# An Overview of Quality Assurance Considerations for (Volunteer) Monitoring Programs

**Linda Green**

**Volunteer Water Quality National Facilitation Project**

USDA-CSREES 2007 National Water Conference

Savannah, Georgia

January 2007

# Characteristics of Successful Volunteer Water Quality Monitoring Programs . . .

- Well-organized
- Sound scientific basis ★
- Report results
- Strong institutional support
- Make a difference

# A Sound Scientific Basis means…

- Clear monitoring goals and questions
- Written study design
- Clear documentation of instructions for all monitoring activities
- Monitoring scope and complexity appropriate for capabilities
- QA appropriate for data use

**…a Data Quality System**

# Main Uses of Volunteer Data*

- **Promote Public Awareness**
- **Water Quality or Watershed Education**
- **Document Existing Conditions**
- **Establish Baseline**
- **Research / Problem Identification**
- **Advocacy / Community Organizing / Local Decisions**

The Providence Journal

SATURDAY
March 25, 2000
50 cents
$2.20 per week by carri

**QUALITY CONTROL:** URI Watershed Watch monitors are being sought for several lakes and ponds in Rhode Island, including Valley Falls Pond, in Central Falls, where tall grasses wave in the breeze in the mud flats along its shore.

Journal photo/MARY MURPHY

## Rainfall – or lack of it – affects quality of state's lakes, ponds

By PETER B. LORD
Journal Environment Writer

Remember last summer's drought? And the torrential rains two summers ago? Both extremes had major and unexpected effects on Rhode Island's lakes and ponds, according to data collected at the University of Rhode Island.

Reports submitted by hundreds of volunteers for URI's Watershed Watch program showed that last summer's drought lowered water levels in some lakes and ponds by 3 feet. Stillwater Pond in Smithfield and Spalding Pond in North Stonington, Conn., were so shallow that volunteers couldn't launch their boats.

The water that remained in some ponds was more polluted than usual because there was less water but the same amount of contaminants. In other ponds, however, the water was clearer because the lack of rainfall meant that contaminants weren't washed into the body.

Turn to **POND**, Page A-4

* Nat'l Dir. of Envir. Mon. Progs. - 5th Ed.

# The Continuum of Monitoring Data Use

Education/ Awareness → Baseline, Problem ID, Assess Impairment, (local Decisions) → Legal & Regulatory (county/state)

Increasing Time - Rigor - QA - Expense $$

Geoff Dates, River Network

# World Water Monitoring Day

**www.worldwatermonitoringday.org**

Water Temperature

pH

Turbidity/Clarity

Dissolved Oxygen

# Monitoring for Assessing Baseline Conditions

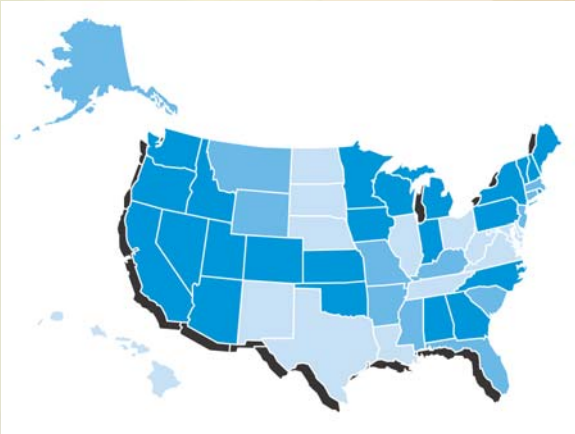
Volunteers typically use kits or send samples to professional laboratories.

Sampling and analytical methods used are generally comparable to those used by professionals.

Alabama Water Watch

IOWATER
Volunteer Water Quality Monitoring

Maine SHORE STEWARDS



GREAT BAY COAST WATCH
UNH COOPERATIVE EXTENSION / SEA GRANT

Cooperative Extension
URI
Watershed Watch
Natural Resources Science

www.usawaterquality.org/volunteer

# Monitoring for Legal and Regulatory Purposes

- **TMDL**
- **305b**
- **303d**
- **CALM**

**Meeting your state's requirements**

# Data Quality System

- **Before: Plan your Quality Assurance**
  "the broad plan for maintaining overall quality"
  (study design, QAPP, monitoring manuals)

- **During: Implement your Quality Control procedures**
  "mechanisms to control errors & increase accuracy"
  (training, follow procedures, proficiency testing)

