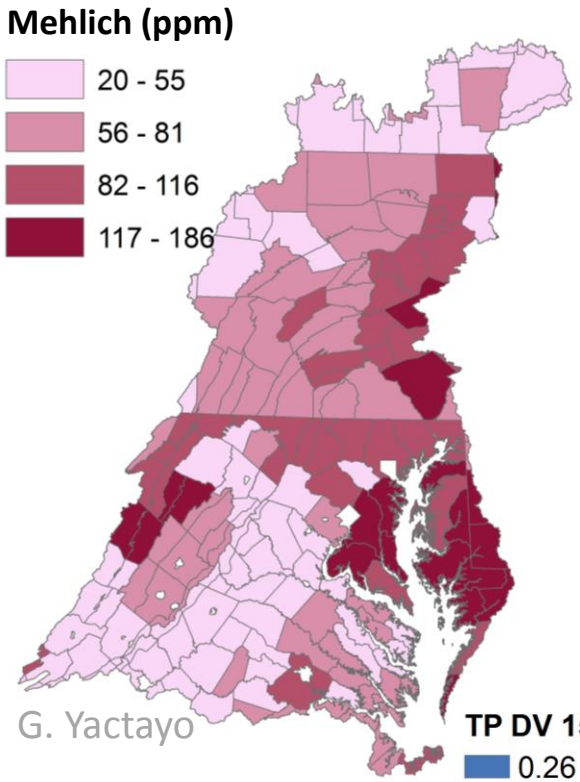
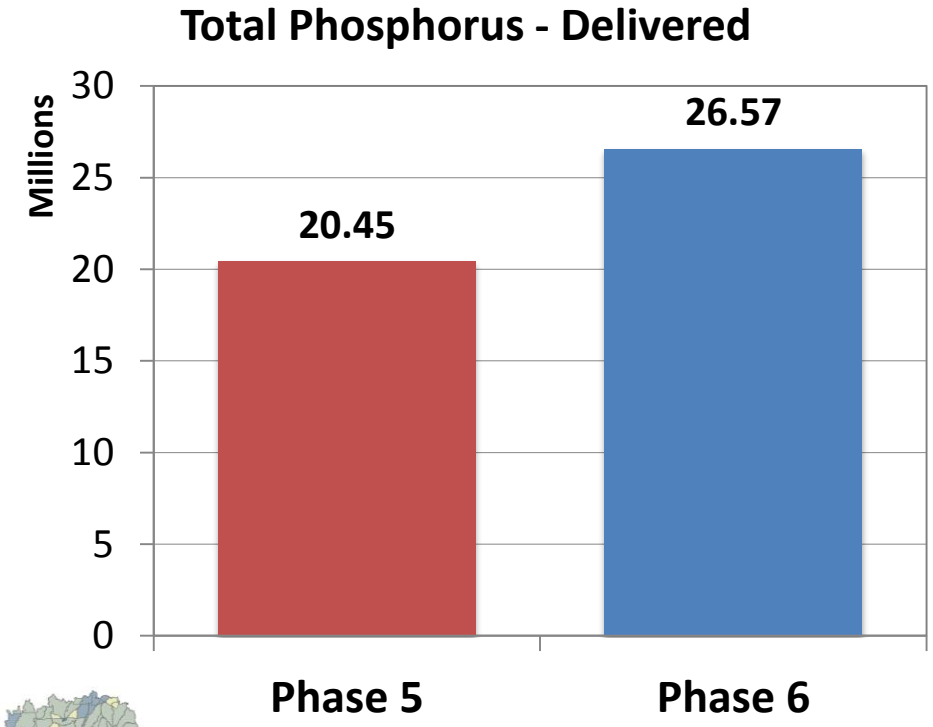
Phase 6 Watershed Model

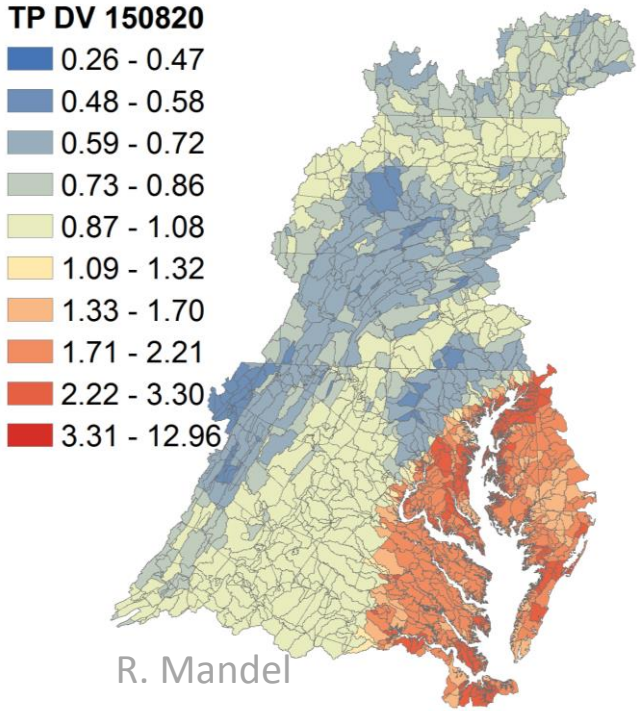
Revised Phosphorus Calibration (version August 2015)

Gopal Bhatt (gopal.bhatt@psu.edu)
Research Associate, Penn State University



G. Yactayo





R. Mandel

Model is capturing additional phosphorus loads than Ph-5 due to higher export/delivery from coastal watersheds.

