

Partnership Review of the Chesapeake Bay Program's Phase 6 Watershed Model

Gary Shenk – USGS - Chesapeake Bay Program

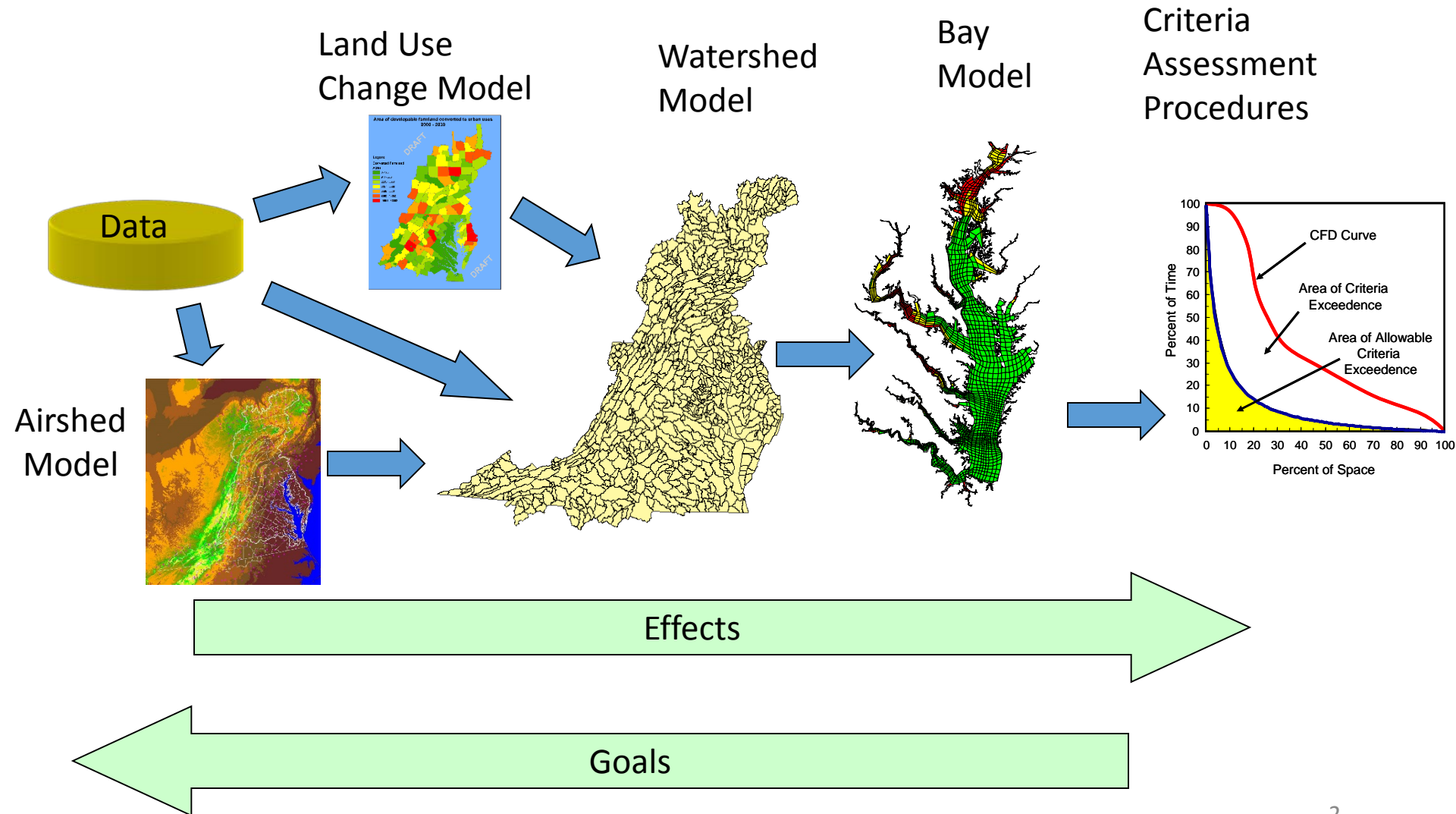
Presentation to STAC

6/13/16

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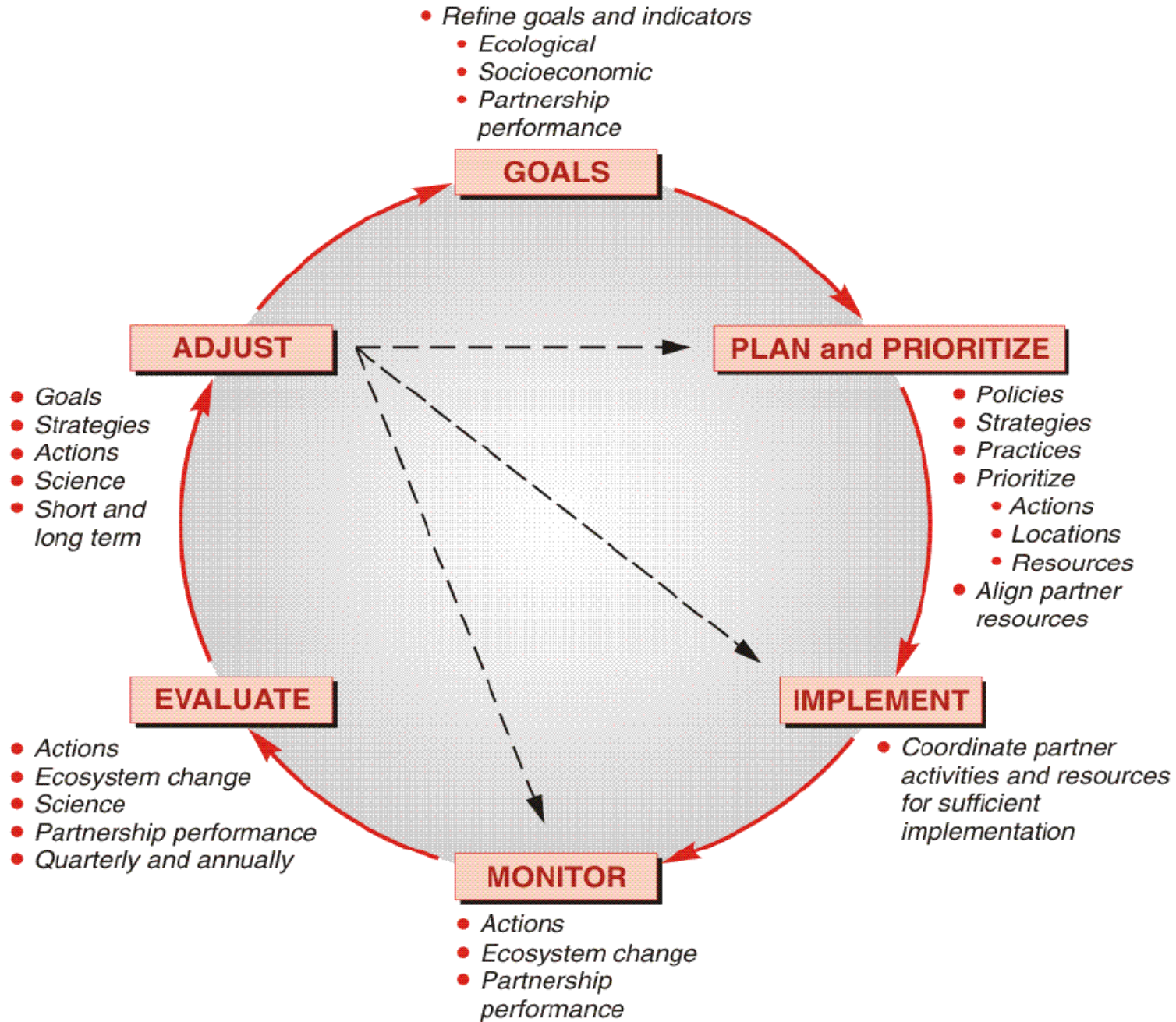
Preliminary Information-Subject to Revision.
Not for Citation or Distribution

Decision Support System



Continual Updates to Models

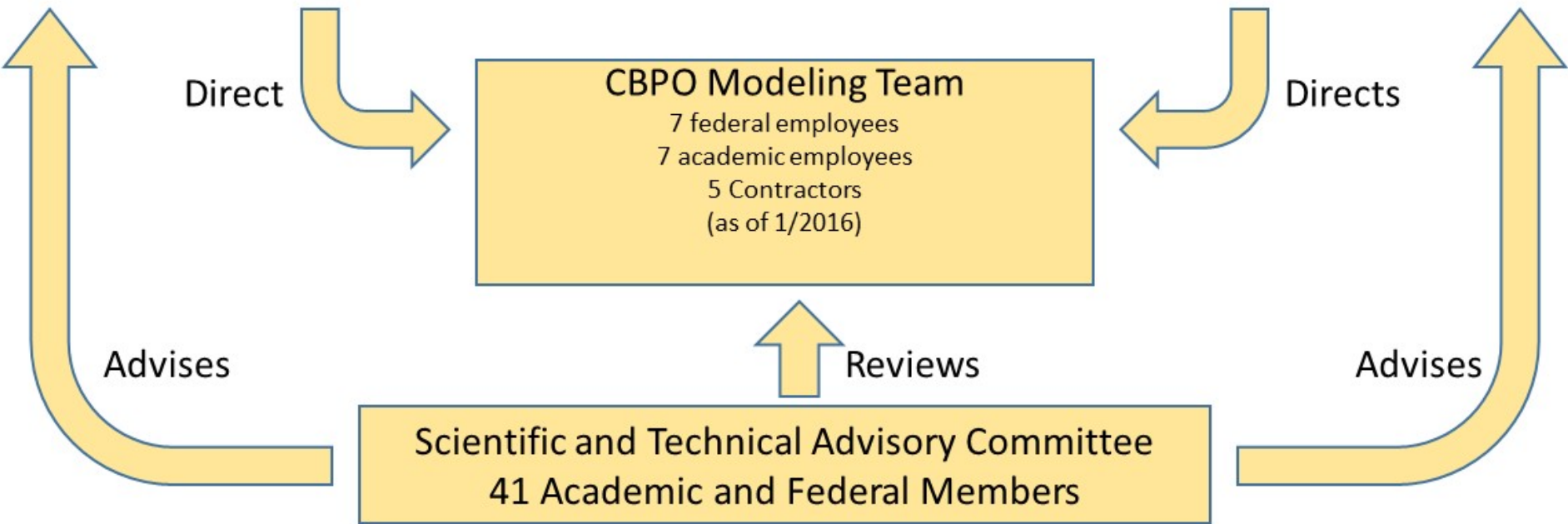
Year	Model Phase	Goal
• 1987	0	40% reduction
• 1992	2	40% of controllable loads
• 1997	4.1	Confirm 1992 loads
• 2003	4.3	Reallocation
• 2010	5.3.0	TMDL & WIPs
• 2011	5.3.2	Phase 2 WIPs & targets
• 2017	6.0	Phase 3 WIPs & targets



Sources: Williams et al. 2007, Levine et al. 2009.