- **After: Conduct your Quality Assessment review**
  "review , evaluate, correct, reconcile"

## Produce Data of Known Quality

## What is the cost of being wrong?

National Facilitation Project factsheet VI: *Building Credibility: QA/QC for Volunteer Monitoring Programs*

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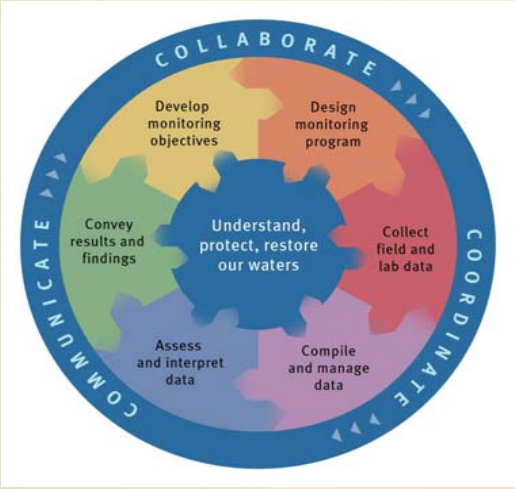
National Facilitation Project factsheet VI: *Building Credibility: QA/QC for Volunteer Monitoring Programs*

# *Before -*
# Plan Quality Assurance

- Create your **study design,** the foundation of credibility
- **figure out your DQO's** & develop your Quality Assurance Project Plan (QAPP),
- Develop your monitoring manual & training materials

# *Planning - **Study Design***: Important Questions to Consider

- Why **do you want to monitor?**
- Who **will use the data?**
- How **will the data be used?**
- How good **do the data need to be?**
- What resources **are available?**
- What type of monitoring **will you do?**
- Where **will you monitor?**
- When **will you monitor?**




*Modified from EPA Volunteer Stream Monitoring Methods &*

*NWQMC A Framework for Monitoring*

# *Planning* – ***Study Design***
# Assess What is Possible

## Consider

- **Skills and knowledge**
- **Financial resources**
- **Potential data uses and users**
- **Level of commitment**

**Matrix of Monitoring Activities**

**The following table describes in broad terms some of the monitoring activities typically performed by volunteers. This matrix is intended to help direct the selection of monitoring activities according to data objectives and available resources. The table is arranged with the monitoring activities that generally require less effort and resources at the top, increasing in complexity toward the bottom. Within each monitoring activity, there is also often a range of data objectives and resources needed, with more intense data objectives requiring more resources.**

| | | Resources Needed | | | | |
|---|---|---|---|---|---|---|
| Monitoring Activities | Data Objectives | Examples of Activities | Equipment & Supplies | Education & Training | Frequency of monitoring | QA/QC Level & Standards |
| Shoreline Survey | Educational; General awareness; Gross problem identification or screening; Baseline data; Targeting sites for additional study | Field observations; shoreline land use assessment; I.D. potential sources of pollutants | Map of waterbody, field data sheets<br><br>Optional: Camera, GPS unit | Understanding of maps and features of concern. Can be self taught or training on how to complete maps and data sheets | Annually | No formal QA/QC plan required. Field Observations on standard forms. |
| Watershed Assessment | Educational; General awareness; Gross problem identification or screening; Baseline data; Targeting sites for additional study | Field observations, watershed wide land use assessment, I.D. potential sources of pollutants | Map of watershed, field data sheets<br><br>Optional: camera; permission to access private property, GPS unit | Understanding of maps and features of concern. Can be self taught or training on how to complete maps and data sheets | Annually or less often | No formal QA/QC plan required. Field Observations on standard forms. |
| Habitat Assessment | Educational; General awareness; Gross problem identification or screening; Baseline data; Targeting sites for additional study/restoration | Visual assessment of critical habitat features; may include measurements of some features. Intensive surveys measure channel depths, sinuosity, etc. | Map of waterbody, field data sheets, measuring tape, measuring stick<br><br>Optional: camera; permission to access private property, GPS unit | Understanding of maps and features of concern. Training in evaluating habitat features and in how to complete maps and data sheets recommended | Several times a year during different seasons or less is typical, many programs assess habitat annually | Basic written plan – assessment purpose, methods, sites, and schedule. |

Page 1

U.S.D.A. National Facilitation of C.S.R.E.E.S. Volunteer Monitoring Efforts Website http://www.usawaterquality.org/volunteer/