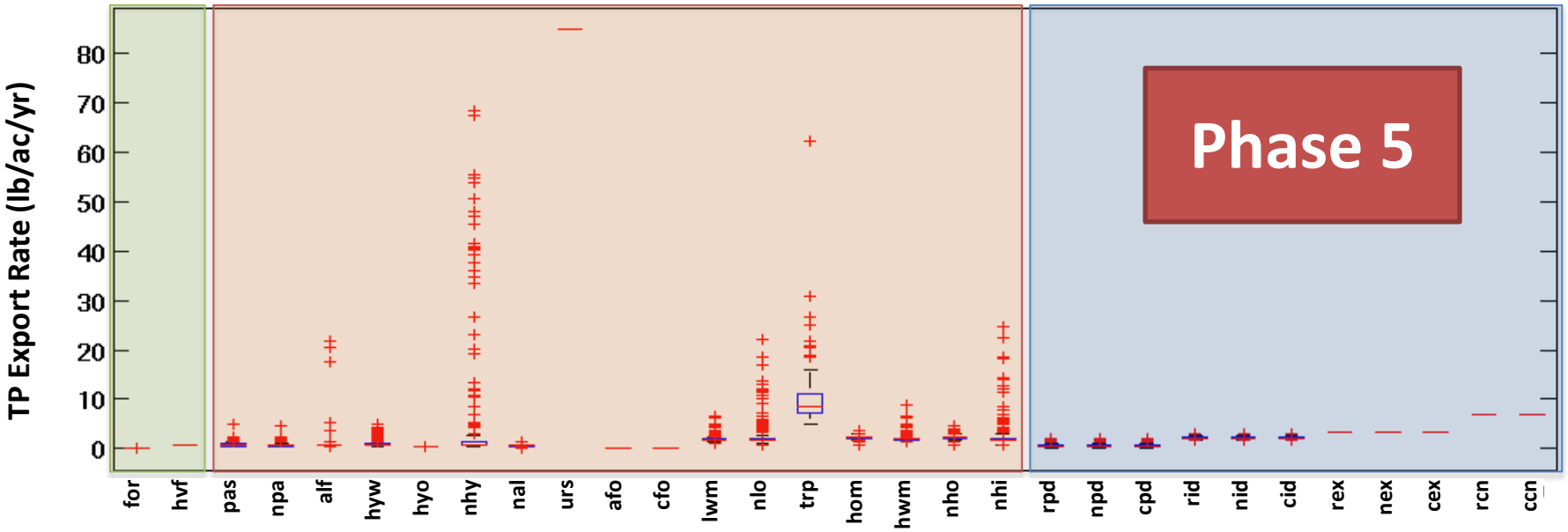
Model Calibration Updates …

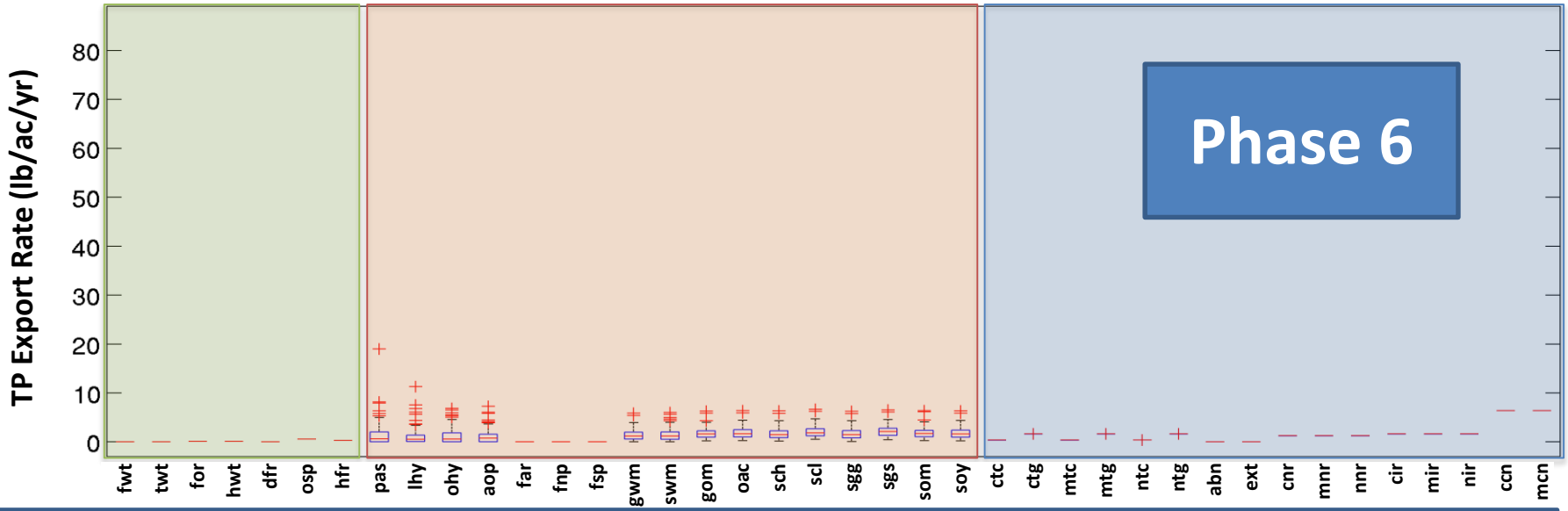
- Revised land-use phosphorus export targets based on APLE sensitivities and Soil Mehlich P.

- Revised *land-to-water* phosphorus *delivery variances (DVs)* from SPARROW.

- Edge-of-field nutrient calibration period was updated to 1985-2013, as used for indicator loads, and export target calculation.

