# Which Trail-Mix piece has the highest concentration of sugar ?

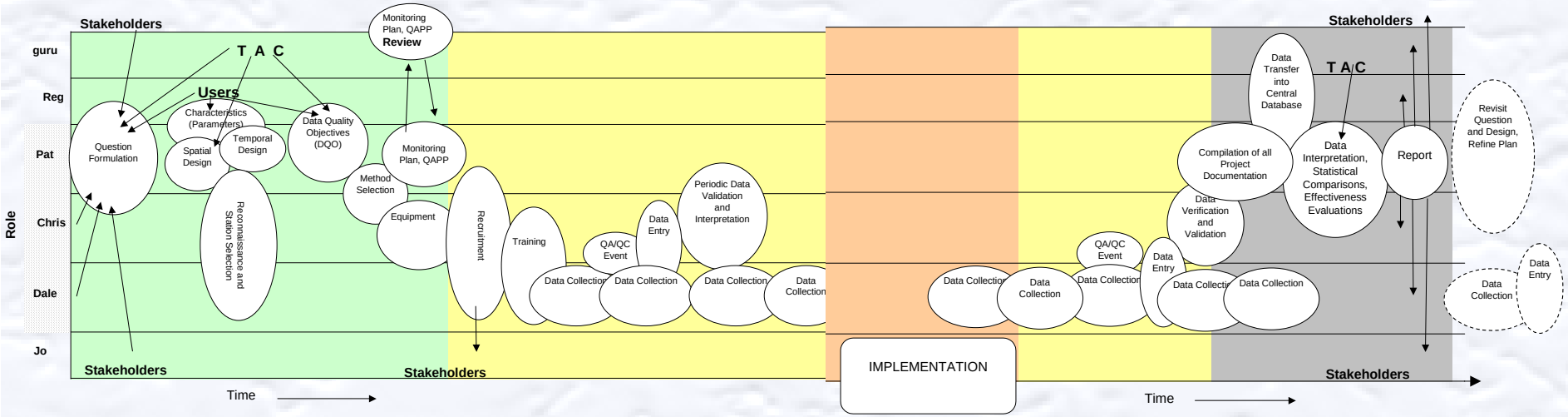
Did you… Pick at Random?
First sort by Type (stratify), then random?
Try one of each, in sequence, systematically?
Picked what you fancy right now, anecdotally?

Did you stay away from the coconut flakes ‘cause you don’t like ‘em anyway (are we being judgmental here…?) or are you directing your choice because you know something I don’t?

# Designing an Environmental Monitoring Project

**Revital Katznelson**

State Water Resources Control Board




# Egg Race poster

# Session Overview

Tasks, roles, and responsibilities

Question/hypothesis

Sampling Design (what where when)

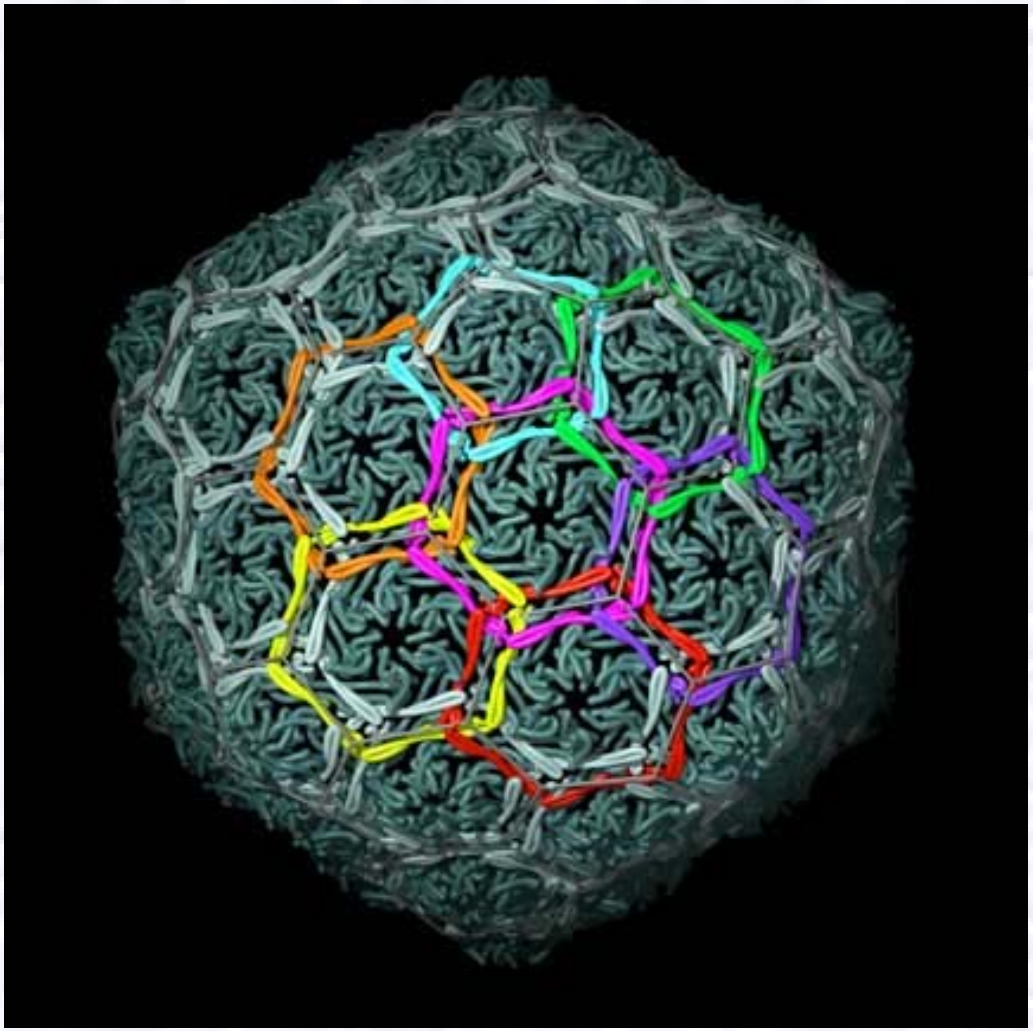
DQOs, MQOs, WQOs, PBMS….

