Best-guess efficiencies drive risky BMP choices

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Estimates of BMP efficiencies are needed to:

- Predict aggregate BMP effects (e.g. using the Chesapeake Bay Program Watershed Model)
- Select BMPs for WIPs to meet TMDL goals

For aggregate BMP effects:

- Estimating average efficiency is useful despite uncertainties.
- A best guess ("best professional judgment") will do.
- The effect of individual BMPs might be over- or under-estimated but the effect of a suite of BMPs will not be overly biased.

For BMP selection:

- Using the best-guess efficiency biases selection toward inexpensive, poorly-understood (risky) BMPs.

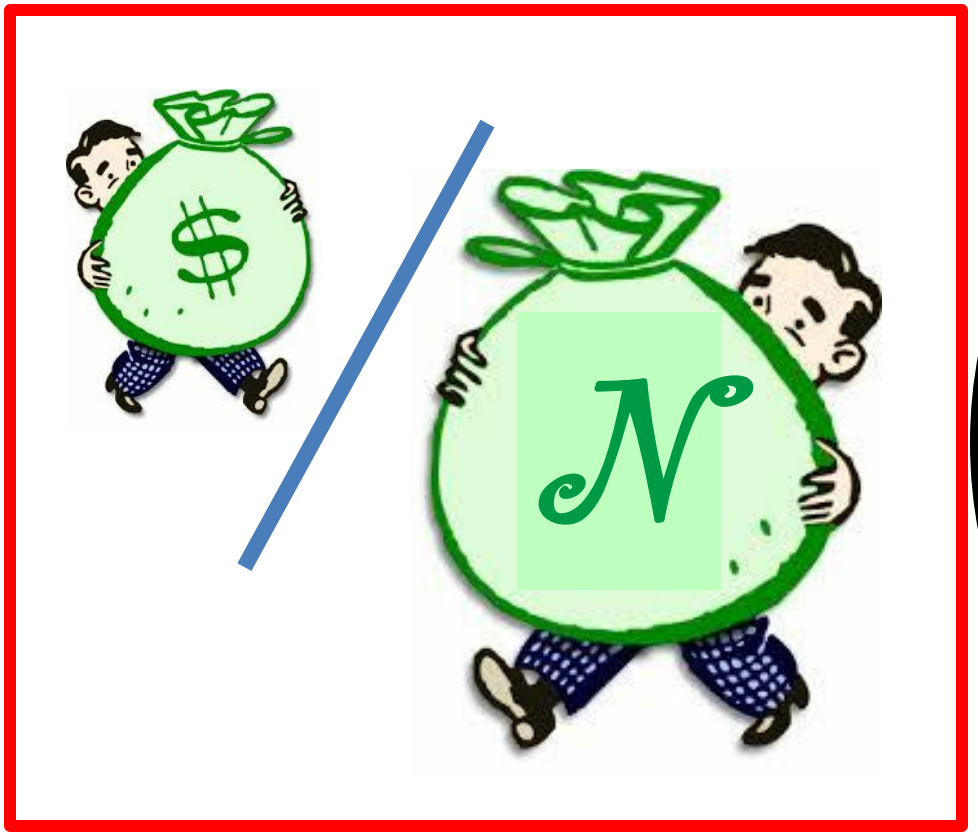
Here's why…

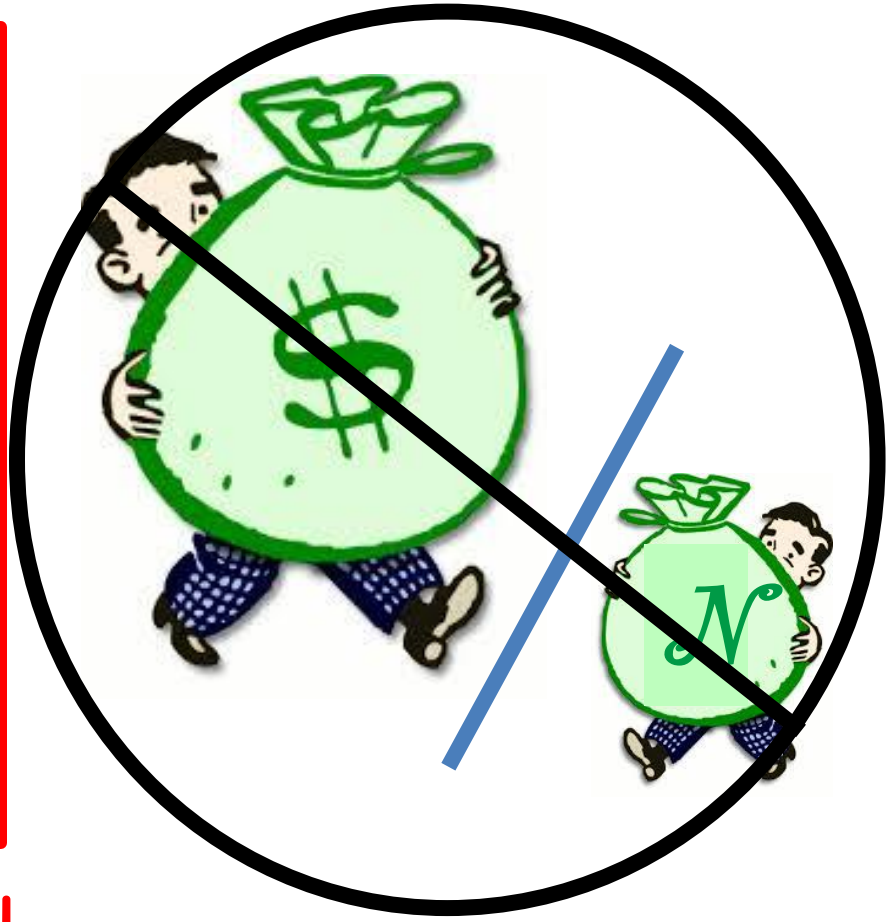
- BMP efficiencies are known with differing amounts of uncertainty.
- As uncertainty increases, BMP efficiency can be over- or under-estimated by larger degrees.
- BMPs with over-estimated efficiency will seem to offer greater nutrient removal per cost.
- Greater over-estimation will result in greater attractiveness for BMP selection.

Conversely…

- BMPs with under-estimated efficiency will tend not to be selected because they seem to offer less nutrient removal per cost.

Why pay more for your nitrogen removal?





Smart shopper's choice of BMP!

Result:

- BMPs with over-estimated efficiency will be selected preferentially.
- A suite of BMPs selected based on best-guess efficiency estimates will under-perform.
