

Continuous Monitoring: Resources Available



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NWQMC Aquatic Sensor workgroup

QA Matrix

- The Sensor QA (ACRR) Matrix is a checklist of actions you can do to Affect, Check, Record, and Report the quality of your Sensors' measurements. A number of data quality aspects are addressed.

Methods and Data Comparability Board

Aquatic Sensor Workgroup



Quality Assurance (ACRR) Matrix

QA Checklist for Calibration, Quality Checks, and Record Keeping to Ensure that Data Are of Known and Documented Quality



April 19, 2010 acwi.gov/methods

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1. General: All Sensors

Data Quality Aspect	Mode (See Notes)	Quality Assurance Actions		Documentation Actions	
		Affect (Control, act to influence the outcome)	Check (Test to evaluate or verify)	Record (Keep everything documented)	Report (Communicate the data quality indicator)
Operator's competence	All	Train, refresh, supervise.	Run proficiency tests, review work products.	Record operator name, test/review date, and Test outcome or review summary.	Pass/fail procedure-specific proficiency tests (by individual).
Accuracy/ Bias	All	Use certified non-expired Standards for calibration and accuracy checks.	Compare previous lot/batch of standards with new lot with a high-resolution instrument.	Reading of standard solutions from the two lots.	Report "Standard Solution Drift," the difference between values measured in solutions of the two lots.
	All	Calibrate the instrument at the project's prescribed values and intervals and under the prescribed conditions.	Conduct accuracy checks at the project's prescribed values and intervals and under the prescribed conditions.	Instrument reading, value of standard, temperature /pressure /salinity as relevant [Tips A1-A2], electrode voltage, cell constant, and other diagnostics as relevant, including their acceptable ranges.	Report bias: Instrument drift, i.e., difference from known ("true") value of standard, expressed either in measurement units or as percent of Standard's "true" value, whichever is higher [Tip A3].
	All	Calibrate the instrument after every service event and after instrument has been subject to an impact (e.g., during transport or deployment).	Conduct and accuracy check after every service event and after the instrument has been subject to an impact (e.g., during transport or deployment).	Instrument reading and value of standard.	Report bias: Instrument drift, i.e., difference from known ("true") value of standard, expressed either in measurement units or as percent of standard's "true" value, whichever is higher.
		Avoid switching the power off or disconnecting the sensor from its display unit between sites.	Check accuracy after turning the instrument on again [Comment A1].		
Precision	All	Use consistent procedures under same conditions, always wait for the reading to stabilize.	Repeat measurements often. (i) Repeat measurements 3-5 times after the reading has stabilized, under controlled (non-changing) environment in the lab, during every calibration or accuracy check event. (ii) Repeat field measurements at each site/point in at least 2 sites per trip [Comment A2].	(i) Record several (3-5) consecutive values after instrument reading's stabilization. (ii) Results of the repeated field measurements.	(i) Compute the standard deviation of the 3-5 values and report in measurement units. (ii) Compute the relative percent difference (RPD), which is the difference between repeated field measurements pair (or between two extreme values among several repetitions), expressed as percentage of pair average. (iii) Compute the relative standard deviation (RSD), which is the standard deviation expressed as a percentage of the average of all repeated values [Tip A4].
Lack/ Extent of interference or contamination	All	Clean the probe before and after each use and never let it dry dirty, promptly wash off any Standard materials used for calibrations and accuracy checks, protect sensors from harmful liquids or vapors.	In situ: Measure in stream before moving sensor (or measure in bucket with stream water), then move, clean, return to stream/bucket, measure again. After retrieval: Conduct two-point accuracy check w Standards at zero and at high end of expected range, before and after cleaning the probe.	Document sensor fouling with a digital camera and inspection records before cleaning [Tip A5]. Record Instrument readings in situ (or bucket), or in Standard, before and after probe fouling removal.	Calculate fouling error (bias) as the difference between the reading of the uncleaned sensor and the cleaned sensor, expressed as a percent of the reading after cleaning [Tip A2].

Continued on Reverse...