Water Quality Goal Implementation Team
30 State, Federal, Academic, and NGO members
7 WQGIT Workgroups
Over 300 State, Federal, Academic, and NGO members
(as of 1/2016)

Modeling Workgroup
17 State, Federal, and Academic members
(as of 1/2016)



STAC Guidance

2005



Chesapeake Bay Watershed Model Phase V Review

February 20, 2008

Lawrence Band¹, Theo Dillaha², Christopher Duffy³,
Kenneth Reckhow⁴, Claire Welty⁵

Review of the Chesapeake Bay Watershed Modeling Effort

By

Lawrence Band¹, Kenneth Campbell², Russell Kinerson³,
Kenneth Reckhow⁴, and Claire Welty⁵

STAC Guidance

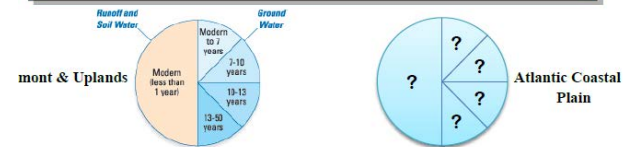
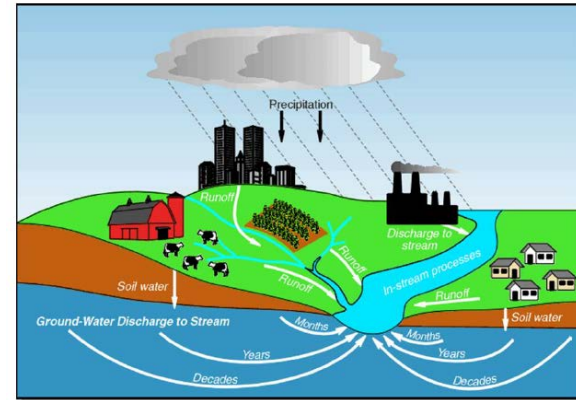
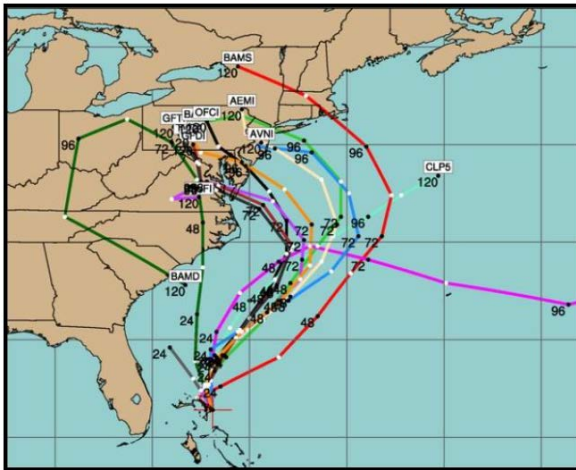
The Role of Natural Landscape Features in the Fate and Transport of Nutrients and Sediment



A Review of Agricultural P-dynamics in the Chesapeake Bay Watershed Model



Multiple Models for Management in the Chesapeake Bay



Incorporating Lag-Times Into The Chesapeake Bay Program

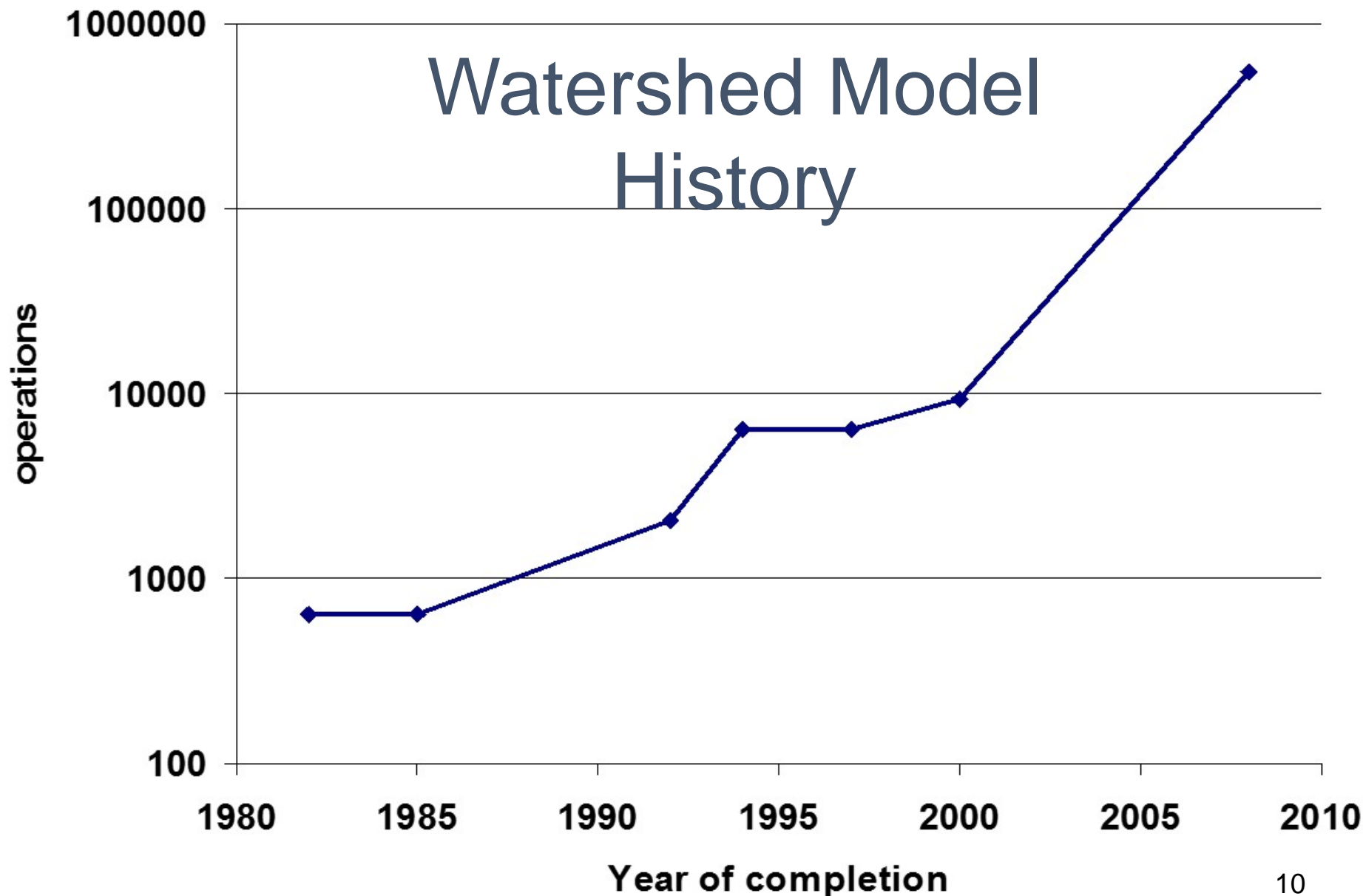
Partnership Feedback on Modeling

- **Scientific and Technical Advisory Committee**

- Multiple Models
- Phosphorus
- Complex Reservoir Dynamics
- Fine-scale processes

Include Everything!!!

Number of segment / land-use / years in watershed model



Partnership Feedback on Modeling

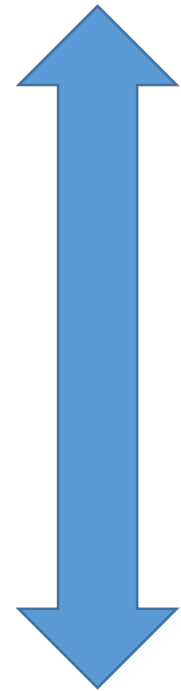
- **Scientific and Technical Advisory Committee**

- Multiple Models
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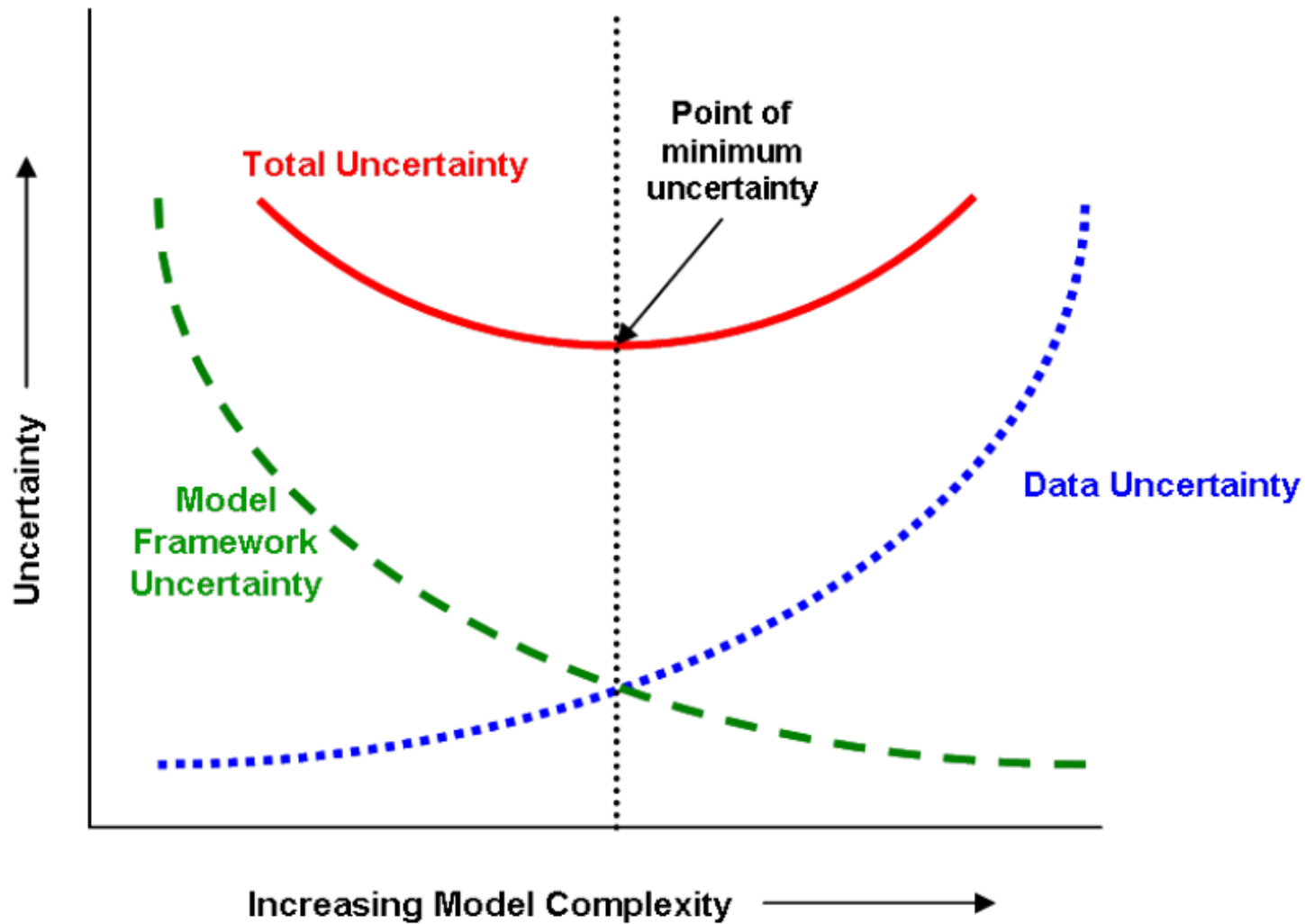
- **Water Quality Managers**

- Need more **transparent and easier** to understand decision-support tools to enable successful engagement of local partners

Include Everything!!!



