (today's standard for contamination alarm systems in USA)

s::can Calibration Method

"Calibration" should read Parameterization:

- Not done in classical sense to tune in instrument. Rather
- Thousands of spectra from similar sources analysed and typical parameters built into "Global KALIB" file. Can be the source of some confusion since it is not classical calibration.

Local "Calibration"

- If results don't match lab's results accurately enough, "Local Calibration" is necessary
- Samples are taken and correlated with Spectra, and Lab results are fed back to instrument
- Calibration automatic standard or manual
- Kalib is only as good as reference measurement protocols
- Multi-point-calibrations possible (spectro::lyser model only)

s::can Calibration

Advanced “Calibration”

- for “difficult” or unique water matrix
- Fast changing / Variable composition of water
- for non-standardized applications and/or new parameters (in case no suitable “Global Calibration” is available)
- individual service by s::can partner to develop new spectral algorithm for individual water qualities or individual Parameters
- s::can software tools or traditional Chemometric tools (PCA & PLS) as well as ana::larm and contami::spec can be used

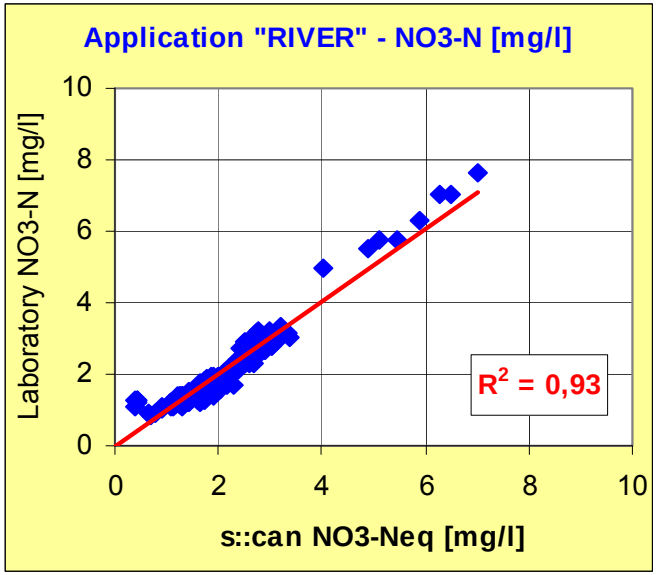
- opens unlimited applications in UV/VIS spectrometry