# Read

**When you start thinking about your monitoring question**

# Collaboration

Hopefully started at the conceptual proposal phase!

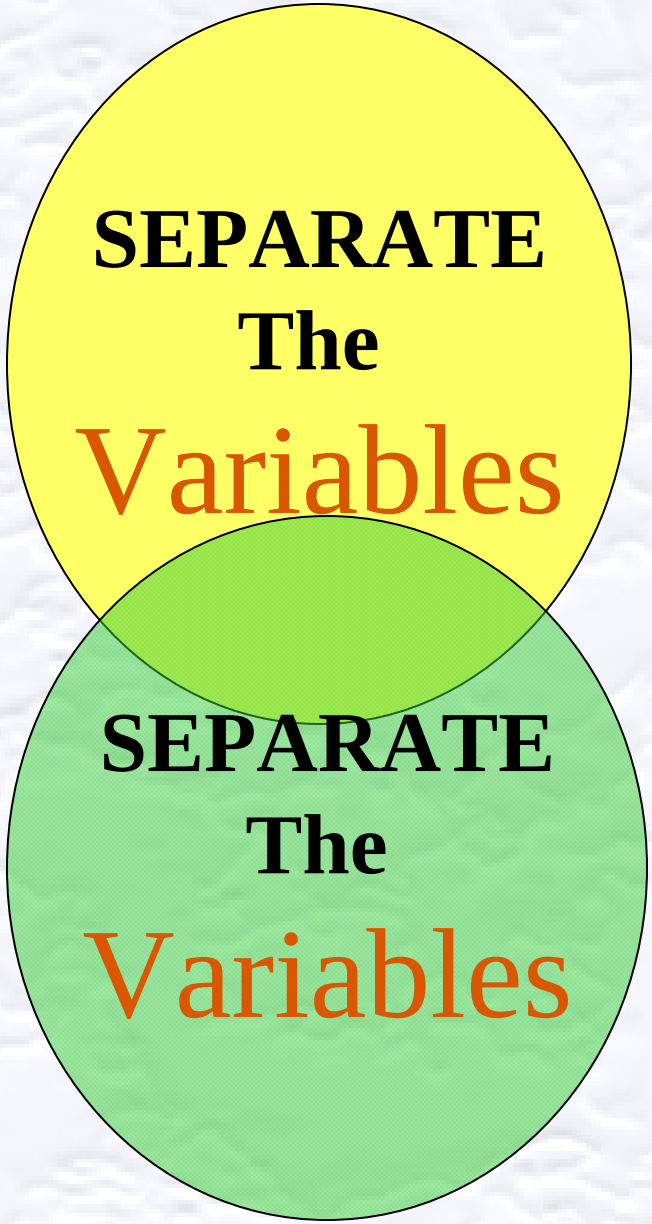


# Is your Question specific enough?

**Example: What are the major sources of sediments and which sources are a result of human activities and which ones can be fixed?**

"If your green peas are always wrinkled and your yellow peas are always smooth, you are not separating the variables!"

(after Gregor Mendel, 1860)



# Parameter Package

"If you measured 7 mg/l of dissolved oxygen in your Station, it could be very good or very bad, but I cannot tell if I do not have information about flow".

"Never try to assess ammonia toxicity if you do not know the pH"

# Enhance

Make the value
of your
resources
**higher**
by combining
your data with
data collected
by others in
your watershed

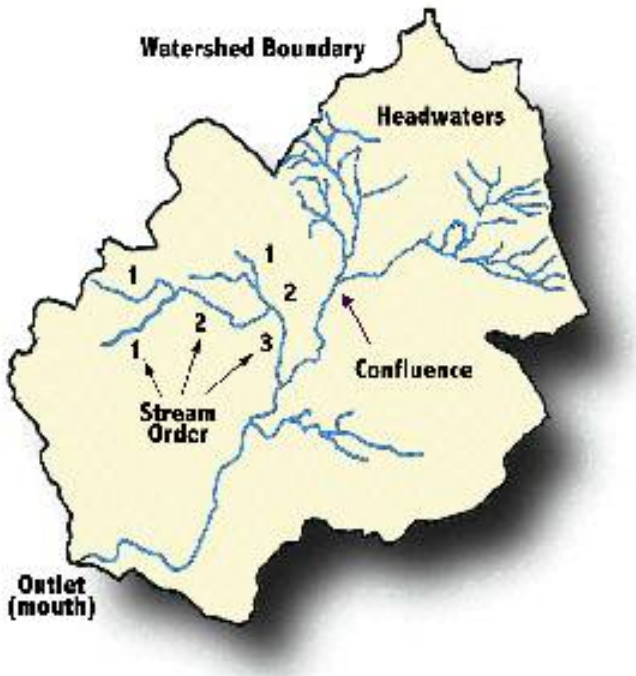
# Apply Sampling Design Principle when you decide…

