Treatment of BMP Performance Uncertainty within the Existing CBP Expert Panel Process

Kurt Stephenson & Carl Hershner

VIRGINIA TECH

VIMS

Consideration of BMP Performance Uncertainty STAC Workshop
November 14, 2017

stac

Outline

1. Describe process for assessing “BMPs” (urban, ag, in situ/waste assimilation)

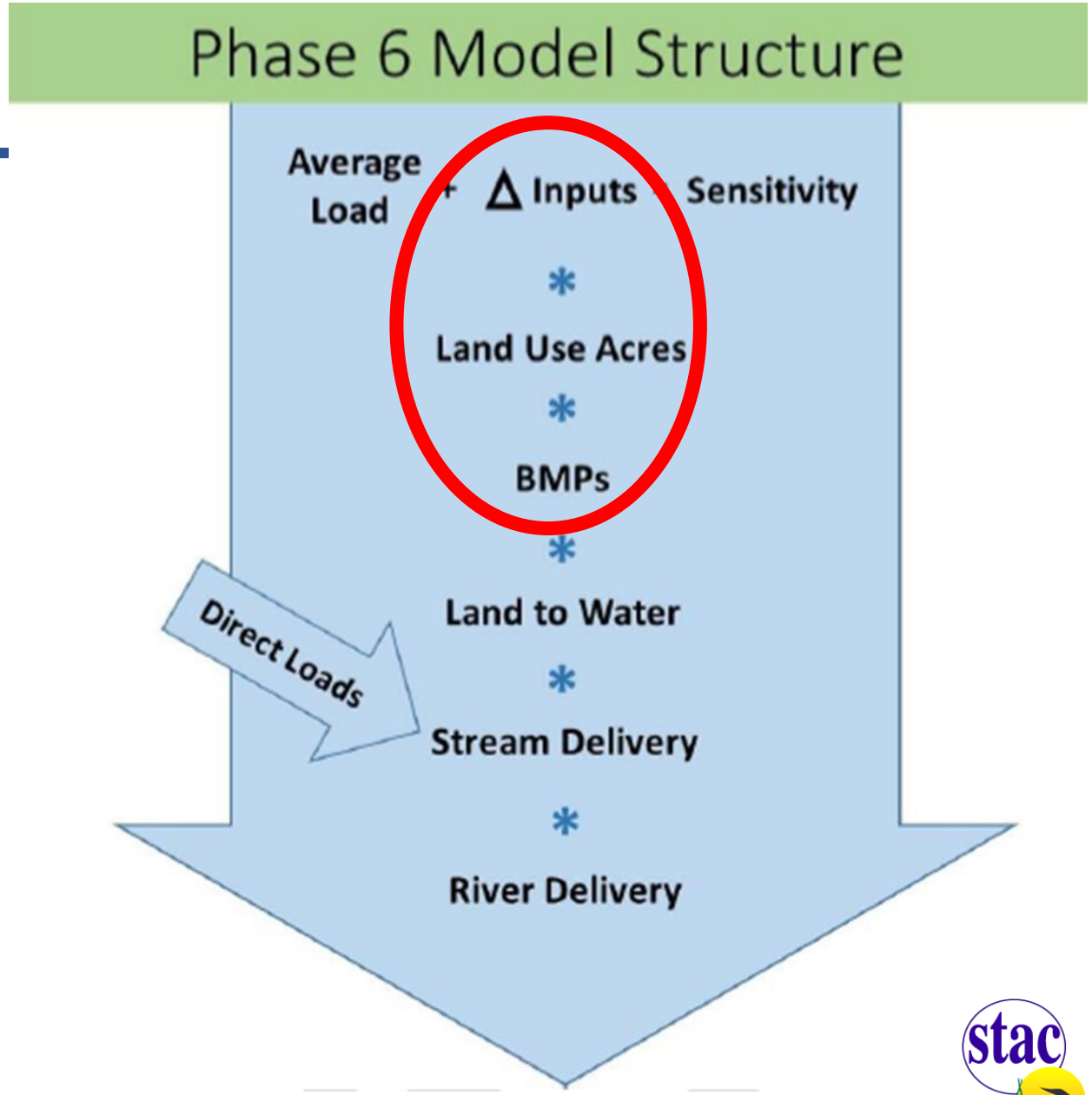
2. Summarize and compare how CBP expert panels address uncertainty in BMP performance

Role of Expert Panels

Generate estimates of pollutant (N, P, & S) removal effectiveness of best management practices (BMPs) and nutrient inputs

These estimates:

1. Are critical modeling inputs/parameters
2. Become efficiencies state and local governments use to calculate their load reductions & TMDL compliance



