Overview of the Key Scenarios of 1985 Progress, 2009 Progress, WIP2 Level of Effort, E3, and No Action, and Others

STAC WQSTM Peer Review
July 7, 2017

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Modeling Team

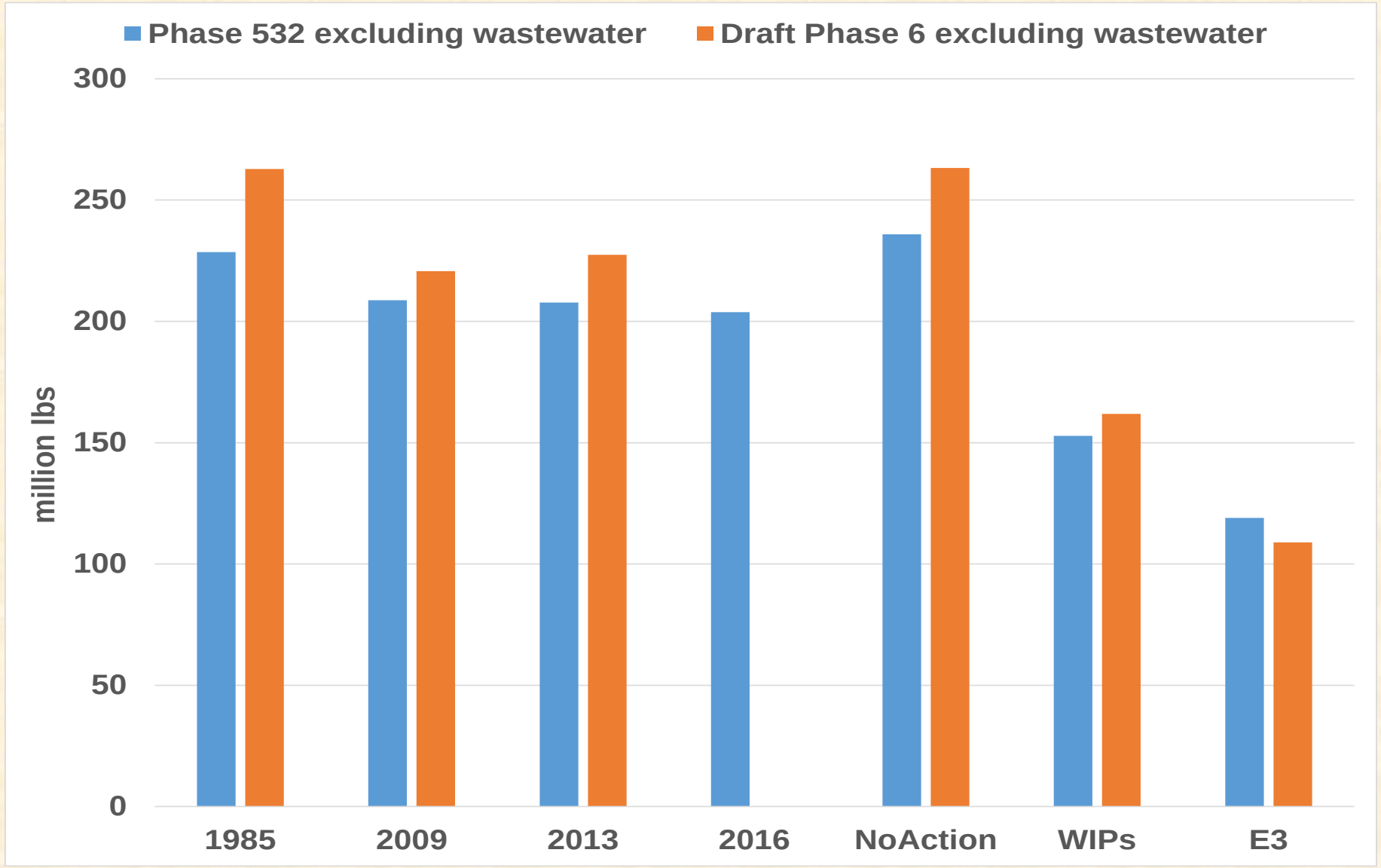
Chesapeake Bay Program
Science, Restoration, Partnership

Overview:

An overall review of the Phase 6 Watershed Model (WSM) scenarios will be presented with an overall objective of understanding what is changing between the 2010 and 2017 WQSTM inputs and response. (The task covers Phase 6 WSM scenarios only, not the WQSTM, because the WQSTM interim calibration to the June 1 WSM loads will not be completed until early July and the final WQSTM calibration will be completed until the close of July.)

Phase 5 and Phase 6

Nitrogen Loads, CB Watershed-wide (excludes wastewater)



Initial Set of Phase 6 Model Scenarios

Big Changes from Phase 5 to Phase 6

- Inputs, inputs, inputs matter
- High resolution land use
- Nitrogen simulation improved using multiple model approach
- Phosphorus simulation tied to soil P
- Sediment simulation enhanced using NRCS RUSLE2 model at high resolution land use
- Regional factors removed
- Calibration quantifiably improved

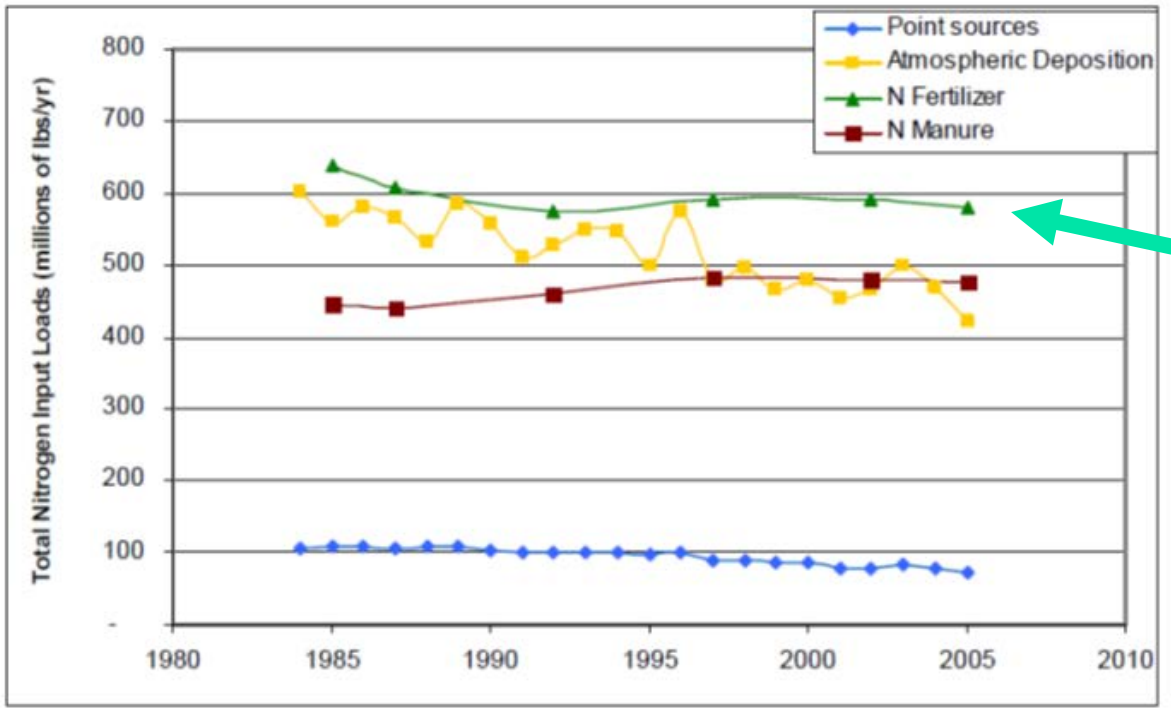
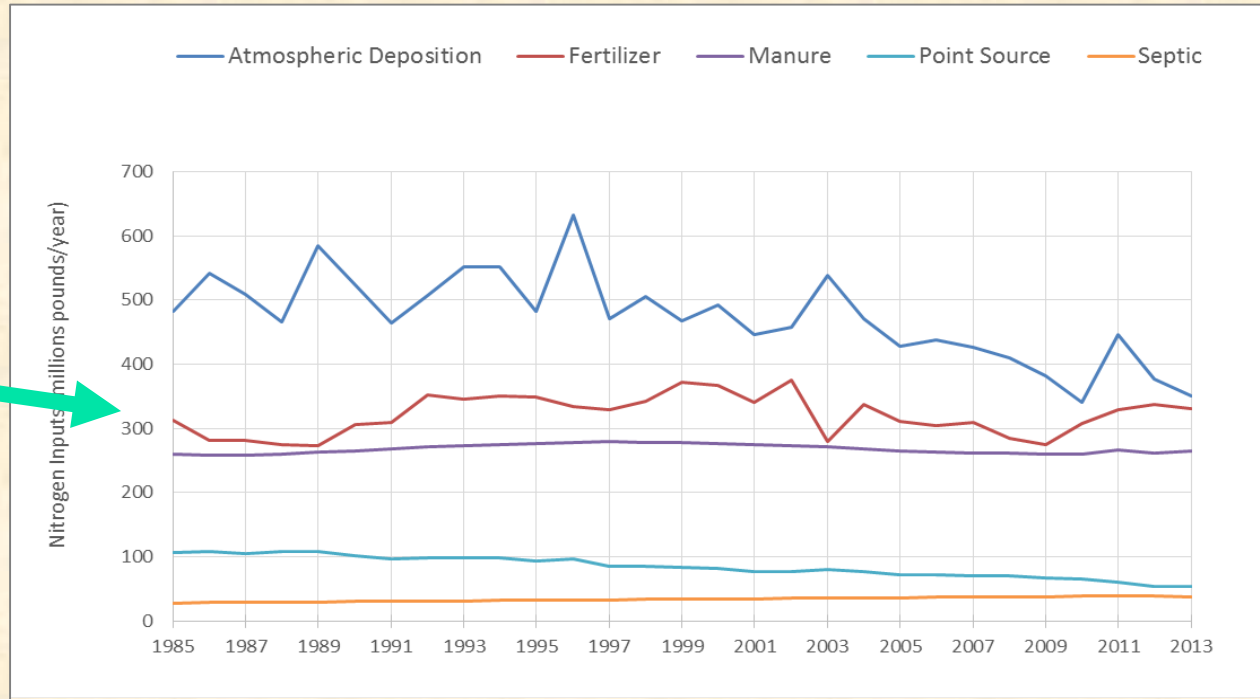
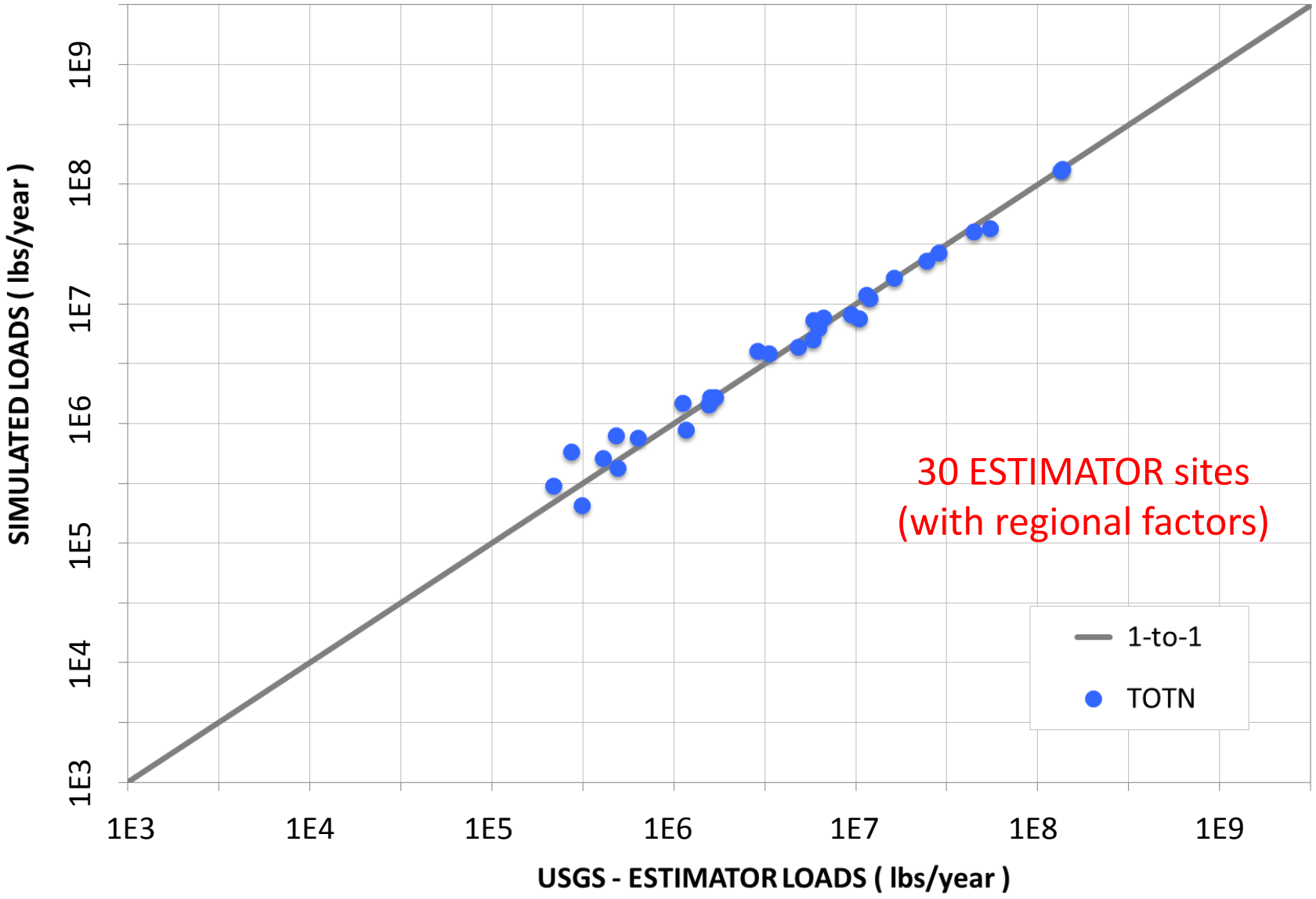