Both general and specific QA issues and recommendations are listed

https://www.watersensors.org/pdfs/ASW_QA_Matrix_web.pdf

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- **Illustrated Field Deployment Guide for Rivers and Streams**
 - is intended to be used as a checklist of considerations to guide both new and experienced users in the deployment of water-quality monitoring systems using sensors.
- https://www.watersensors.org/field_deploy/



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The Illustrated Field Deployment Guide for Rivers and Streams

Intro System Selection Site Selection Installation Example Installations References

1. System Selection

System selection as used here refers to whether a water-quality sensor is to be used to collect data with a human always present ("Attended monitoring") or if the sensor is to be deployed to collect data for a given period of time with no human present during most of the time ("Unattended monitoring").

1a. Attended Monitoring -- the simplest way to deploy water-quality sensors is shown in the photo below. Attended monitoring is appropriate when one or a few discrete data points are sufficient and continuous data are not needed or required for the study.

Advantages to this method are that the instrument can be freshly calibrated, damage from debris and fouling is minimized, and readings from multiple locations can be made quickly. This is all we will discuss attended monitoring on this web page.



Above: USGS scientists collecting water-quality data using a multiparameter sonde. (Photo: USGS)

1b. Unattended Monitoring -- the main topic of this photographic guide is the deployed, or unattended, application of water-quality sensors. The variety of deployment applications and thus the supporting infrastructure needed varies widely. Unattended stations may require telemetry if data are needed in near real time. This guide is by no means an exhaustive

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Water Quality Data Elements for Sensors ("Continuous" Monitoring)

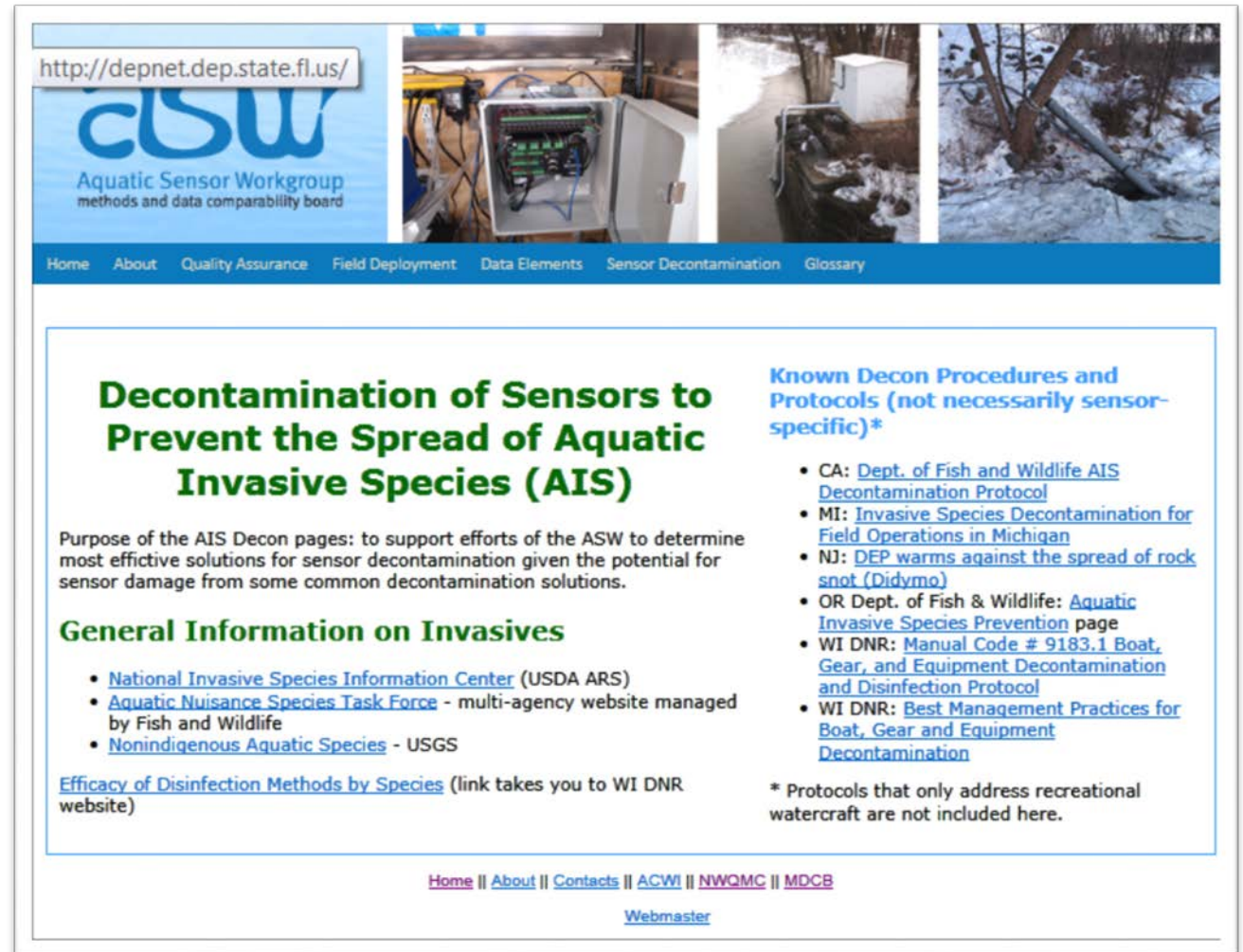
Category No.	Category Name (& WQDE Module)	Group No.	Group Name	Subject No.	Subject Name	Field ID	Field name
1	Monitoring Project ("Contact")	1	Project Identifiers	1.1.1	Identity	1.1.1.1	Project ID
1						1.1.1.2	Project Name
1		1		1.1.2	Descriptors	1.1.2.1	Project Duration
1		2	Organization identifiers	1.2.1	Identity	1.2.1.1	Organization ID
1		2				1.2.1.2	Organization Name
1		2		1.2.2	Organization Descriptors	1.2.2.1	Organization Category
1		2				1.2.2.2	Organization Type
1		2				1.2.2.3	Organization Function in Project
1		3	Project Contacts	1.3.1	Person	1.3.1.1	Contact Last name
1		3				1.3.1.2	Contact First name
1		3				1.3.1.3	Contact Role
1		3		1.3.2	"Essentials"	1.3.2.1	Address Line 1
1		3				1.3.2.2	Address Line 2
1		3				1.3.2.3	City
1		3				1.3.2.4	State
1		3				1.3.2.5	Zip
1		3				1.3.2.6	Phone at Work
1		3				1.3.2.7	Extension
1		3				1.3.2.8	Fax
1		3				1.3.2.9	Phone-Mobile
1		3				1.3.2.10	Email
1		3				1.3.2.11	URL/Website
2	Result ("Result")	1	Result (how much?)	2.1.1	Value	2.1.1.1	Result Value
2		1		2.1.2	Unit	2.1.2.1	Result Unit
2		1		2.1.3	Result Batch Affiliation	2.1.3.1	Result Batch ID
2		1				2.1.3.2	Result Batch Type