Keep it Simple!!



Relationship between model framework uncertainty and data uncertainty, and their combined effect on total model uncertainty. Application niche uncertainty would scale the total uncertainty. Adapted from Hanna (1988) and EPA (2009a).

Main Prediction of the Watershed Model for decision support

- Change in Anthropogenic Load
 - BMPs
 - WWTP
 - Land use Change
 - Response to Change in inputs
- How to keep it simple and include everything?

Phase 6 Model Structure

Average Load + Δ Inputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

Stream Delivery

*

River Delivery

Direct Loads

Phase 6

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Keep It Simple

Include Everything

Average Load + Δ Inputs * Sensitivity

*
Land Use Acres

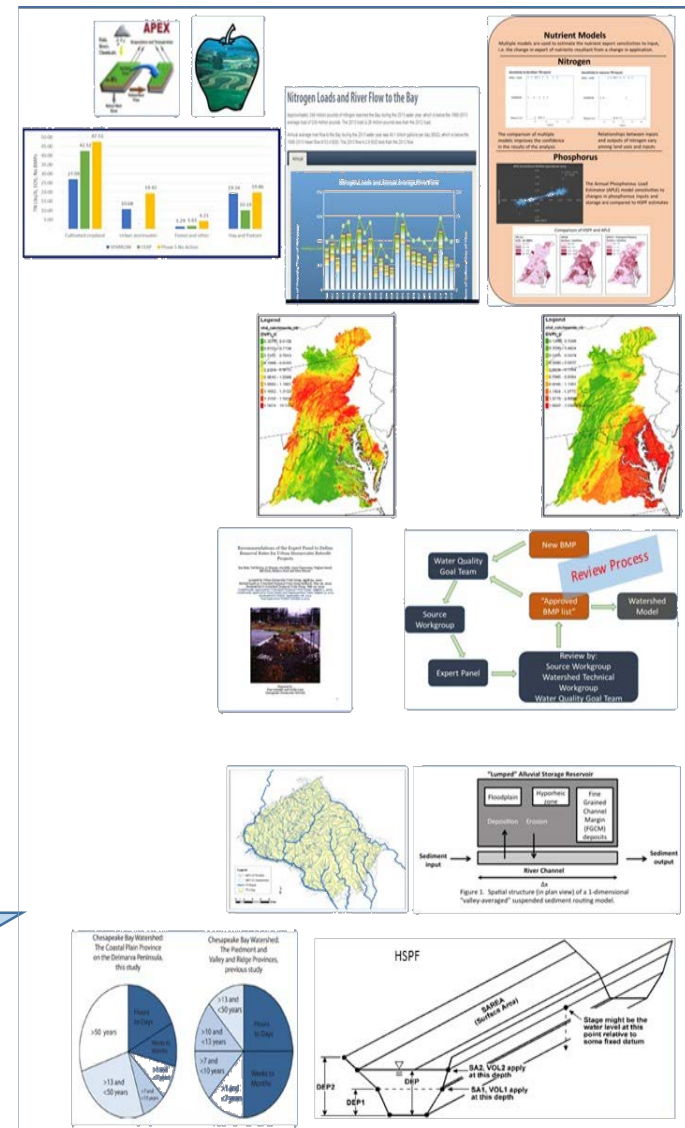
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BMPs

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Land to Water

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Stream Delivery

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River Delivery

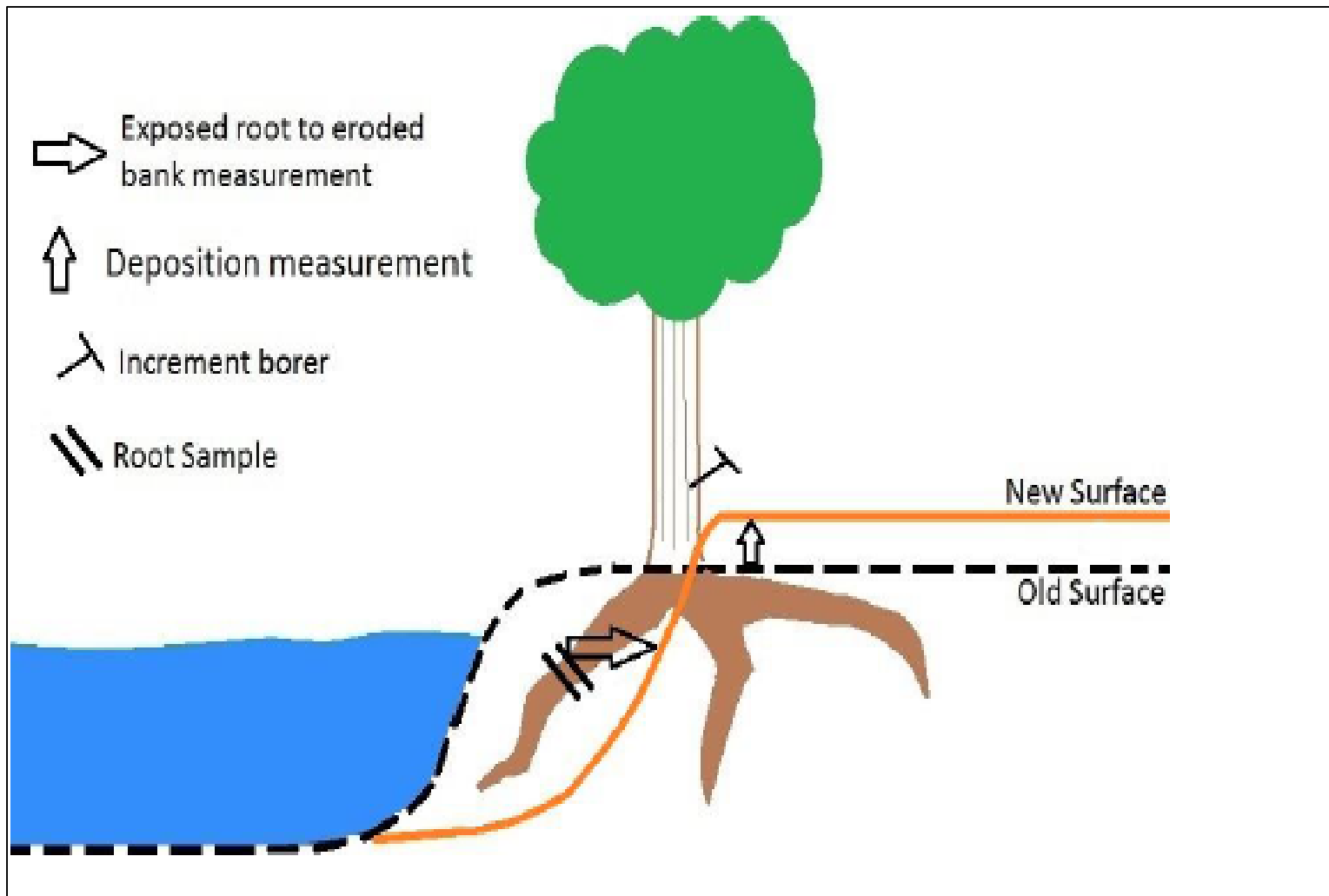
Direct Loads



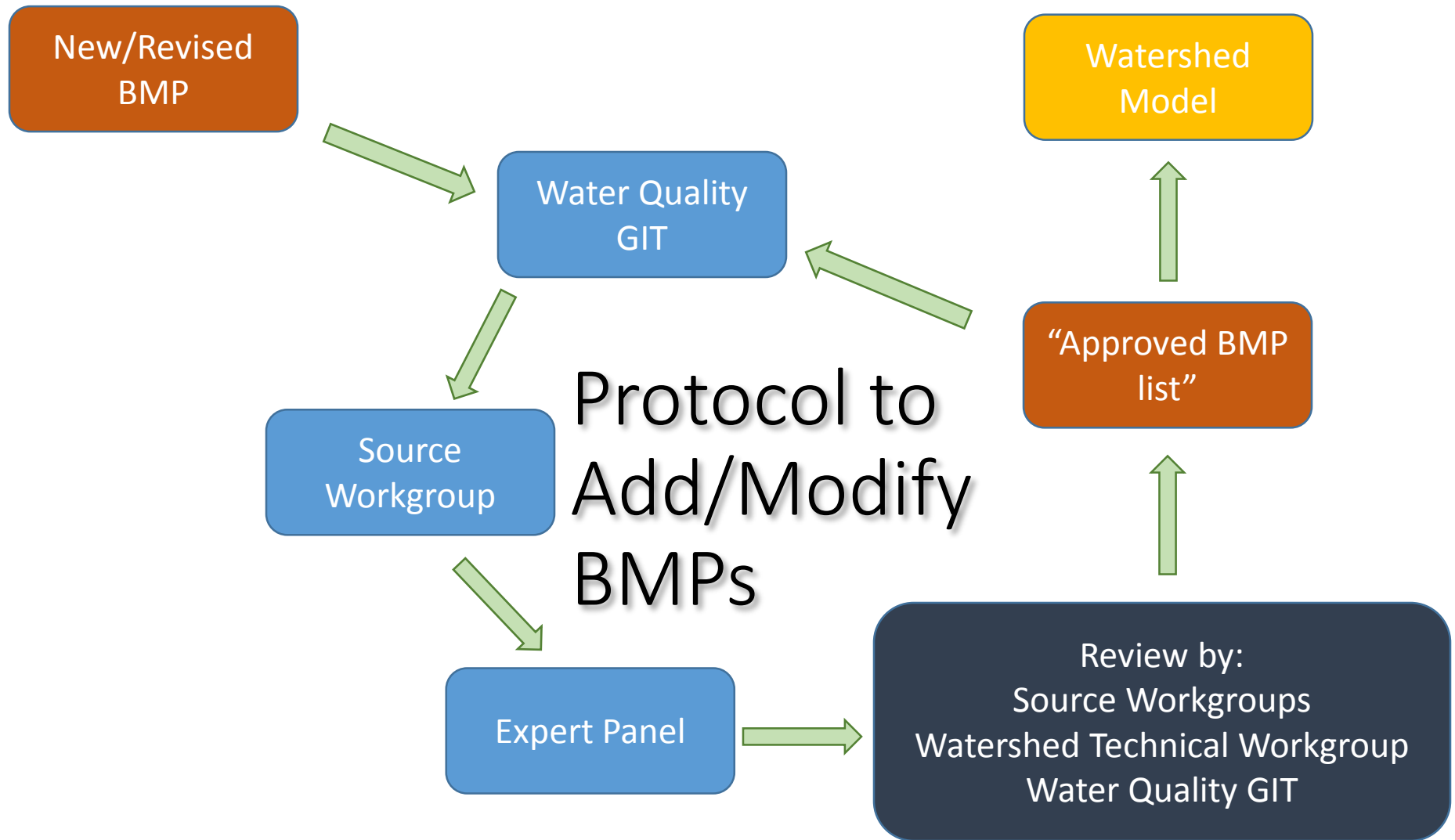
Use of Multiple Models for Nitrogen Export Rate

Sector	Crop	Pasture/ Hay	Developed	Natural
CBP Phase 5 model	47.5	19.9	19.4	4.2
USDA-CEAP Model	42.5	10.2	Not used	1.6
USGS- SPARROW Model	22.9	10.2	8.9	0.4
Average Ratio to Crop Rate	1.00	0.37	0.40	0.05