Figure 5-1. Time series of atmospheric, fertilizer, manure, and point source total nitrogen input loads to the Chesapeake Bay Watershed Model (Phase 5.3 calibration).

Phase 5

Phase 6

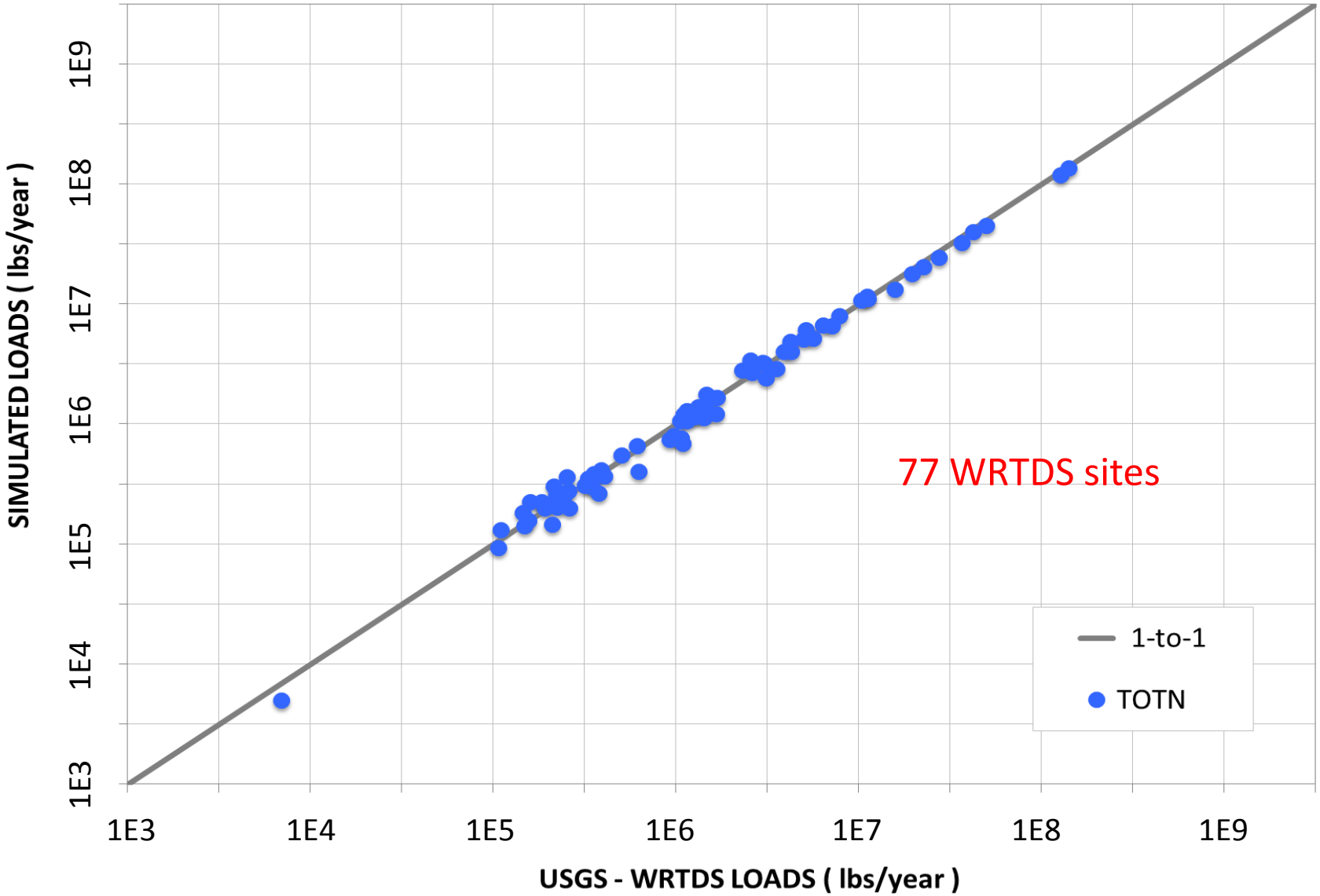


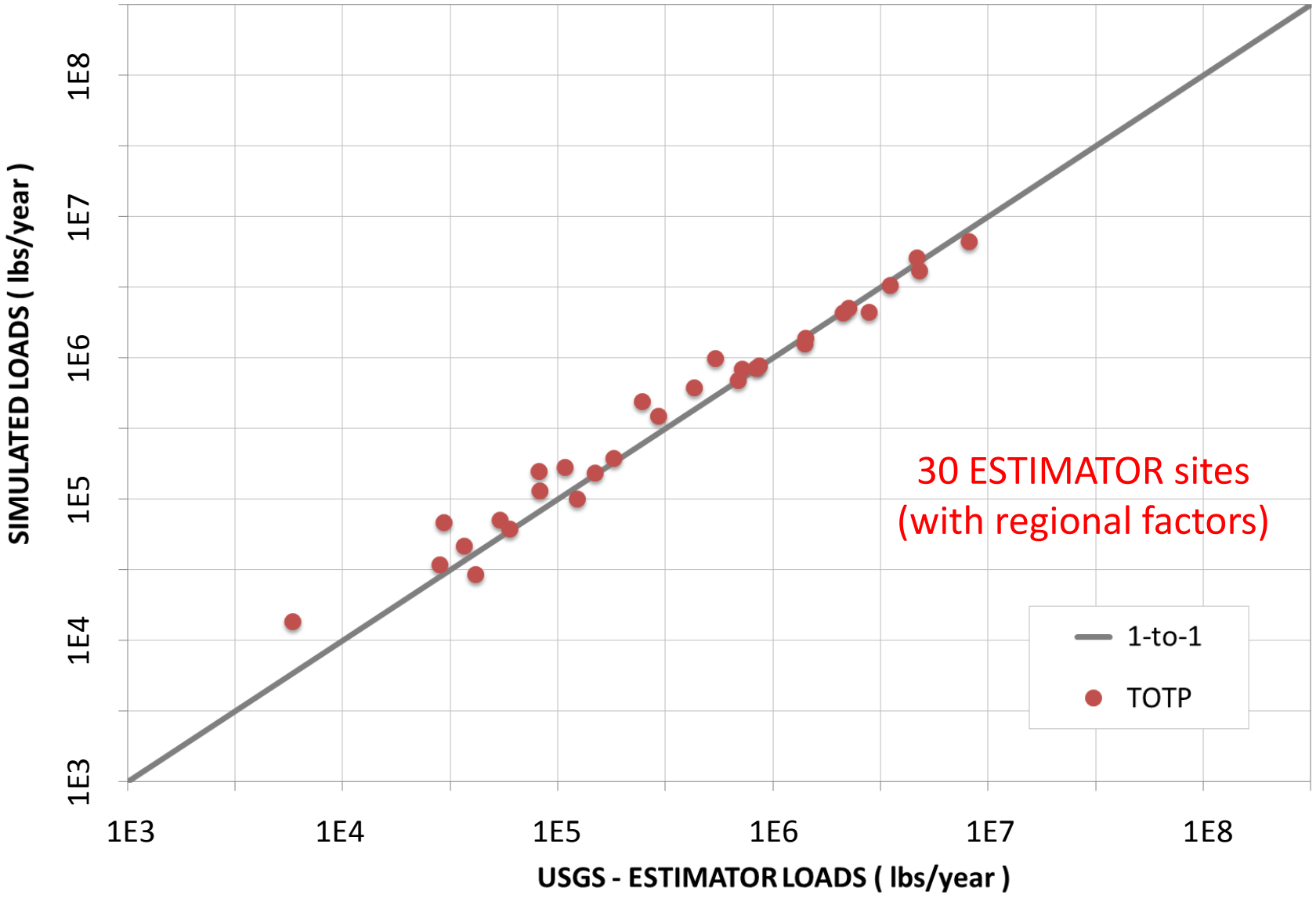

SIMULATED LOADS (lbs/year)
1E3
1E4
1E5
1E6
1E7
1E8
1E9
USGS - ESTIMATOR LOADS (lbs/year)
1E3
1E4
1E5
1E6
1E7
1E8
1E9