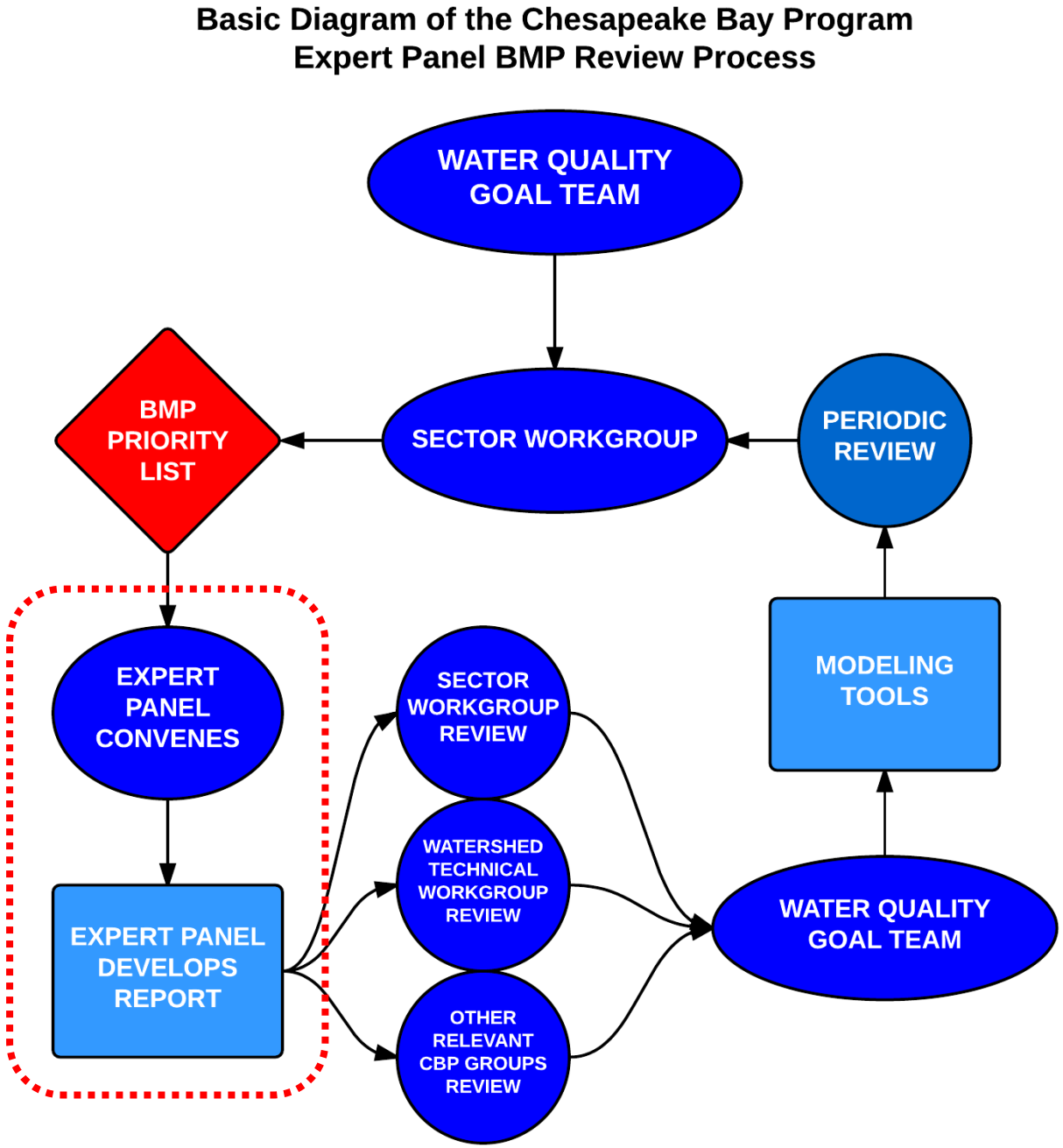
BMP Efficiency Review & Approval Process

EXPERT PANELS:

Charge: Produce BMP pollutant removal estimate

- Made up of scientific/technical volunteer experts
- CBP support staff for panel

Expert panel recommendations are reviewed and approved by CBP program



BMP Expert Panel Protocol

The *Protocol* governs the process panels use to develop BMP efficiency estimates and panel reports.

Protocol requires:

- Guidelines for new and revised BMPs
- Characterization of data sources
- Guidelines for factors to consider when developing estimates
- ***Description for how the panel addressed scientific uncertainties and variation in removal effectiveness***
- ***Documentation of uncertainties in literature***

What Expert Panels Produce

Point estimates of N, P and sediment removal effectiveness

Depending on BMP, point estimates may be produced for broad physiographic regions or land uses.

