Sensors Workgroup Deployment Guide

National Water Quality Monitoring Council
February 12, 2015

The Methods and Data Comparability Board Aquatic Sensors Workgroup

- The Methods and Data Comparability Board and the Aquatic Sensors Workgroup maintain web pages to share information with practiced veterans and neophytes of continuous water quality monitoring at: http://www.watersensors.org/

- This includes a Field Deployment Guide which is currently under review/revision.

Aquatic Sensor Workgroup
methods and data comparability board

Field Deployment Guide

Checklist for Sensor Selection, Deployment, and Maintenance: **Rivers & Streams**

March 24, 2010 acwi.gov/methods

Aquatic Sensor Workgroup
methods and data comparability board

How to Use the Field Deployment Guide

A basic assumption of this guide is that a monitoring location has been defined based on the project requirements; that is, you have determined that you will be sampling (for example) Black Earth Creek in the vicinity of the Highway 14 bridge near the town of Cross Plains. The next step is to visit the site and determine how and where your monitoring will take place, and if continuous data are to be collected, what are the considerations for location of structures and placement of sondes, sensors, or orifice intake lines.

1. System Selection

Measurements must accurately represent a water body based on the purpose of the monitoring and the data-quality objectives. All other factors in water-quality monitoring must be balanced against these two factors. The selection of the type of monitoring system to use is the first step.

Attended monitoring is used when relatively infrequent discrete samples are adequate for the monitoring needs. Attended monitoring requires no permanent installation at a site. In this guide, considerations for attended monitoring include all "General" comments and those marked with a **green dot**.

Unattended, or in-situ, monitoring is where only the sensors are placed directly at the measuring point in the aquatic environment and communication cables are run to the data logger and power system located in a weather-resistant shelter. Power requirements for in-situ monitoring may be met by the use of batteries, perhaps supplemented by solar panels. Considerations for in-situ systems include all "General" comments and those marked with a **yellow dot**.

Flow-through monitoring system has a pump that delivers water from the measuring point to the sensor(s) or sonde housed in a shelter. Access to power is a requirement for flow-through monitoring systems. Considerations for flow-through systems include all "General" comments and those marked with a **blue dot**.

	Advantages	Disadvantages
Attended Monitoring	Calibration should be done right before data are collected, ensuring data of the highest, known quality. Vandalism not an issue. No need for expensive shelters.	Does not take full advantage of new technology. Each data point is expensive.
Unattended: In-situ Monitoring System	Remote locations are possible. Small shelters can be used. No power is needed to pump water, and electrical hazards are reduced. With satellite telemetry, data can be transmitted to the office location. System can be monitored remotely for problems. No pump maintenance.	Sensors are susceptible to vandalism. Sensors are more prone to fouling than in flow-through system. Servicing sensors during flooding can be difficult. In shallow bank or poorly mixed installations, properly locating intakes or sensors in the cross section is difficult. Sensors are susceptible to debris or high flow. Shifting channels may require adjustments to sensor placement. Susceptible to freezing.
Unattended: Internal-logging Monitoring System	Location options are flexible. No electrical hazards. Exposure to vandalism may be reduced. No pump maintenance.	Sensors are susceptible to vandalism. Sensors are more prone to fouling than in flow-through system. Servicing sensors during flooding can be difficult. In shallow bank or poorly mixed installations, properly locating intakes or sensors in the cross section is difficult. Data are available only during site visits. Sensors are susceptible to debris or high flow. Shifting channels may require adjustments to sensor placement. Status of equipment can only be checked while servicing. Site visit required to view data and assess data loss. Susceptible to freezing.
Flow-through System	Unit can be coupled with chlorinators to reduce membrane fouling. Expensive sensor systems can be secured in vandal-resistant shelters. Sample water from more than one measuring point can be	110-volt AC power source is needed. Large shelters are required, incurring higher installation costs. Pumps in streams can clog from algal fouling or high sediment loads. In shallow bank or poorly mixed installations, properly locating

Remote Deployed Water Quality Monitoring Stations

Remote deployed water quality monitoring stations must be developed with data use, data quality /quantity objectives, and consideration of the environment in which the station will be deployed.

Remote Water Quality Station Considerations

Data Quality

What's the question you need to answer?

What quality data do you need and how much?

Parameters

Discharge

Basic (T/SC/pH/DO)

Basic+ (T/SC/pH/ODO and other optical)

Nutrients

Service Intervals

How much data can you afford to lose?