30 ESTIMATOR sites
(with regional factors)
1-to-1
TOTN

DRAFT P6

Lower Susquehanna Reservoirs, Conowingo Infill, and point-sources

NITROGEN

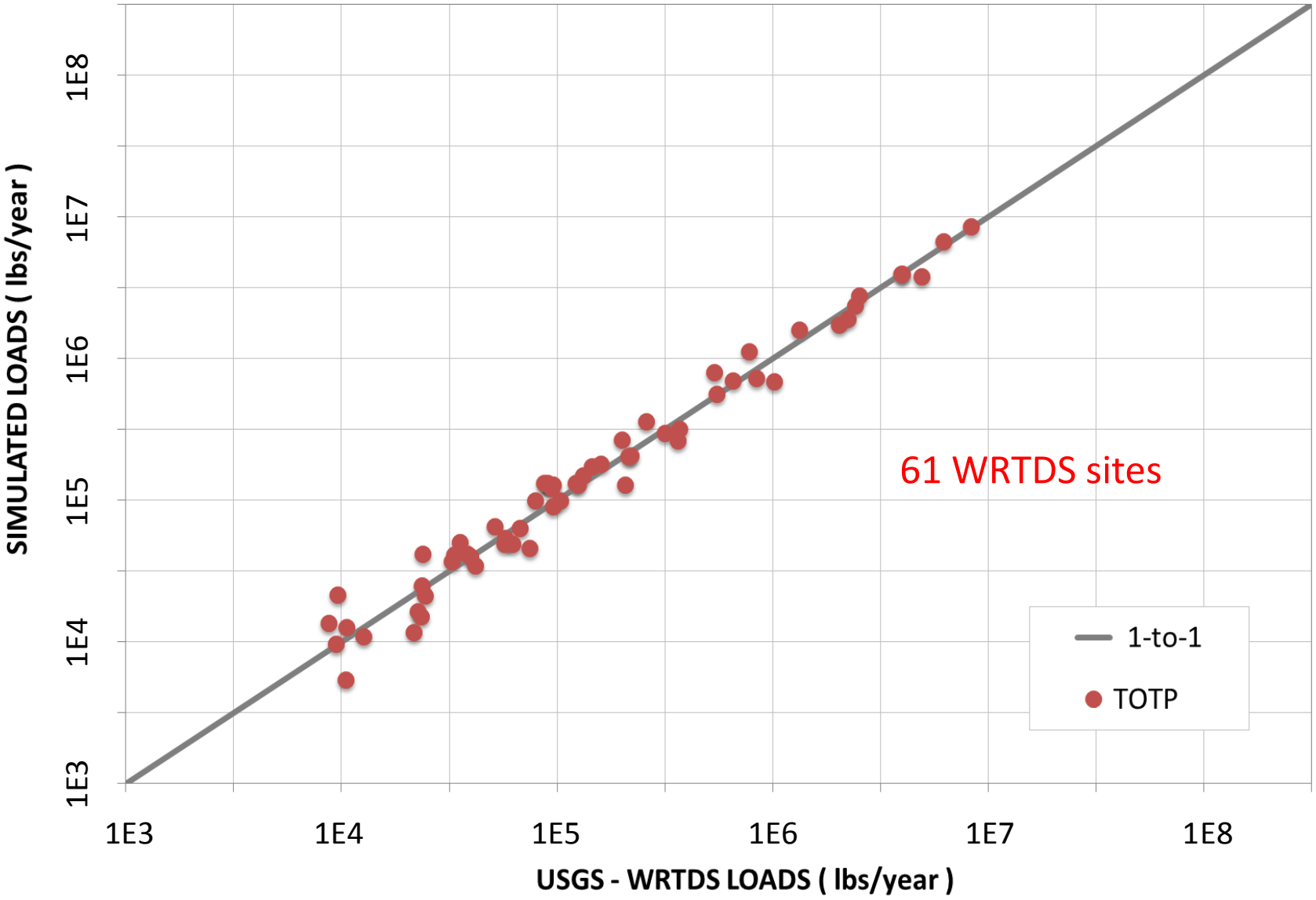


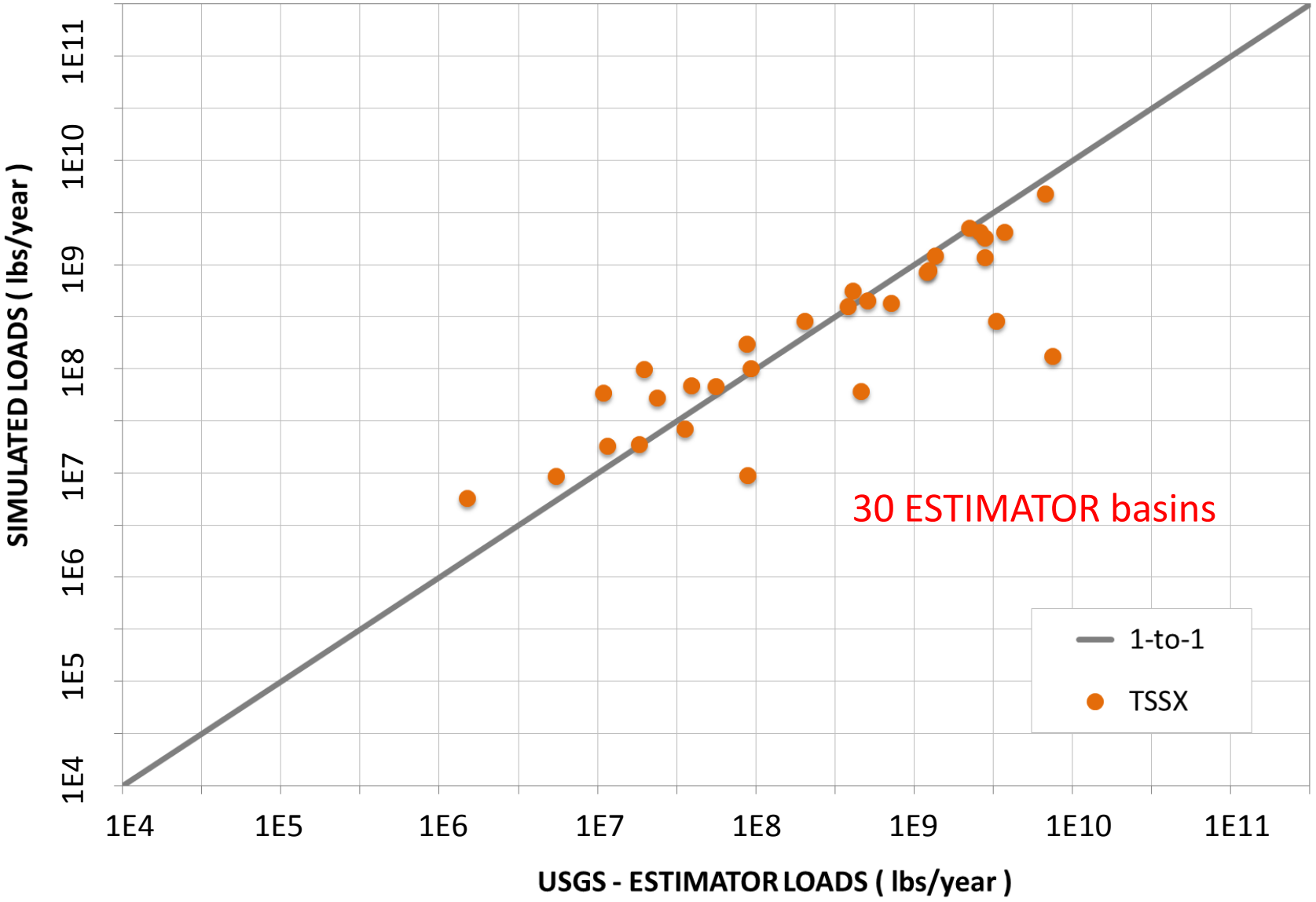

SIMULATED LOADS (lbs/year)
1E8
1E7
1E6
1E5
1E4
1E3
1E3
1E4
1E5
1E6
1E7
1E8
USGS - ESTIMATOR LOADS (lbs/year)
30 ESTIMATOR sites
(with regional factors)
1-to-1
TOTP