- The TMDL will not be met.

Solution:

- Consider uncertainty and risk when selecting BMPs.

Types of uncertainty

- Errors in measuring BMP efficiency

- Real variability of BMP efficiency caused by poorly understood factors, e.g.:
  - Soil type might affect nutrient uptake by constructed wetlands
  - Groundwater flow pathways might affect uptake in riparian buffers
  - BMPs may fail during extreme events

Types of risk:

- Selecting a BMP that is less efficient than estimated

- Not being able to verify BMP performance: How long would it take to find out that the BMP is not working as expected?


Remember the lag times.
The BMPs will kick in eventually.
Our expert panels used their best professional judgment.
2025

Examples considering uncertainty and risk

A gold standard BMP: Sewage treatment upgrade

A gold standard BMP: Sewage treatment upgrade

- The technology is well studied.
- Effects are predictable with low uncertainty.
- Effectiveness is constantly monitored.

A silver standard BMP: Cover crops

A silver standard BMP: Cover crops

- Effects have been fairly well studied.

- Effects can be assessed by remote sensing of the cover crop and by measuring soil nutrients.

Bronze BMP? Riparian buffers

Bronze BMP? Riparian buffers

- There have been many studies but efficiencies are variable and imprecisely measured.
- It is difficult to verify performance.
- Verification of performance is rarely done after implementation.