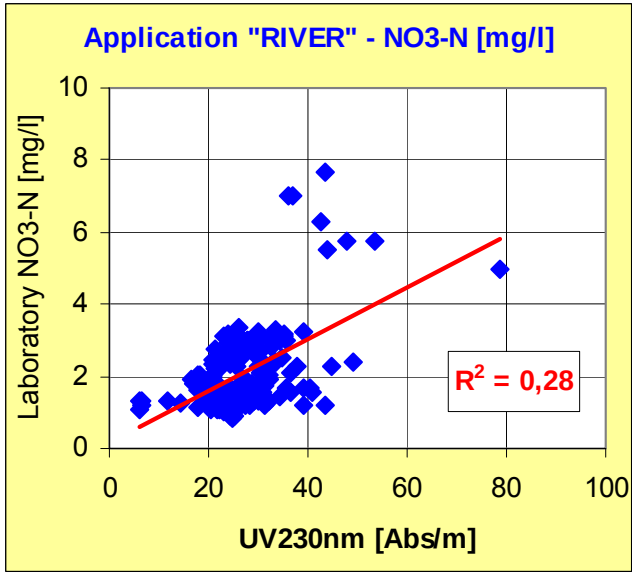
spectro::lyser Global Calibrations

Set of standardized spectral algorithms allow for multiple parameters a once

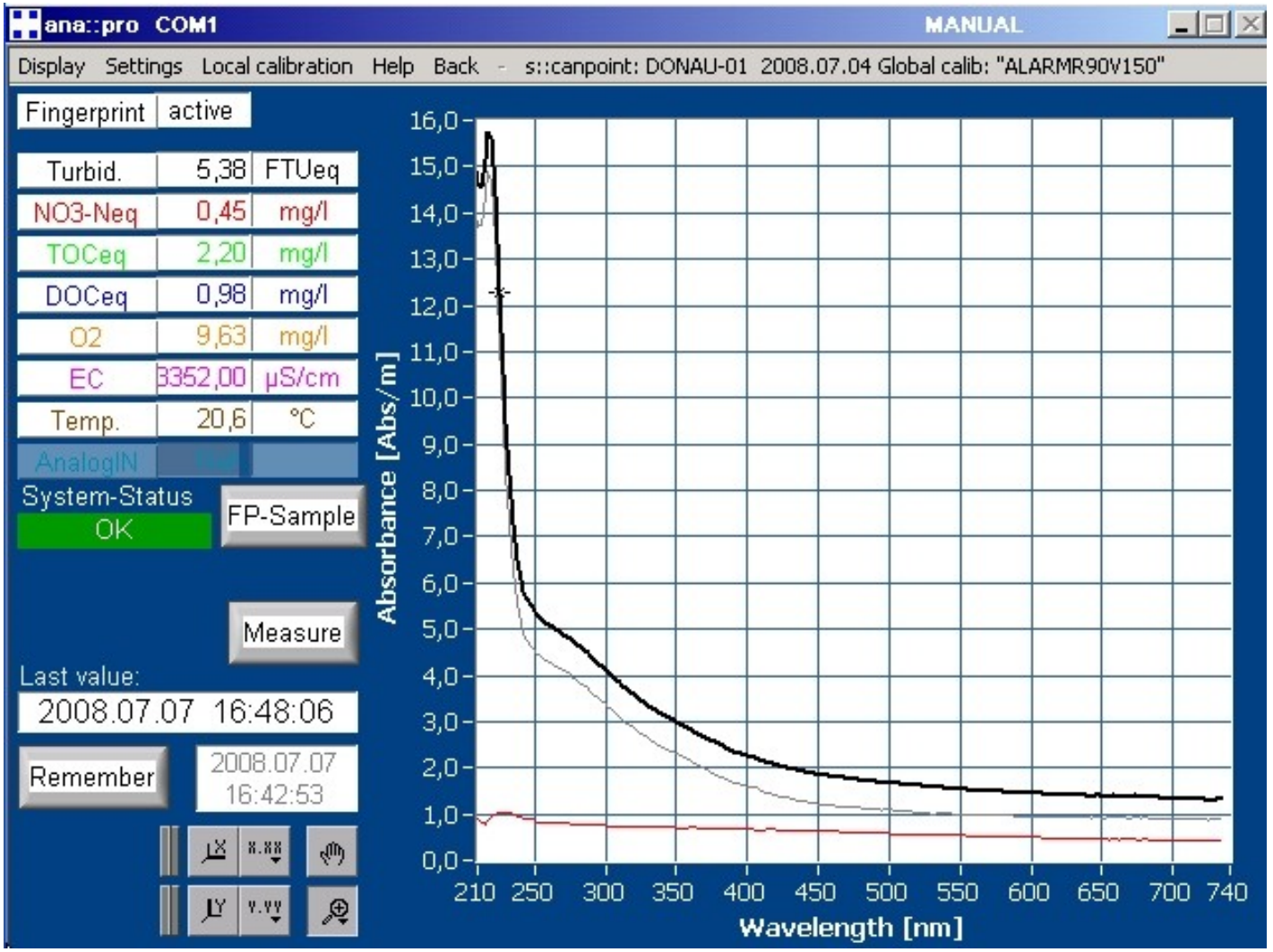
River	• Turbidity, NO3, TOC, DOC, SAC254, Fingerprint
Rivercol	• Includes True Colour and Apparent Color
RiverBOD	• Includes CODeq and BODeq