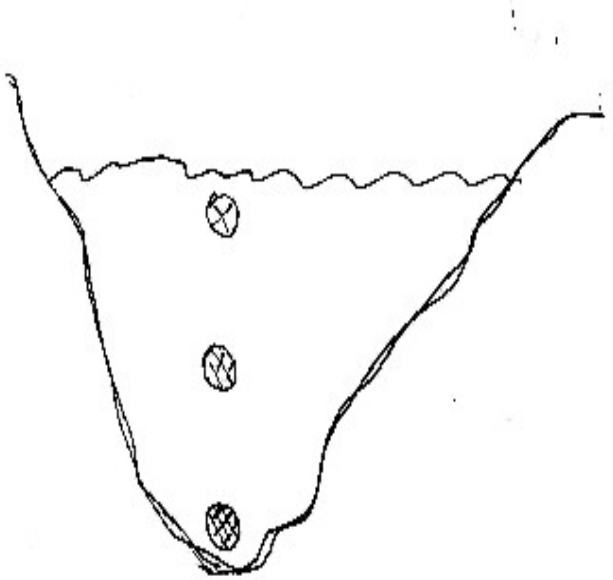
## Where to monitor

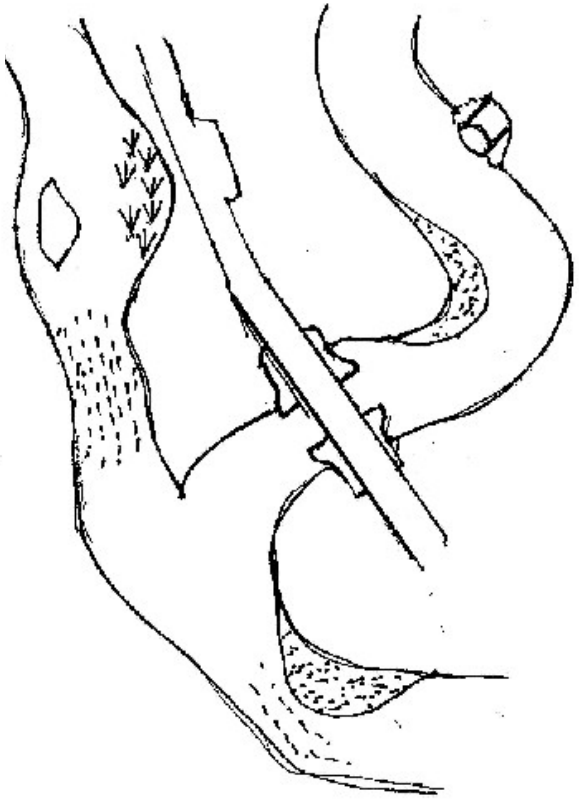
Station selection within Watershed, stream channel, or water column

## When to monitor

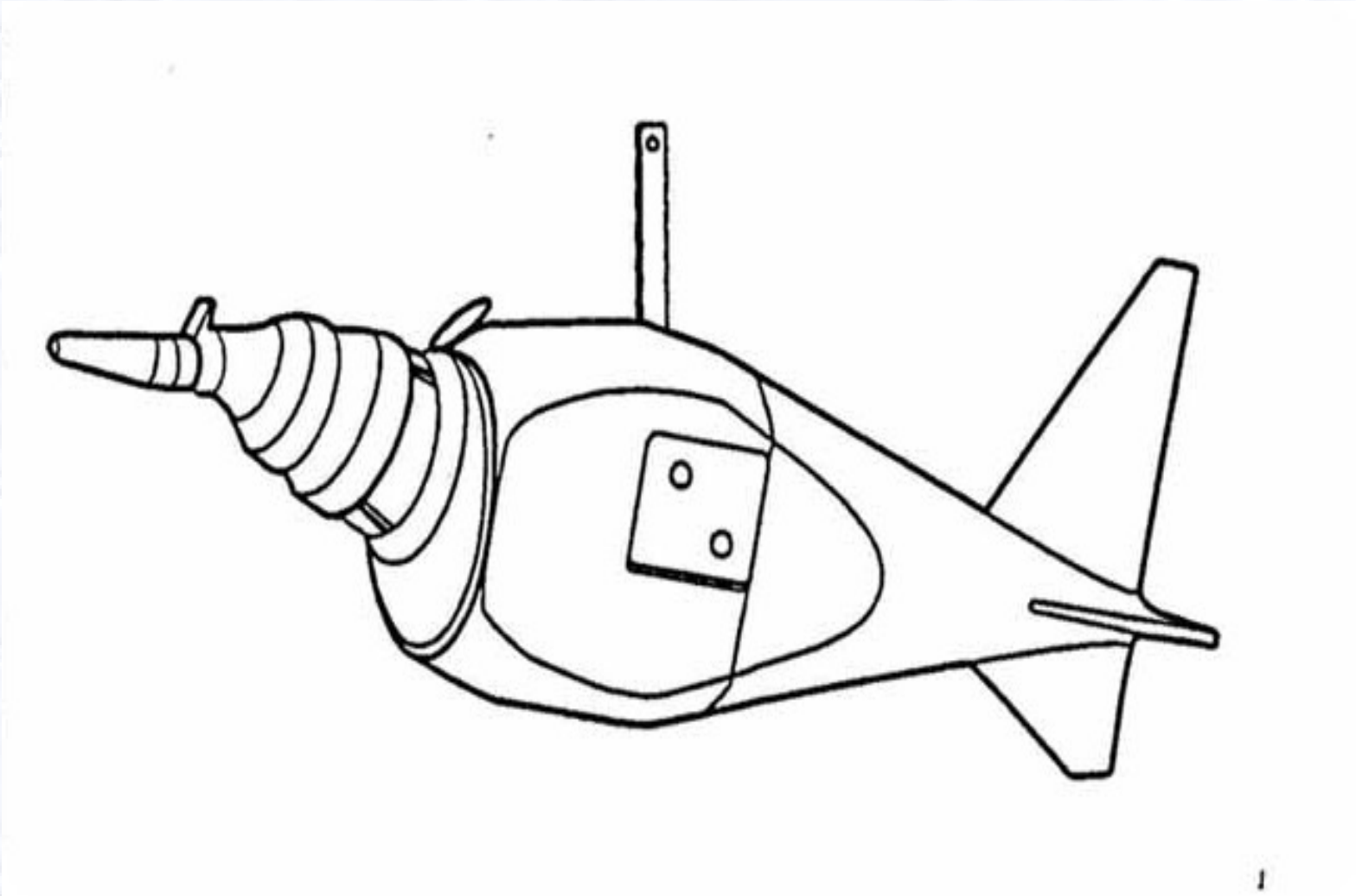
Timing of sampling within seasons, hours of the day, or point in special events



