Other Considerations & Review Building a Successful Monitoring Plan

Fundamentals of Developing a Water Quality Monitoring Plan
Wednesday, October 3, 2012
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Mention of trade names or commercial products does not constitute their endorsement.

Other Considerations

• Specialized Types of Monitoring
• Equipment Needs
• Personnel Constraints
• Laboratory Costs
• Resource Availability & Budget Constraints
• Data Management
• Importance of Project Planning
Specialized Monitoring

- Provide monitoring data for models
- Bacterial source tracking (BST)

Monitoring Data Needs for Models

- Monitoring Data Uses
  - Input data to represent boundary conditions of tributaries and upstream/downstream end of models
  - Comparison of measured data to simulated predictions for model verification process
    - Calibration Step (Using part of data)
    - Validation Step (Using remaining data)
Required Monitoring is Model Specific

- Watershed modeling – daily streamflow and long-term monitoring data sufficient to estimate loadings
- Receiving water models – synoptic data sets; multiple stations monitored frequently over a brief period of time; certain models will also need long-term data
Watershed Model Example: SWAT Predictions for a Subbasin of North Bosque River (Streamflow)

SC020 Monthly Average daily streamflow

- Measured
- Predicted

E = 0.30
%E = -29.0
M = 0.11
P = 0.08

SWAT Predictions for a Subbasin of North Bosque River (Total Phosphorus)

SC020 Monthly Total TP

- Measured
- Predicted

E = 0.87
%E = 199
M = 88
P = 263
Bacteria Source Tracking

BST is the use of genetic and phenotypic tests to identify bacterial strains that are host-specific so that the original host animal and source of the fecal contamination can be identified.

Library Dependent & Library Independent Methods

One Example: Isolation of E.coli From Feces and Water

Each E. coli colony is called an “Isolate”
BACTERIA SOURCE TRACKING

- Water Samples
  - Isolated E. coli
- Fecal Samples
  - Isolated E. coli

Sample Site 1, Sample Site 2, Sample Site 3

Dog Sample, Human Sample, Cow Sample

Evaluate Equipment Needs, Personnel Constraints, Available Resources, Lab Costs, & Budgets Constraints
Examples of Sampling Equipment & Approximate Costs

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• Automated Sampling Equipment
   ISCO sampler combination with flow meter ~ $5,500
   Sheet metal shelter ~ $500-$1,000
   Individual ISCO Units
    o Sampler ~ $3,000-$3,500
    o Flow meter with phone modem ~ $4,500-$5,000

Flow measurement – Wadeable Stream

• Sontek Flow Tracker
  ~ $7,000 - $9,000
• Wading rods ~ $1,000 - $1,400
Flow measurement – Non-Wadeable Stream

- Sontek River Surveyor
  ~ $15,000 - $42,000
(toward the low price range suffices for many applications)

Personnel Constraints

- Specialized skills: for example, fish and macrobenthos sampling and identification
- Scheduling of personnel (and lab services): stormwater sampling outside of normal work days

Flathead catfish - *Pylodictis olivaris*
Including of Laboratory Costs

TCEQ Routine Parameters

- total Kjeldahl nitrogen (TKN)
- total phosphorus (TP)
- total ammonia (NH₃-N)
- total nitrite plus nitrate (NO₂+NO₃-N)
- soluble reactive phosphorus (dissolved PO₄-P)
- total dissolved solids (TDS)
- total suspended solids (TSS)
- volatile suspended solids (VSS)
- chloride
- sulfate
- total alkalinity
- total organic carbon (TOC)
- chlorophyll-α

Cost Per Sample: ~$200-$300
Approximate Cost of Some Common Lab Tests (Water Matrix)

- *E. coli* (Colilert Method) ~$35/sample
- *E. coli* (m-TEC Method) ~$50/sample; used with bacterial source track (BST) work
- Enterococcus ~45
- Total Phosphorus ~$35
- Total Ammonia ~$25
- Total Nitrite+Nitrate ~$30

Including a Data Management Plan

- Components:
  - Path of data from generation to final use
  - System design – equipment, hardware, software
  - Migration/transfer/conversion
  - Backup/Disaster Recovery
  - Archives & Data Retention
  - Information dissemination

- Do not neglect the resource commitment for this effort.
### PURPOSEFULLY INCLUDE “PROJECT PLANNING”

- Integrate monitoring component into the overall project
- For monitoring effort consider:
  - Time for Stakeholder involvement, buy-in, input, BMP selection
  - Exploratory data review (including assessing data gaps)
  - Lead time for reconnaissance & site determination
  - Lead time for Monitoring Plan and QAPP development and approval
Steps of a Successful Monitoring Plan:

1. Define specific data quality objectives
2. Know approximate budget and personnel constraints
3. Review existing data; check for “data gaps”
4. Determine sample locations, sampling procedures and frequency, variables to monitor and analytic techniques (i.e., develop a monitoring design plan and QAPP)
5. Initiate and continue monitoring program
6. Prepare regular reports and recommendations
7. Modify and adjust monitoring as needed
Step 1. Define Specific Data Quality Objectives

EXAMPLES:
• Analyze long-term trends
• Document changes in management and pollutant source activities
• Measure performance of specific management practices
• Fill data gaps in watershed characterization (e.g., suspected hotspots)
• Track compliance and enforcement in point sources
• Provide data for educating and informing stakeholder
• Calibrate and validate models

Step 2. Know Budget and Personnel Constraints

• Monitoring can be very expensive (e.g., wet-weather monitoring, streamflow gauges, equipment, lab costs)
• Monitoring can require specialized skills of personnel and their availability when needed (routine monitoring vs. wet-weather monitoring demands on personnel)
Step 3. Review Existing Data

EXAMPLES:

- Exploratory data analysis.
- Is good streamflow data available (e.g., USGS streamflow recording station)?
- What is the nature of the water quality data (e.g., temporal and spatial density)?
- What do the data show?
- Can existing data be used to characterize pre-management conditions?

Past Experiences Indicate:

- Obtaining adequate pre-treatment or pre-implementation water quality data is often a problem. And this problem is not easily overcome without delaying implementation efforts.
Step 4. Develop a Monitoring Design Plan

- What questions are we trying to answer?
- What assessment techniques will be used?
- What statistical power and precision is needed?
- Can we control for the effects of weather and other sources of variation?
- What are our constraints (financial, personnel, time, etc.)?
- Will our design allow us to attribute changes in water quality to the implementation program?

Financial and Personnel Constraints Always Exist!

- Coordination with other monitoring programs (SWQM, CRP, etc.) if possible.
- Is there a role for volunteer monitoring in your project? (Texas Stream Team, River Systems Institute, Texas State Univ.)
Common Statistical Designs for Monitoring BMP Effectiveness

- Single Watershed – Before and After
- Single Watershed - Above and Below (Upstream – Downstream) with Before and After
- Single Watershed – Trend or Step Trend
- Paired Watershed Study Design

Steps 5-7. Implement Your Monitoring Design Plan & Build in an Evaluation Process

- Initiate and continue monitoring program.
- Prepare regular reports and recommendations. (don’t wait until the end of your project to look at the data thoroughly)
- Modify and adjust monitoring as needed.
Steps 5-7. (Continued)

- Consider delaying monitoring components with anticipated long response time to pollution control practices (e.g., biological monitoring)

Thank You

Questions?