New Scientific Input Floodplain Regression – Greg Noe



Collaborative Stakeholder Processes



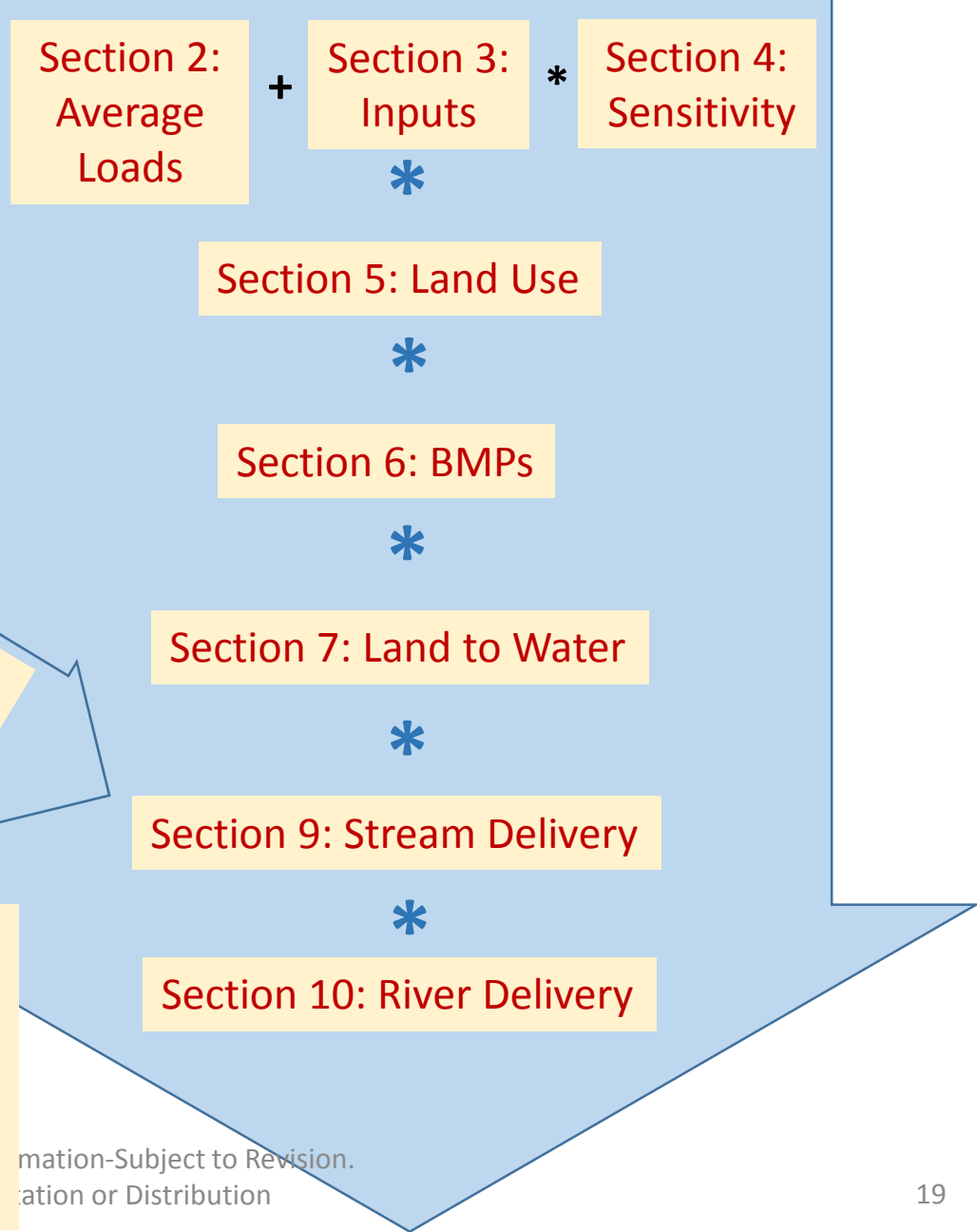
Phase 6 Model Documentation



Section 1:
Overview

Section 8:
Direct Loads

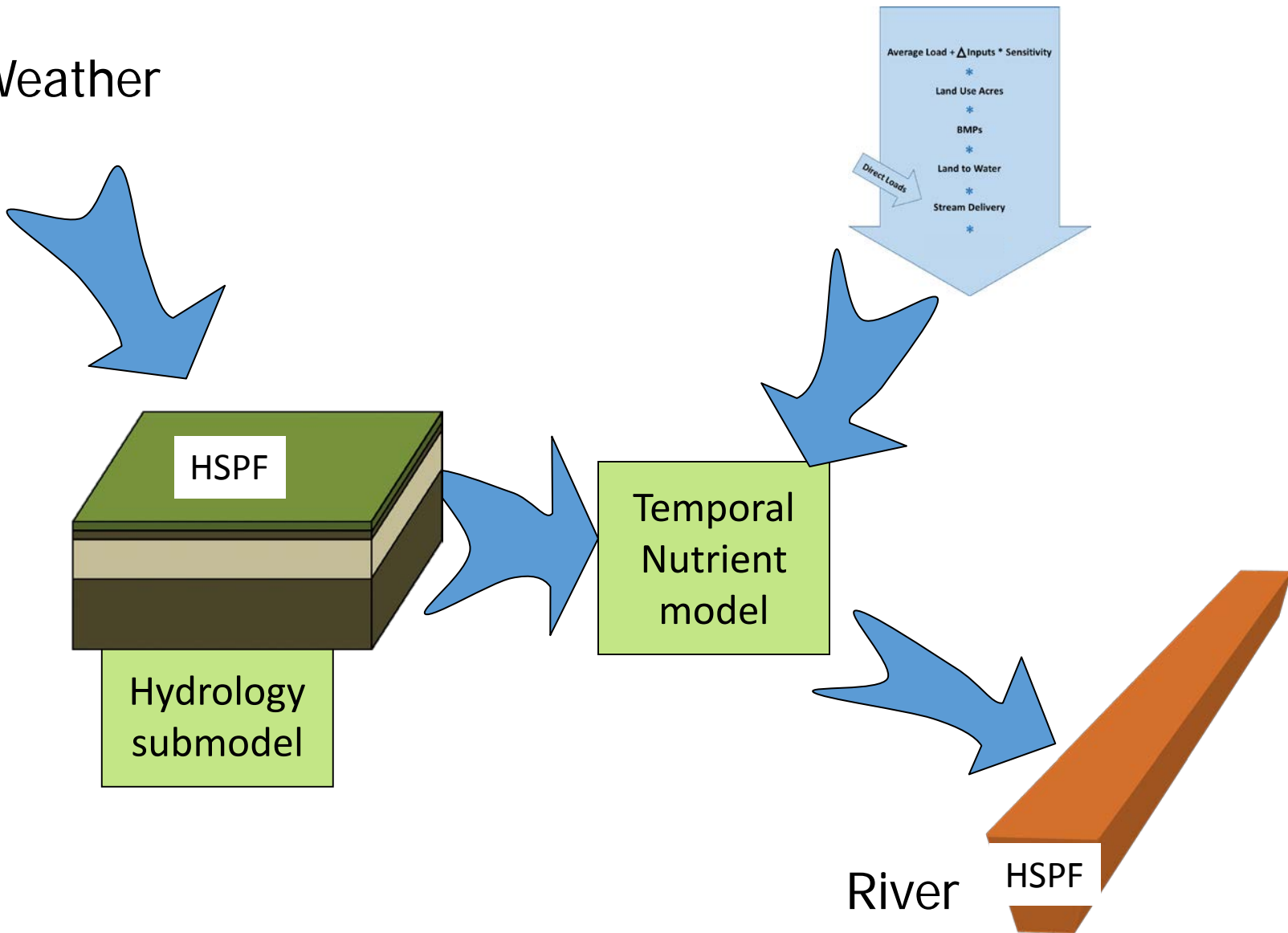
Other Sections
11 Setting
12 Applications
13 Reviews
14 References