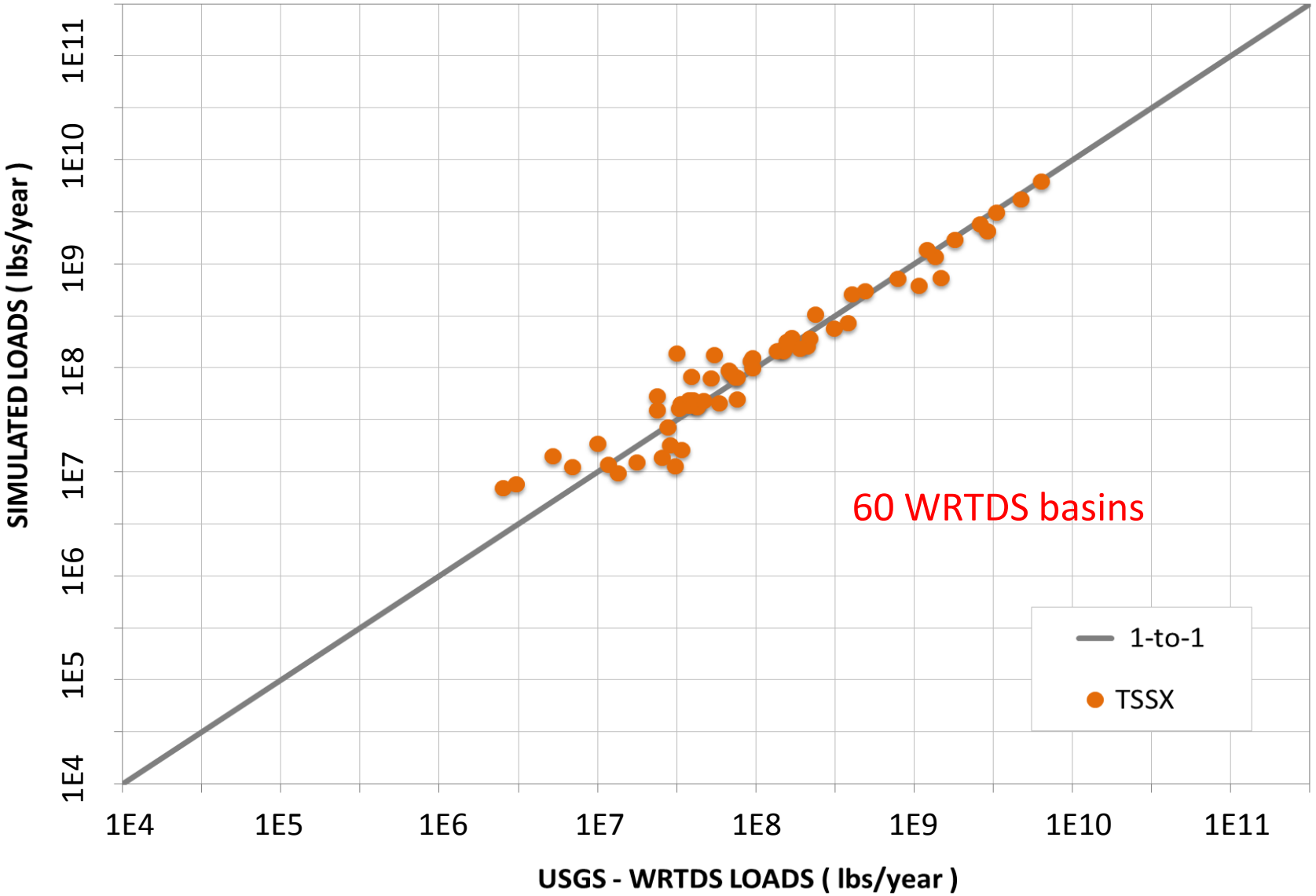
DRAFT P6

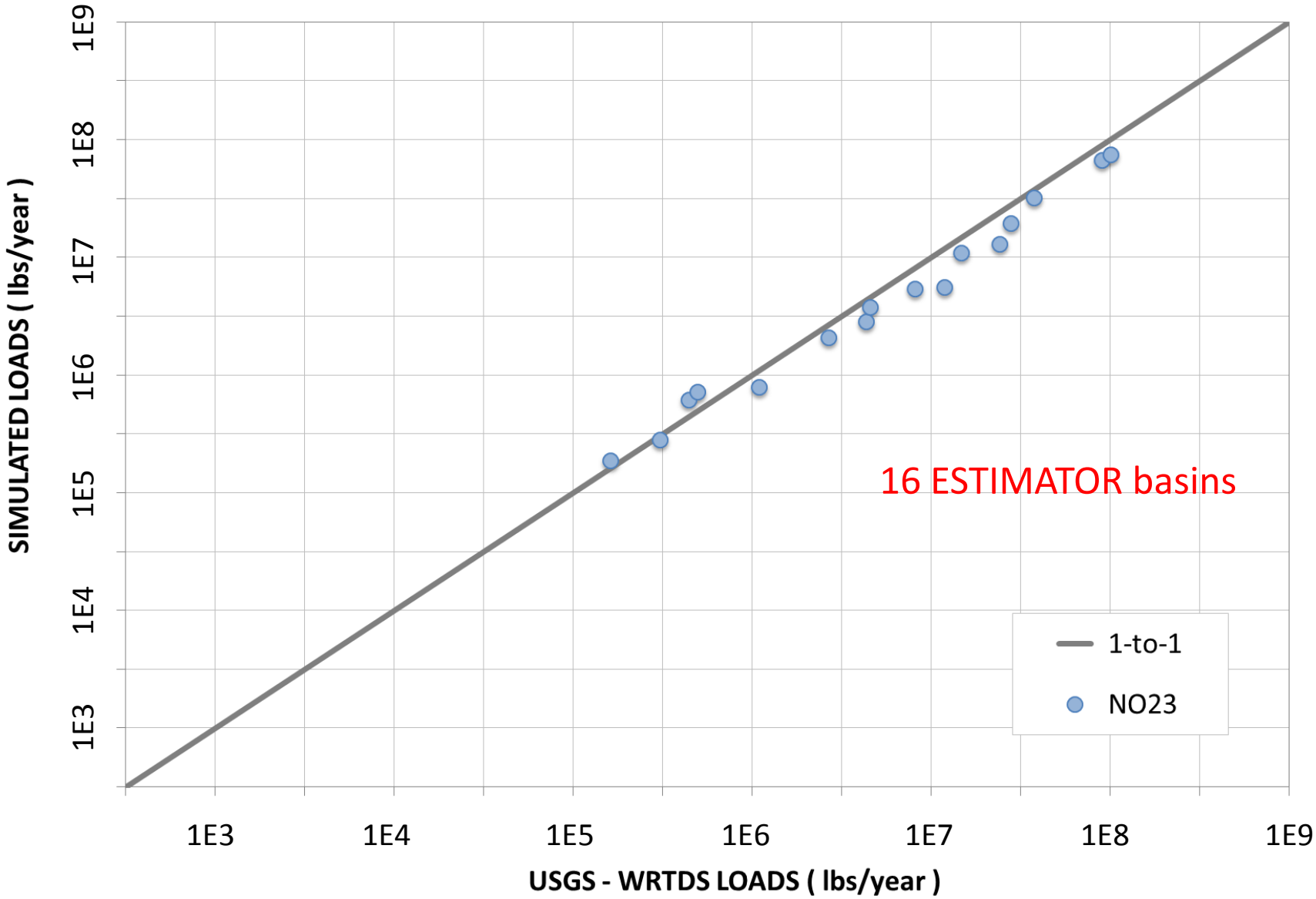
Lower Susquehanna Reservoirs, Conowingo Infill, and point-sources

PHOSPHORUS




SIMULATED LOADS (lbs/year)
1E4
1E5
1E6
1E7
1E8
1E9
1E10
1E11
USGS - ESTIMATOR LOADS (lbs/year)
30 ESTIMATOR basins
1-to-1
TSSX

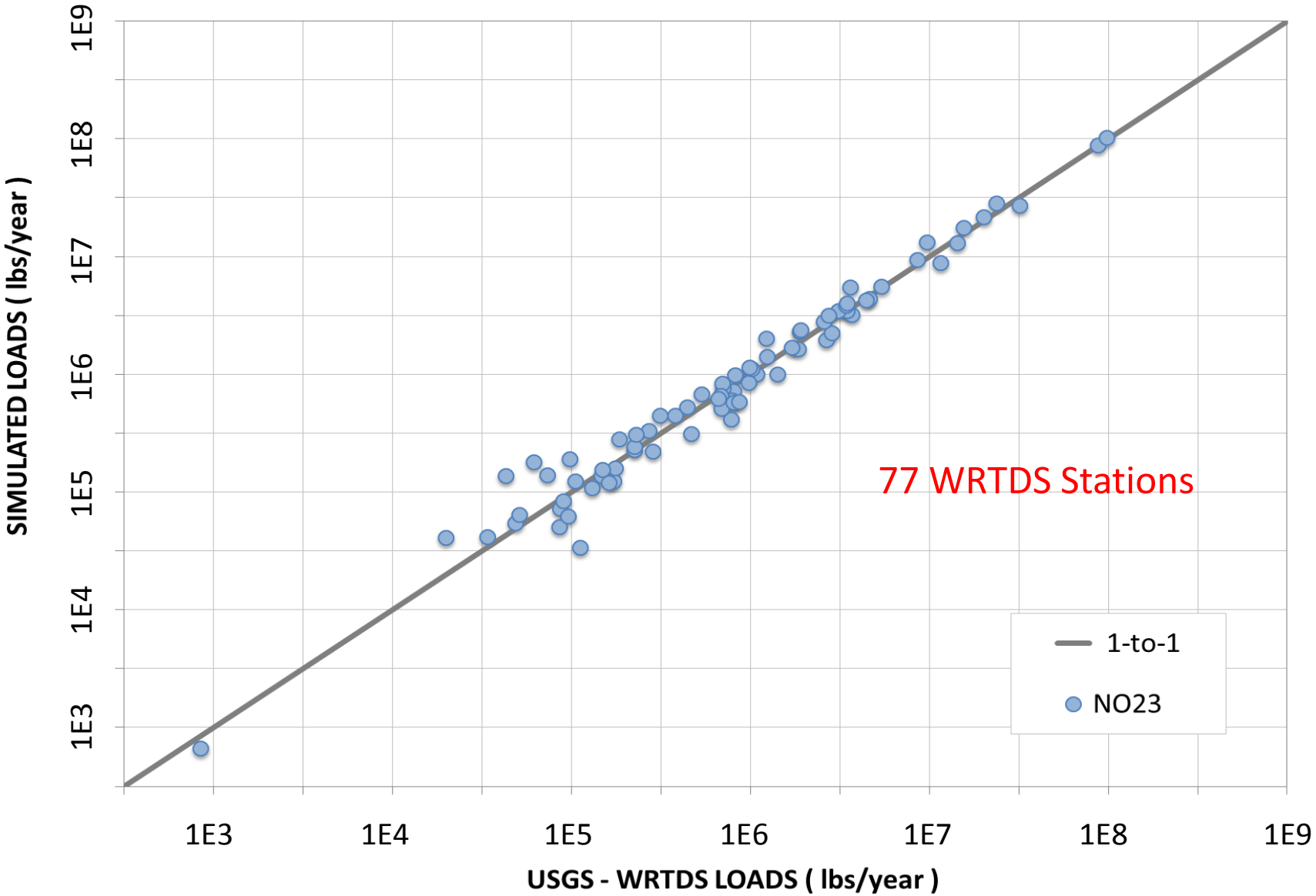

SIMULATED LOADS (lbs/year)
1E4
1E5
1E6
1E7
1E8
1E9
1E10
1E11
USGS - WRTDS LOADS (lbs/year)
1E4
1E5
1E6
1E7
1E8
1E9
1E10
1E11
60 WRTDS basins
1-to-1
TSSX


