Quantifying Stream Ecosystem Responses to Smart Growth:
How to Design an Assessment

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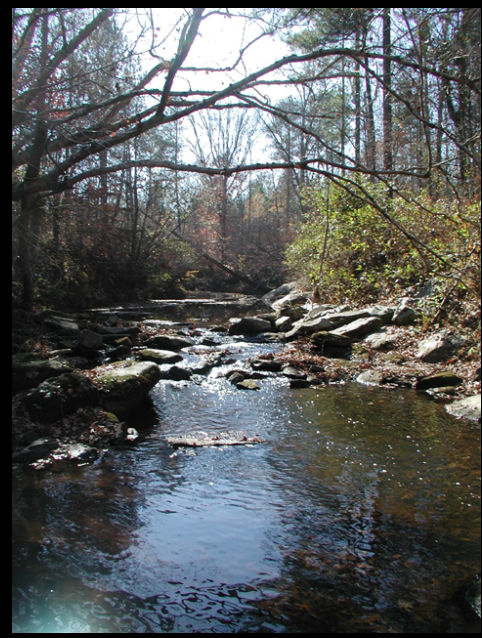
Potential Aquatic Ecosystem Benefits of Smart Growth

SMART GROWTH may include:

- Compact development
- Reduced impervious surfaces
- Improved water retention/infiltration
- Protected "sensitive" areas
- Increased public transit

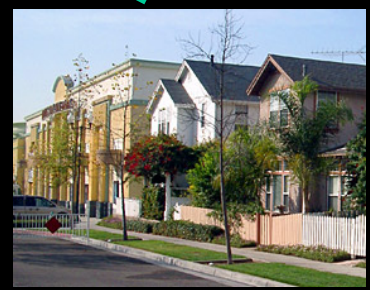


Which *may* result in:

- reduced stream "flashiness"
- reduced sedimentation
- improved water quality
- healthier biotic assemblages

QUESTION:
How do you quantify water resource responses to smart growth?

hydrology
geomorphology
water quality
ecology



ANSWER:
You can't.

WHY NOT?

- Proportion of watershed mitigated is often small
- Comparable control streams are hard to find
- Natural temporal and spatial variability overwhelms the ability to detect a response
- Typically don't know stream baseline or reference conditions (e.g., geomorphology, diversity, etc.)
- Unclear what level of indicator is desired

HOWEVER,

Monitoring is an Essential Component of Watershed Protection and Restoration

- Must demonstrate improvements to economically, politically, legally, and socially justify protective/restorative measures
- If protective design measures are part of the TMDL process, then need need to quantify improvements
- Helps to identify potential thresholds of response and defend management guidelines




How do you plan an assessment to maximize the probability of detecting change, if it occurred?

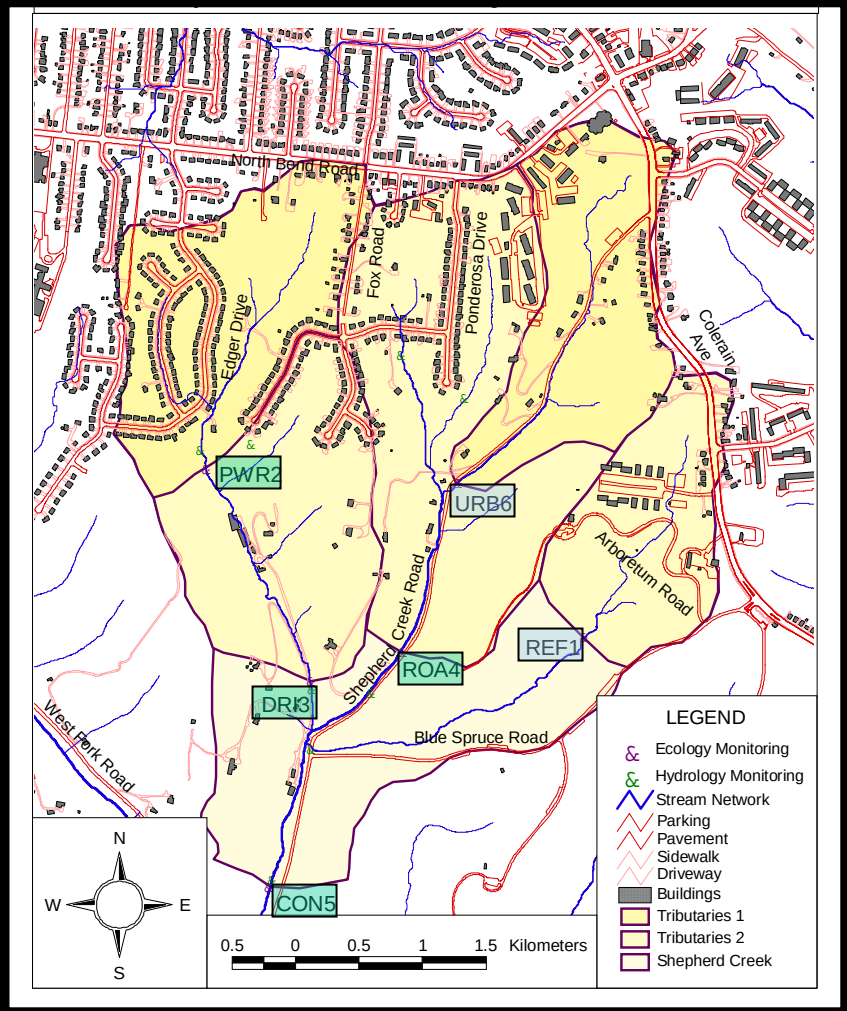
STEPS:

1) Consider the analysis in initial design phase
2) Select ideal indicators
3) Choose an appropriate spatial scale
4) Pick a useful temporal scale for selected parameters

1. Consider the analysis in initial design phase

Before/After Analysis
Control/Treatment Analysis
- Replicated treatments?
- Replicated controls?

Note: If you don't have the resources to sample controls or to sample long enough to understand temporal variability, then don't bother!!!



2. Select ideal indicators

- Likely to show a response
- Relatively easy to measure
- Able to control for temporal and spatial variation
- Known level of health/improvement
- Clear ecosystem implications

landscape → hydrology → water quality → habitat → biota





3. Choose an appropriate spatial scale

Small scales – higher likelihood of response, but more stochastic variability

vs

Large scales – risk of diluting response, but less expected variability

→ Sample at a small enough scale such that the proportion of watershed impacted is large enough to predict a response; if stream is ephemeral or intermittent, also include downstream sites

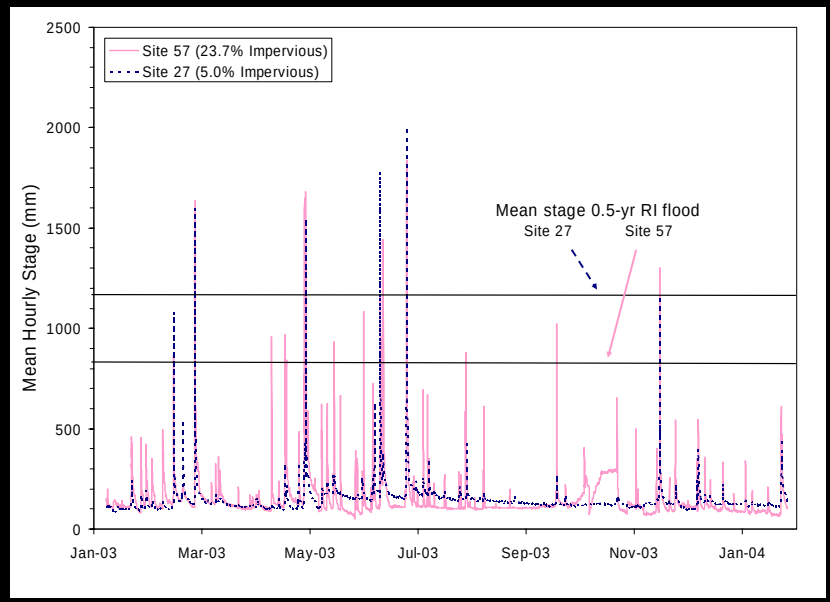
4. Pick a useful temporal scale for selected parameters

Hydrology:
- continuous monitoring (stage OK for before/after)
- enough events of various sizes (e.g., 40-50 events)

Water Quality:
- several baseflow and stormflow samples

Algae & Macroinvertebrates:
- constant habitat
- seasonal (light, organics)
- quantitative

Number of years before/after will depend on how "typical" climate conditions are

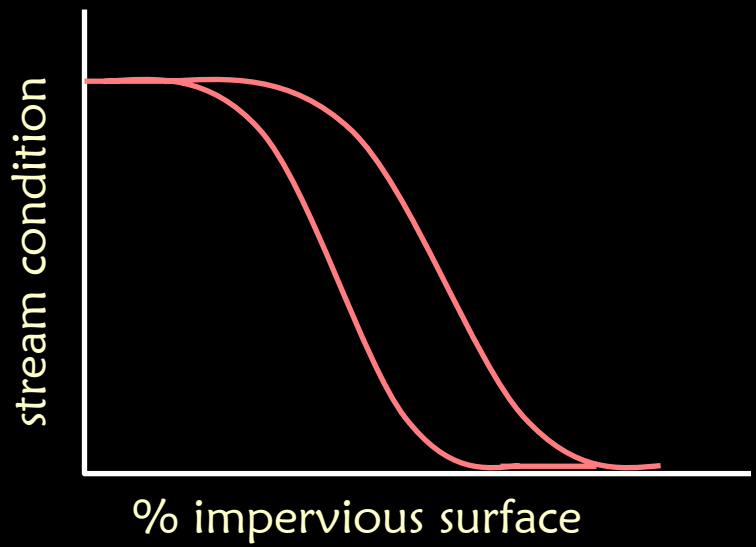


What if no in-stream effect is found???

- Describe any shortfalls in the monitoring design which may have prevented seeing a response.

- Look for project failures…are the low impact design measures doing what they're supposed to?

- Accept that ecosystem improvement may not have happened given:
  - % of watershed mitigated
  - time scale of monitoring




If you don't monitor,
you don't know….