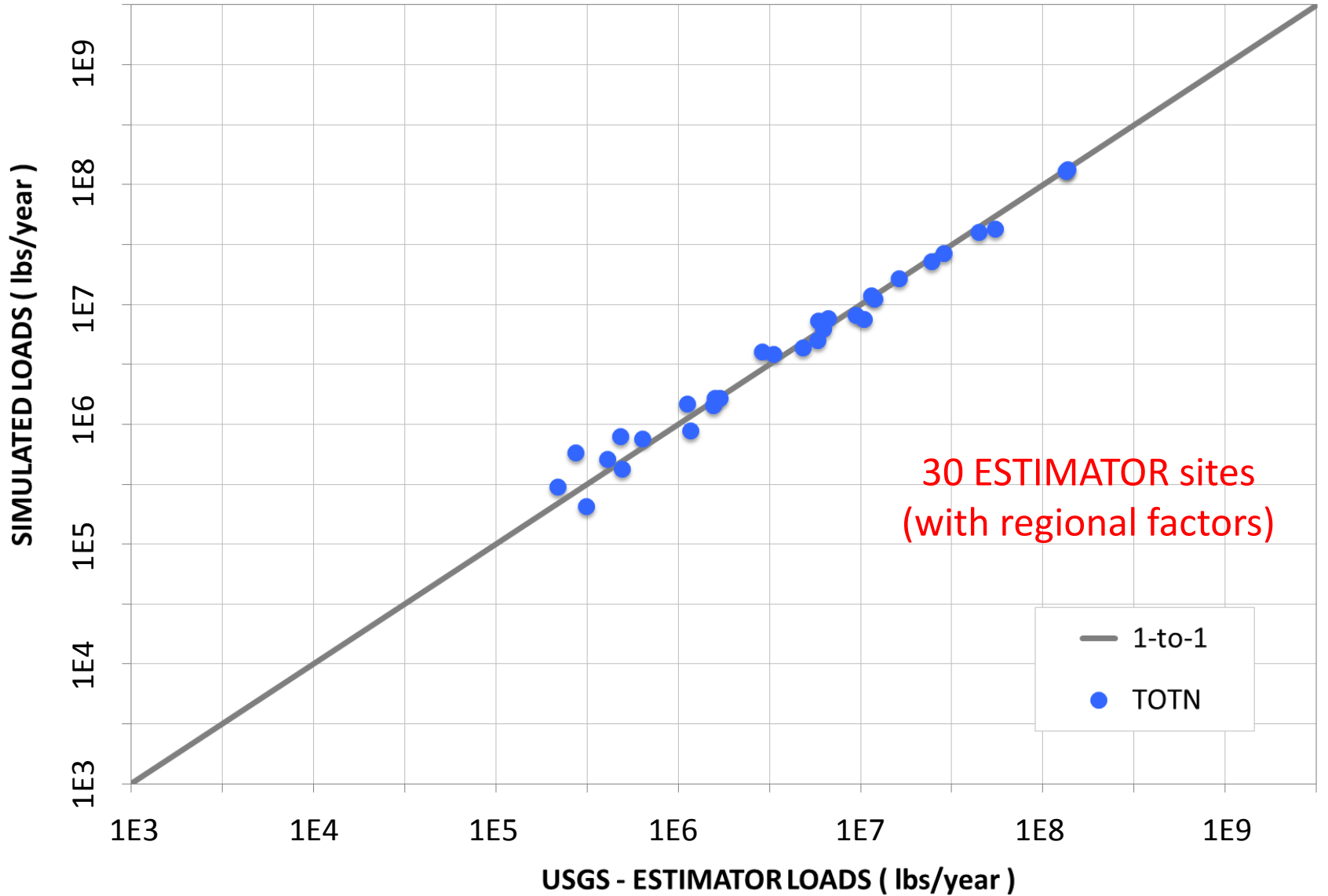


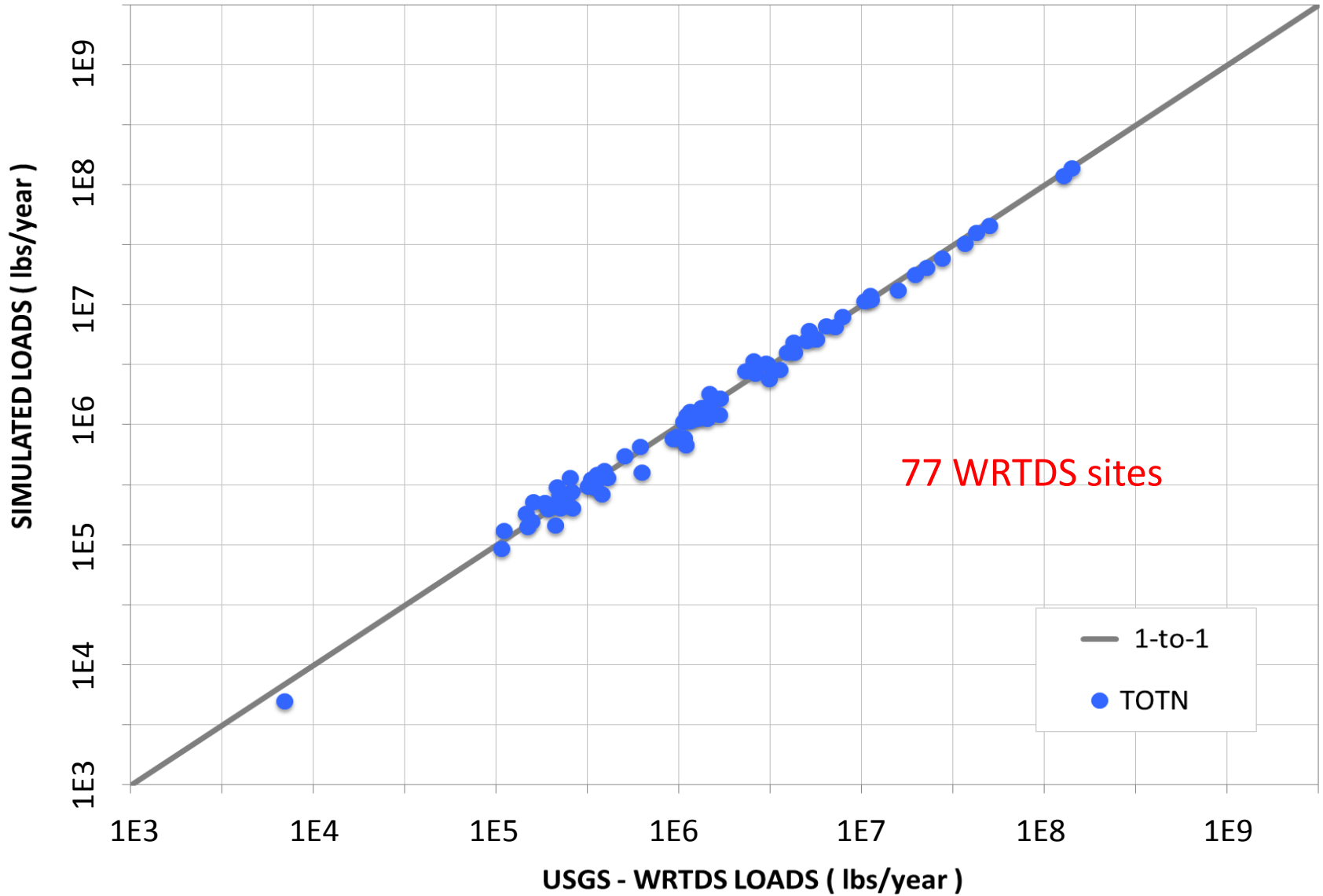
Information-Subject to Revision.
Information or Distribution