Quantifying risks

- Relative importance of particular BMPs to overall WIP

- Consequence of long-term undetected underperformance

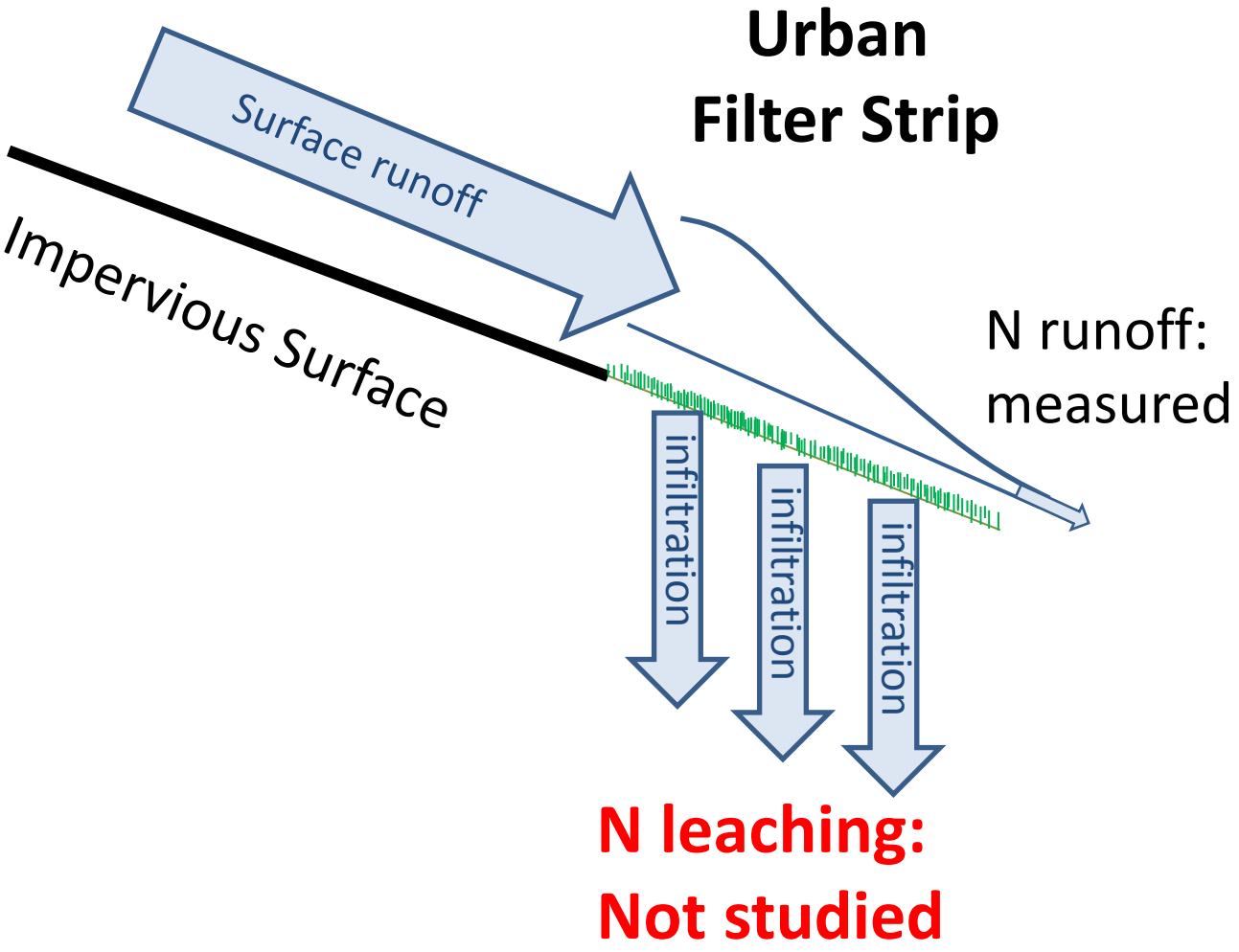
Quantifying uncertainties

- If there are multiple measurements: range, percentiles, standard deviation, confidence limits.

- If there are few measurements, it is difficult to quantify uncertainty.

- What if there are no measurements?

A case with no measurements: Nitrogen uptake by urban filter strips



Given there are no direct measurements, my suggestion is :

Give a value of **zero** nitrogen credit

- Estimating N uptake greater than zero would discourage research needed to quantify the value of the BMP.

- Why fund or do research if a panel of experts has already assigned an N efficiency based on “best professional judgment?”

