DESIGNING MONITORING PROGRAMS TO EVALUATE BMP EFFECTIVENESS

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Examples from the Little Bear River CEAP Project
Pre-treatment problems:
Bank erosion, manure management, flood irrigation problems
Treatments:

- bank stabilization,
- river reach restoration,
- off-stream watering,
- improved manure and water management
Common problems in BMP monitoring programs:

- Failure to design monitoring plan around BMP objectives
- A failure to understand pollutant pathways and transformations and sources of variability in these dynamic systems.
- Tend to draw on a limited set or inappropriate approaches
• Failure to design monitoring plan around BMP objectives
• A failure to understand pollutant pathways and transformations and sources of variability in these dynamic systems.
• Tend to draw on a limited set or inappropriate approaches Designing monitoring to address specific objectives

Little Bear River Watershed, Utah
<table>
<thead>
<tr>
<th>Year Range</th>
<th>Discharge</th>
<th>Total phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976 - 2004:</td>
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<td>241</td>
</tr>
<tr>
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<td>13</td>
</tr>
<tr>
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<tr>
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</tbody>
</table>
• Failure to design monitoring plan around BMP objectives

• A failure to understand pollutant pathways and transformations and sources of variability in these dynamic system.

• Tend to draw on a limited set or inappropriate approaches
Understanding natural variability – annual variation
Since 2005, measure flow and turbidity at 30 minute intervals

Stage recording devices to estimate discharge

Turbidity sensors

Dataloggers and telemetry equipment

http://www.campbellsci.com

http://www.ftsinc.com/
Capturing pollutant movement from source to waterbody.
The relative importance of different sources of variability

Sampling frequency

Regressions of TP and turbidity

Coefficient of variation of estimates

Grab samples -- sampling frequency (d)

Continuous monitoring -- $R^2$ between TP and turbidity
• Failure to design monitoring plan around BMP objectives

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• Tend to draw on a limited set or inappropriate approaches
Problems with “one-size-fits-all” monitoring design

![Graph showing Rees Creek TSS load over weeks with two lines: one for above and one for below. The graph shows a peak load in week 5.]
Problem: excess phosphorus

Average flow = 1000 cfs

BMP = fence cattle OUT of riparian area and revegetate
Focuses on the considerations and decisions necessary as a project is first being considered.

NOT a “how-to” manual of protocols

Document in review
Training workshops underway
What is your objective?

- ✓ Long term trends?
- ✓ UPDES compliance?
- ✓ Educational?
- ✓ Assessment for impairment?
- ✓ Track response from an implementation?
How do pollutants “behave” within your watershed.

✓ How does the pollutant move from the source to the waterbody?

✓ How is the pollutant processed or transformed within a waterbody?

✓ What is the natural variability of the pollutant? Will concentrations change throughout a season? Throughout a day?

✓ What long term changes within your watershed may also affect this pollutant?

✓ What else must be monitored to help interpret your data?
What to monitor?

- Monitor the pollutant(s) of concern?
- Monitor a “surrogate” variable?
- Monitor a response variables?
- Monitor the impacted beneficial use?
- Monitor the BMP itself?
- Monitor human behavior?
- Model the response to a BMP implementation.
- Collect other data necessary to interpret monitoring results OR calibrate and validate the model?
Where and when to monitor?
Choose appropriate monitoring or modeling

Control

Treatment “A”

BACI Design

Sampling points

Above and below treatment design

Above-treatment monitoring stations

Below-treatment monitoring stations
How to monitor?

✓ points in time versus continuous
✓ integrated versus grab samples
✓ consider:
  
  cost

  skill and training required

  accessibility of sites
The road to more effective monitoring:

- Monitoring plans require careful thought before anything is implemented.
- Consider how the data will be used to demonstrate change.
- Use your understanding of your watershed and how the pollutants of concern behave to target monitoring most effectively.
- Use different approaches for different BMPs.
different sources of variability in estimates of loads