SIMULATED LOADS (lbs/year)
1E3
1E4
1E5
1E6
1E7
1E8
1E9
USGS - WRTDS LOADS (lbs/year)
1E3
1E4
1E5
1E6
1E7
1E8
1E9
16 ESTIMATOR basins
1-to-1
NO23

DRAFT G

Revised inputs, model refinements, and calibration methods

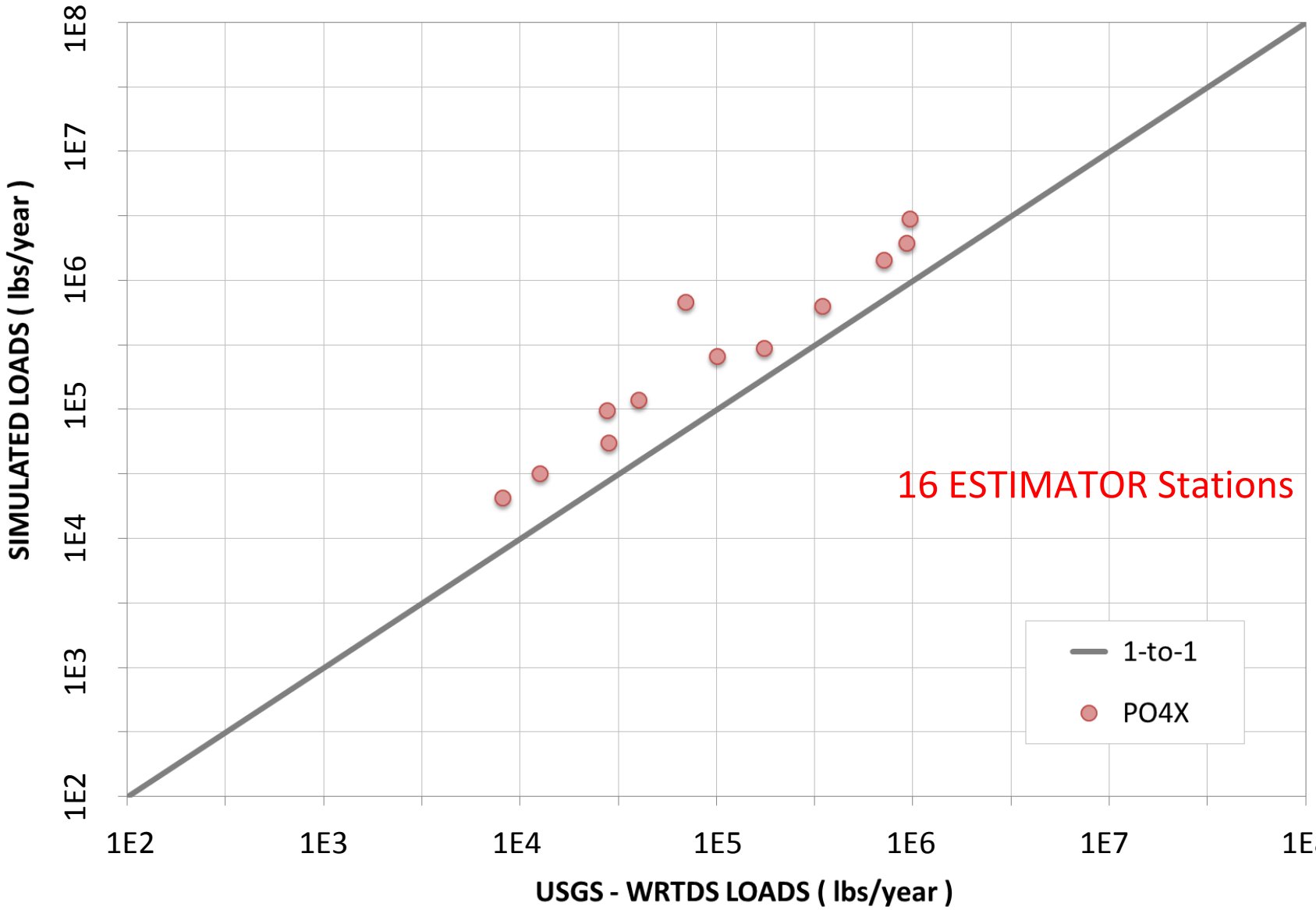
NITRATE



PHASE 5

Phase 5.3.2

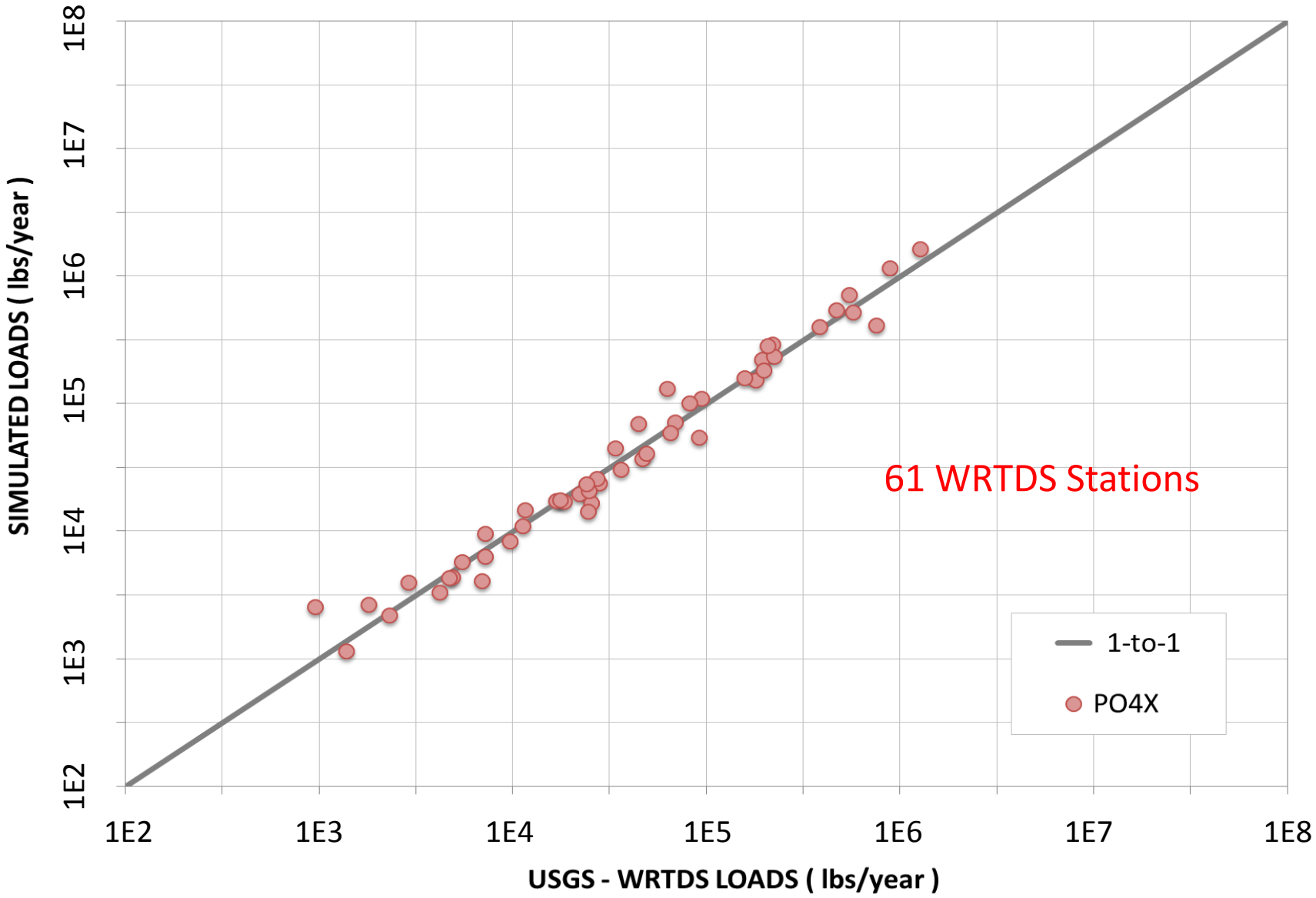
DISSOLVED PHOSPHATE



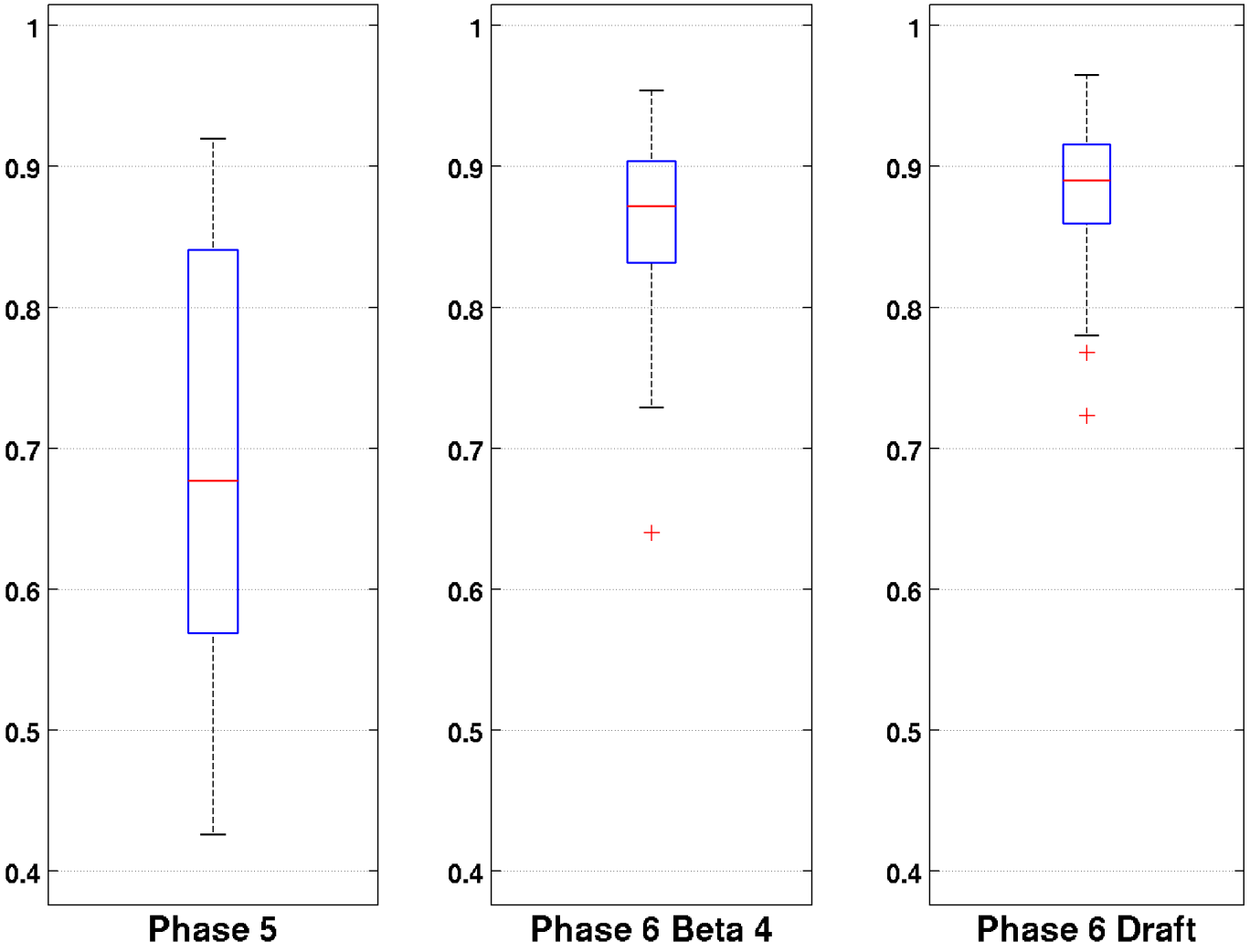
DRAFT G

Revised inputs, model refinements, and calibration methods