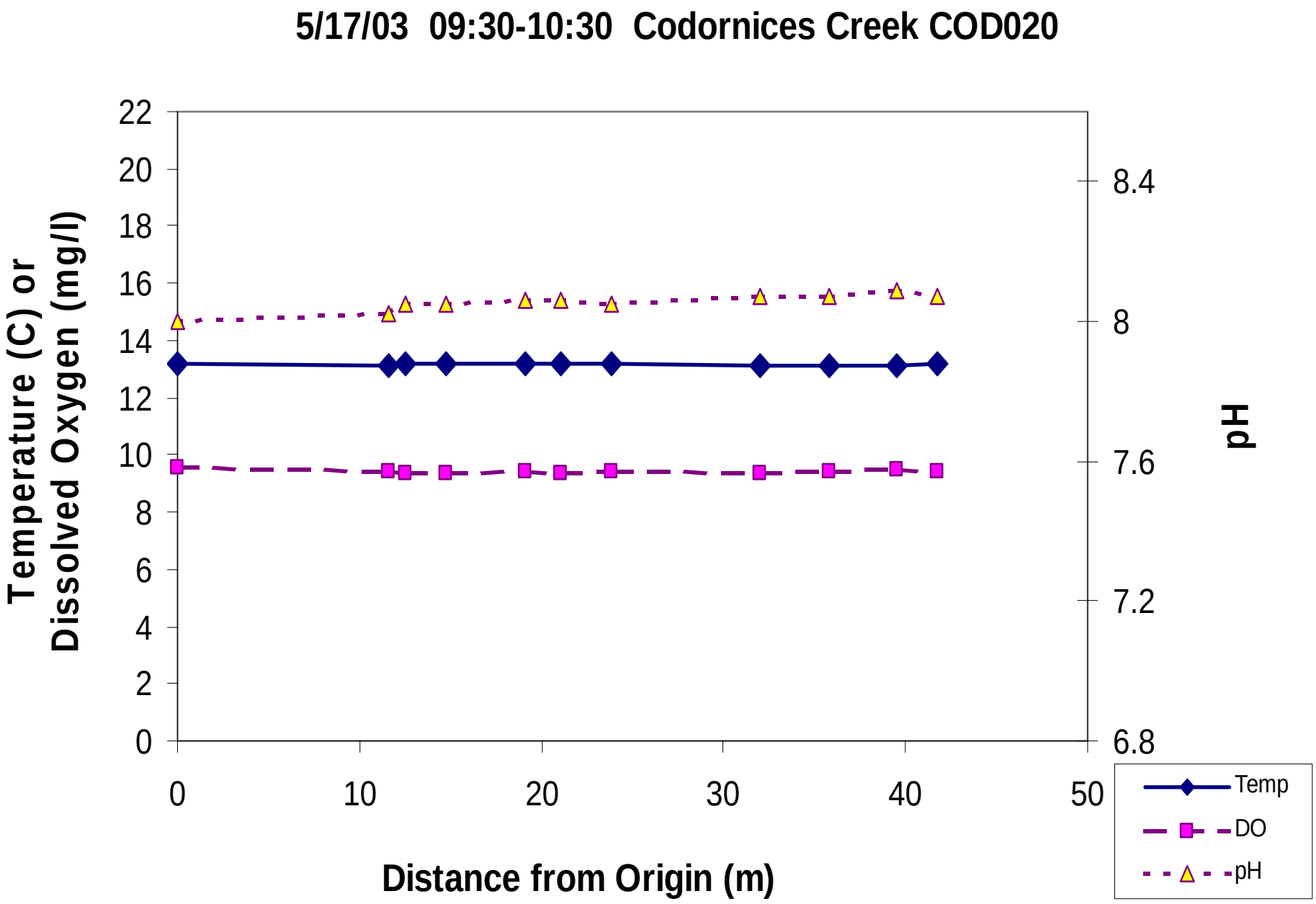





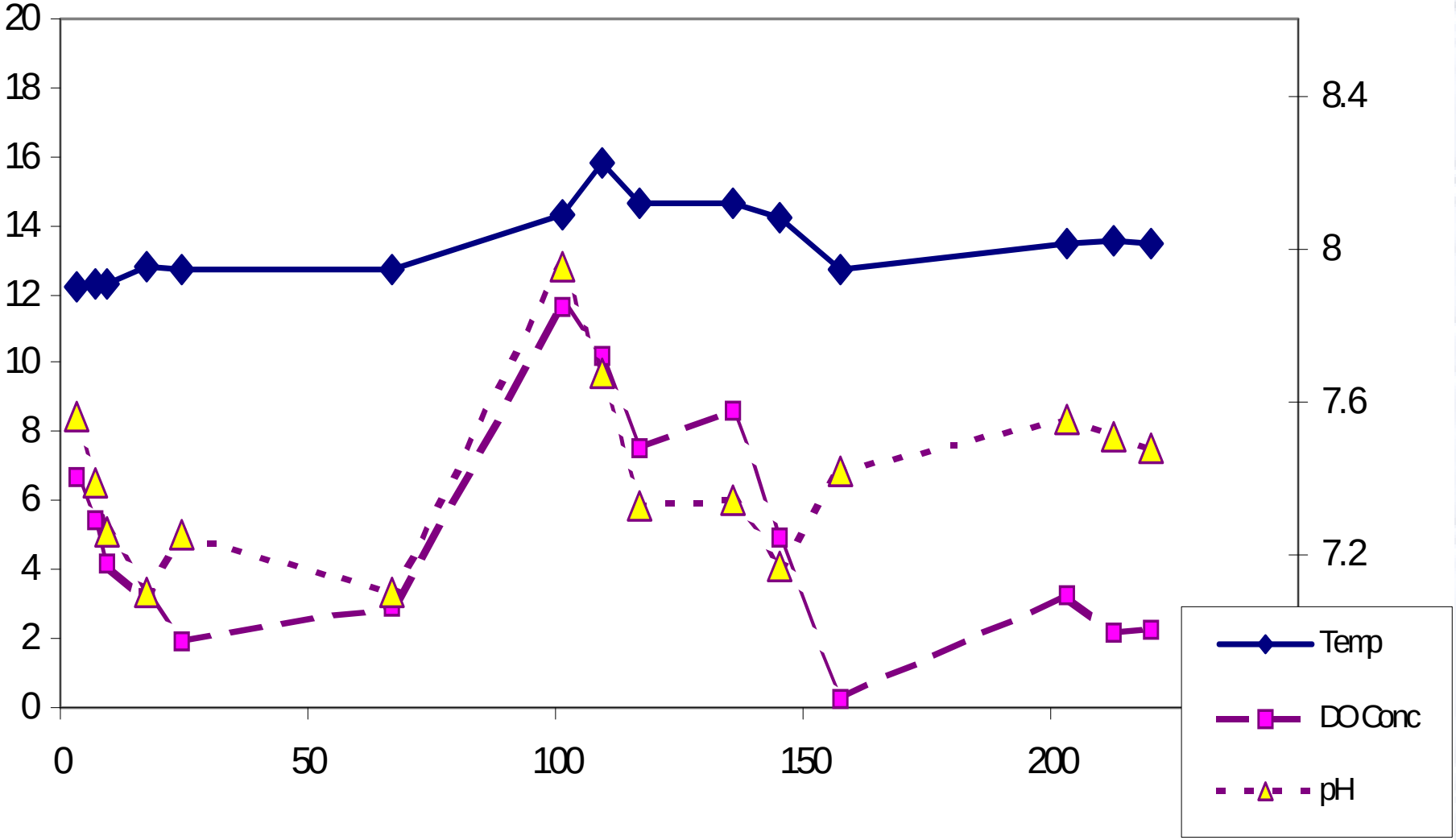
Spatia
l
Scale



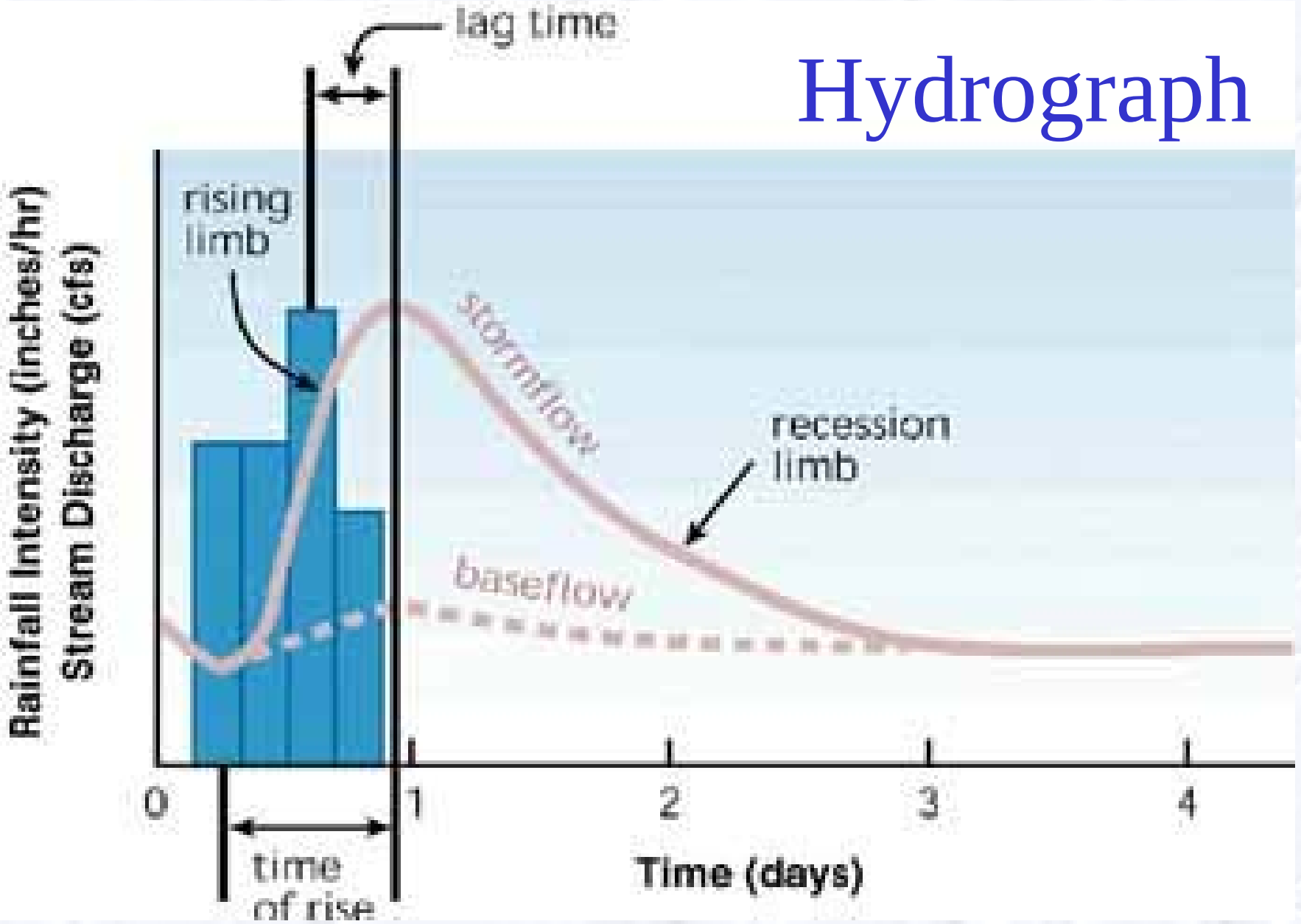
# Isokinetic sampler


5/17/03 09:30-10:30 Codornices Creek COD020
Temperature (C) or Dissolved Oxygen (mg/l)
pH
Distance from Origin (m)
0
2
4
6
8
10
12
14
16
18
20
22
6.8
7.2
7.6
8
8.4
0
10
20
30
40
50
Temp
DO
pH

# 5/17/03 09:30-10:30 San Leandro Creek SLE045



# Hydrograph


lag time
rising limb
stormflow
recession limb
baseflow
Rainfall Intensity (inches/hr)
Stream Discharge (cfs)
0
1
2
3
4
time of rise
Time (days)