*National Facilitation Project Matrix of Monitoring Activities;*
*EPA Stream Monitoring Methods, p. 42*

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CSREES
Volunteer Water Quality Monitoring
National Facilitation Project
Applying knowledge to improve water quality

# Useful Sources to Locate Methods

- EPA Guidance Manuals
- The *Volunteer Monitor* newsletter
- LaMotte/Hach kits and catalog
- Volunteer Program websites
- Volunteer monitoring listservs
- Secchi Dip-In website (http://dipin.kent.edu/)
- Standard Methods for the Examination of Water and Wastewater

The Volunteer Monitor

THE NATIONAL NEWSLETTER OF VOLUNTEER WATERSHED MONITORING Volume 15, Number 1 • Winter 2003

University Partnerships


VA SOS Modified Method 6
Floating Classroom 10
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Citizen Science in Delaware 16
Cooperative Extension Programs 18
National Water Monitoring Day 21
Participatory Research at UNH 22


Sherman's Creek Conservation Association members learn about macroinvertebrate monitoring at ALLARM workshop.

the ALLARM Program

growth, change, and lessons learned

by Candie Wilderman, Alissa Barron, and Lauren Imgrund

*After 10 years of operation, we renamed our college-community partnership. The program formerly known as ALLARM would henceforth be called … ALLARM. Although the name change—from "Alliance for **Acid Rain** Monitoring" to "Alliance for **Aquatic Resource** Monitoring"—may have been subtle, it signaled a far-reaching change in the relationship between Dickinson College and volunteers from the surrounding community.*

The original ALLARM was started by the college's Environmental Studies Department in 1986 to collect more information about the impact of acid deposition on Pennsylvania's streams. The new ALLARM has a dramatically broader focus. While we have continued the acid rain monitoring, now the majority of our effort is devoted to helping community groups perform their own monitoring and research on issues of their own concern.

A continuum of models

"Citizen science" projects, including volunteer monitoring, rely on partnerships between citizens and professional scientists. These partnerships can take many forms, which may be arranged along a continuum of increasing community involvement and control. ALLARM's experience of evolving from a single-issue, "top-down" program to a multi-issue, "bottom-up" program has given us some special insights into the strengths and challenges of the different models.

The following five questions help situate a given partnership along the continuum:

1. Who defines the problem?
2. Who designs the study?
3. Who collects the samples?

continued on page 3

**Don't re-invent the monitoring method!**

# *Planning* - Data Quality Objectives: Important Questions to Consider

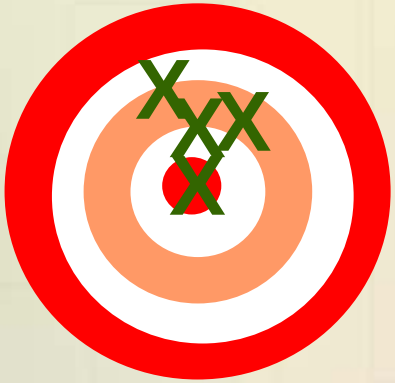
- **What will the data be used for?**
- **Who will use the data?**
- **What quality do your data need to be?**
  - ✓ **Precision**
  - ✓ **Bias**
  - ✓ **Accuracy**
  - ✓ **Comparability**
  - ✓ **Completeness**
  - ✓ **Representative**
  - ✓ **Sensitivity**

# Data Quality Objectives: Precision

- The degree of agreement among repeated measurements of the same characteristic or parameter
- Tells you how consistent or reproducible your methods are by showing you how close your measurements are to each other
- Measured by **standard deviation** and coefficient of variation

# Data Quality Objectives: Bias

- Systematic or persistent distortion of a measurement process which causes errors in direction
- How far away from the “true” value