Spectral algorithmns better than single wavelength



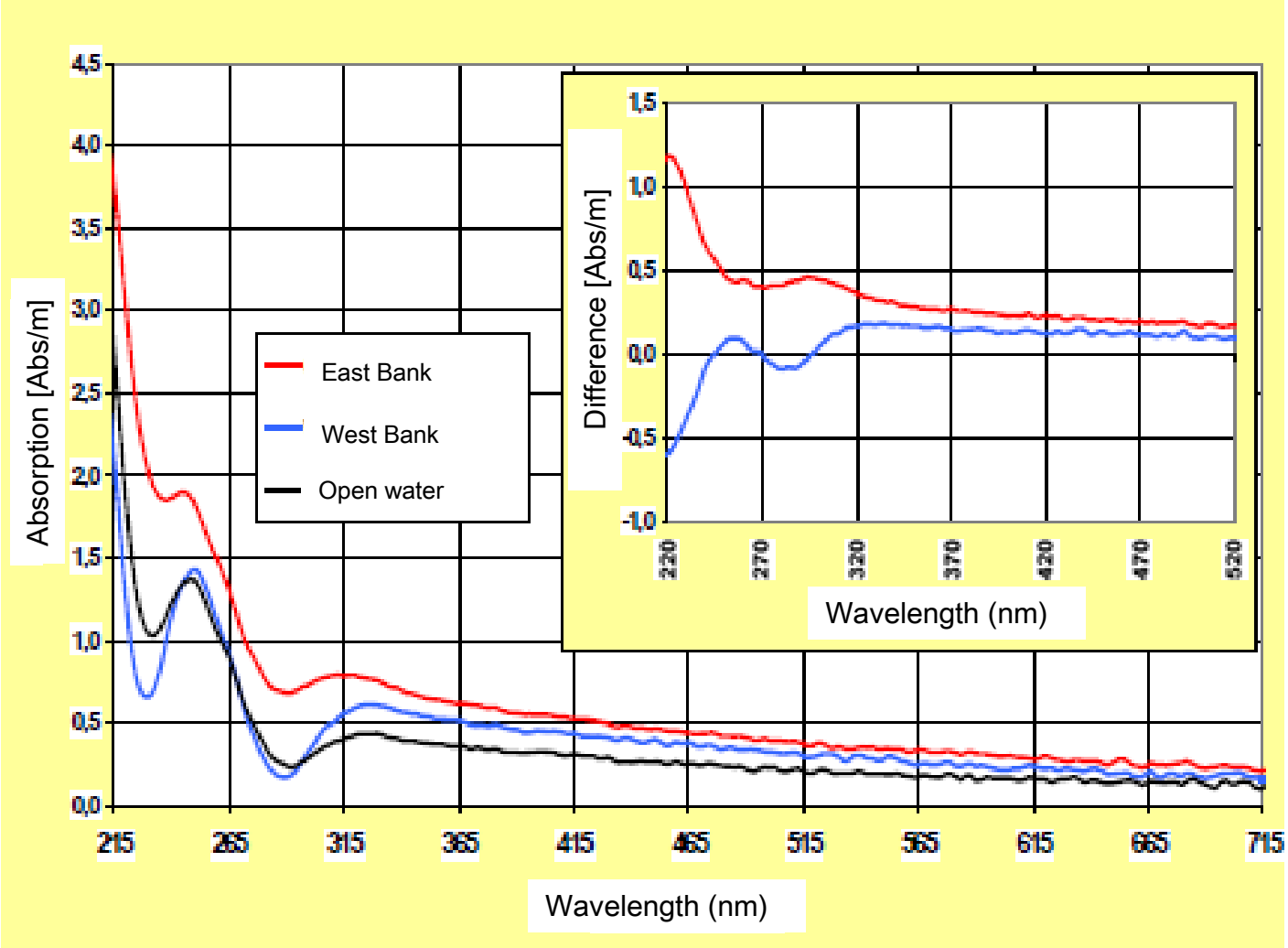


ana::pro Software – Difference Spectra



Aquatic Life ltd.

s::can Fingerprint



Absorption fingerprints comparing three different water sources.

Aquatic Life Ltd.

