Overview of Models Useful for Stormwater Quality Management

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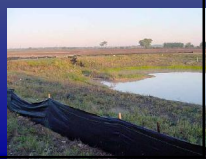
NASECA Wisconsin Annual Conference
February 5, 2010

Winning Model Requirements

- Predict runoff water quality and quantity accurately
- Analyze existing conditions and alternative land uses
- Analyze BMPs – structural & non-structural
- Model Assumptions! (What was it built for?)

Drivers – Why are we here?

- Reasons to model stormwater quality
  - Analyze existing conditions
  - Anticipate effects of development
  - Develop storm water quality improvement strategy
  - Regulatory compliance (Ordinance Compliance, Phase II, TMDL, etc.)
- What do the models need to do?



Water Quality Models

from EPA 841-B-97-006
Compendium of tools for watershed assessment and TMDL development

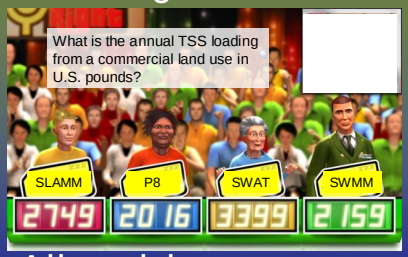
Watershed-scale loading models
- Simple methods
- Mid-range models
- Detailed models

Field-scale loading models

Integrated modeling systems

Receiving water models

Modeling Truism No 1:



All models are wrong – Some are useful

Water Quality Models

Watershed-scale loading Models (Section 2.3)

EPA 841-B-97-006

Simple Methods	Mid-Range Models	Detailed Models
• EPA Screening	• SITEMAP	• STORM
• Simple Method	• GWLF	• ANSWERS
• Regression Method	• Urban Catchment Model P8	• DR3M-QUAL
• SLOSS-PHOSPH	• Automated Q-ILLUDAS	• SWRRBWQ
• Watershed	• AGNPS	• SWMM
• Federal Highway Aministration Model	• SLAMM	• HSPF
• Watershed Management Model		• SWAT

Model Summary

- SLAMM
  - http://www.winslamm.com/
  - Only urban applications
- P8
  - http://wwwalker.net/p8/
  - Only urban applications
- SWAT
  - http://swatmodel.tamu.edu/
  - Primarily agricultural model but also does urban loading

Hydrology (cont.)

- Which is best?
- SLAMM approach is purely empirical
  - Appropriateness depends on applicability of calibration sites to modeled site.
- P8 straightforward to understand and appears reasonable
- SWAT not appropriate based on typical understanding of big deal issues for urban applications but can do surprisingly well.

Hydrology

- All are continuous simulation models
  - P8 and SWAT can model through winter / snowmelt. SLAMM does not.
- Goal of models: Predict sediment loading
  - Urban application: Need to do a good job of runoff from impervious surfaces (pervious surfaces less important)
  - Agricultural Application: Opposite is true

Pollutant Loading in SLAMM

- Streets
  - Accumulation and washoff are empirical functions.
- Remaining surfaces
  - Average concentration of pollutant in runoff from monitoring data
- Advantage of SLAMM – loading varies based on land use and impervious cover type.

Hydrology (cont.)

- SLAMM
  - Runoff is a fraction of rainfall depth, based on monitoring data
- P8
  - Pervious surfaces use SCS curve number technique
  - Impervious surfaces- runoff begins after cumulative rainfall exceeds user-specified depression storage
- SWAT
  - Pervious surfaces use SCS CN (although can use Green Ampt)
  - Impervious surfaces lumped with pervious surface

Pollutant Loading in P8

- Impervious surfaces
  - Particle accumulation and washoff- similar approach as SLAMM (although differences do exist)
- Pervious surfaces
  - Computed from empirical equation using a benchmark of a one inch/hour rainfall intensity
- Drawback from P8 – All impervious areas treated equally.

Pollutant Loading in SWAT

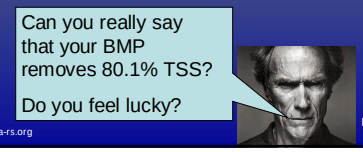
- Agricultural Areas:
  - MUSLE for agricultural uses (differs from USLE only in the estimation of erodibilty from a rainfall event)
- Urban Areas: Build-up / washoff function

BMP Analysis

- SLAMM
  - Combination of empirical relationships from monitoring data and theory
  - Wide array of BMP's available
- P8
  - Theory calibrated by monitored data
  - Most typical BMP's available
- SWAT
  - "End of Pipe" BMP modeling typically crude
  - Basic "end of pipe" BMP's available and non-intuitive input

Sediment Characterization

- SLAMM: No sediment distribution (just a load) unless modeling a BMP where settling velocities are used.
- P8 based on a sediment distribution
  - NURP 50% Distribution Curve - Characterized by a five point curve of settling velocities (one-two significant digits).
- SWAT: No sediment distribution (just a load)
- Model input versus output resolution…



International Stormwater BMP Database

Purpose

- Develop monitoring protocols
- Collect existing BMP performance data
- Develop data evaluation protocols
- Create a international BMP database

www.bmpdatabase.org

Data-based approaches to pollutant loading

- NURP
- Local & state data collection
- Example: New summaries of NPDES program monitoring results are being developed: See Robert Pitt's website on The National Stormwater Quality Database (NSQD, version 3)
- http://unix.eng.ua.edu/~rpitt/Research/ms4/mainms4.shtml

Conclusions

- Need to consider modeling goal and land uses when selecting model.
- Need to understand model assumptions.
- There's data to be found (don't just believe the output)
- Need to understand what the model is doing.
  - Famous Last Words: It ran! …I'm done now, right?


Thank You
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