Total Phosphorus Land-use Export Targets

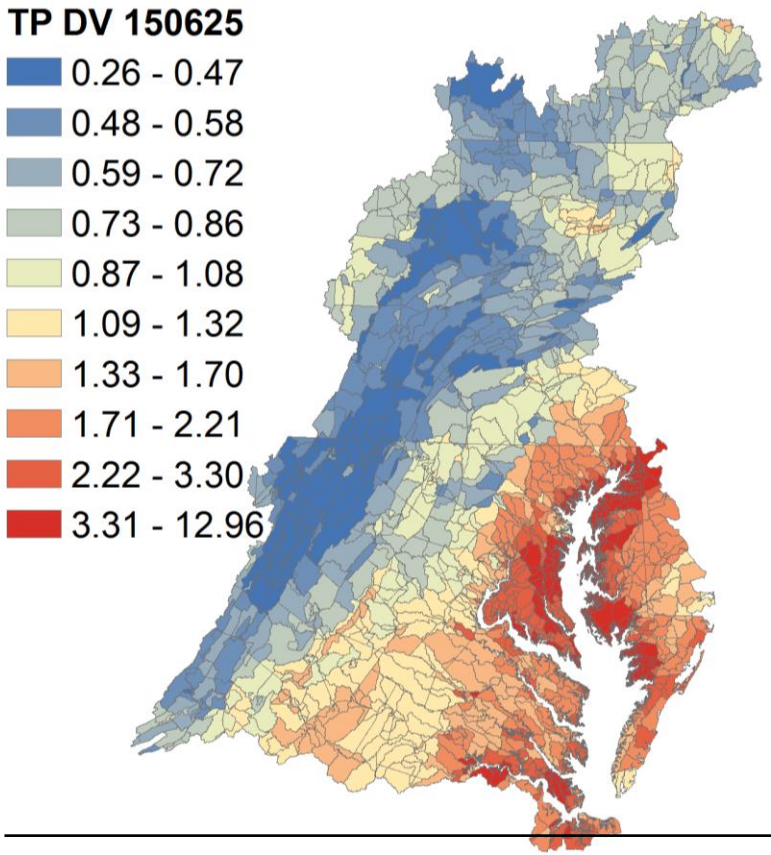


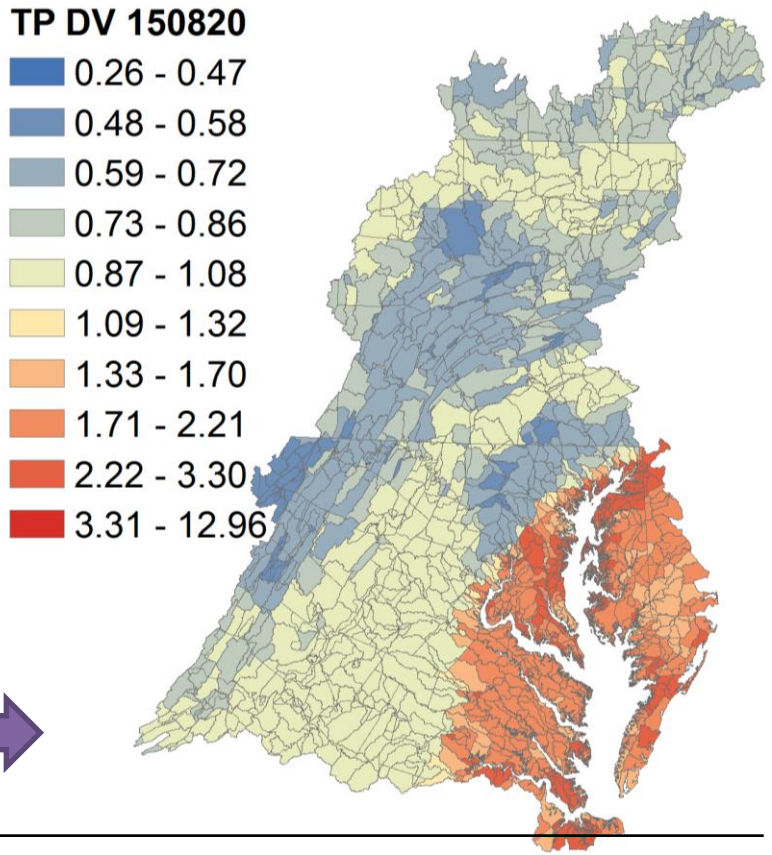


Based on APLE sensitivities for precipitation, sediment washoff, Mehlich, uptake, & application rates.

DVs w.r.t. (1) Precipitation, (2) Well-drained soils, (3) Erosivity, (4) Percent Coastal Plain