May recommend more than one method to quantify BMP effectiveness (*more on this later*)

Provide feedback/recommendations on BMP verification

Review of Treatment of Uncertainty in BMP Expert Panel Reports

How is BMP performance uncertainty characterized and addressed within the existing expert panels?

Expert Panels Reports Reviewed, 2012-2016

Ag BMPs

Nutrient Management
Conservation Tillage
Cover Crops
Animal Waste Management Systems
Manure Treatment Technologies

In-Situ/Assimilation/Other

Wetland Restoration
Stream Restoration
Algal Floways
Oyster Aquaculture
Shoreline Management
Riparian Forest & Grass Buffers

Urban BMPs

Erosion & Sediment BMPs
Urban Filter Strips
Urban Tree Canopy
Urban Nutrient Management
Street Sweeping/Drain Cleaning
Elimination of Discovered Discharges
Runoff to Amended Soils
On-site Wastewater

Summary of BMP Expert Panel Reports

1. Amount of information/literature ***available*** on BMP performance?
2. Amount of information/literature ***used*** to develop BMP removal est.?
3. What approach used to characterize/summarize variability in literature?
4. How did the panel translate literature into BMP performance est?
5. Did the panel explicitly address/consider uncertainty in final est?
6. What did the panel members consider the greatest source of uncertainty in developing BMP performance estimate?
7. How was uncertainty assessed when developing estimate?

Availability of Literature

The amount of empirical literature varied substantially across panels

- ~50% panels: “extensive”
- ~20% panels: “limited”

Most panels used only a fraction of the available literature in developing an estimate.

Characterizing Variability in the Literature

Less than a third of panels quantified the variation in performance found in the literature