DISSOLVED PHOSPHATE

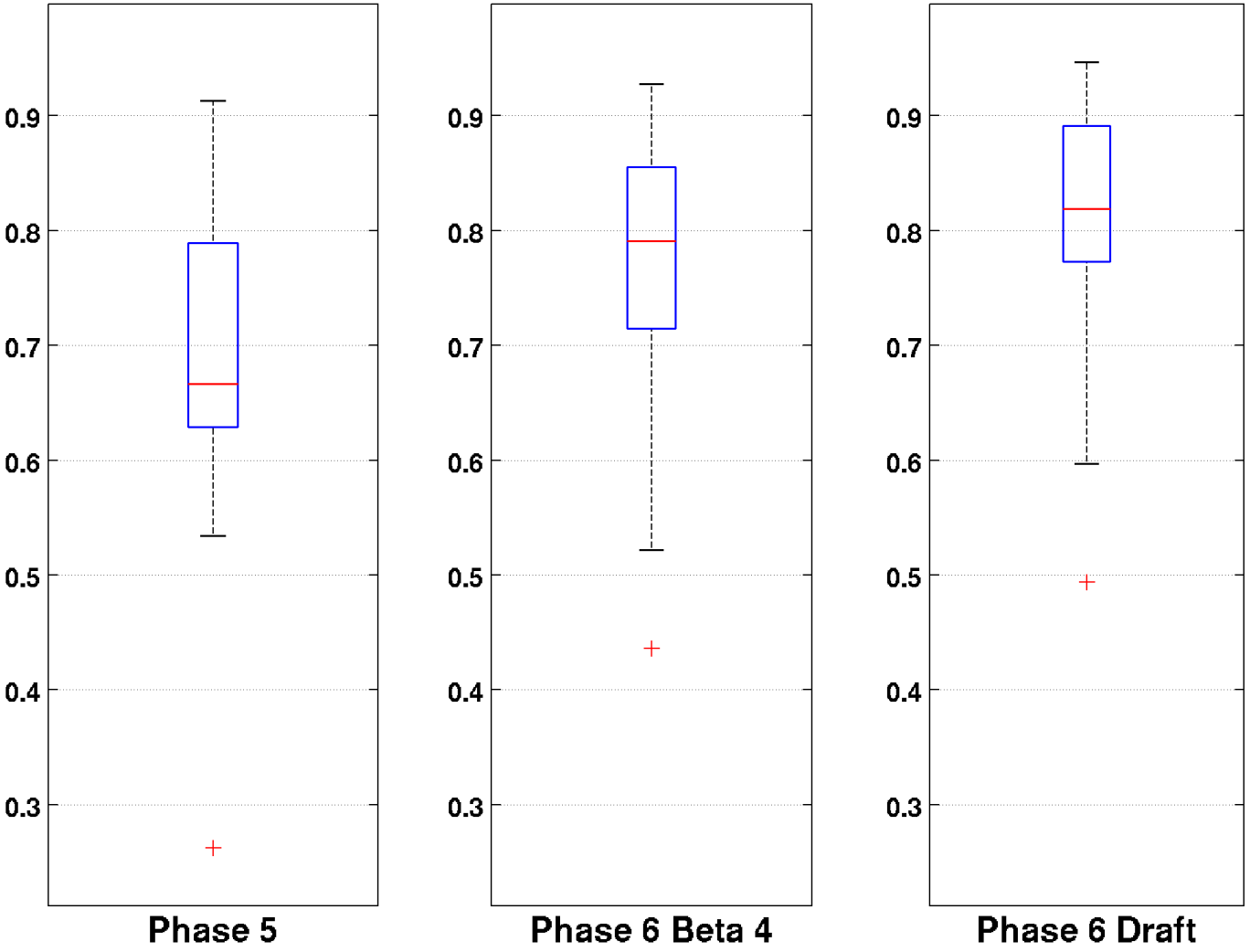


Monthly Correlation of WRTDS and Simulated Loads: Total Nitrogen



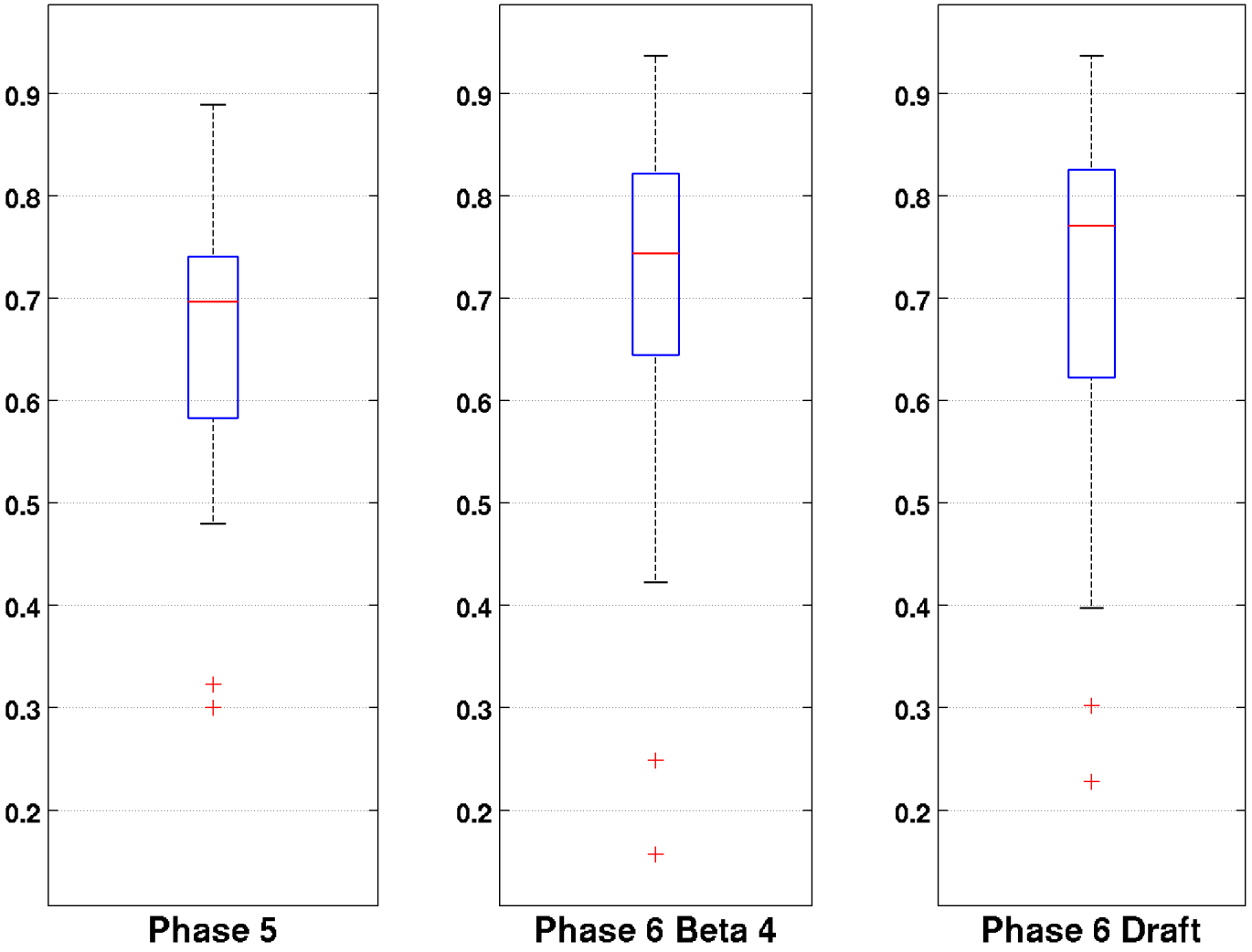
The correlation coefficient ranges from −1 to 1. A value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all data points lying on a line for which Y increases as X increases. A value of 0 implies that there is no linear correlation between the variables.