DVs w.r.t. (1) Well-drained soils, (2) Percent Coastal Plain

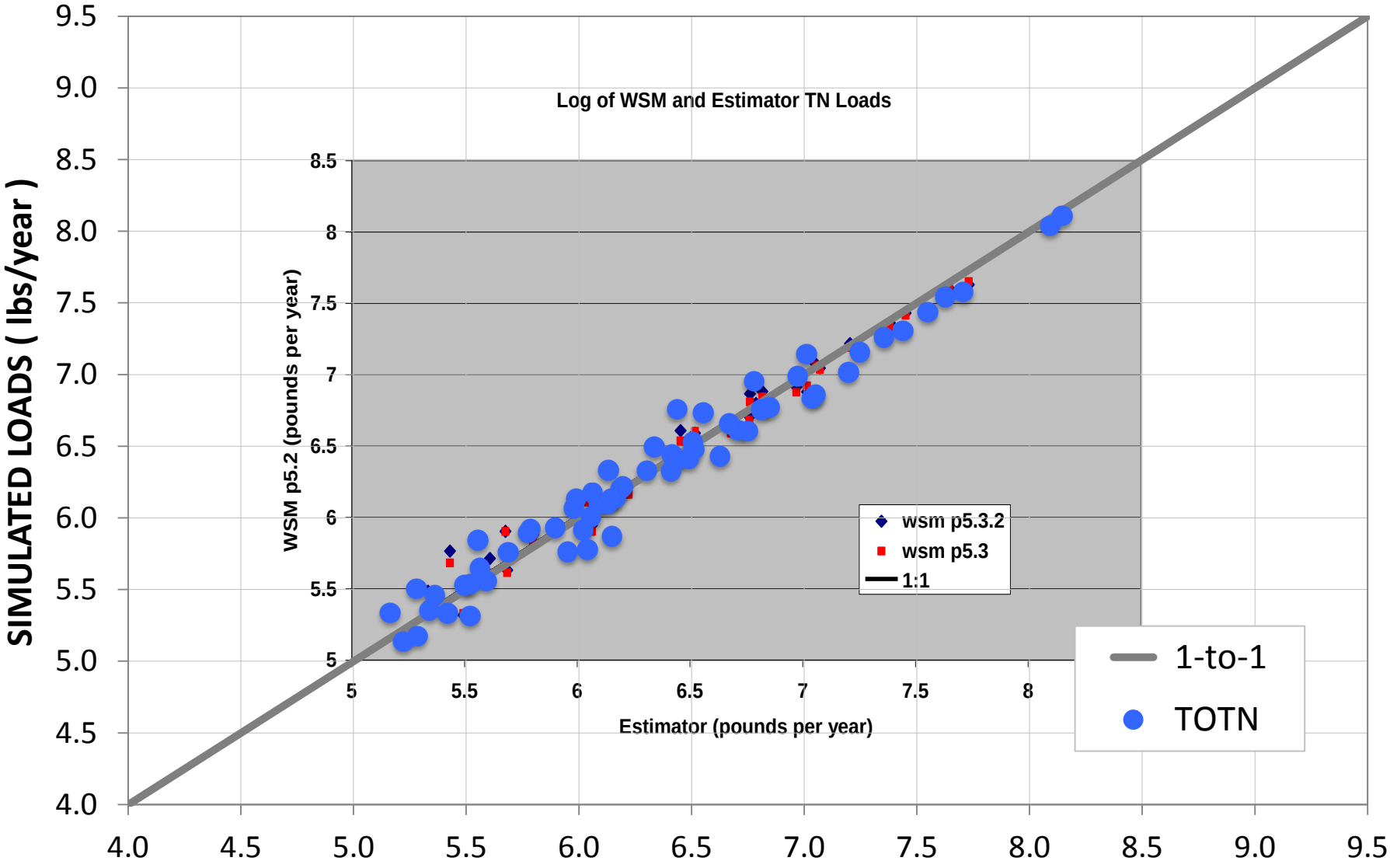




Minimum	0.26	0.51
Mean	1.53	1.20
Median	1.07	0.97
Maximum	12.96	2.69

6.3 Average Annual Load

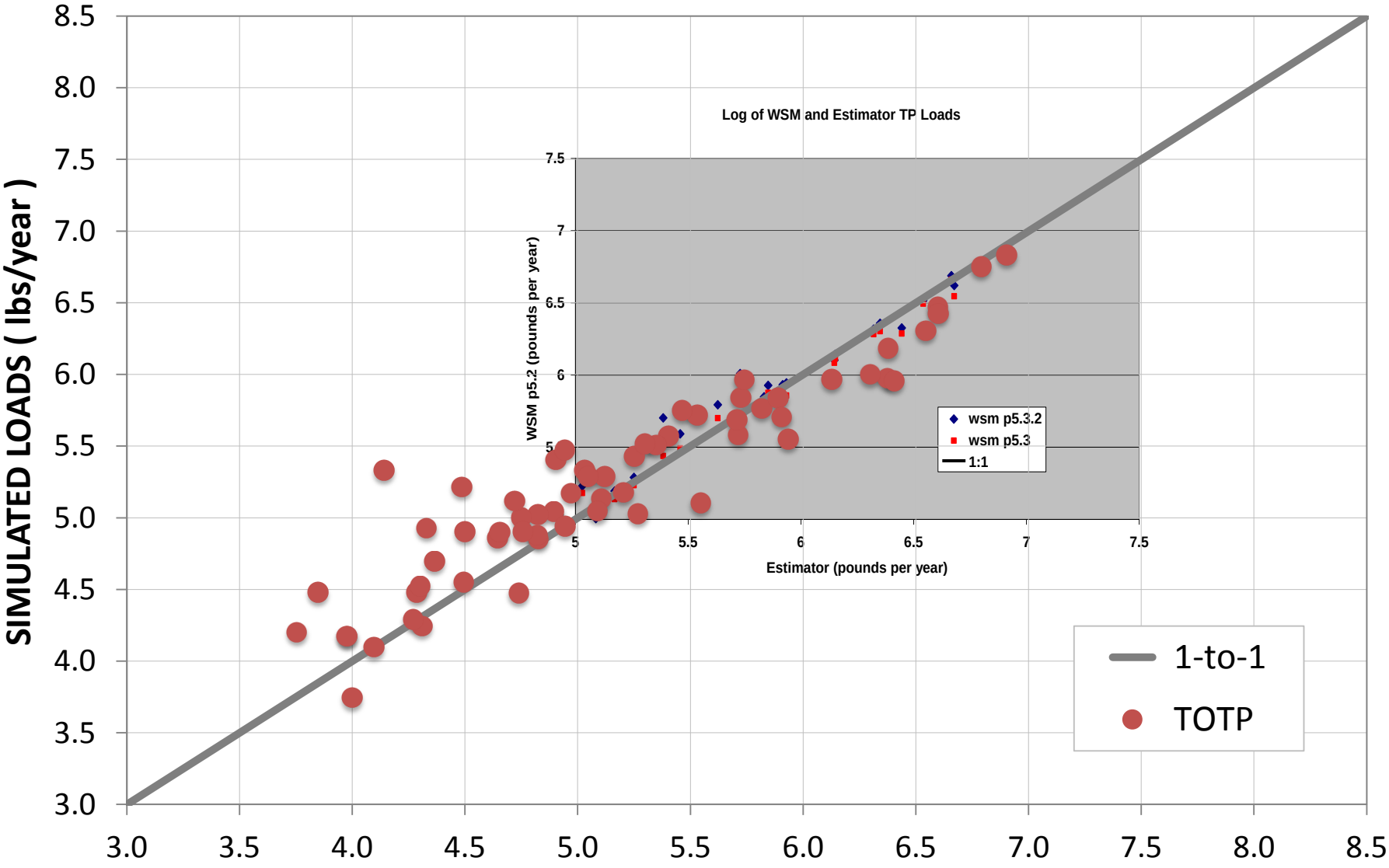
NITROGEN