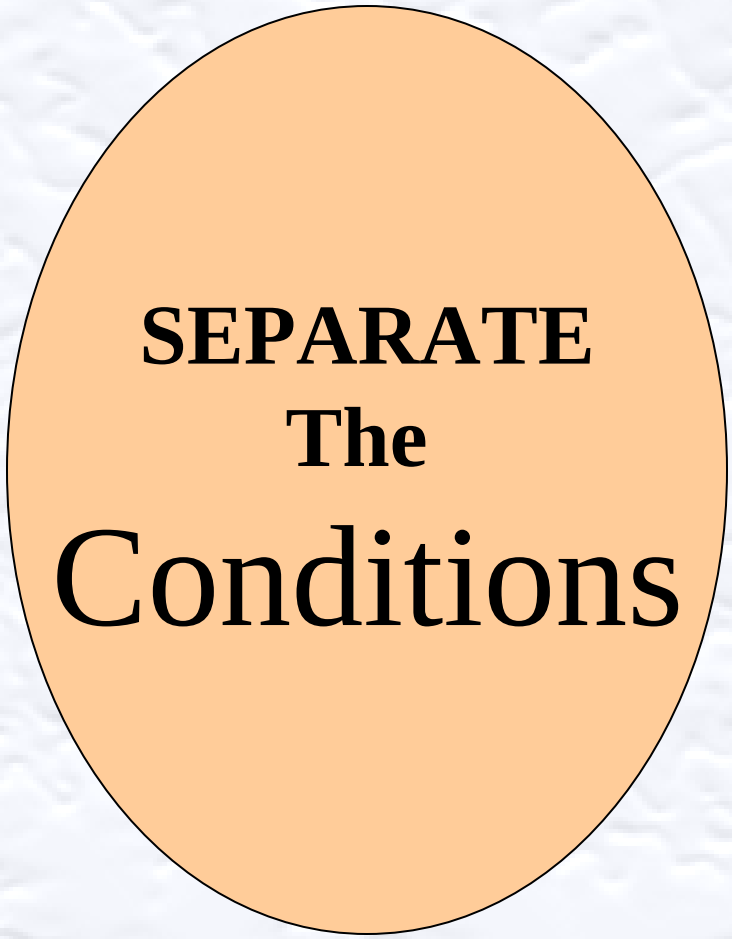
# Separate the Conditions

Examples:

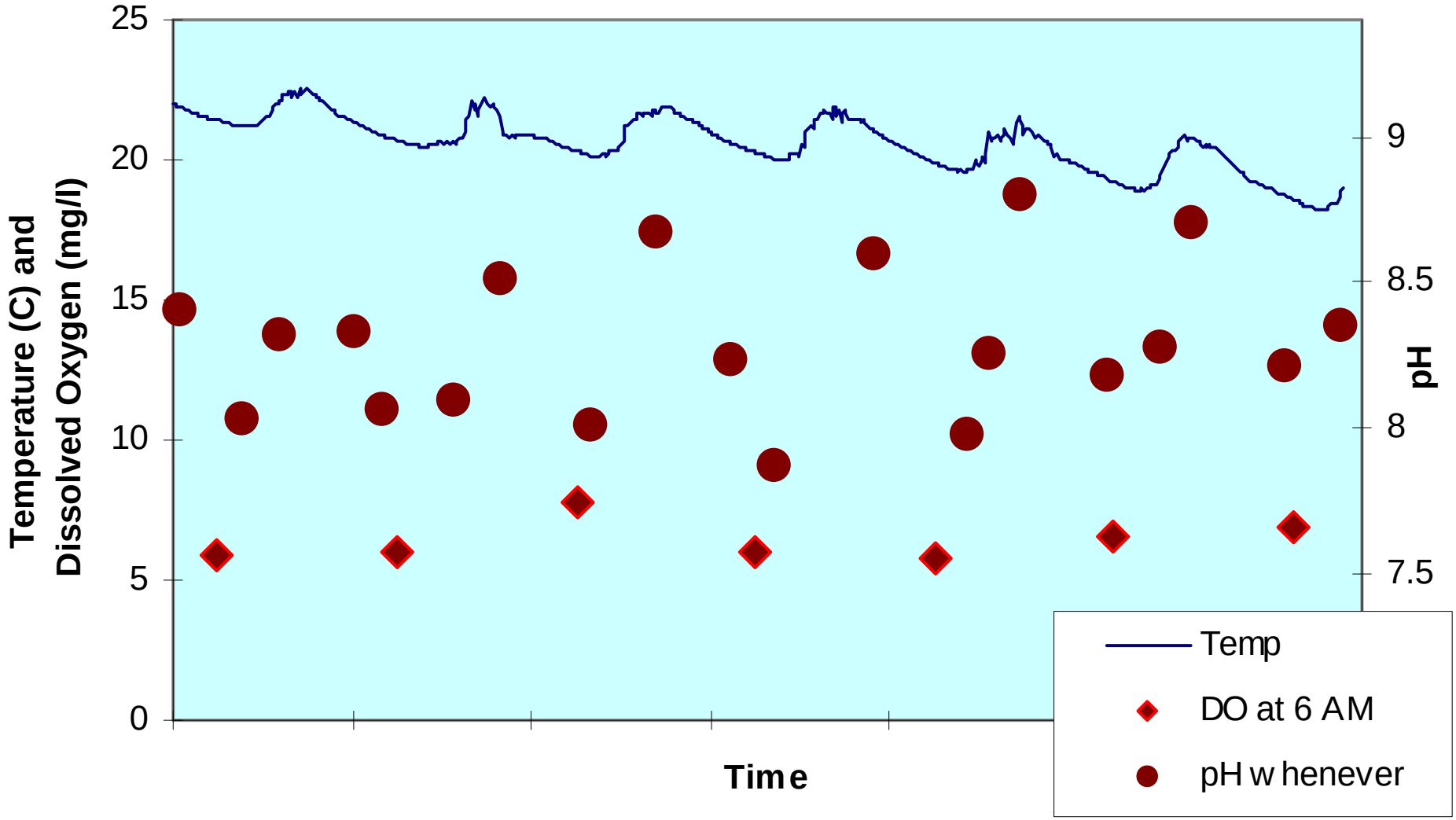
Dry versus wet weather;

Low versus high flow (seasonal);