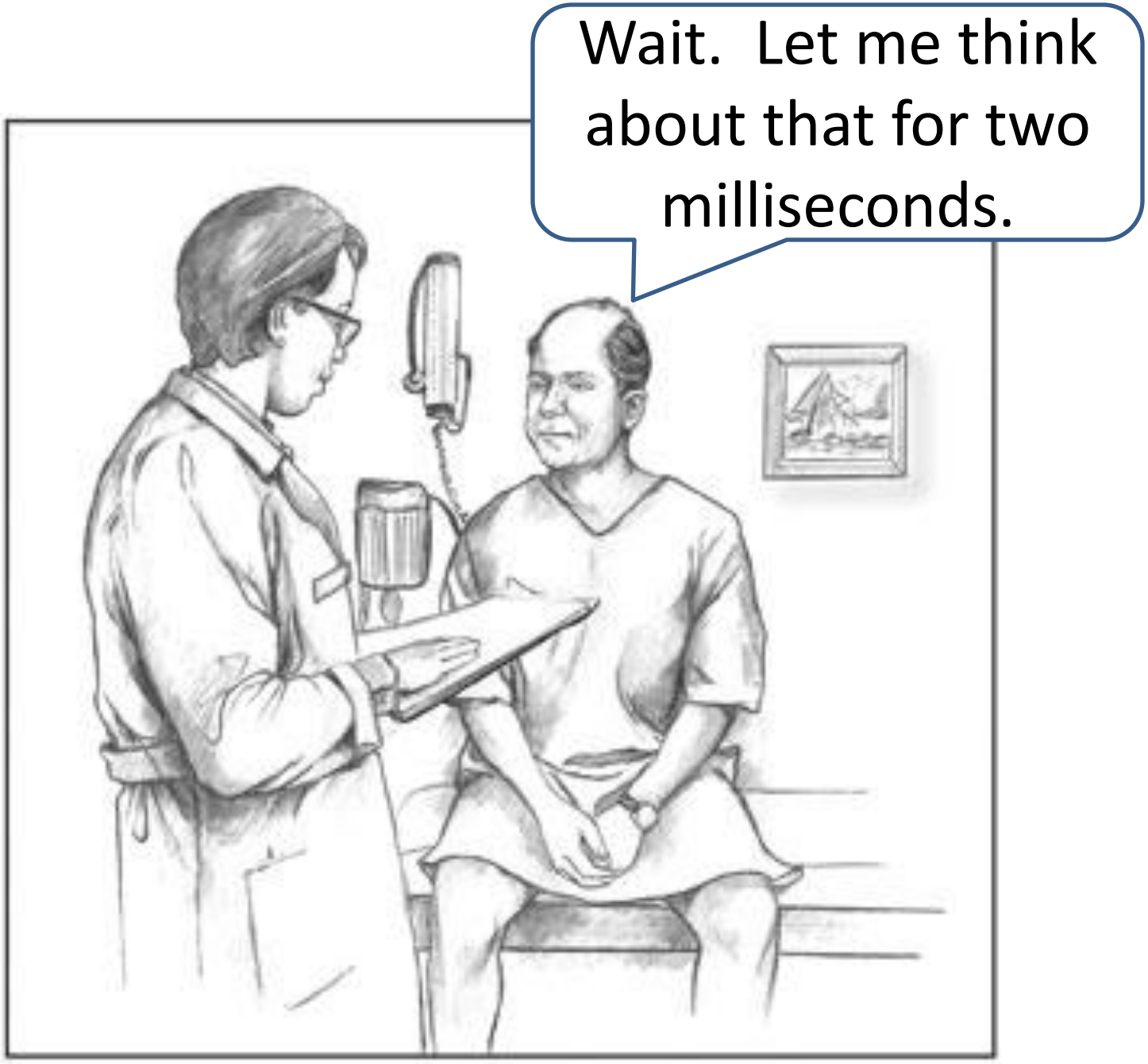
The FDA does not approve a medication without scientific demonstration of its effectiveness.

Why should we approve a BMP without evidence of its effectiveness?

Proven Effective

VS.

Untested but experts think it will work


Wait. Let me think about that for two milliseconds.

Expert Panel reaction to my suggestion of zero credit:

This would be too harsh a standard to apply compared to those used in panels for other BMPs.

Expert Panel consensus:

Urban filter strips remove 20% of the N input.

The Water Quality Goal Implementation Team (GIT) approved the panel report recommendations 6/9/14.

My Recommendations

- Apply methods for risk-based decision making as used by insurance and investment companies.
- Determine what information will be needed for risk-based decision making.
- Instruct expert panels to provide such information.

Broader Context

- STAC has recommended that the CBP quantify uncertainty for its model predictions, and then use that information in decision making.

- Those principles should be extended into the BMP review process to account for uncertainty and the risk when selecting BMPs for WIPs.