# Data Quality Objectives: Accuracy -

**The closeness of a measurement to the true value, a combination of precision and (minimal) bias**

**IMPRECISE AND BIASED**

**NOT BIASED BUT IMPRECISE**

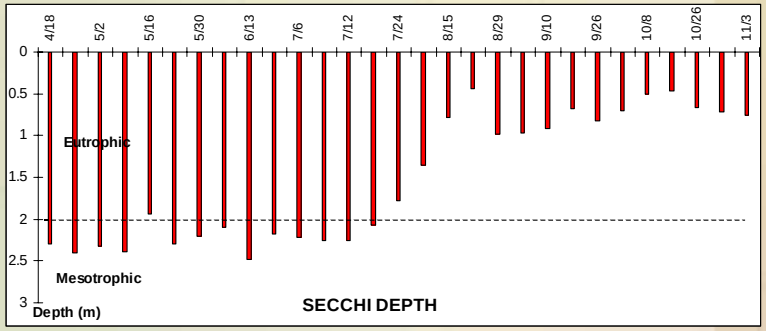
**PRECISE BUT BIASED**

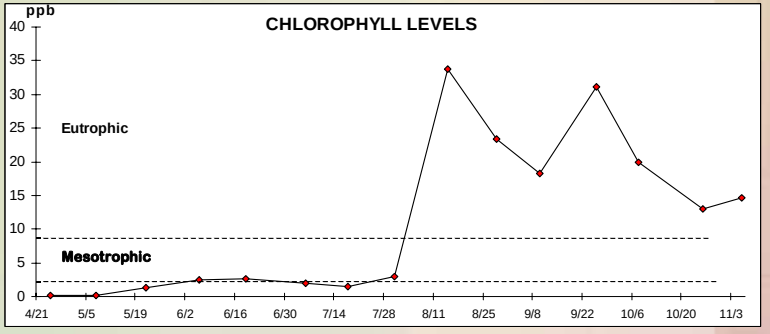
**PRECISE AND UNBIASED**

**10-20%**

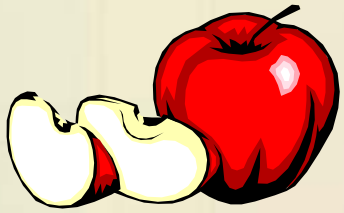
# Data Quality Objectives: Representativeness

- The extent to which measurements actually depict the true environmental condition or population being evaluated
  - data collected at a site just downstream of an outfall may not be representative of an entire stream, but it may be representative of sites just below outfalls



# Data Quality Objectives: Comparability



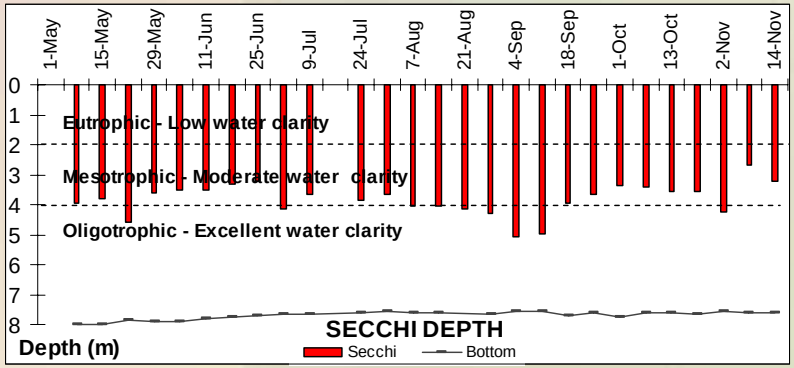
Comparability is the extent to which your data can be compared to directly to:

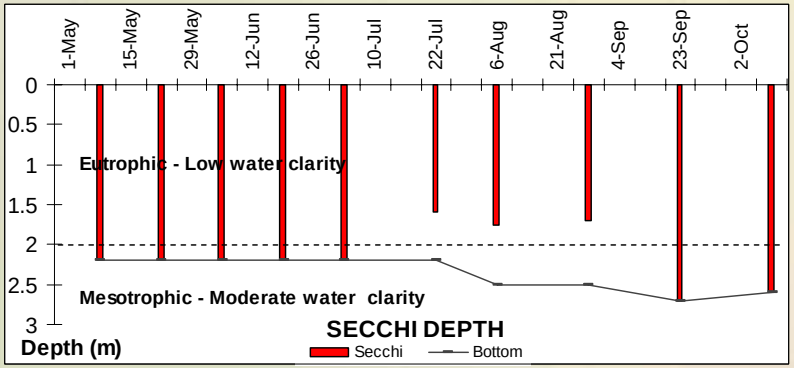
- Past data from the current project or
- Data from another study
- Prescriptive (must use…)
- Performance (must meet…)