Parameter File Example

80208018_35_0x0100_spectro::lyser_RI
VER000V120 results of s::canpoint: LEARYS

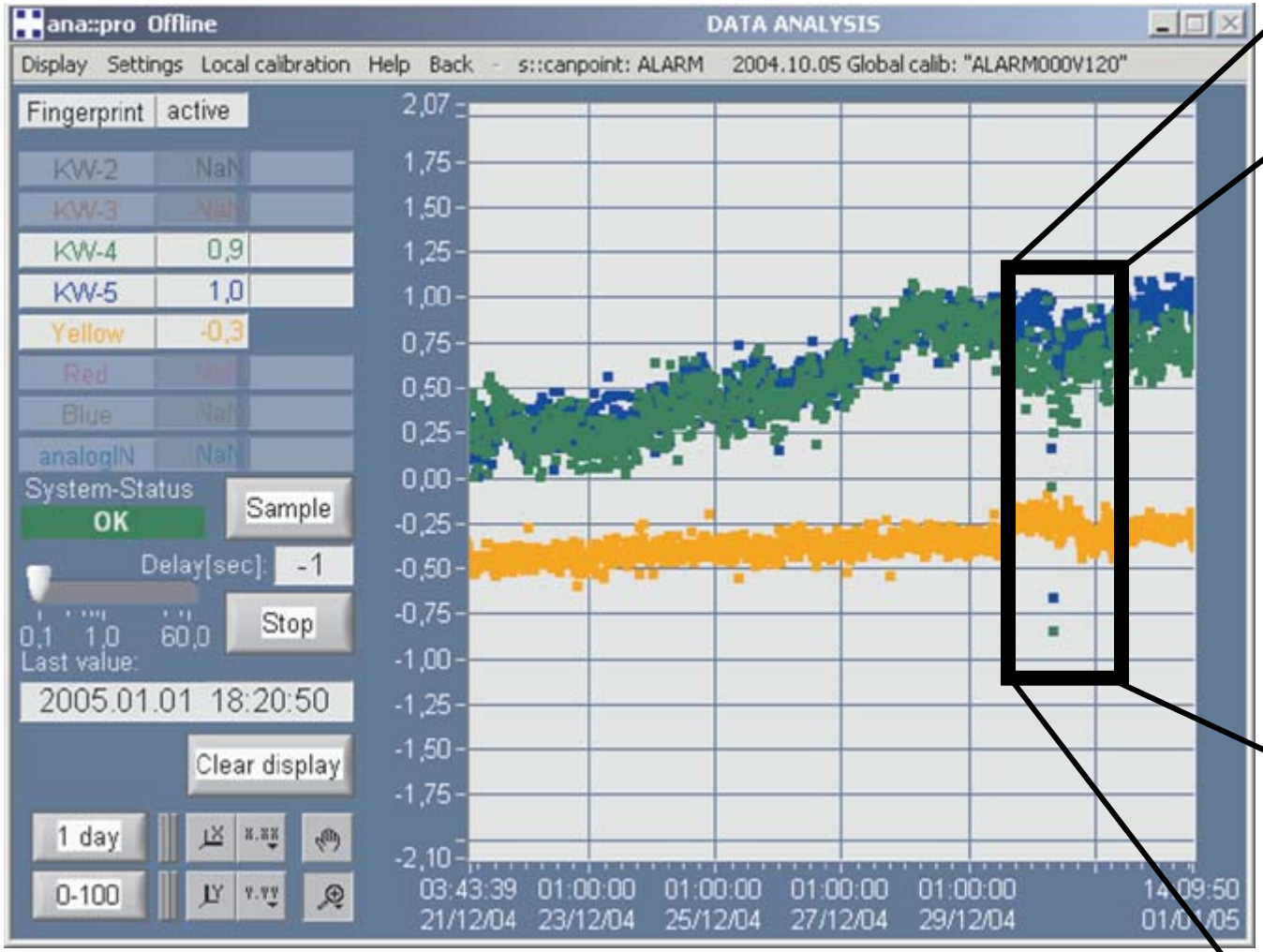
Date/Time	Status	Turbid. [FTUeq]200.00-0.00_2	[Turbid._0_1.0_0.0_0.0]	NO3-Neq [mg/l]10.00-0.00_2	[NO3-Neq_0.0_1.0_0.0_0.0]	TOCeq [mg/l]25.00-0.00_2	[TOCeq_0.0_1.0_0.0_0.0]	DOCeq [mg/l]12.00-0.00_2	[DOCeq_0.0_1.0_0.0_0.0]
2009.07.15 13:08:01	Ok	8.742	0	0.029	0	3.74	0	1.619	0
2009.07.15 13:10:01	Ok	9.177	0	0.056	0	3.824	0	1.447	0
2009.07.15 13:12:01	Ok	8.565	0	0.056	0	3.779	0	1.56	0

