

ENST 427/ENBE 462

## Monitoring Pollution

Reading: Monitoring Process Article

# Theme: Monitoring System Design

## A. Why is a design necessary?

### 1. Design provides a blueprint for a study

#### a. Helps assure useful information

i. How, when, where to collect samples

ii. Laboratory analysis ( measurement - not to be confused with data analysis)

iii. Storage, retrieval and analysis of data

iv. Interpretation and reporting

#### b. Helps assure data/information are obtained efficiently (least cost, least effort)

### 2. Provides "buy in" by all involved parties

## **B. Data vs. Information**

1. Data are not equivalent to information
2. Data are the raw materials of which information is made
3. Data must be interpreted to produce information
4. Monitoring designs should be based on producing information; in some cases data production may be sufficient

## C. Conceptual Portrayal of a Monitoring Process

The process should:

1. Accommodate the dynamics of the Water / Environment
2. Justify the number and method for Sample Collection
3. Completely describe how to Analyze Samples
4. Describe how to Handle Data from field/source to laboratory to complete data set

## C. Conceptual Portrayal of a Monitoring Process

The process should:

5. Describe how to Analyze Data
6. Describe how to Report Data
7. Describe how to Use Information
8. Result in an accurate understanding of water quality/  
environmental conditions

# Theme: Monitoring System Design

Generation of Useful Information  
Should Be An Overriding Goal

# Theme: Monitoring System Design

## D. Framework for A Monitoring System Design

1. Identify information needs (translate clients words)
  - a. What do "managers" or others want
  - b. Are there legal mandates?
  - c. Define reporting and information utilization procedures
  - d. Determine appropriate statistical design to produce desired information (proof)

## **D. Framework for A Monitoring System Design**

2. Define information producible by monitoring
  - a. State what information can be produced and point out shortcomings
  - b. Compare information needs (1. above) to information producible from monitoring
  - c. Resolve differences in monitoring system design stage, not after installation and data collection begin!

## **D. Framework for A Monitoring System Design**

### 3. Design monitoring network

- a. Reconnaissance area and existing data
  - i. map
  - ii. library
  - iii. field visit(s)
- b. Determine what to measure
- c. Determine sampling frequency
- d. Determine where to sample

## **D. Framework for A Monitoring System Design**

4. Document data collection procedures
  - a. Establish QA/QC. Justify QA/QC.
  - b. Set field sampling operations and procedures
  - c. Define laboratory analysis methods and operations
  - d. Establish data storage, checking, and retrieval system

## **D. Framework for A Monitoring System Design**

5. Document information generating and reporting procedures
  - a. Select data analysis hardware and software
  - b. Establish reporting format and frequency
  - c. Concur on information utilization procedures
  - d. Estimate cost.

## **D. Framework for A Monitoring System Design**

6. Not a linear process!! Iterative

- a. Must resolve needs, wishes, and reality
- b. Must reconcile budget and time constraints with desires for information

# Theme: Monitoring System Design

## **E. More Complete Design Process**

**(Expansion of Item C, p 1)**

1. Determine monitoring objectives & relative importance of each
2. Express objectives in statistical terms
3. Determine budget available for monitoring & amount allocated to each objective
4. Define characteristics of the area to be monitored; select a scale & describe system

**E. More Complete Design Process  
(Expansion of Item C, p 1)**

5. Determine variables to be monitored
6. Determine sampling locations
7. Determine sampling frequency
8. Reconcile or revise original objectives with subjective considerations

## **E. More Complete Design Process (Expansion of Item C, p 1)**

9. Develop operating plans & procedures to implement the design, including QA/QC
10. Develop data and information reporting formats & procedures
11. Develop feedback mechanisms to fine tune design (review data as gathered)
12. Prepare a network design report; gain consensus

# Now Expand Item E for even more detail

## **E-1. Determining Objectives**

- A. **MUST** define specific objectives and write them
- B. From an information standpoint, can start by defining the types of info that could be produced
  1. Narrative info: good for lay public, but often imprecise and subject to interpretation
  2. Numerical info: raw, uninterrupted data; could be an end product or step toward graphical/statistical interpretation to achieve an information goal
  3. Graphical info: most useful means for conveying info to diverse audiences

## E-1. Determining Objectives

B. From an information standpoint, can start by defining the types of info that could be produced

4. Statistical info: permit quantitative statements about processes involving error & uncertainty; most useful for making quantitative decisions
5. Water quality indices: combine info from several variables into one measure or index, e.g. biological indices; useful for lay audiences

# Now Expand Item E for even more detail

## **E-1. Determining Objectives**

- C. Also, from an info standpoint, can define info needs
  - 1. Legal mandates
  - 2. Other NPS needs
    - a. Impacts caused by a particular land use, land management practice (BMP), or combination of practices or land uses
    - b. Compliance
    - c. Baseline or background data needs
    - d. Basic data (e.g., for models, waste load allocations, planning)
  - 3. Management functions (e.g., WSSC, ICPRB)

Now Expand Item E for even more detail

## E-1. Determining Objectives

D. Need to reconcile B & C

B. From an information standpoint, can start by defining the types of info that could be produced

C. Also, from an info standpoint, can define info needs

# Now Expand Item E for even more detail

## **E-1. Determining Objectives**

E. Can ascertain needs by:

1. Review of regulations, permits, etc.
2. Interviews
3. Evaluation of how past data/information have been utilized. Be critical of data collection and interpretation.
4. Don't forget to ascertain how "timely" information must be generated to be useful

# Now Expand Item E for even more detail

## E-2. Expressing objectives in statistical terms

- A. Must address data interpretation issues first, i.e. agree on a procedure for how data will be analyzed. This is information needs.
- B. Statistical methods must match both needs and attributes of the data record (e.g., are special assumptions required for a statistical test that are not satisfied by the sample population?)
- C. Use the highest powered statistical design possible consistent with cost, manpower & other constraints

# Now Expand Item E for even more detail

## **E-2. Expressing objectives in statistical terms**

D. Some problems with NPS data sets include the following, resulting from natural environmental variability and inadequacies of the sampling program:

1. Missing values
2. Changing sampling frequencies
3. Multiple observations within one sampling period
4. Uncertainty in measurement procedures
5. Censoring of measurements (limits of detection)
6. Small sample sizes
7. Outlying data

# Now Expand Item E for even more detail

## E-3. Determining Budgets, Making Allocations

- A. Very difficult, especially for new designs because costs are uncertain
- B. Must have clear and prioritized objectives
- C. Must have agreement among all concerned, especially bean counters, of what will be done. Agree on both money and deliverables (buzz word).
- D. If, monitoring as an ambient project, budgets are set -- often un-scientificallly
- E. If monitoring as a special study, must have some idea of study design 1<sup>st</sup>

# Now Expand Item E for even more detail

## **E-3. Determining Budgets, Making Allocations**

- F. Multiple costs involved
  - 1. Salaries, regular & overtime
  - 2. Supplies - sampling, lab supplies, office supplies, etc.
  - 3. Analytical (contract or expendables)
  - 4. Travel, shipping
  - 5. Communication
  - 6. Equipment, both capital and maintenance (e.g. shovels to trucks)
  - 7. Construction e.g. build a weir
  - 8. Contractual (info gathering, data, computation, etc.)