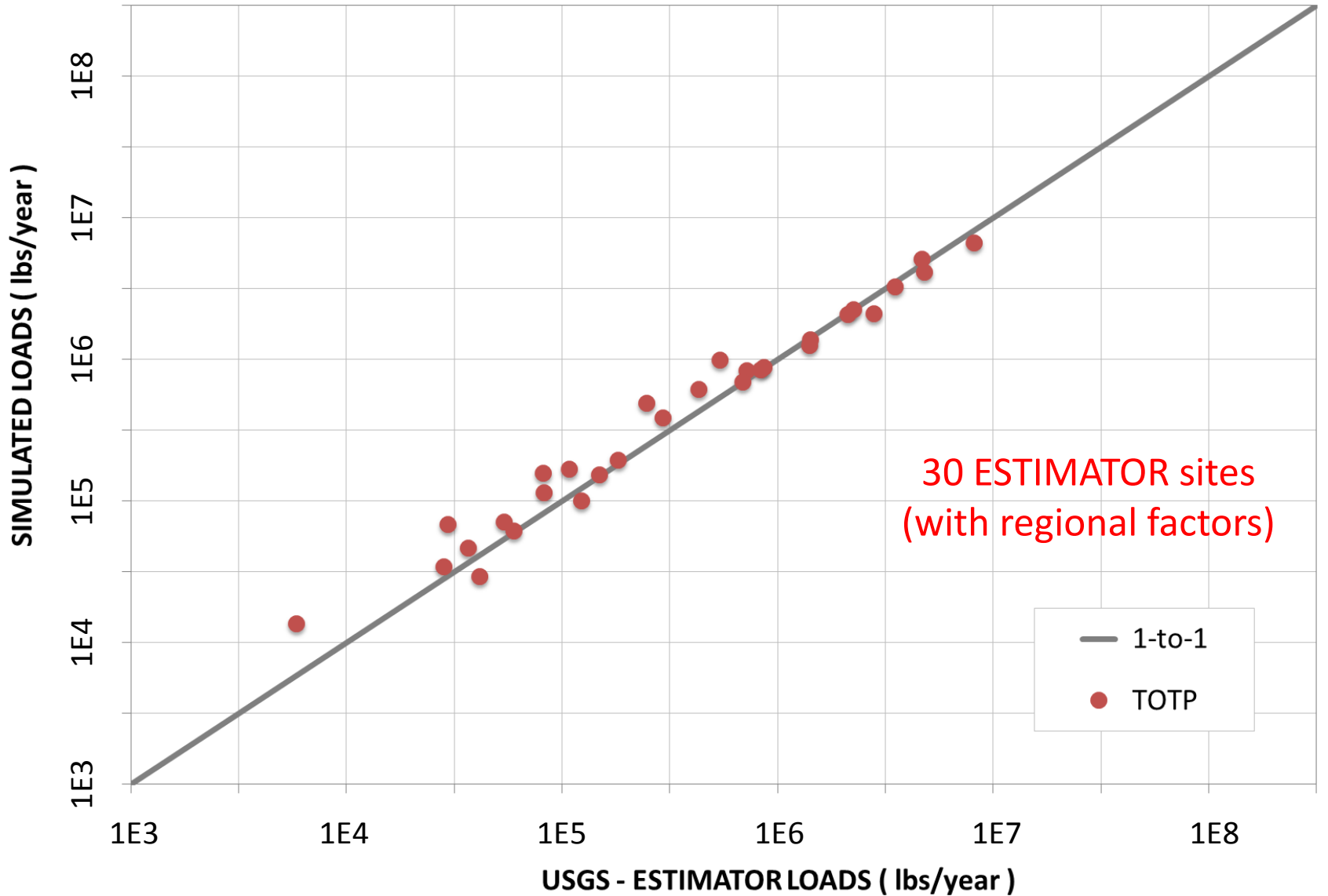
Model to compare against Observations

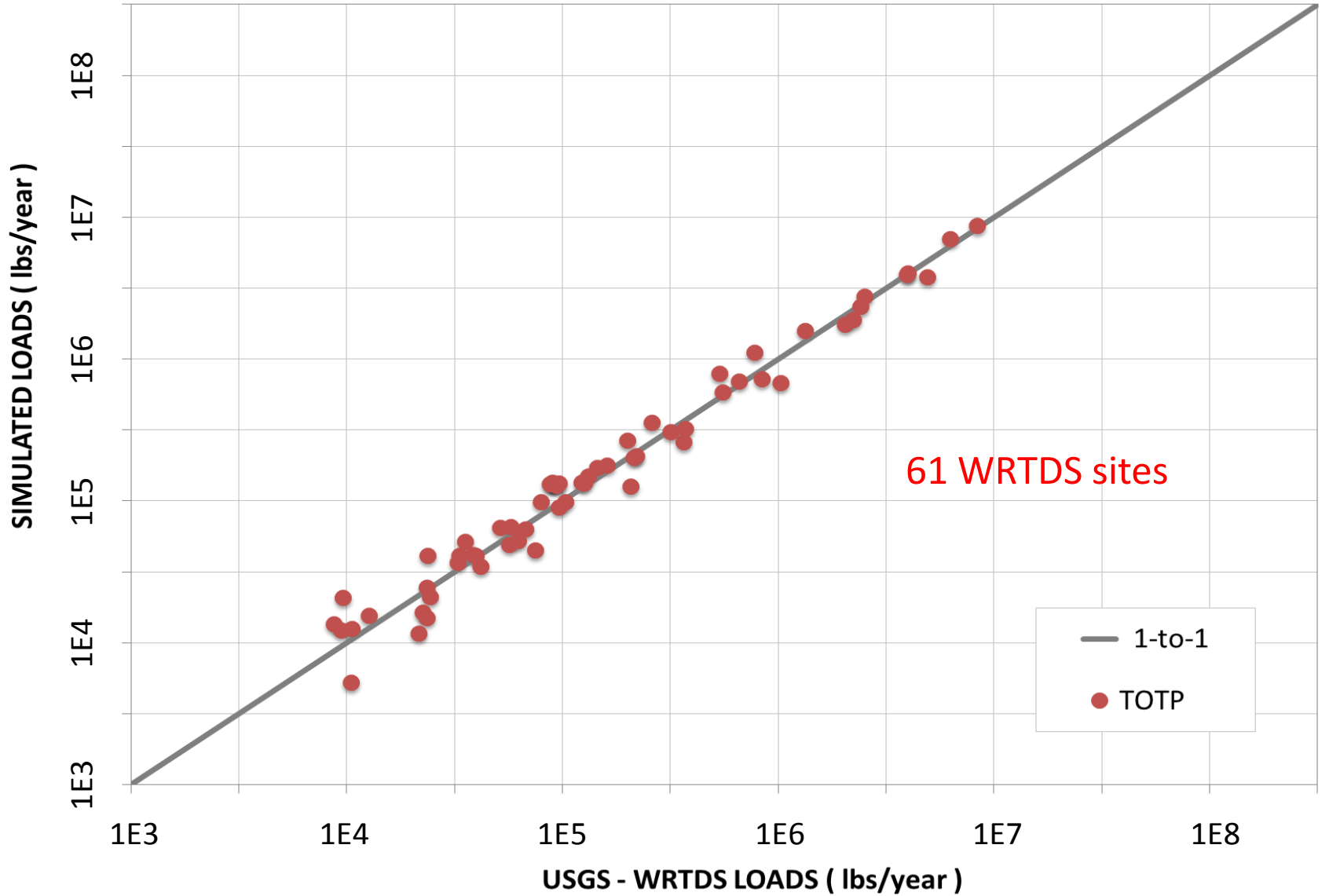
Weather

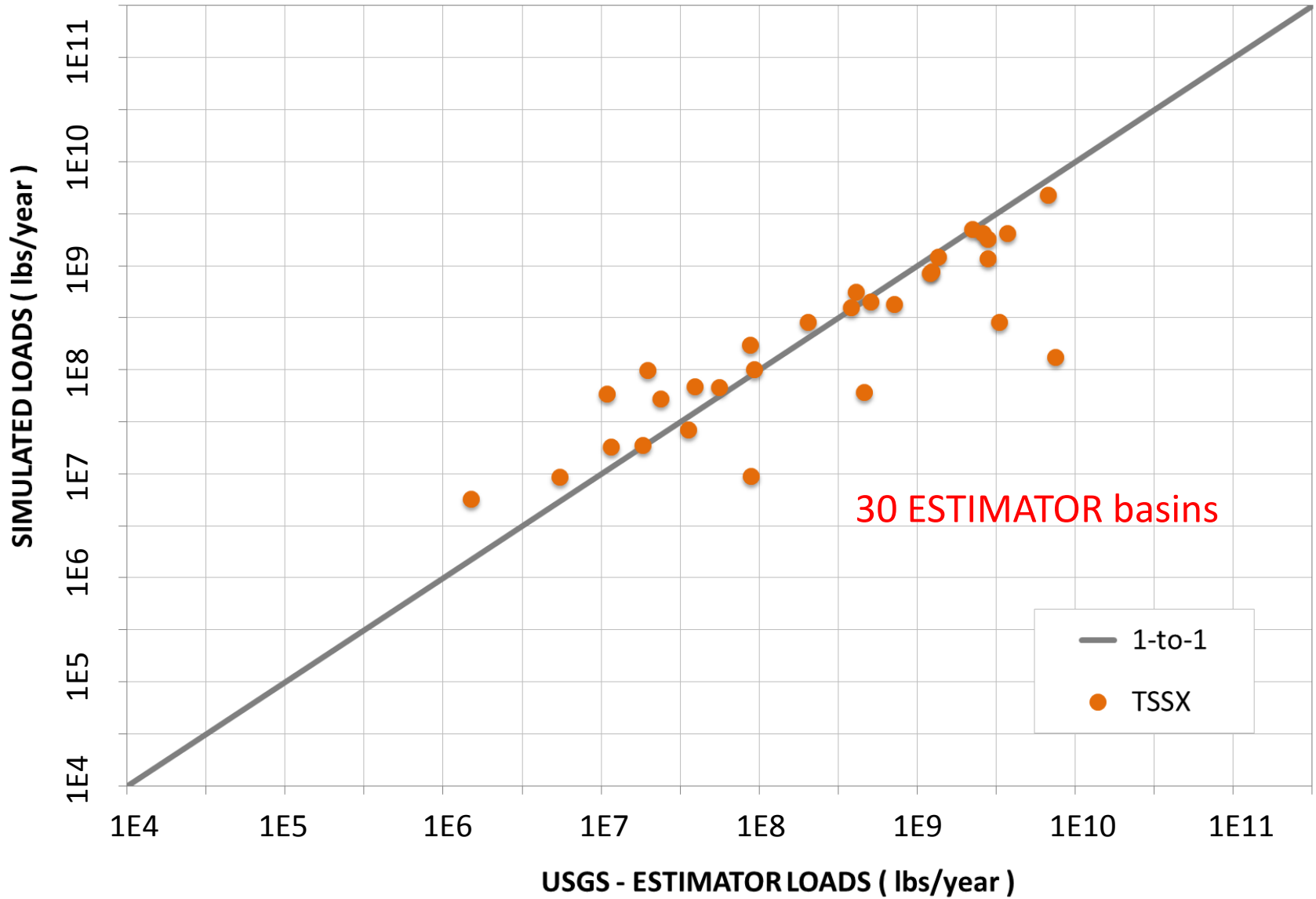


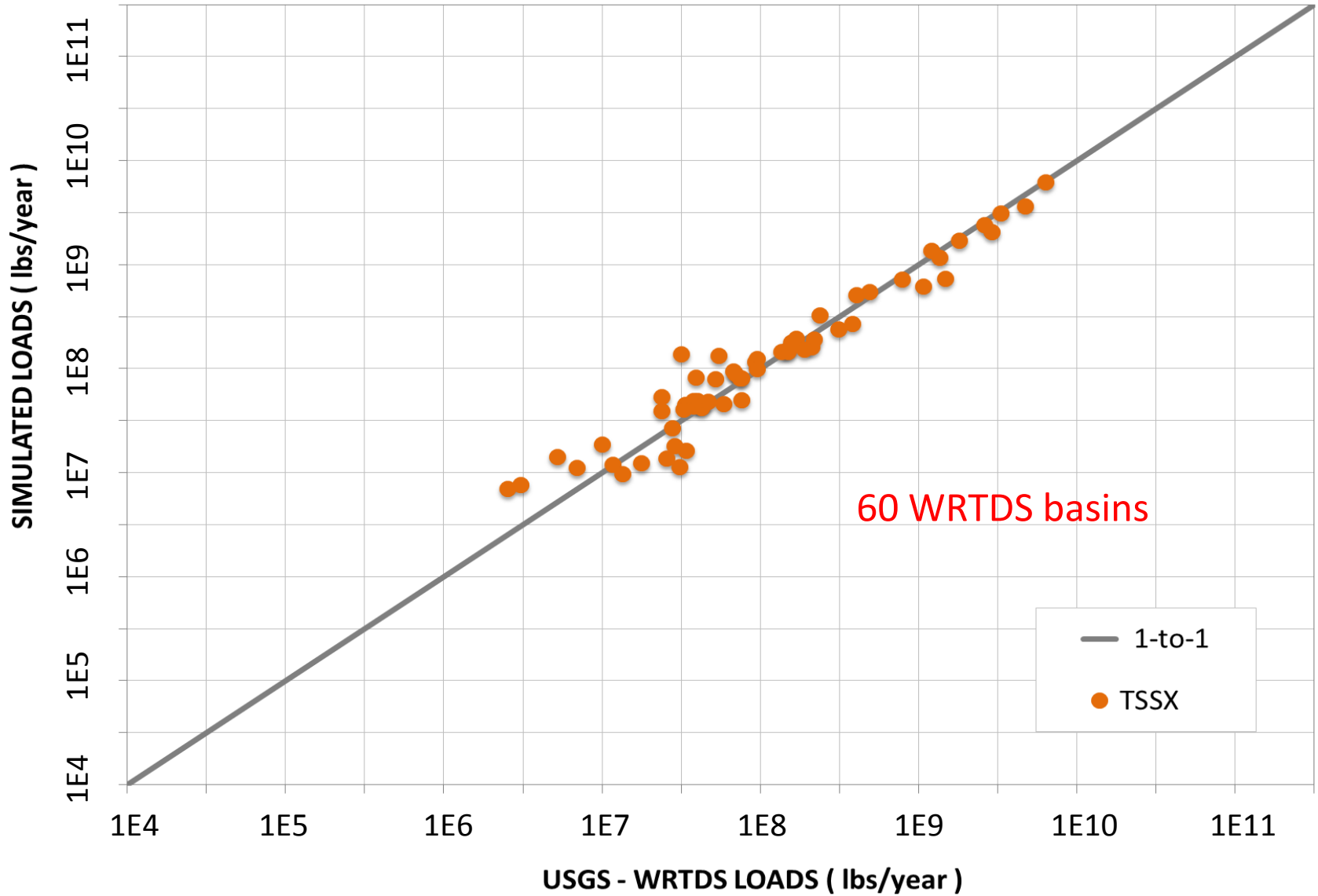




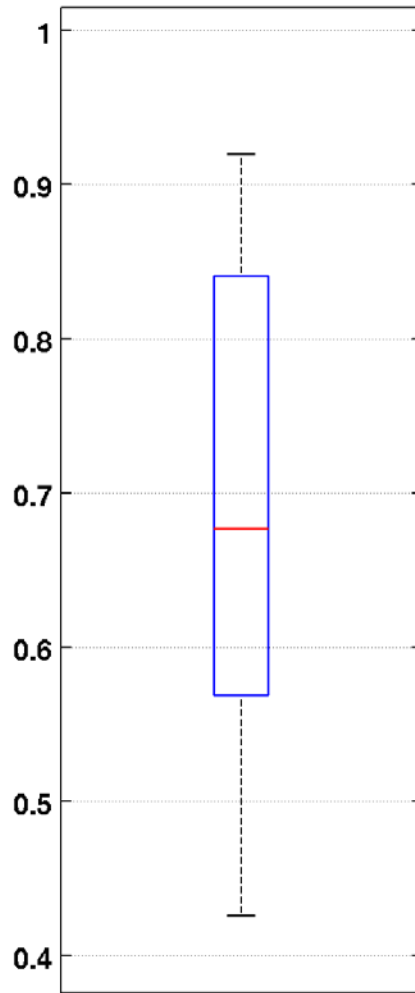




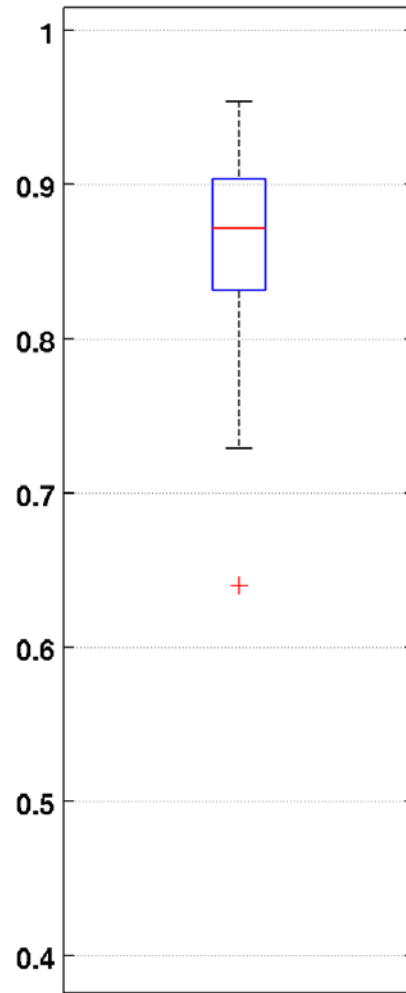




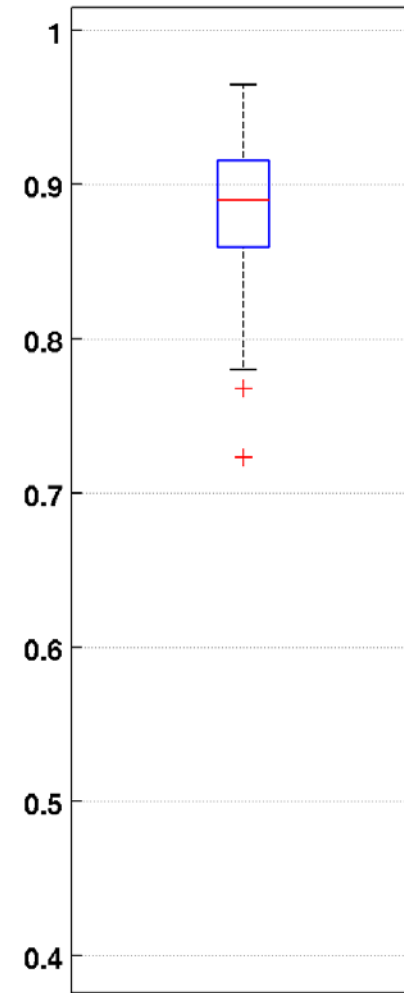
Monthly loads correlation: total nitrogen