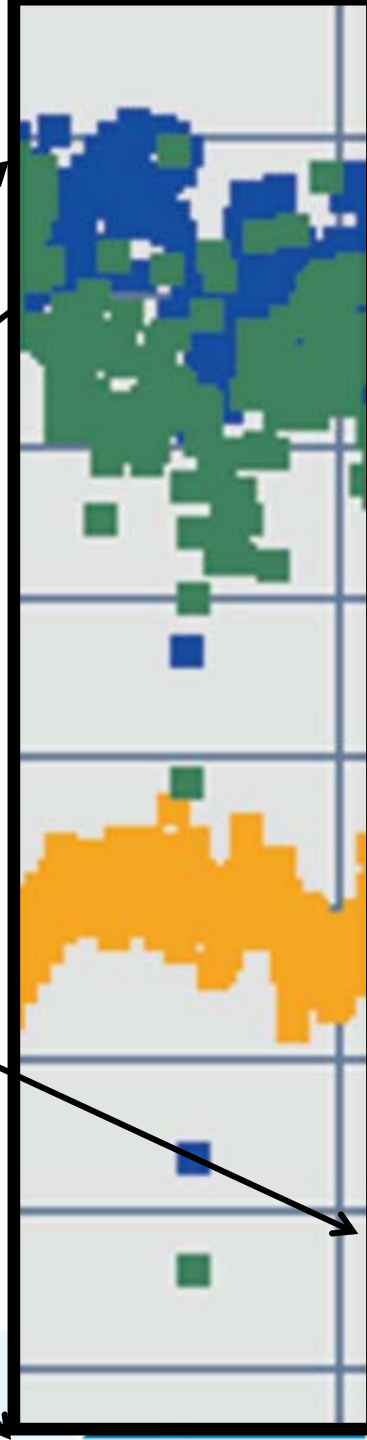
Fingerprint File

80208018_35_0x0100_spectro::lyser_RIVER000V120 results of s::canpoint: LEARYS

Date/Time	Status_0	200	202.5	205	207.5	210	212.5	...
2009.07.15 13:08:01	Ok	46.4089	43.5807	40.737	37.2501	33.5732	29.7008	...
2009.07.15 13:10:01	Ok	47.0013	44.2568	41.4239	37.938	34.1645	30.1617	...
2009.07.15 13:12:01	Ok	47.7868	44.9812	42.115	38.6449	34.865	30.7539	...