Phase 6 – August 2015

Average Annual Load

PHOSPHORUS

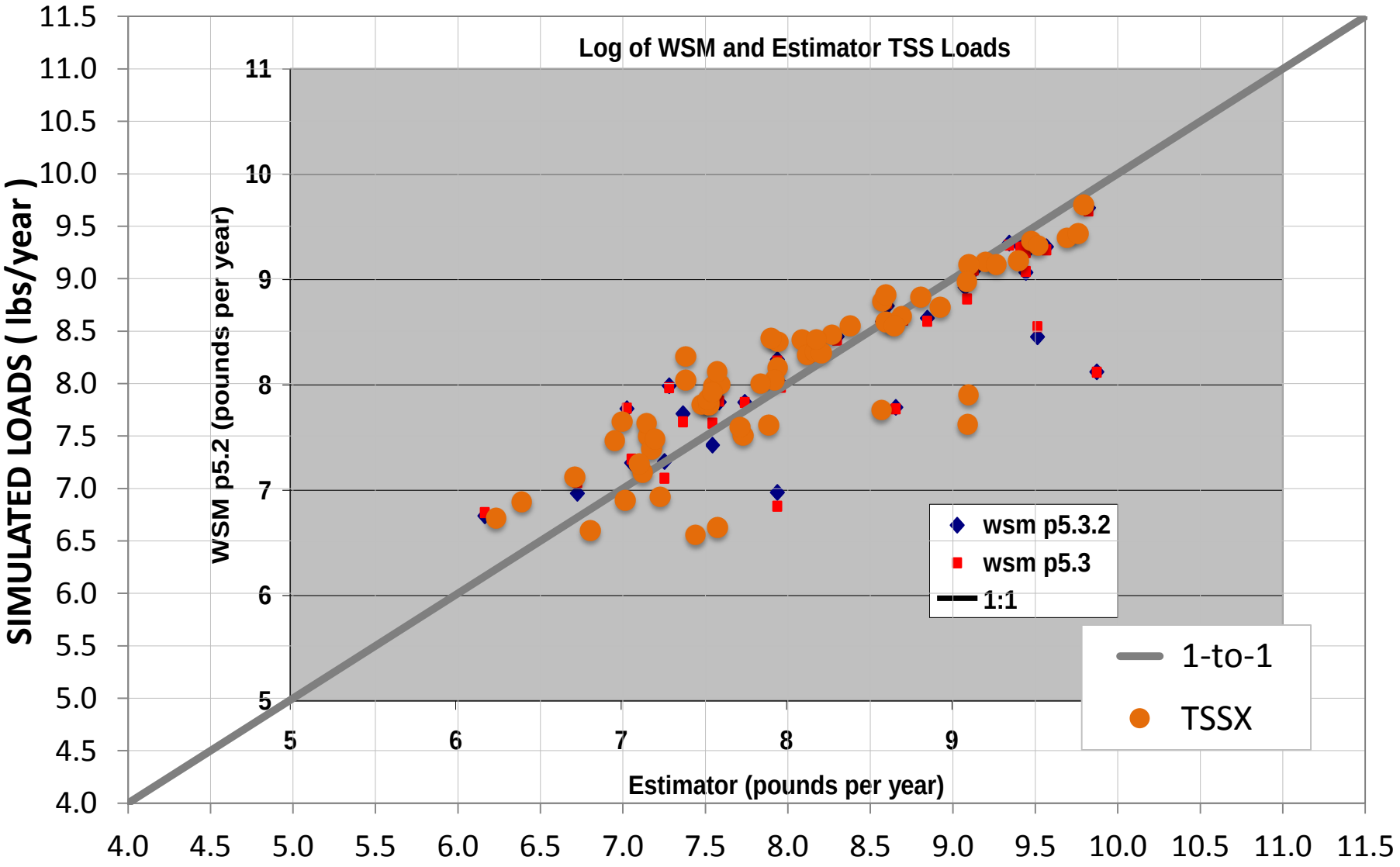


USGS - WRTDS LOADS (lbs/year)

Phase 6 – August 2015

Average Annual Load

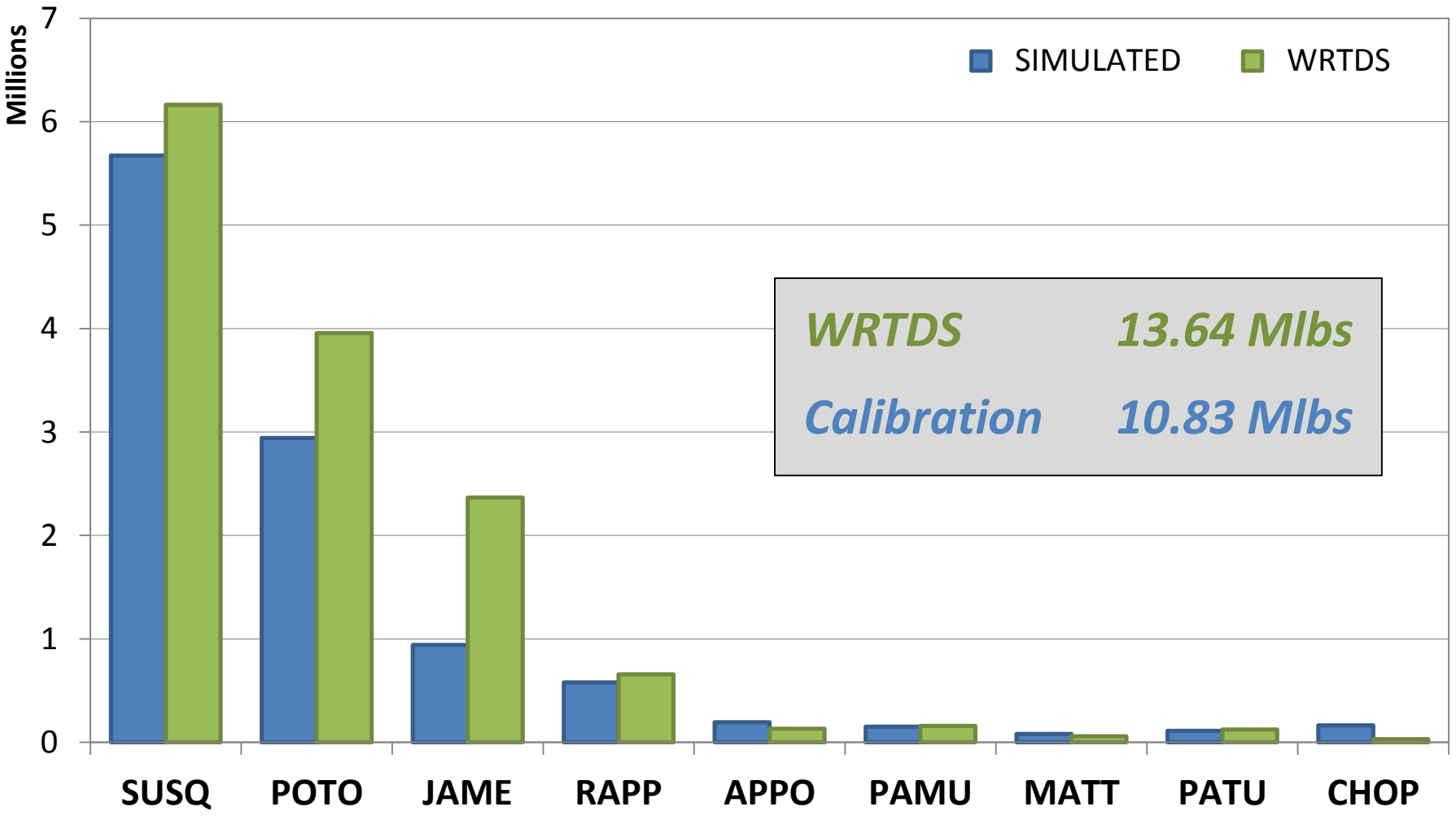
SEDIMENT



USGS - WRTDS LOADS (lbs/year)