Phase 5

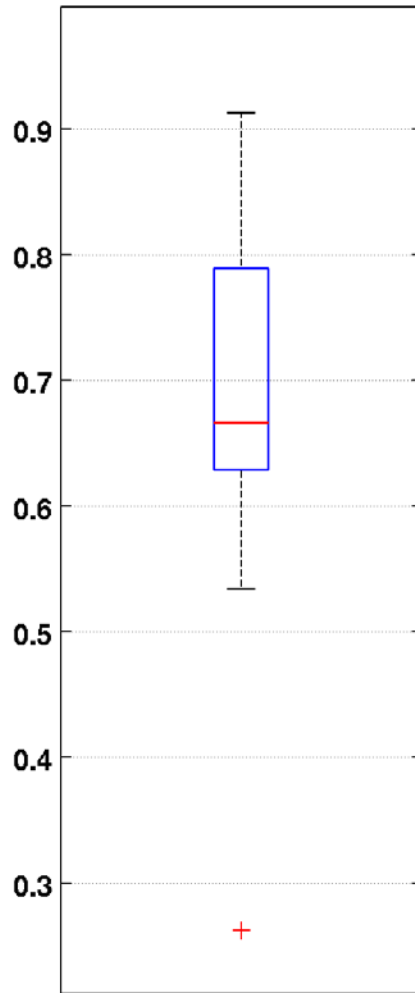


Phase 6 Beta 4

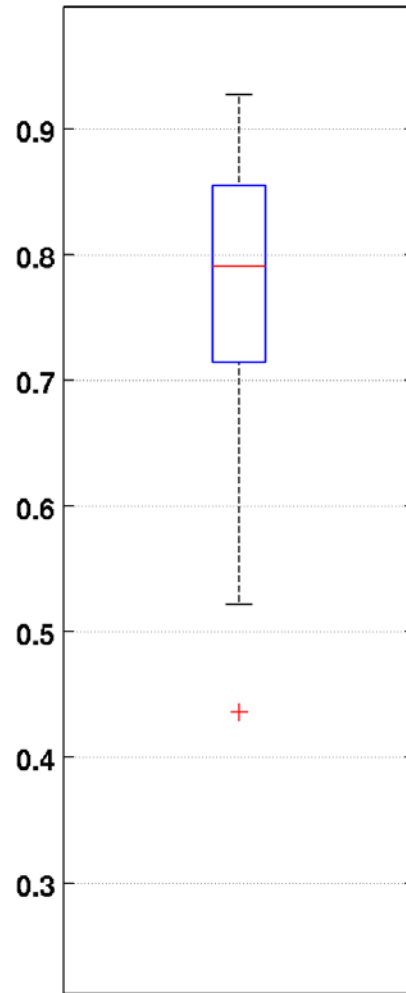


Phase 6 Draft

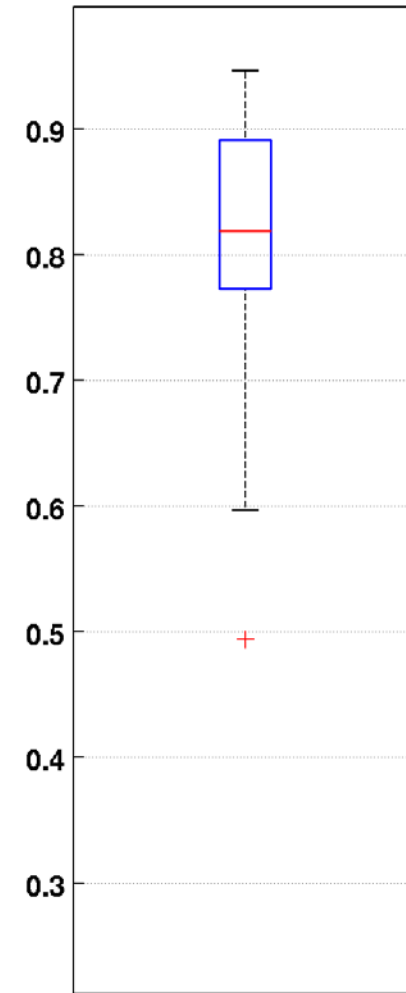
Monthly loads correlation: total phosphorus