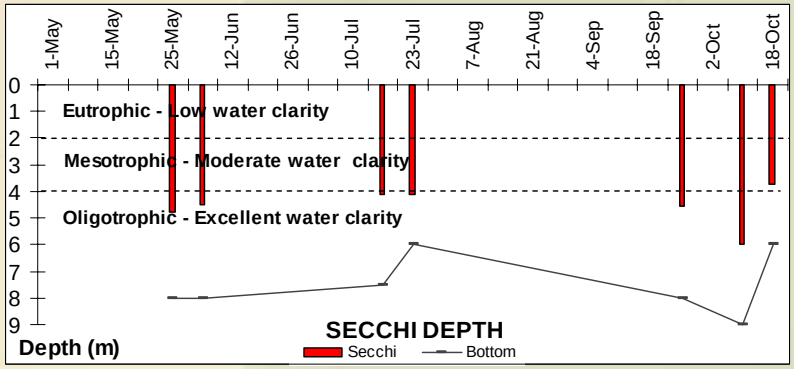
# How Do You Define Comparability? And What is the Cost/Benefit of Getting It Right?

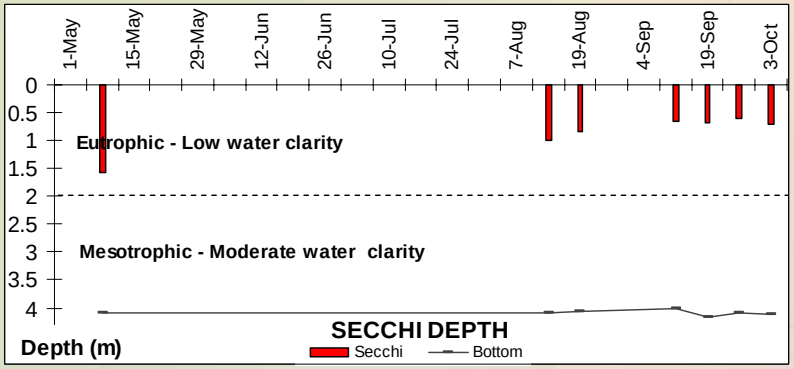
# Data Quality Objectives: Completeness

comparison between the amount of data you planned to collect versus how much usable data you collected



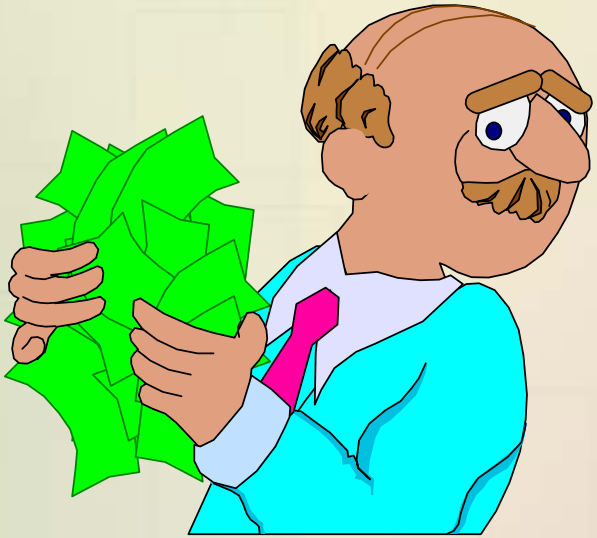



# Data Quality Objectives: **Sensitivity**

- **Ability to differentiate between different measurement levels, also referred to as resolution**
- **Example: pH**
  - **Litmus paper (acid or base)**
  - **Test strips (single units to 0.2 units)**
  - **Color comparators (wide range-units, narrow 0.1unit)**
  - **Pocket pH testers (0.1 unit)**
  - **Laboratory instruments (0.02 units, may read to 0.001 units)**

**“Where such situations seem to exist (that is, identical results)** either the measurement is not sensitive enough **to detect differences** or the person making the measurement is not performing it properly**.”**



**IDENTICAL RESULTS DO NOT MEAN PERFECTION**

# Data Quality Objectives: Detection Limit

- The lowest concentration of a given constituent that can be detected and reported as > 0.
- Example: measuring phosphorus
  - "TesTabs" 0,1,2,3,4 ppm –whole numbers
  - Color comparator 0 0.2, 0.4, 0.6 ppm
  - Spectrophotometer – > 0.003 ppm (3 ppb)

P in NE lakes is <0.003 – 0.1 ppm, High P is > 0.026 ppm P

# Quality Assurance Project Plan

- **Documents the *Why, Who, What, When, Where* and *How* of your monitoring effort**
- **USEPA approved QAPP has fairly rigid format**
  - **Guidance documents are available**
  - **Approved Volunteer QAPPs on-line**