Draft water quality data elements

- includes all the information bits, or metadata, that document the "who, what, when, where, how, and why" associated with your monitoring results. Many descriptors of the results are verbal categories. The file contains an additional spreadsheet with a set of pick-lists, a.k.a. "lookup tables", with lists of verbal "values" that are allowable for a specific data element.
- The Matrix reflects the Sensors QA Workgroup's consensus on recommendations for a minimal list of actions which will still ensure delivery of data of known and documented quality.
- <https://www.watersensors.org/dataelements.html>

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Decontamination of Sensors to Prevent the Spread of Aquatic Invasive Species (USGS, FWC, 6 states)



<http://depnet.dep.state.fl.us/>

ASW
Aquatic Sensor Workgroup
methods and data comparability board

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Decontamination of Sensors to Prevent the Spread of Aquatic Invasive Species (AIS)

Purpose of the AIS Decon pages: to support efforts of the ASW to determine most effective solutions for sensor decontamination given the potential for sensor damage from some common decontamination solutions.

General Information on Invasives

- [National Invasive Species Information Center](#) (USDA ARS)
- [Aquatic Nuisance Species Task Force](#) - multi-agency website managed by Fish and Wildlife
- [Nonindigenous Aquatic Species](#) - USGS

[Efficacy of Disinfection Methods by Species](#) (link takes you to WI DNR website)

Known Decon Procedures and Protocols (not necessarily sensor-specific)*

- CA: [Dept. of Fish and Wildlife AIS Decontamination Protocol](#)
- MI: [Invasive Species Decontamination for Field Operations in Michigan](#)
- NJ: [DEP warns against the spread of rock snot \(Didymo\)](#)
- OR Dept. of Fish & Wildlife: [Aquatic Invasive Species Prevention page](#)
- WI DNR: [Manual Code # 9183.1 Boat, Gear, and Equipment Decontamination and Disinfection Protocol](#)
- WI DNR: [Best Management Practices for Boat, Gear and Equipment Decontamination](#)

* Protocols that only address recreational watercraft are not included here.