Monthly Correlation of WRTDS and Simulated Loads: Total Phosphorus



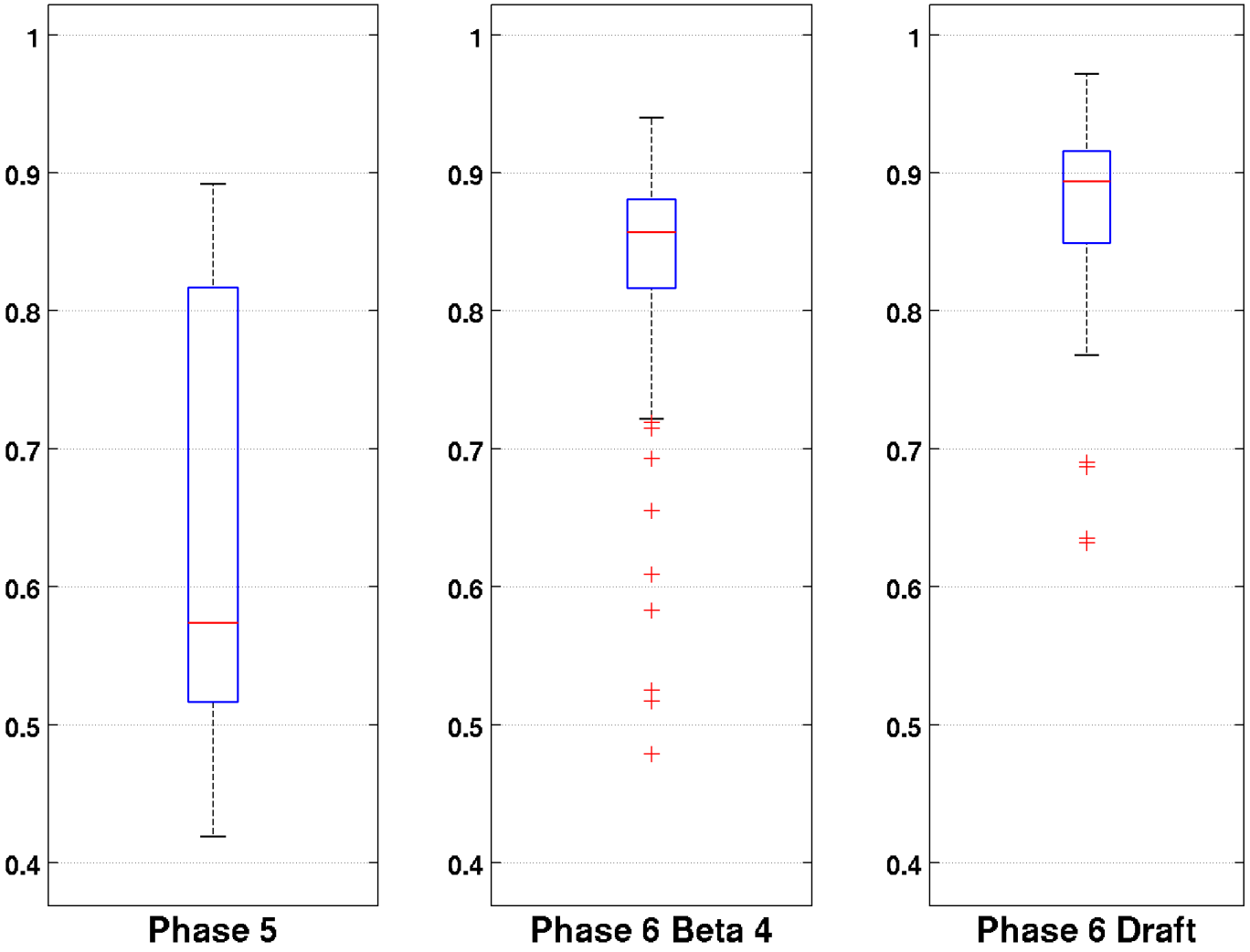
The correlation coefficient ranges from −1 to 1. A value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all data points lying on a line for which Y increases as X increases. A value of 0 implies that there is no linear correlation between the variables.

Monthly Correlation of WRTDS and Simulated Loads: Sediment



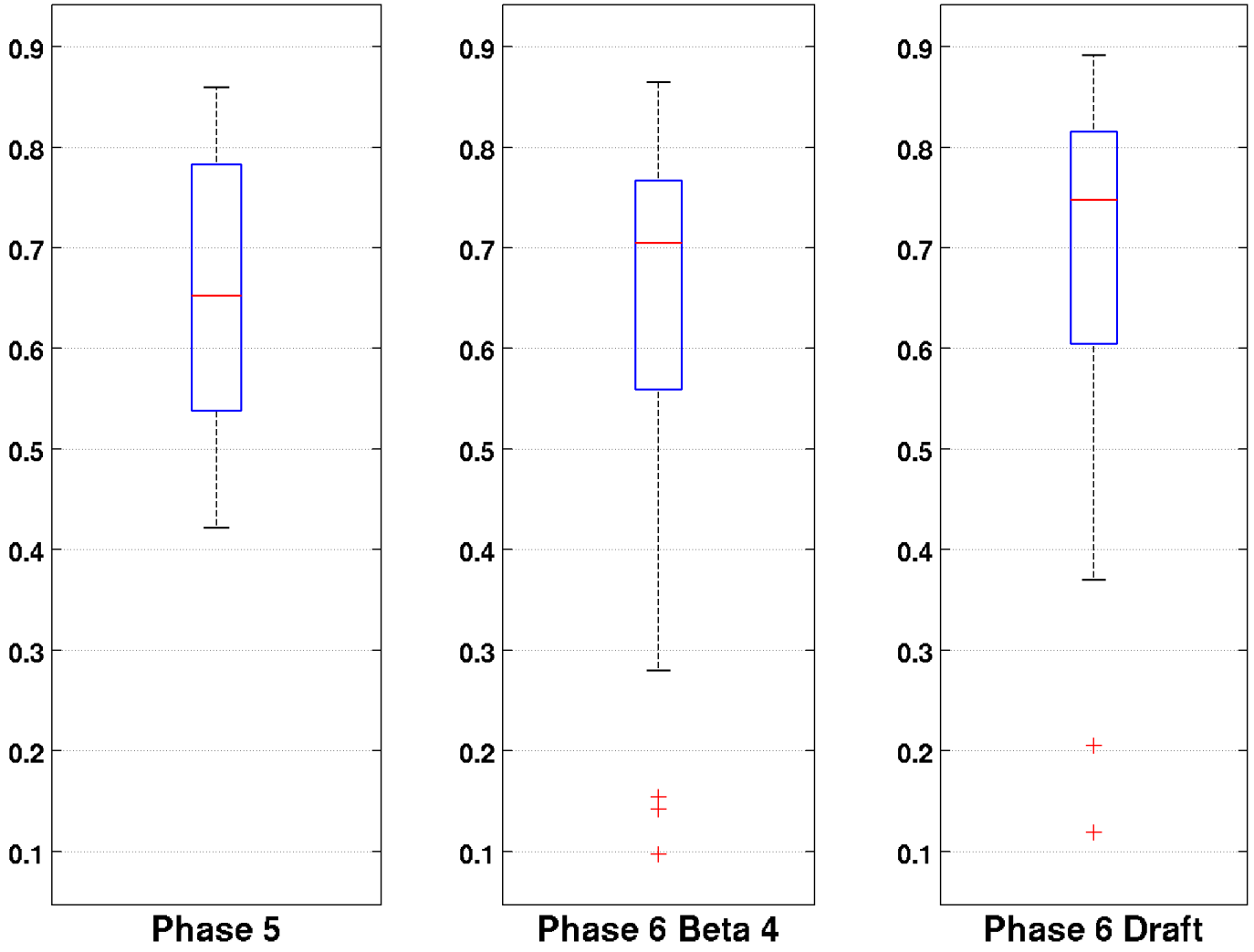
The correlation coefficient ranges from −1 to 1. A value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all data points lying on a line for which Y increases as X increases. A value of 0 implies that there is no linear correlation between the variables.

Monthly Correlation of WRTDS and Simulated Loads: Nitrate



The correlation coefficient ranges from −1 to 1. A value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all data points lying on a line for which Y increases as X increases. A value of 0 implies that there is no linear correlation between the variables.

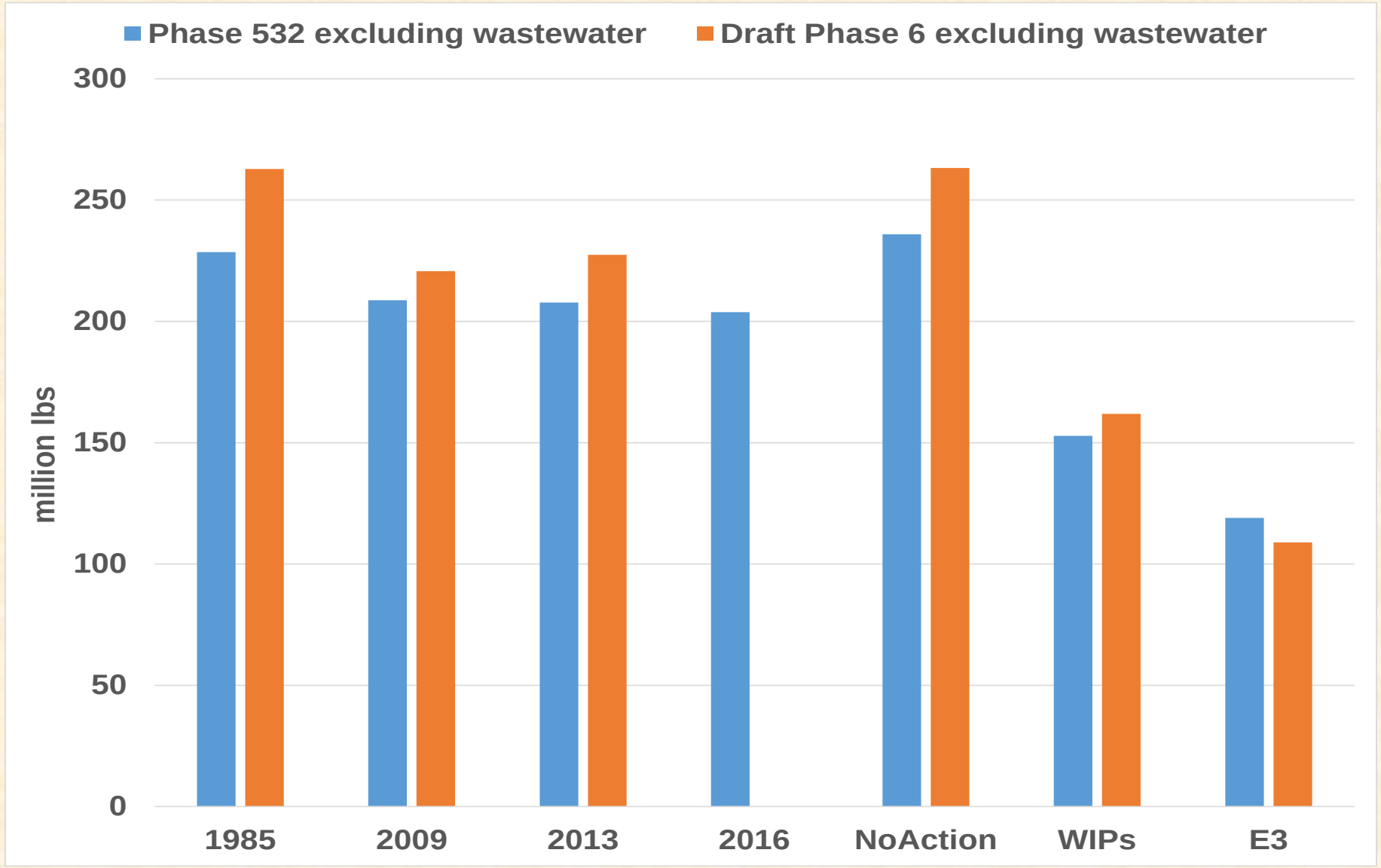
Monthly Correlation of WRTDS and Simulated Loads: Dissolved Inorganic Phosphorus