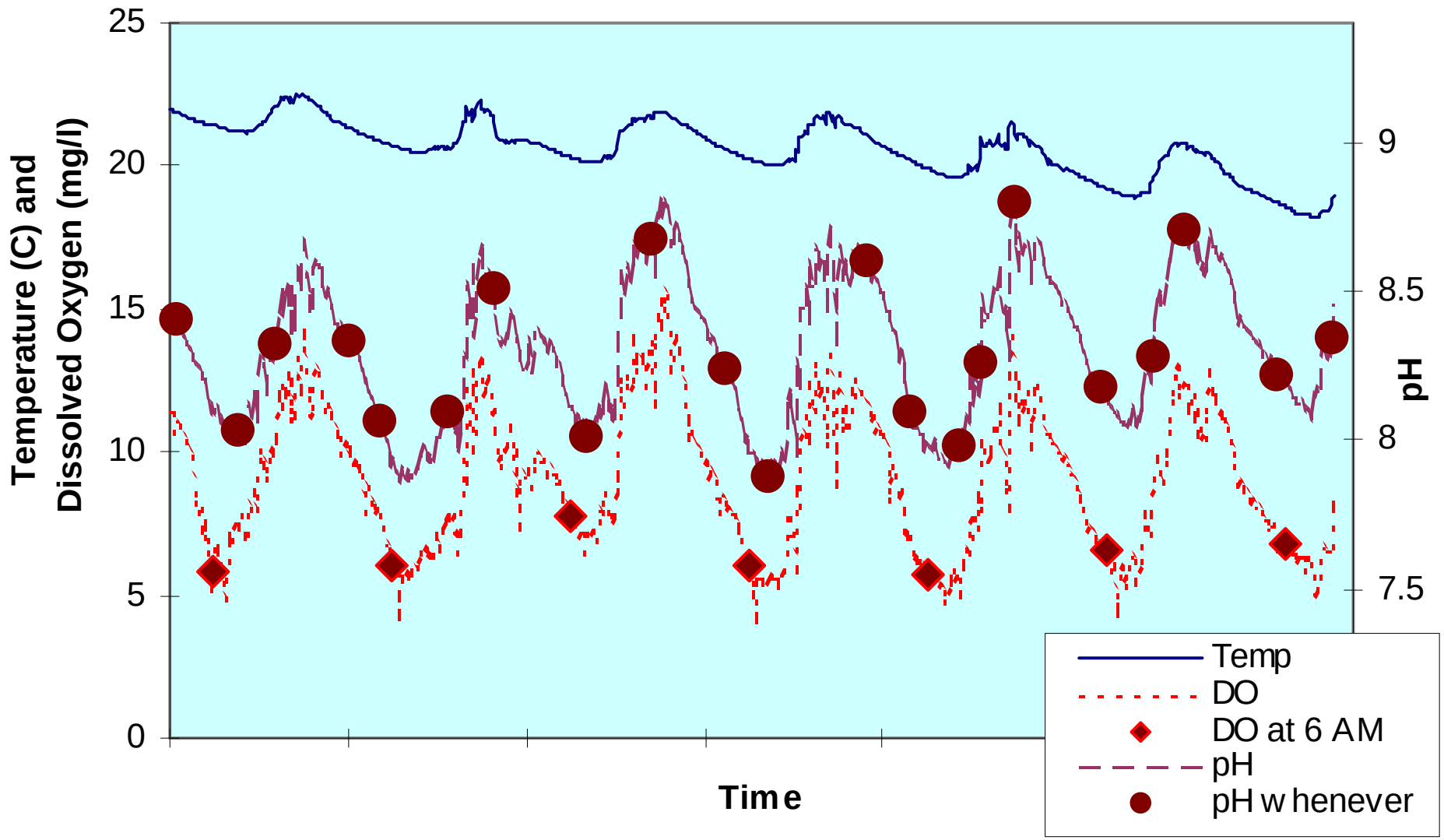
Worst-case versus best-case versus "normal" (whatever that is)



# LAKE WATER QUALITY DATA
## 10/10/96 - 10/16/96



# LAKE WATER QUALITY DATA
## 10/10/96 - 10/16/96



# Communicate

- Your Intent
  - Characterization?
  - Worst case scenario?
  - Effectiveness Evaluation?
- Your study design
  - Directed?
  - Random?
  - Systematic?

# Comparisons:

Before vs After

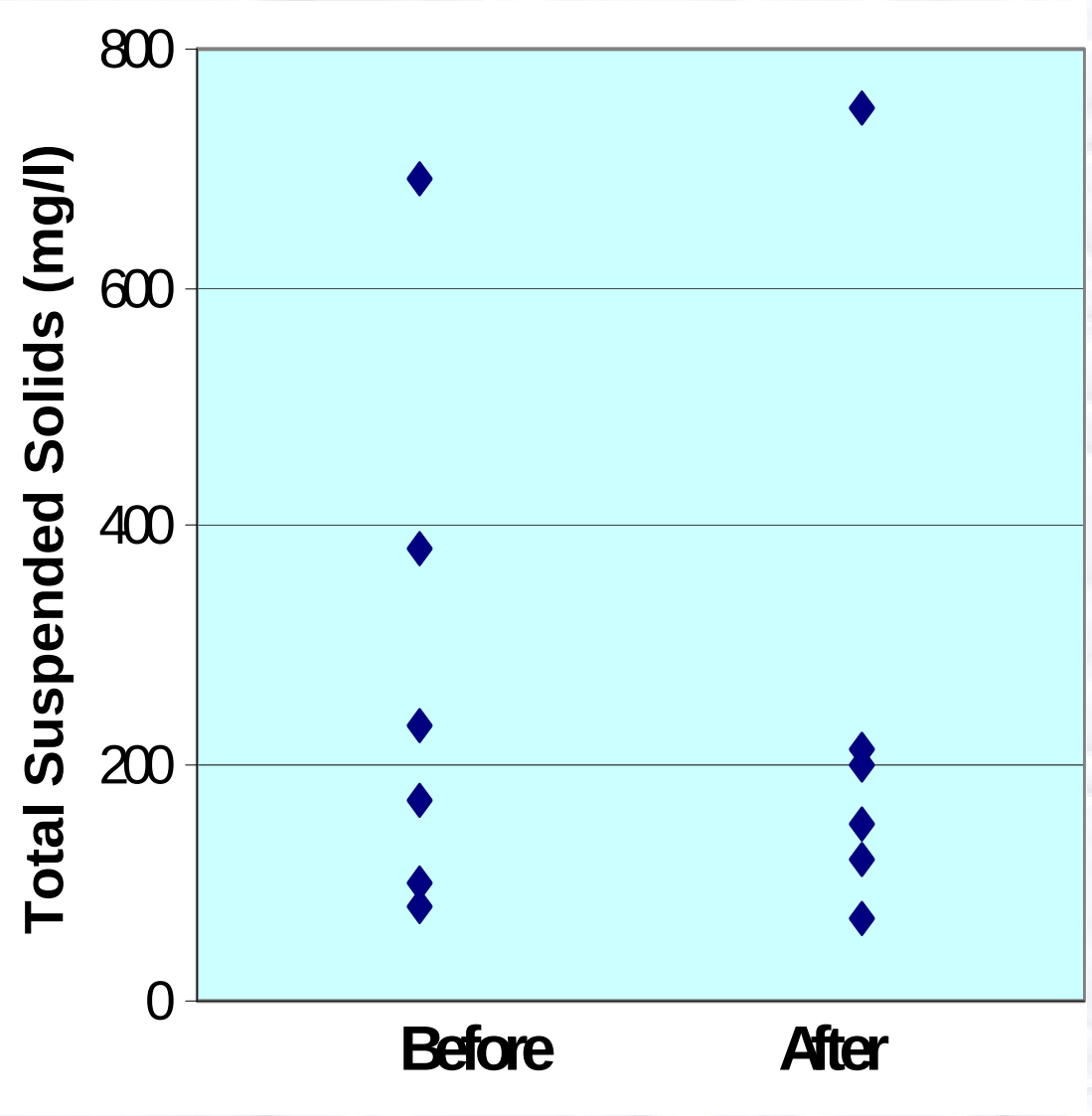
Problem: ‘Conduit Memory’