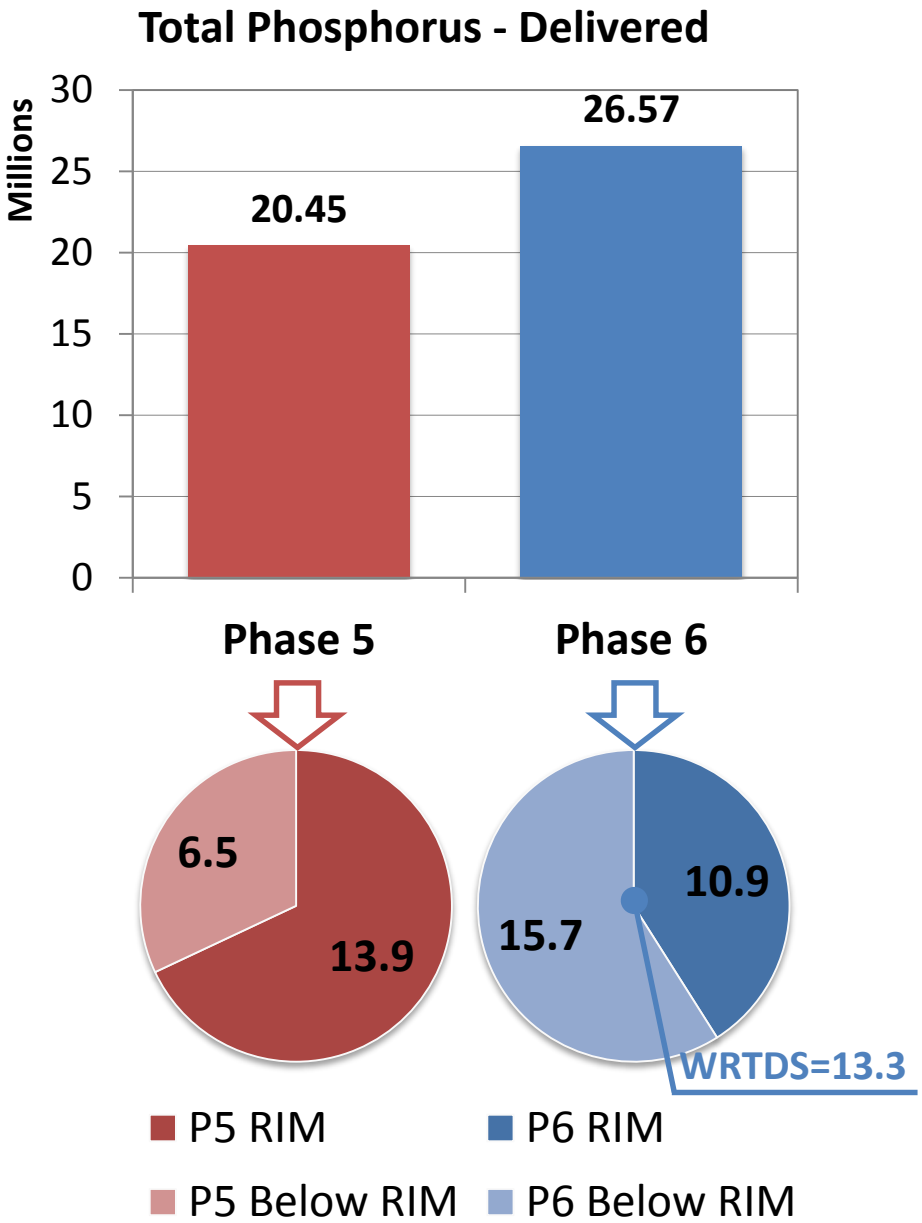
Phase 6 – August 2015

Total Phosphorus Loads at RIMP Stations (1985-2014)*

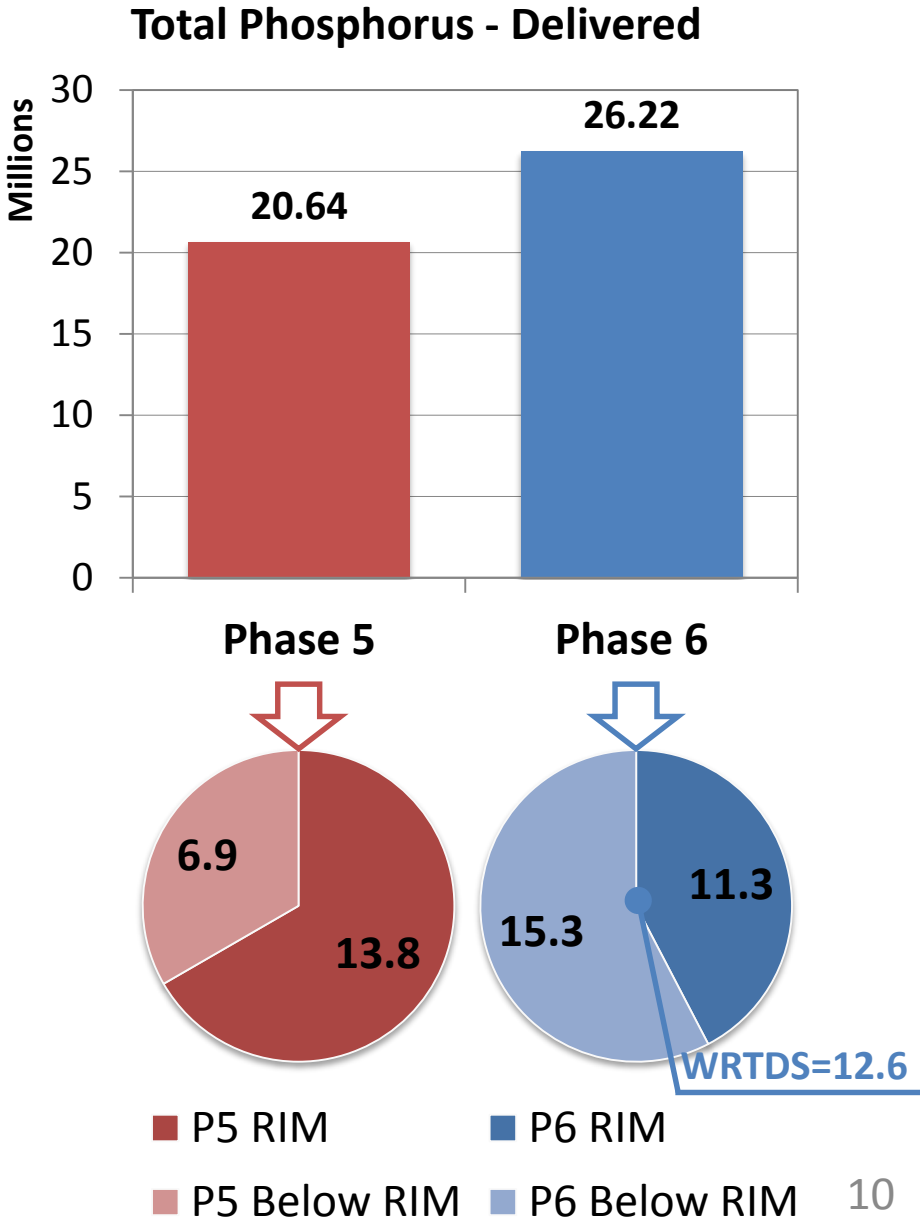


Calibrated phosphorus is ~2.81 Mlbs short of WRTDS.