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Webmaster

https://www.watersensors.org/ans_decon/index.html

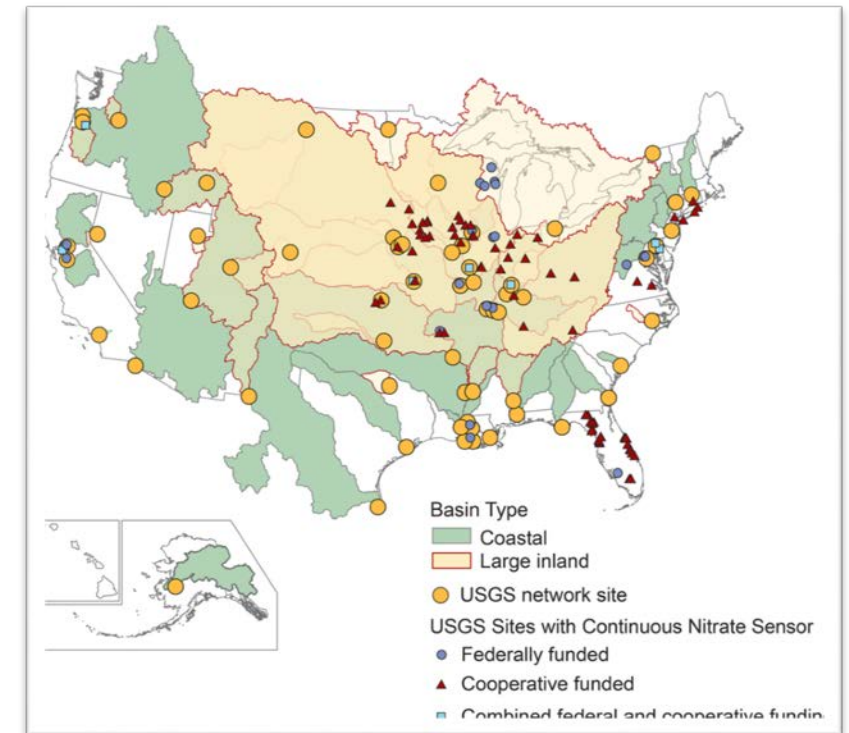
USGS

- Nutrients

- <https://water.usgs.gov/coop/features/real-time.nitrate.summary.pdf>
- https://acwi.gov/monitoring/webinars/national_monitoring_council_webinar_092414b_Pellerin.pdf
- <http://onlinelibrary.wiley.com/doi/10.1111/1752-1688.12386/full>

- Guidelines & standard procedures

- <https://pubs.usgs.gov/tm/2006/tm1D3/>



DEAR CM Workgroup

Continuous Monitoring SOP

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7. pH Calibration

8. Turbidity Calibration

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Appendix.....

Table 1. Field

Table 2. Solution

1. Objective

The purpose of this SOP is to ensure that environmental instruments are calibrated and maintained to provide accurate and reliable data.

Organization/Agency	Sonde Type	Sensors used with sonde	Describe any pros this system
SJRWMD	SUNA V2		
Ocean Research and Conservation Association, Inc. (ORCA)	YSI EXO 2 / NuLab	Water temperature, Water depth, Salinity, Conductivity, Dissolved Oxygen, Flow Speed, Flow Direction, pH, ORP, Nitrogen, PO4, Chlorophyll, Blue Green Algae, FDOM	NuLab wet chemistry system is only system we have found to work in estuarine waters. YSI EXO 2 sonde has most parameters available on sondes.
DEP Florida Coastal Office	YSI 6600	Turb, cond/temp, optical DO, pH	Aquatic Preserves around the state and NERRS around the country are using these sondes, probes and the CDMO protocol so there is constancy in the program.
Rookery Bay NERR	YSI 6600, YSI EXO2, YSI EXO1	pH, Conductivity/Temp, DO, Turbidity, Depth	EXO2 is much easier to calibrate, sensors have on-board memory, wireless communications, reduction of fouling, central wiper keeps probes clean, reduced water intrusion and probe failure, less maintenance cost over time

- General SOP for future acceptance of field measurements into statewide db
- Spreadsheet of information about CM sensor use in Florida
- Next: Data Management

Coming this fall!