Paired Watershed

Problem: Hard to find match and/or to stagger implementation

# Think about the end of the road

**Question:**
**Is there a significant reduction in sediment load after the MM implementation?**



# Power Analysis

**Example: Based on inherent variability, determine how many samples are needed to show statistically significant change**

# Communicate More

How many samples?
What frequency?
How will you assess inherent variability?
What's your optimal design?

# Juggle

The “What”
“Where”
“When”
To fit your budget

# Data Quality Objectives (DQOs)

"Statements about the level of uncertainty that a decision maker is willing to accept in data used to support a particular decision" (USEPA 1998)

## Subgroup: Measurement Quality Objectives (MQOs)

Statements about the extent of measurement error and uncertainty that we can tolerate and still be able to answer the study question

# DQOs

Statements about the desired quality of the

DATA

# WQOs

Statements about the desired quality of the

WATER

# Water Quality Benchmarks

(a generic name for Water Quality Objectives, Goals, Standards, Targets, Limits, Criteria, etc. )

Statements about the concentrations thought to be harmless to aquatic life or human health.

Example: RBs' Basin Plan dissolved copper acute Water Quality Objective for protection of aquatic life.

# Data Quality Objectives (DQOs)

Representativeness
Completeness
Comparability

Subgroup:
Measurement Quality Objectives (MQOs)

**Accuracy**, **precision**, sensitivity in terms of **resolution** and **detection limits**, and **sample integrity**

# Developing DQOs

- Ecological significance at critical range
- Comparisons to WQ benchmarks
- Load assessment

SWAMP DQOs:
Good enough for all regulatory purposes

# SWAMP MQOs for accuracy of field measurements

| | |
|---|---|
| Dissolved Oxygen mg/l | +/- 0.5 |
| Specific Conductivity | +/- 5% |
| Temperature | +/- 0.5 C |
| pH units | +/- 0.5 |

# Measurement Method Selection

Will it achieve MQOs?

Performance Based Method System (PBMS): the proof is in the pudding.

# Assemble a Monitoring Plan

(The five W's and the H, Plus the inevitable)

"Admin"
Why?
Who?
What, Where, and When?
How?
Quality Assurance
Data analysis & reporting

# Compile QAPP

Use traditional EPA 24 elements, e.g., SWAMP template, if needed

# Get Feedback!

Use the Planning Documents review process to communicate with experts and to consult your gurus

# Recruitment

# Training (Awareness)

- Awareness of error
- Attitude
- Personal Responsibility

# Training (Skills)

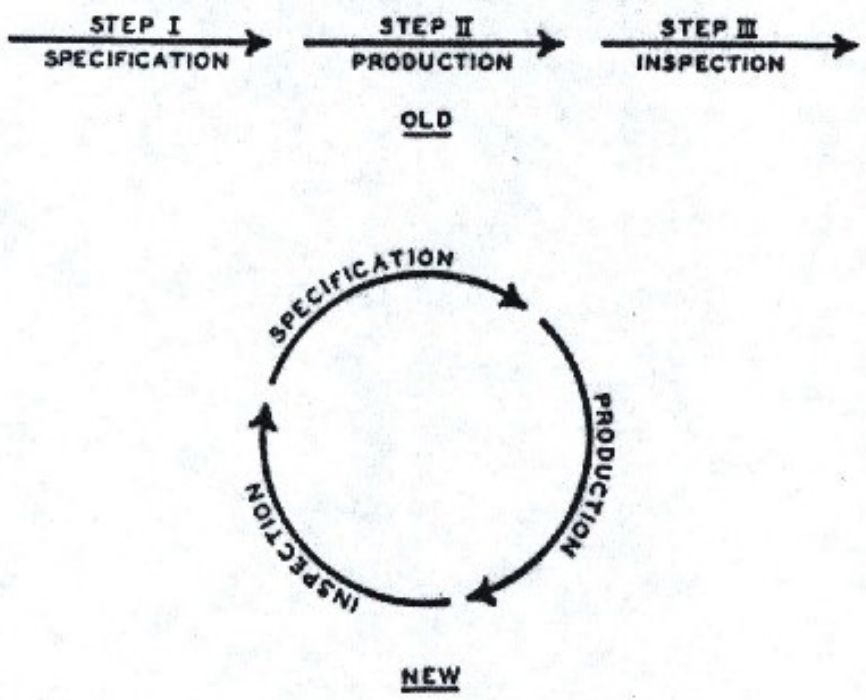
## Everything else

# Finally….. Monitoring

# Quality Control: Do The Loop

Control = Specification, Production, Inspection.

(Shewhart 1939)



# Implementation

# Implementation

# Session Overview

Tasks, roles, and responsibilities

Question/hypothesis

Sampling Design (what where when)

DQOs, MQOs, WQOs, PBMS….

# Desired Outcome

Wish I could give you the magic bullet for designing a fully blown Monitoring Project… but all I can hope for is….

A bit of Confusion Abatement

Understanding need for consulting technical experts

Being able to separate the variables