Phase 5

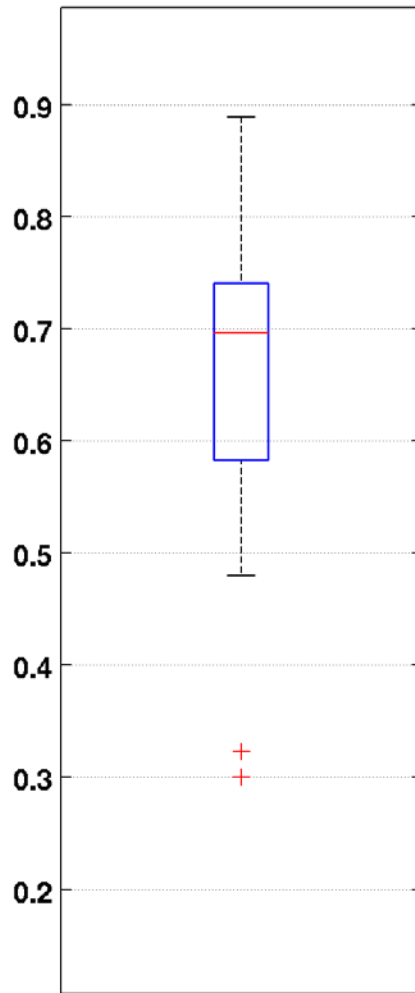


Phase 6 Beta 4

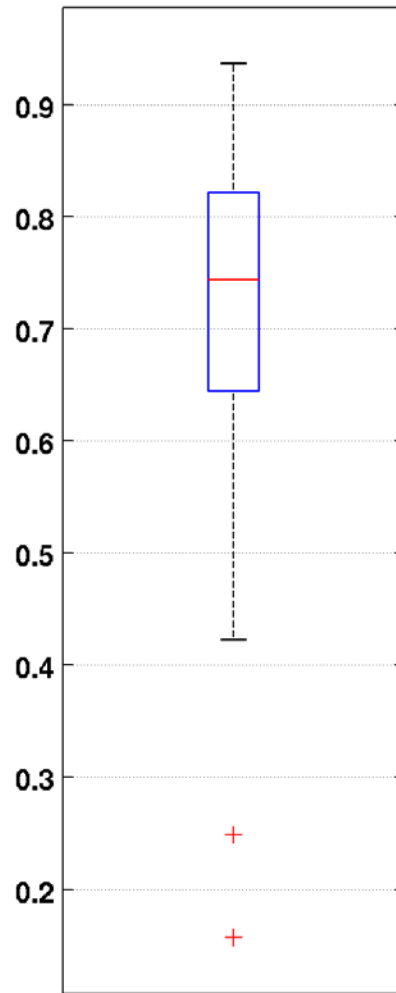


Phase 6 Draft

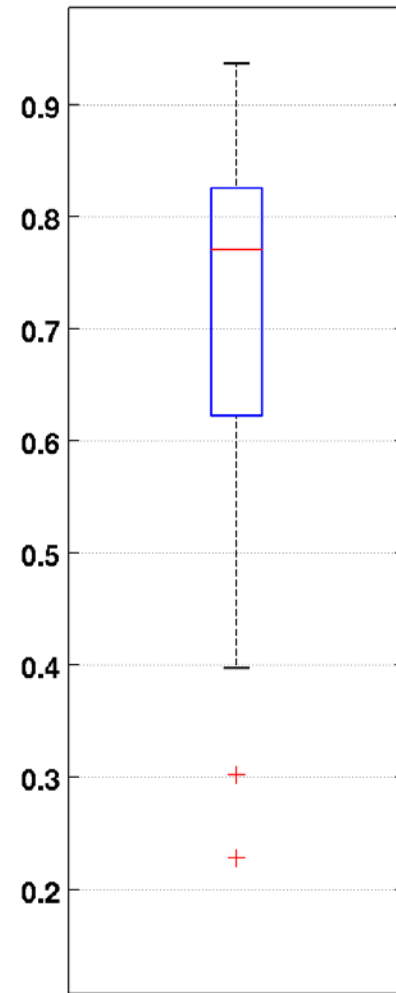
Monthly loads correlation: sediment



Phase 5

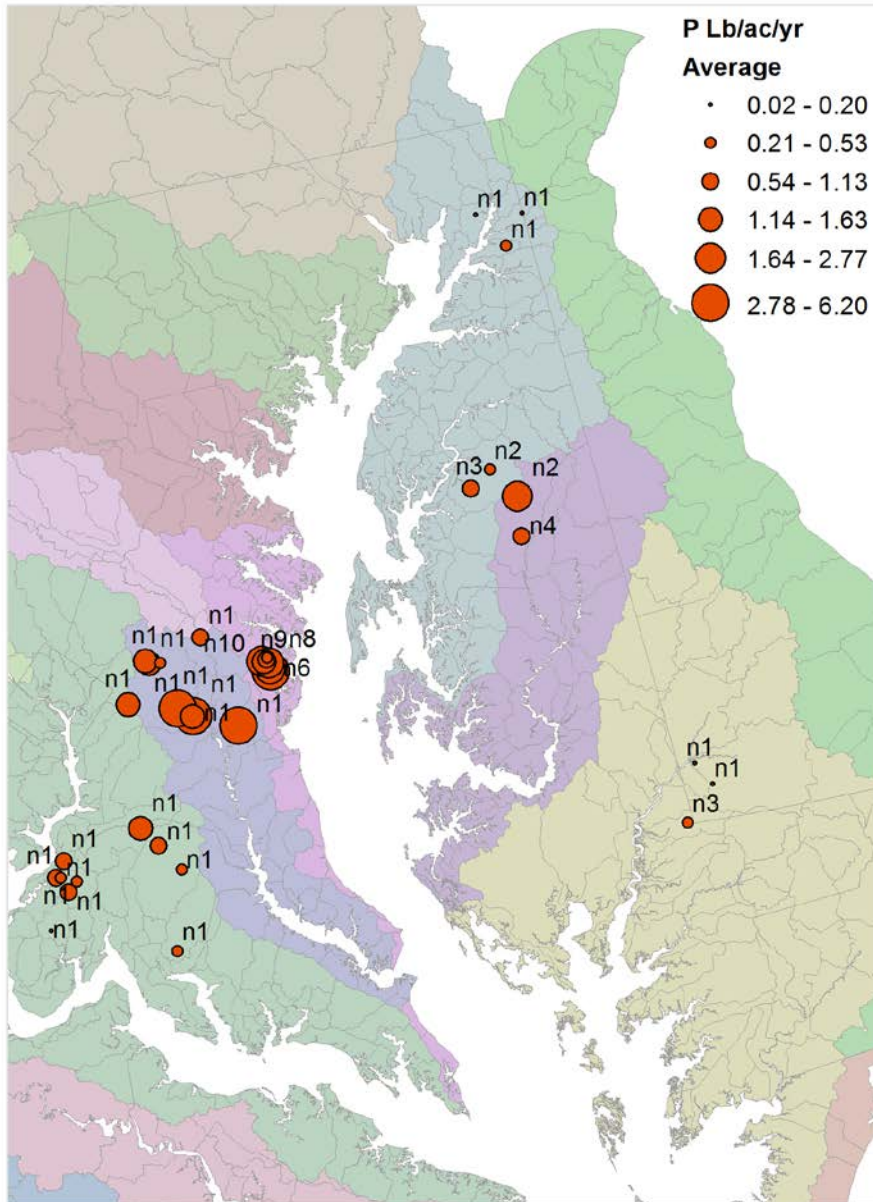


Phase 6 Beta 4

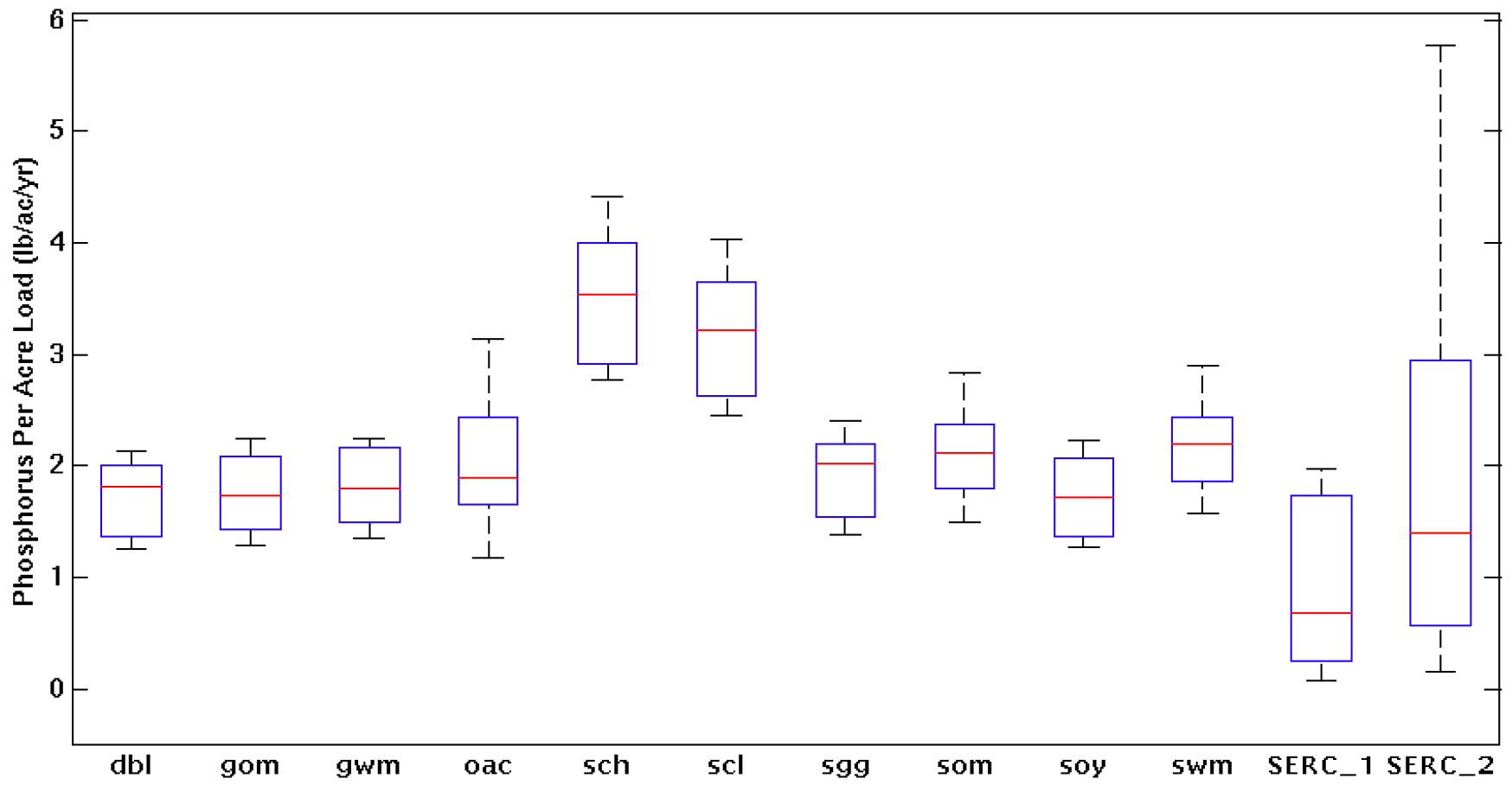


Phase 6 Draft

Annual Phosphorus Runoff



Major/Minor Basin	Nobs
Eastern Shore of Chesapeake Bay	19
Upper Eastern Shore	8
Middle Eastern Shore, including Choptank River	6
Lower Eastern Shore	5
Western Shore of Chesapeake Bay	71
Lower Western shore	71
Patuxent River Basin	9
Patuxent River below Bowie, Maryland	9
Potomac River Basin	10
Lower Potomac River, below Chain Bridge	10

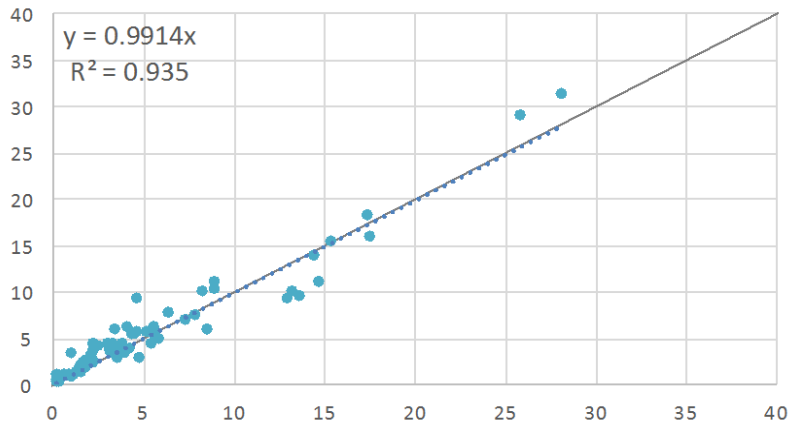


SERC_1 – phosphorus per watershed acres

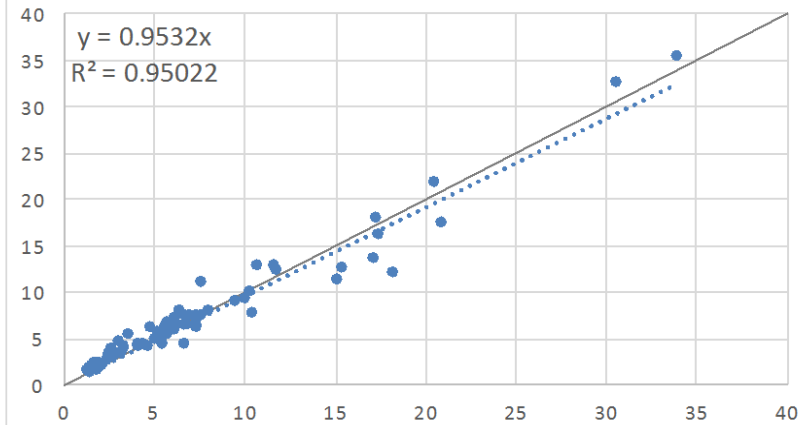
SERC_2 – phosphorus per non-natural acres

Draft Phase 6 – geographic efficiencies

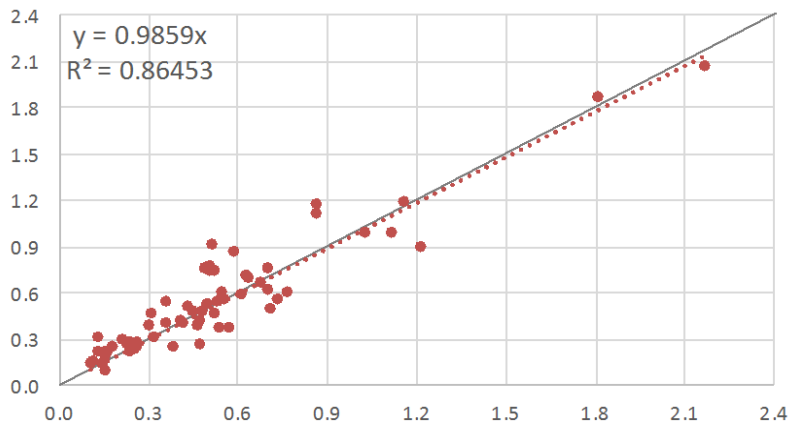
Nitrate Per Acre Load, NSE = 0.9336



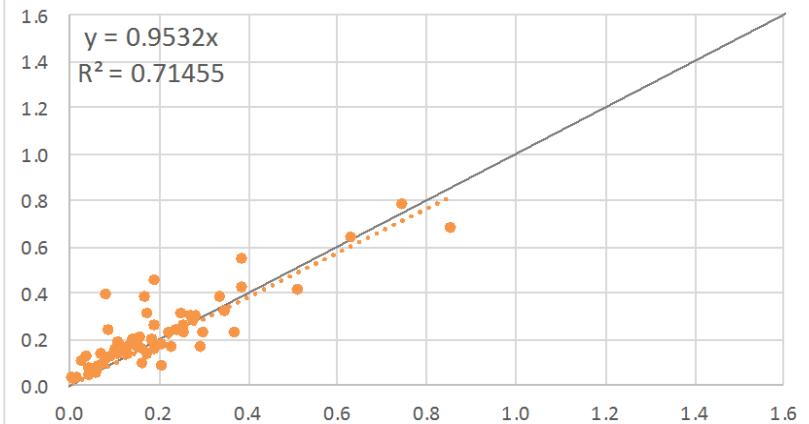
Nitrogen Per Acre Load, NSE = 0.9483



Phosphorus Per Acre Load, NSE = 0.8657



Sediment Per Acre Load, NSE = 0.7428



Simulated Per Acre Load

WRTDS Per Acre Load

Summary of geographic efficiencies

Constituents	Phase 5	Draft Phase 6
Nitrate	0.8284	0.9336
Nitrogen	0.8704	0.9483
Phosphorus	0.6321	0.8657
Sediment	-0.0770	0.7428

Schedule

- June and July – Partnership ‘Fatal Flaw’ Review
 - Criterion #1 – problem with the model
 - Failure to follow partnership instructions
 - Omission of data received by 12/31/2016
 - Overall failure of calibration
 - Illogical results
 - Criterion #2 – Significant impairment in the ability to
 - Set planning targets
 - Assess progress
- September – Final Phase 6
- December – Final Planning Targets