1985 – 2005



1991 – 2000



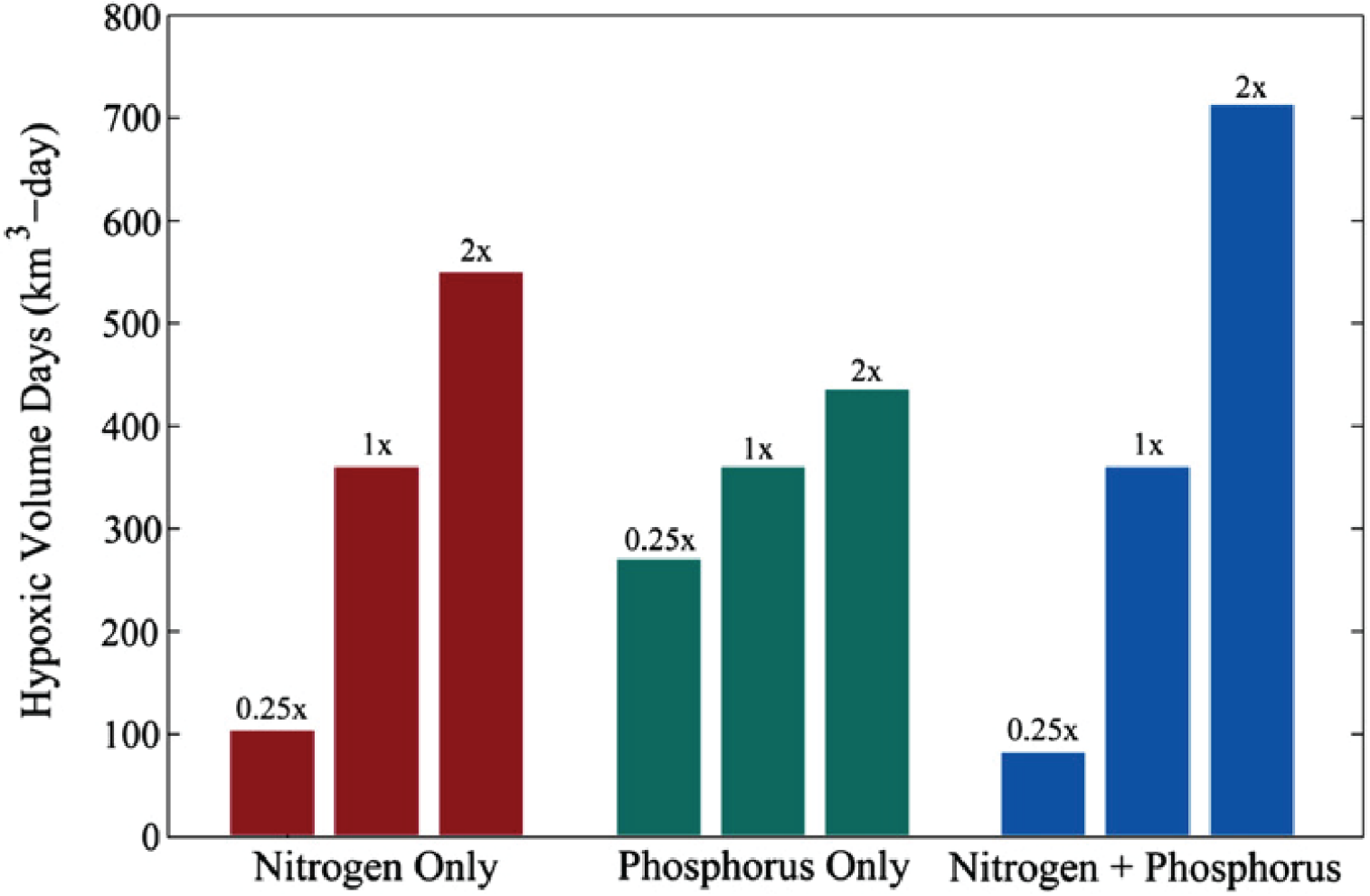
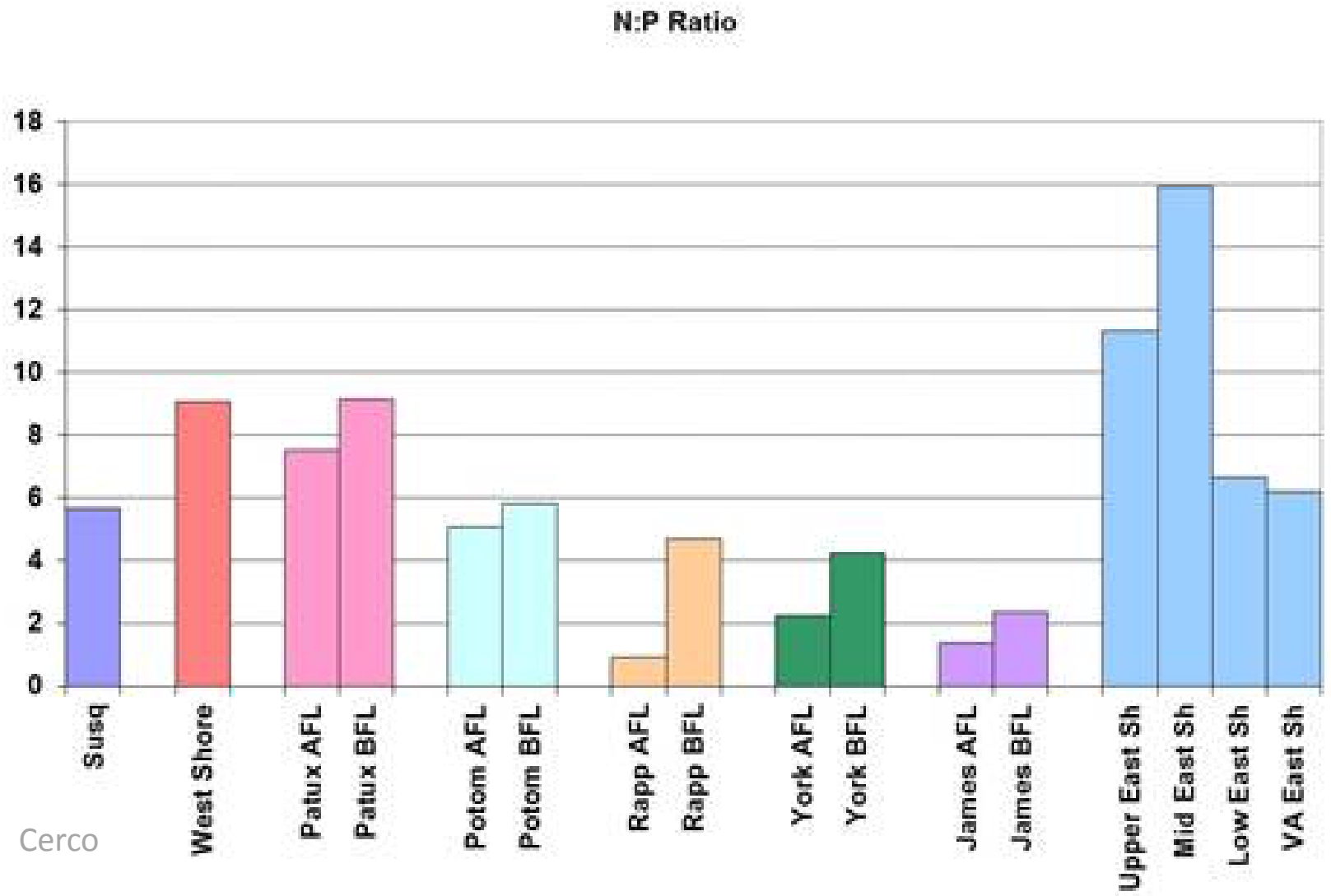