ana::alarm

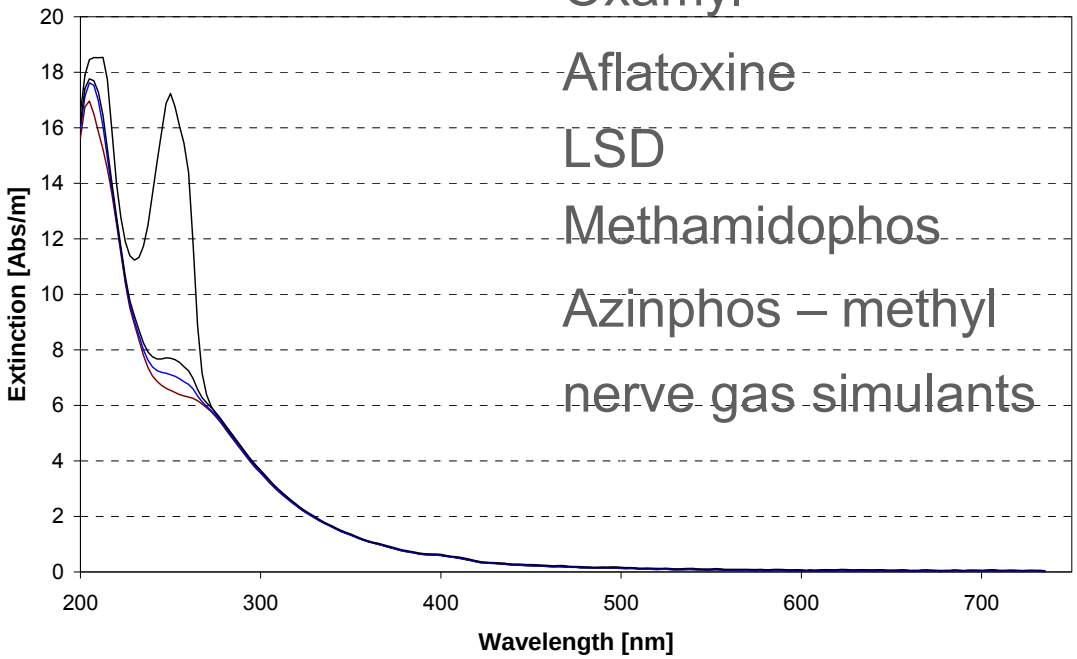




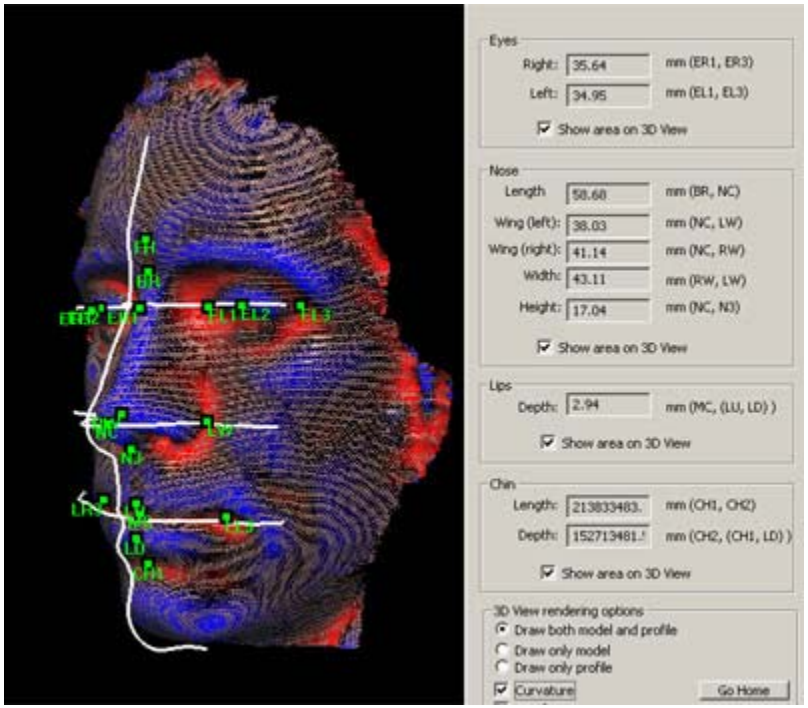
Strength independent discrimination of contamination

Detection limits in drinking water (KIWA & RIVM test reports)

compound	detection limit
Isoproturon	0,05 mg/L
Aldicarb	0,1 mg/L
Oxamyl	0,1 mg/L
Aflatoxine	0,2 mg/L
LSD	0,5 mg/L
Methamidophos	1 mg/L
Azinphos – methyl	2 mg/L
nerve gas simulants	0,1 – 50 mg/L