Most described variation in performance qualitatively

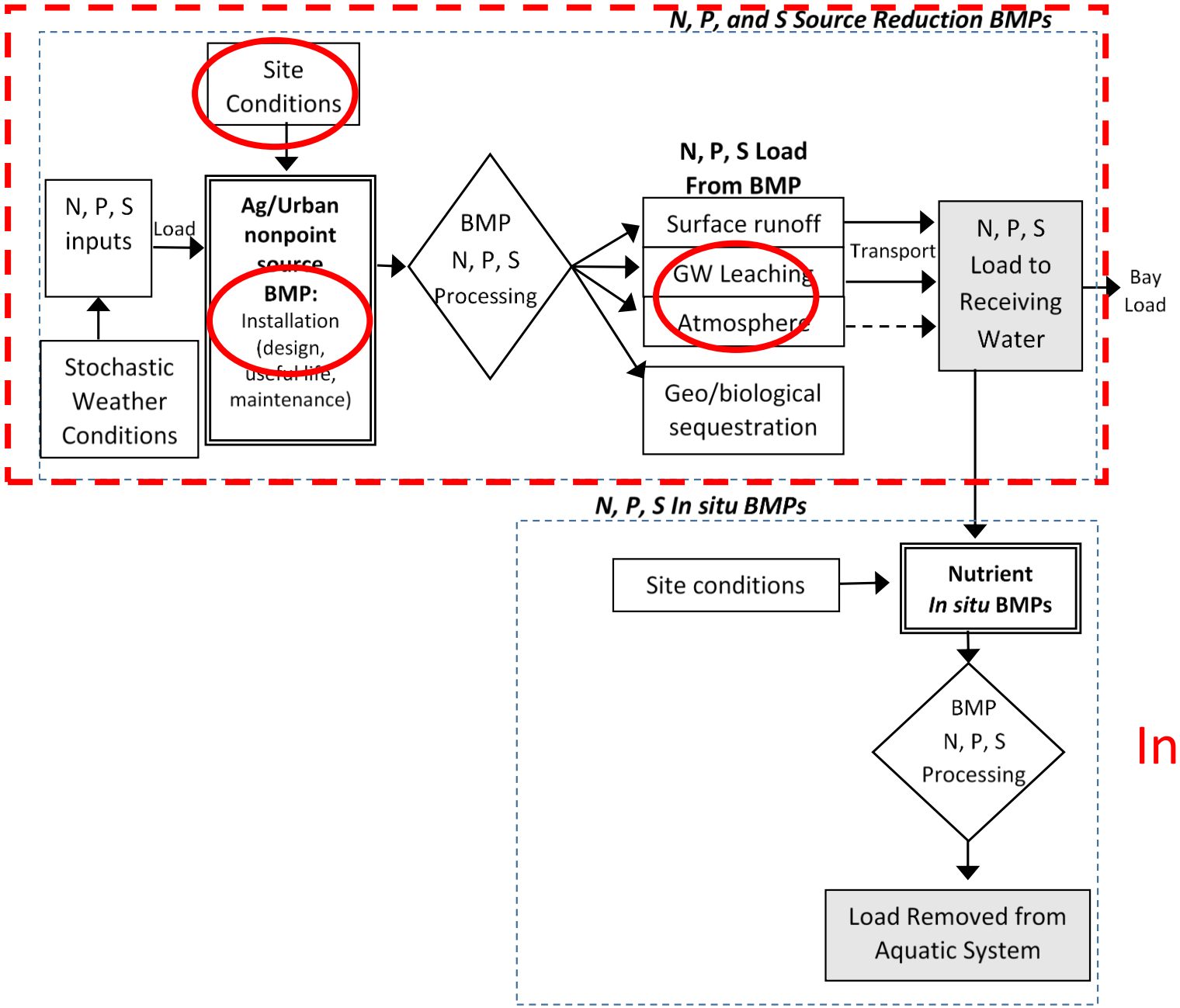
Approach to Derive an Estimate

"Best Professional Judgment" (BPJ) most common approach (~80%)

Panels sometimes used models to help generate an estimate of pollutant removal (most common with urban BMP panels)

Less than a third used some type of statistical measure to generate (or inform) an estimate

Sources of Greatest Uncertainty



Ag & Urban BMPs

In situ Practices

How Was Uncertainty Addressed?

What did panels do when confronted with uncertainty regarding an important component of the pollutant removal process?

~75% of panels described their estimate as “conservative” (relative to WQ objective)

The remainder of panels aimed to provide best estimate of the central tendency of the removal performance (“neutral”)

How Was Uncertainty Addressed?

7 of 19 panels developed multiple quantification procedures to partly address uncertainty

- Develop “conservative” default estimate

- More “neutral” estimate (higher removal estimate) if implementer either
  1) provided more information on an installed practice
  or 2) measured performance directly

Implementation Factors Influencing Certainty of Pollutant Removal Effectiveness (Ag)

BMP Expert Panel	# of BMP Quantification Protocols	What is Observed?	Type of Verification	Frequency
Agricultural BMPs				
Nutrient Management	1	Practice	Indirect (nonvisual)	Sample
Conservation Tillage	1	Practice	Direct (visual)	Sample
Cover Crops	1	Practice	Direct (visual)	Sample
Animal Waste Mgt Systems	1	Practice	Direct (visual)	Sample
Manure Treatment Technologies	3	(1)Practice (2) Practice (3) Outcomes	(1) Indirect (nonvisual) (2) Direct (visual) (3) Direct (visual/records)	Sample Permit Schedule

Implementation Factors Influencing Certainty of Pollutant Removal Effectiveness (Urban)

BMP Expert Panel	# of BMP Quantification Protocols	What is Observed?	Type of Verification	Frequency
Urban BMPs				
Runoff to Amended Soil	3	(1) Practice (2) Practice (3) Practice	(1) Direct (2) Direct (3) Direct	Permit Schedule
Erosion & Sediment BMPs	1	Practice	Direct	Permit Schedule
Urban Filter Strips	1	Practice	Direct	Permit Schedule
Urban Tree Canopy	1	Practice	Indirect	
Urban Nutrient Management	1	Practice	Indirect	Annual/Sample
Street/storm Drain Cleaning	1	Practice	Indirect (records)	Annual
Elimination of Discovered Discharges to Grey Infrastructure	2	(1) Practice (2) Outcomes	(1) Direct (2) Direct	
On-site Wastewater Systems	1	Practice	Not specified	Not specified

Implementation Factors Influencing Certainty of Pollutant Removal Effectiveness (In situ)

BMP Expert Panel	# of BMP Quantification Protocols	What is Observed?	Type of Verification	Frequency
Stream Restoration	2	(1) Practice (2) Practice	(1) Direct (2) Direct	Every 5 years
Wetland Restoration	1	Practice	Direct	Variable schedule
Algal Flow Way Technologies	2	(1) Outcomes (2) Outcomes	(1) Direct (visual/records) (2) Direct (visual/records)	Annual Quarterly
Oyster Aquaculture	2	(1) Outcomes (2) Outcomes	(1) Direct (records) (2) Direct (records)	Annual Annual
Shoreline Management Projects	2	(1) Practice (2) Practice	(1) Direct (2) Direct	Every 5 years
Riparian Forest/Grass Buffers	1	Practice	Direct	Sampling

Summary

Within a panel: pollutant removal efficiency estimates based on internally consistent logic

Across panels, differences in:

- Empirical base (available literature)
- Types of uncertainty
- Response to uncertainty
- Level/type of quantification (practice vs performance)
- Verification of measured outcomes