Remote Water Quality Station Considerations

Telemetry Options

None

Hard-wired

Wireless

Satellite

Station Location

Representative X, Y, Z

Accessibility

Safety

Stability

Remote Water Quality Station Considerations

Monitoring Stations

Freshwater

- Conveyance
- Lake/Reservoir
- Stream

Brackish/Saltwater

Edge of Field

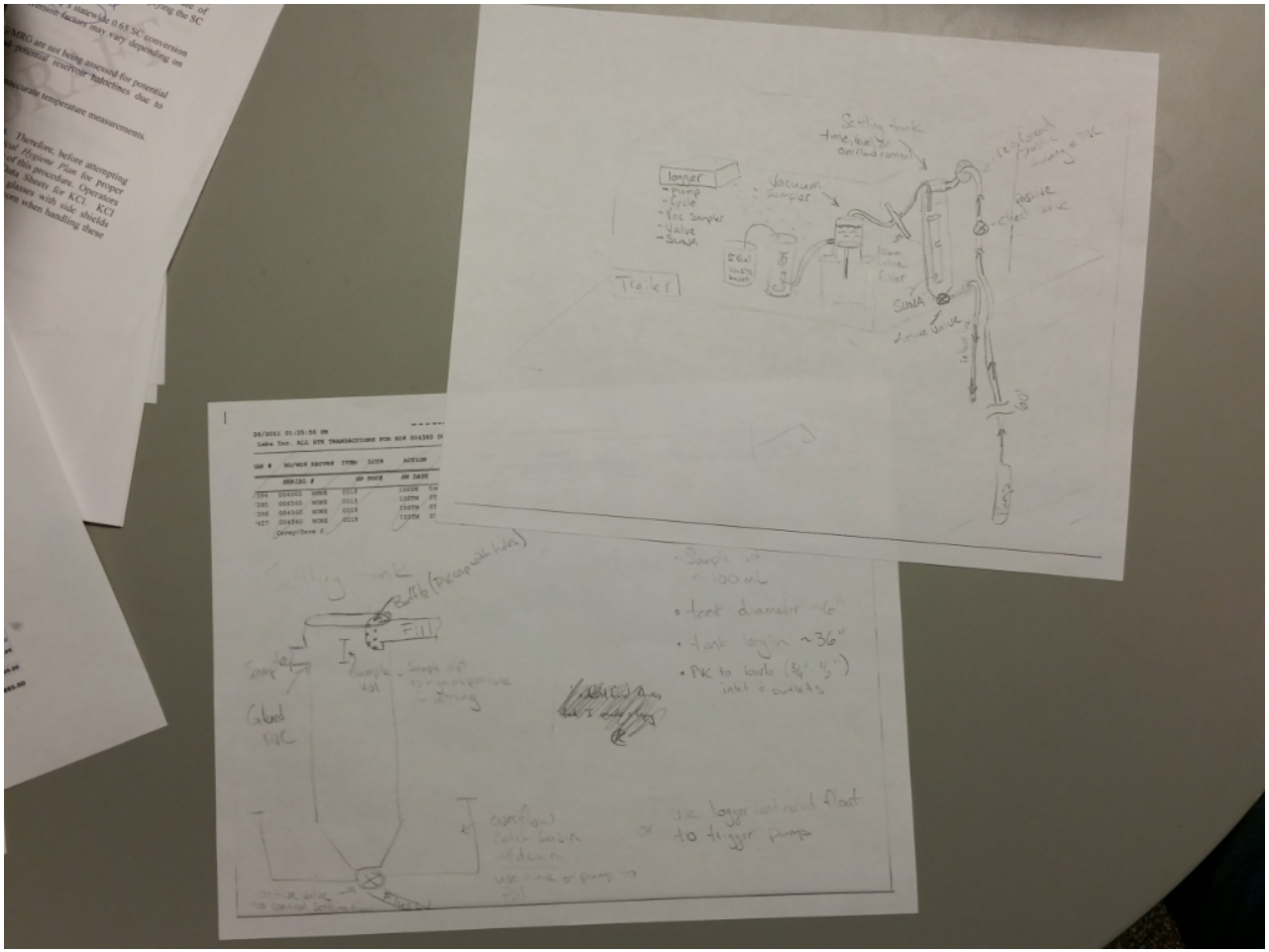
Best Management Practices

Remote Water Quality Station Gallery

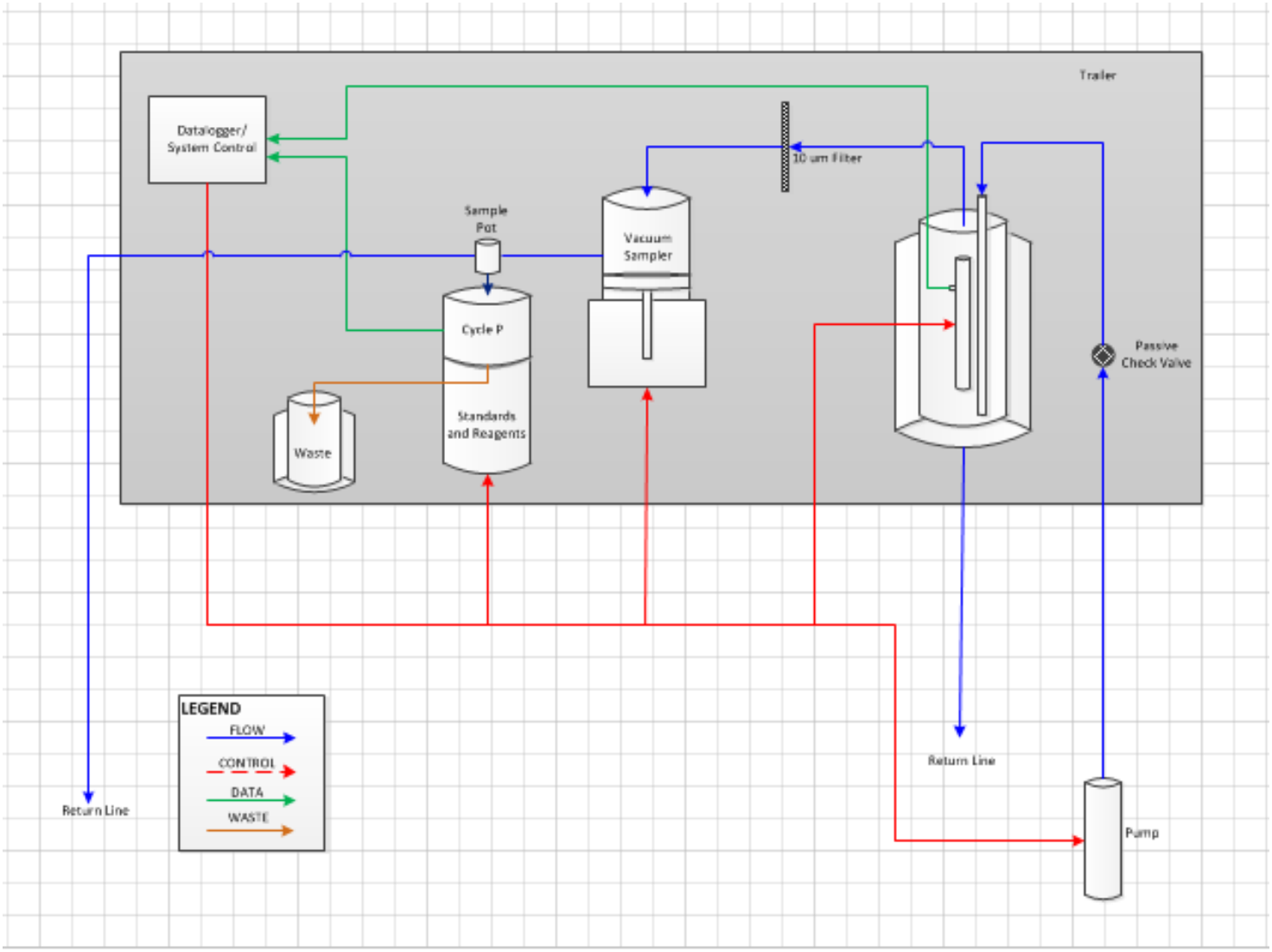
So, what's wrong with this station?

Even with the simplest continuous monitoring station warrants careful consideration to deploy

Let’s start here ….



Is that it …


Trailer
Datalogger/
System Control
10 um Filter
Sample
Pot
Vacuum
Sampler
Cycle P
Standards
and Reagents
Waste
Passive
Check Valve
Return Line
Return Line
Pump
LEGEND
FLOW
CONTROL
DATA
WASTE

Can you build this? Would you want to?

Remote Water Quality Station Gallery

- Examples of what we've learned to date (success stories)
- Examples of how we've learned along the way (creating success out of failure)
- Points of contact

Remote Water Quality Station Gallery

Oswego River at Lock 7, Oswego, NY

Description - 4" Galvanized construction strapped to the Erie Canal wing-wall, with a perforated end section for YSI-multiparameter monitor. The site includes a 2" sampling section for automated sampling on right.
Telemetry – Satellite (GOES)
Location - Oswego River at Lock 7, Oswego, NY (04249000)
Data use - WT, SC, pH, DO, TB 15-minute interval. This site is one of the sentinel sites for the Great Lakes Restoration Initiative for surrogate modeling and loading into Lake Ontario.
Rational for station design - YSI representation of parameters at installation vs. cross-section is considered excellent. However, on the left side of the river dissolved oxygen can be different due to a power diversion outflow structure but is not representative of the basin. Hence, data collection along the right side of the river is appropriate. A steel deployment tube is used because of ice and boat traffic.
Data available (URL) -
http://waterdata.usgs.gov/ny/nwis/uv/?site_no=04249000&PARAmeter_cd=00065,00060
Operator – NY WSC USGS WRD
Operator Contact – Ithaca New York USGS