*Don't Just Copy – the Process is as Important as the Document*

# Examples of Monitoring Manuals

## Volunteer Water Quality National Facilitation Project

## Factsheet IV

## Designing Your Monitoring Strategy: Basic Questions and Resources to Guide You

# Data Quality System

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  "the broad plan for maintaining overall quality"
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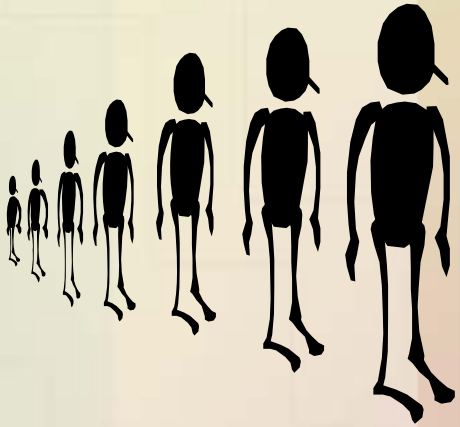
  "review , evaluate, correct, reconcile"

National Facilitation Project factsheet VI: *Building Credibility: QA/QC for Volunteer Monitoring Programs*

# *Implement* Procedures within your Program :

- Training and more training
- Practice a lot (7X to learn)
- Using written monitoring procedures
- Doing the steps in order!
- Repeating monitoring steps
- Monitoring multiple indicators
- QA/QC field and laboratory testing
- Addressing your volunteers' questions

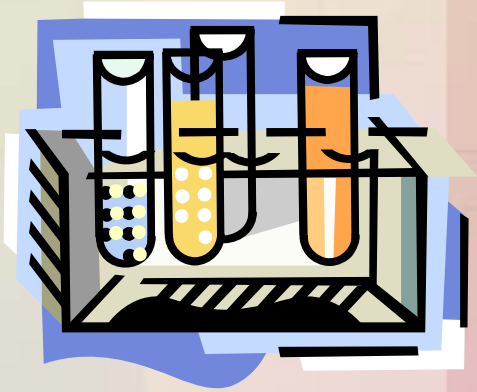


**National Facilitation Project Factsheet V:**

***Training Volunteer Water Quality Monitoring Effectively***

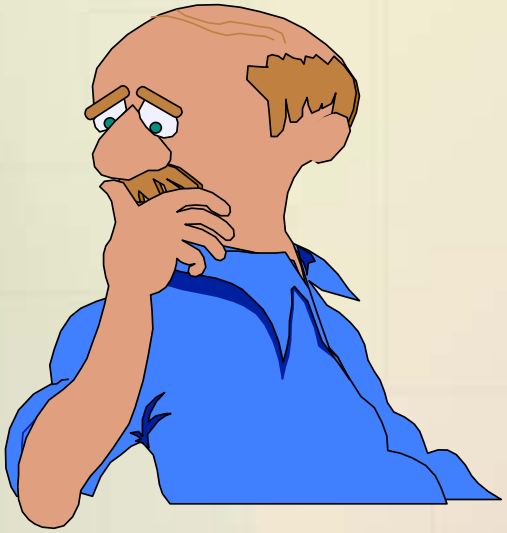
# In the lab…

- Analyze blanks (field and lab)
- Analyze samples of known concentrations (standards)
- Participate in proficiency testing (from outside source)
- Collect & analyze duplicates
- Replicate 10-20% of samples
- New analysis >= 7 times
- Check against other methods



# QA/QC:
## The Monitoring Conundrum

**"Any conclusions reached as a result of tests or analytical determinations are charged with uncertainty. No test or analytical method is so perfect, so unaffected by the environment or other external contributing factors, that it will always produce exactly the same test or measurement result or value."**



**VARIABILITY HAPPENS**

# External Quality Control

- Proficiency Testing
- Enlist outside partners to review your data
- External field duplicates
- Split samples
- Round robins
- Voucher collections

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National Facilitation Project Factsheet VI: *Building Credibility: QA/QC for Volunteer Monitoring Programs*

**Credibility doesn’t mean having the most exacting techniques. It means delivering on your promises, no matter how small or large they are.**

**-Meg Kerr**
**RI River Rescue**

# THANKS!

## Time for a break
## (15 minutes)