The correlation coefficient ranges from −1 to 1. A value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all data points lying on a line for which Y increases as X increases. A value of 0 implies that there is no linear correlation between the variables.

Phase 5 and Phase 6

Nitrogen Loads, CB Watershed-wide (excludes wastewater)



Phase 6 Beta 3		Base 349TN 20.8TP 10.9TSS 1993-1995	All Forest 32.7TN 2.83TP 1993-1995	No Action 439TN 39.9TP 1993-1995	1985 Progress 380TN 29.1TP 1993-1995	2009 Progress 297TN 20.5TP 1993-1995	WIP2 199TN 12.9TP 1993-1995	E3 155 TN 10.4TP 1993-1995
Cbseg	State	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel
CB3MH	MD	16.0%	0.0%	27.7%	22.0%	13.0%	0.2%	0.0%
CB4MH	MD	46.0%	0.0%	59.5%	53.5%	42.2%	11.9%	0.8%
CB5MH	MD/VA	14.2%	0.0%	24.9%	20.3%	11.9%	0.0%	0.0%
CHSMH	MD	37.4%	0.0%	54.1%	41.5%	33.5%	8.7%	0.0%
POTMH	MD/VA	20.2%	0.0%	30.0%	25.8%	15.8%	0.0%	0.0%
POMMH	MD	20.4%	0.0%	30.2%	25.9%	15.9%	0.0%	0.0%
RPPMH	VA	19.0%	0.0%	34.4%	27.6%	15.0%	0.0%	0.0%
EASMH	MD	25.4%	0.0%	46.6%	35.2%	23.3%	7.1%	0.1%
MD5MH	MD	21.7%	0.0%	32.7%	27.0%	19.4%	0.0%	0.0%
VA5MH	VA	4.5%	0.0%	14.3%	11.6%	2.2%	0.0%	0.0%
PATMH	MD	24.8%	0.0%	59.9%	43.1%	7.0%	0.0%	0.0%

Phase 5.3.2		Base 323TN 20.6TP 1993-1995	All Forest 53.6TN 2.6TP 1993-1995	No Action 376TN 37.9TP 1993-1995	1985 Progress 344TN 25.7P 1993-1995	2009 Progress 264TN 18.3TP 1993-1995	WIP2 189TN 13.2TP 1993-1995	E3 138TN 10.6TP 1993-1995
Cbseg	State	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel
CB3MH	MD	16.0%	0.0%	22.0%	19.2%	7.3%	0.2%	0.0%
CB4MH	MD	46.0%	0.0%	52.8%	49.1%	26.4%	2.9%	0.0%
CB5MH	MD/VA	14.2%	0.0%	20.0%	16.7%	0.6%	0.0%	0.0%
CHSMH	MD	37.4%	0.0%	41.5%	37.4%	35.6%	16.6%	2.3%
POTMH	MD/VA	20.2%	0.0%	27.4%	22.7%	0.0%	0.0%	0.0%
POMMH	MD	20.4%	0.0%	27.6%	22.8%	0.0%	0.0%	0.0%
RPPMH	VA	19.0%	0.0%	28.1%	25.1%	0.0%	0.0%	0.0%
EASMH	MD	25.4%	0.0%	35.6%	27.5%	14.0%	1.6%	0.0%
MD5MH	MD	21.7%	0.0%	27.2%	23.8%	3.9%	0.0%	0.0%
VA5MH	VA	4.5%	0.0%	10.7%	7.4%	0.0%	0.0%	0.0%
PATMH	MD	24.8%	0.0%	49.1%	38.2%	11.5%	0.0%	0.0%

Phase 6 Beta 3		Base 349TN 20.8TP 10.9TSS	All Forest 32.7TN 2.83TP	No Action 439TN 39.9TP	1985 Progress 380TN 29.1TP	2009 Progress 297TN 20.5TP	WIP2 199TN 12.9TP	E3 155TN 10.4TP
Cbseg	State	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water
CB3MH	MD	2.1%	0.0%	8.3%	3.4%	1.3%	0.1%	0.0%
CB4MH	MD	21.0%	0.0%	34.3%	27.2%	17.3%	7.3%	2.8%
CB5MH	MD/VA	4.2%	0.0%	8.0%	5.8%	3.5%	1.4%	0.0%
CB6PH	VA	0.0%	0.0%	1.2%	0.6%	0.0%	0.0%	0.0%
CB7PH	VA	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%
CHSMH	MD	25.7%	0.0%	42.4%	34.4%	24.8%	3.3%	0.0%
EASMH	MD	5.9%	0.0%	45.1%	34.5%	3.0%	0.5%	0.3%
PAXMH	MD	6.3%	0.0%	26.4%	15.5%	5.4%	0.0%	0.0%
POTMH	MD/VA	4.1%	0.0%	10.5%	6.5%	3.4%	0.2%	0.0%
POMMH	MD	4.1%	0.0%	10.6%	6.6%	3.4%	0.2%	0.0%
RPPMH	VA	5.9%	0.0%	15.7%	11.0%	4.8%	0.0%	0.0%
SBEMH	VA	0.0%	0.0%	24.5%	8.4%	0.0%	0.0%	0.0%
YRKPH	VA	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
MD5MH	MD	8.5%	0.0%	14.5%	10.9%	7.5%	3.2%	0.4%
VA5MH	VA	0.5%	0.0%	1.4%	1.0%	0.3%	0.0%	0.0%
PATMH	MD	12.4%	0.0%	38.3%	22.0%	3.6%	0.0%	0.0%
MAGMH	MD	51.0%	0.0%	57.1%	57.1%	43.2%	7.9%	1.9%
SOUMH	MD	18.6%	0.0%	29.2%	29.7%	16.9%	2.7%	3.0%
SEVMH	MD	6.1%	0.0%	32.4%	17.5%	6.1%	0.0%	0.0%

Phase 5.3.2		Base 323TN 20.6TP	All Forest 53.6TN 2.6TP	No Action 376TN 37.9TP	1985 Progress 344TN 25.7P	2009 Progress 264TN 18.3TP	WIP2 189TN 13.2TP	E3 138TN 10.6TP
Cbseg	State	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water	1993-1995 Deep Water
CB3MH	MD	2.1%	0.0%	3.4%	2.3%	0.7%	0.1%	0.0%
CB4MH	MD	21.0%	0.0%	27.0%	23.0%	11.2%	5.4%	0.9%
CB5MH	MD/VA	4.2%	0.0%	5.9%	4.9%	1.8%	0.4%	0.0%
CB6PH	VA	0.0%	0.0%	0.8%	0.3%	0.0%	0.0%	0.0%
CB7PH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSMH	MD	25.7%	0.0%	35.8%	31.1%	12.6%	2.9%	0.0%
EASMH	MD	5.9%	0.0%	31.1%	13.9%	2.0%	0.8%	0.0%
PAXMH	MD	6.3%	0.0%	21.5%	11.6%	0.6%	0.0%	0.0%
POTMH	MD/VA	4.1%	0.0%	9.0%	5.1%	0.4%	0.0%	0.0%
POMMH	MD	4.1%	0.0%	9.1%	5.1%	0.4%	0.0%	0.0%
RPPMH	VA	5.9%	0.0%	11.3%	8.3%	0.1%	0.0%	0.0%
SBEMH	VA	0.0%	0.0%	5.0%	3.4%	0.0%	0.0%	0.0%
YRKPH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MD5MH	MD	8.5%	0.0%	11.3%	9.5%	4.1%	1.3%	0.0%
VA5MH	VA	0.5%	0.0%	0.8%	0.7%	0.0%	0.0%	0.0%
PATMH	MD	12.4%	0.0%	31.9%	19.0%	3.6%	0.0%	0.0%
MAGMH	MD	51.0%	0.0%	57.1%	51.0%	51.0%	9.5%	7.1%
SOUMH	MD	18.6%	0.0%	35.5%	22.8%	0.0%	0.0%	0.0%
SEVMH	MD	6.1%	0.0%	30.2%	6.1%	0.7%	0.0%	0.0%

Conclusions:

- The WQSTM inputs are different in 2017 compared to 2010.
- The primary differences are because of improved estimates of nutrient inputs over three decades and an improved WSM calibration.
- Overall early scenarios (1985 etc.) and the No Action Scenario have increased estimated nutrient loads because of better accounting of nutrient inputs. The E3 Scenario has decreased because of the identification of additional management actions.
- Estimated reactive input loads (DIN, DIP, and particulate reactive organics (G1 & G2) from the watershed and shoreline are substantially improved in the 2017 model version.
- The 2017 WQSTM is responsive to the reactive nutrient loads and is consistent with the 2010 WQSTM response.