Remote Water Quality Station Gallery

Neponset River Estuary in Dorchester, MA

Description – Five scientific buoys were constructed for measuring water chemistry in the Neponset River estuary in Massachusetts. The buoys were constructed to provide long term data at low cost in a salt water environment with 13' tides. Each buoy can collect water temperature, salinity, CDOM, chlorophyll-a, turbidity, air temperature, air pressure, wind direction, wind speed, and solar radiation. They are solar powered with two 3 Watt solar panels. They use an Onset U30 for data logging and telemetry and Onset weather sensors. Water quality parameters are collected with Aquatroll, Turner, and Wetlabs sensors at a depth of 0.8 m.
Telemetry – Onset U30 data logger using GSM cellular telemetry.
Location – Neponset River Estuary in Dorchester, MA. The buoys are spread out from the top of the tidal extent of the estuary out into Boston Harbor, where the Neponset River meets the Harbor.
Data use – Water temperature, salinity, and CDOM are used to study carbon out-welling from the Neponset River and from the estuary's salt marshes.
Rational for station design - These buoys were designed to provide a low cost long term data source for evaluating seasonal and annual carbon fluctuations. They can be deployed individually or as part of a network providing data about a whole estuary. The total cost for each buoy was less than $10,000.
Data available (URL) – Currently not deployed. http://www.ceen.org/neponset.php
Operator – UMass Boston Center for Coastal Environmental Sensing Networks (CESN)
Contact – Francesco Peri (francesco.peri@umb.edu), Ben Wetherill (benjamen.wetherill001@umb.edu), Robert F. Chen (bob.chen@umb.edu)

Remote Water Quality Station Gallery

Arroyo Colorado at Rio Hondo, TX

Description – The TCEQ's Monitoring Operations Division authorized to the installation CAMS station C730 in May of 2006. A previous water quality station had been installed at the same site on the Arroyo Colorado at Rio Hondo by the USGS under contract with the TCEQ. The (USGS) station was installed from May-August of 2005 but was never able to operate properly due to extreme biofouling of the near-surface probe and H2S corrosion of the near-bottom depth probe.
Telemetry – GOES and wireless cellular telemetry.
Location – Arroyo Colorado at FM106 in Rio Hondo, TX.
Data use – Water temperature, salinity, and DO are used to model water quality in the Arroyo Colorado.
Rational for station design - The system consists of an YSI multi-parameter sonde equipped with copper shrouds and sensor wipers to extend data collection in these extremely productive waters. A YSI profiler will be used to move the sonde vertically through the water column. The physical motion of the sonde, the changing environmental conditions through the water column, and the brief exposure to water saturated air in the deployment tube is intended to decrease the rate of fouling and deter biological organisms from interfering with the measurements and obstructing the deployment tube. Temperature, specific conductance, and dissolved oxygen will be collected at 4 to 8 equally distributed points through the vertical profile.
Data available (URL) – www.texaswaterdata.org
Operator – USGS Texas Water Science Center
Contact – Cassi Crow (crow@usgs.gov), Chuck Dvoraky (charles.dvoraky@tceq.texas.gov)

Remote Water Quality Station Gallery

Rio Grande at Santa Elena Canyon, TX

Description – The Rio Grande at Santa Elena Canyon includes a data collection platform with an YSI 6600 sonde. The data collection platform is elevated 20' above grade due to the potential for flooding.
Telemetry – GOES satellite telemetry
Location – Rio Grande downstream of Santa Elena Canyon in Big Bend National Park
Data use – Water temperature, SC, pH, and DO support segment delineation, stream standards, reintroduction of endangered species, bed and bank gain/loss studies and flood warning,
Rational for station design - The station previously located on the Rio Grande at Castolon was relocated to the Rio Grande downstream of Santa Elena Canyon. The relocation was designed to reduce the magnitude and frequency of fouling/scouring patterns caused by the hydraulics at the Castolon location.
Data available (URL) – www.texaswaterdata.org
Operator – USGS Texas Water Science Center
Contact – Cary Carman (carman@usgs.gov), Chuck Dvorsky (charles.dvorsky@tceq.texas.gov)

".. go south from Ft. Davis and come to the place where rainbows wait for rain. And the river is kept in a stone box. And water runs uphill. And mountains float in the air except at night when they go away to visit other mountains."

Unknown Vaquero