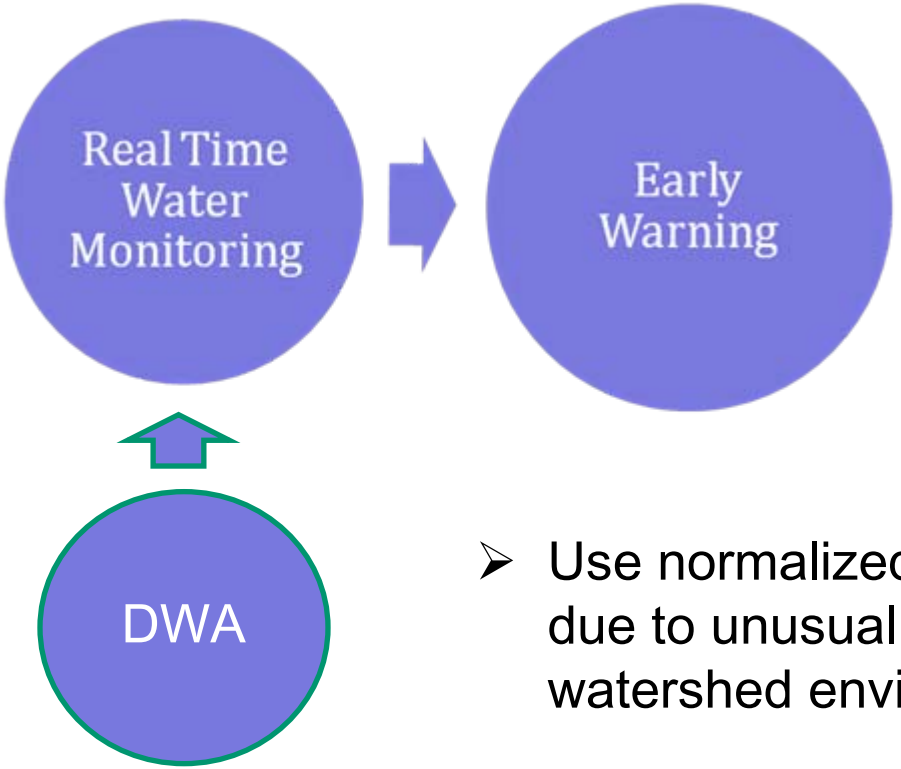
Shift to a Digital Water Archive



We use security fingerprint and facial recognition

Can we not fingerprint our waters???

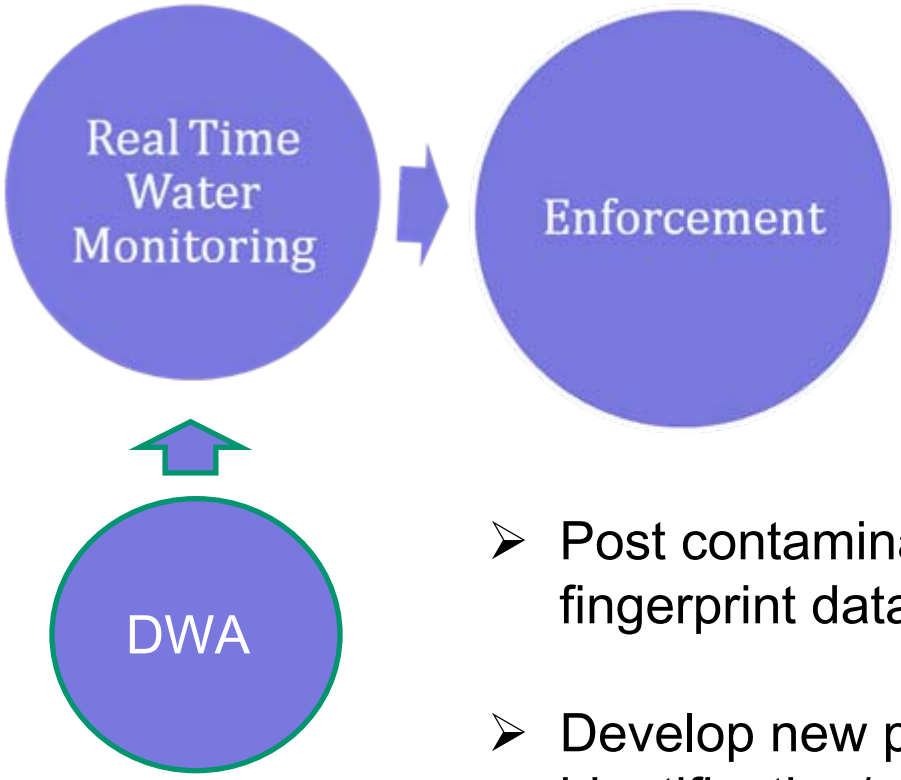
Shift to a Digital Water Archive



- Parameter Exceedence
- Event Detection
- Trigger Autosampler

- Use normalized fingerprint for alarms due to unusual changes in a specific watershed environment
- Improved modeling of the watershed

Shift to a Digital Water Archive



- Toxicity detection
- Parameter exceedence

- Post contaminant analysis using fingerprint database
- Develop new parameter identification/calibrations/surrogates

Shift to a Digital Water Archive

Fingerprint addition to a monitoring database allows for ….

- Post review for specific organic contaminants
- Changes in the overall organic load
- Spectral alarms based normalized fingerprint

Simplified Field Deployment

ISO class 2 air

Onboard G Series
Static IP Address

Standardized
Quick Connects
Fluid and Power
And Air

Lake Winnipeg Water Quality Snapshot

Grand Beach

Questions?

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