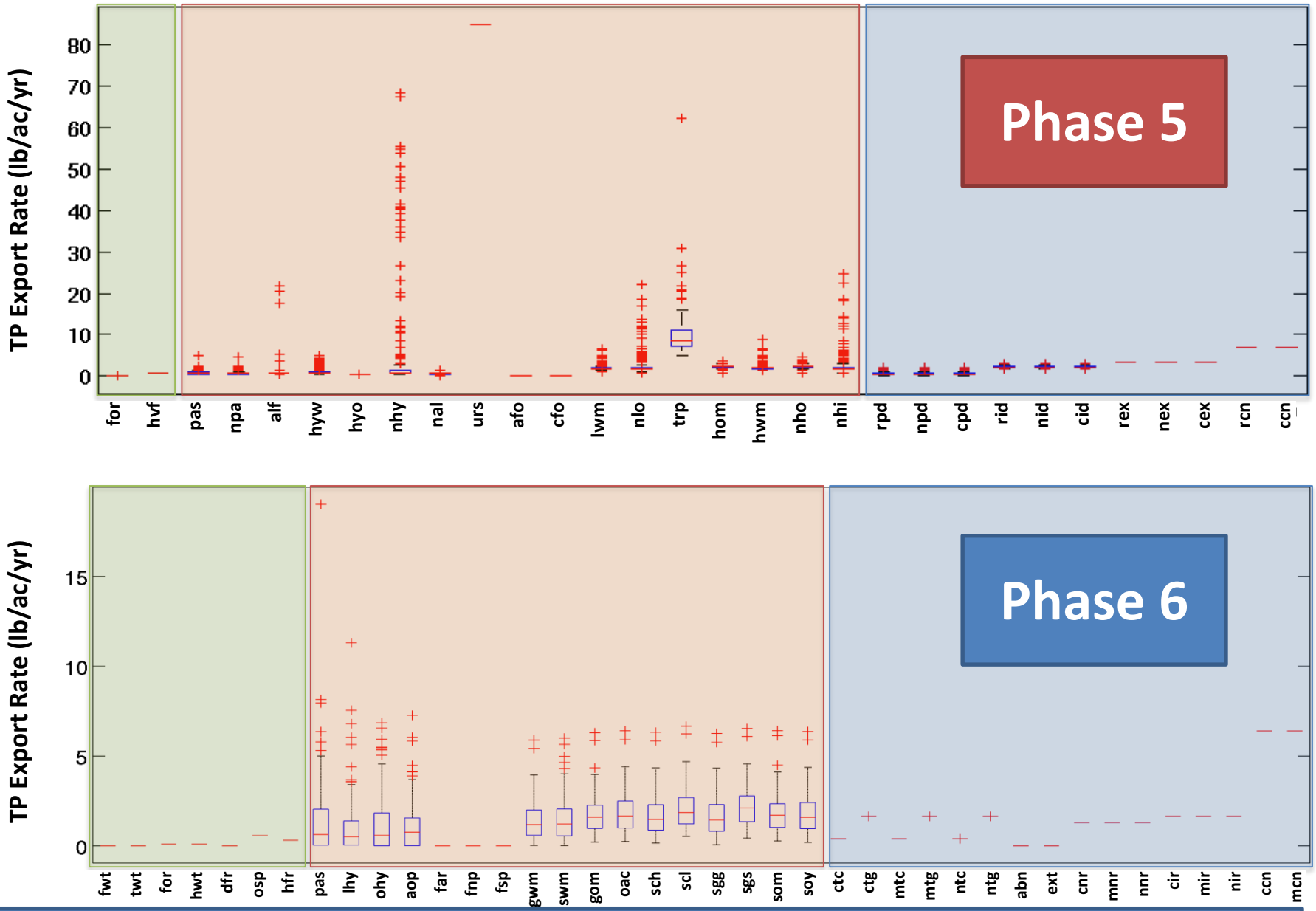
Fig. 10. Comparison of modeled hypoxic-volume-days (HVD) for several different nutrient loading scenarios (0.25×, 1×, 2×) for nitrogen only (red bars at left), phosphorus only (green bars in middle), and nitrogen + phosphorus (blue bars at right).

from Testa et al., 2014. Journal of Marine Systems


N:P Ratio
18
16
14
12
10
8
6
4
2
0
Susq
West Shore
Patux AFL
Patux BFL
Potom AFL
Potom BFL
Rapp AFL
Rapp BFL
York AFL
York BFL
James AFL
James BFL
Upper East Sh
Mid East Sh
Low East Sh
VA East Sh

Cerco

Total Phosphorus Land-use Export Targets



Based on APLE sensitivities for precipitation, sediment washoff, Mehlich, uptake, & application rates

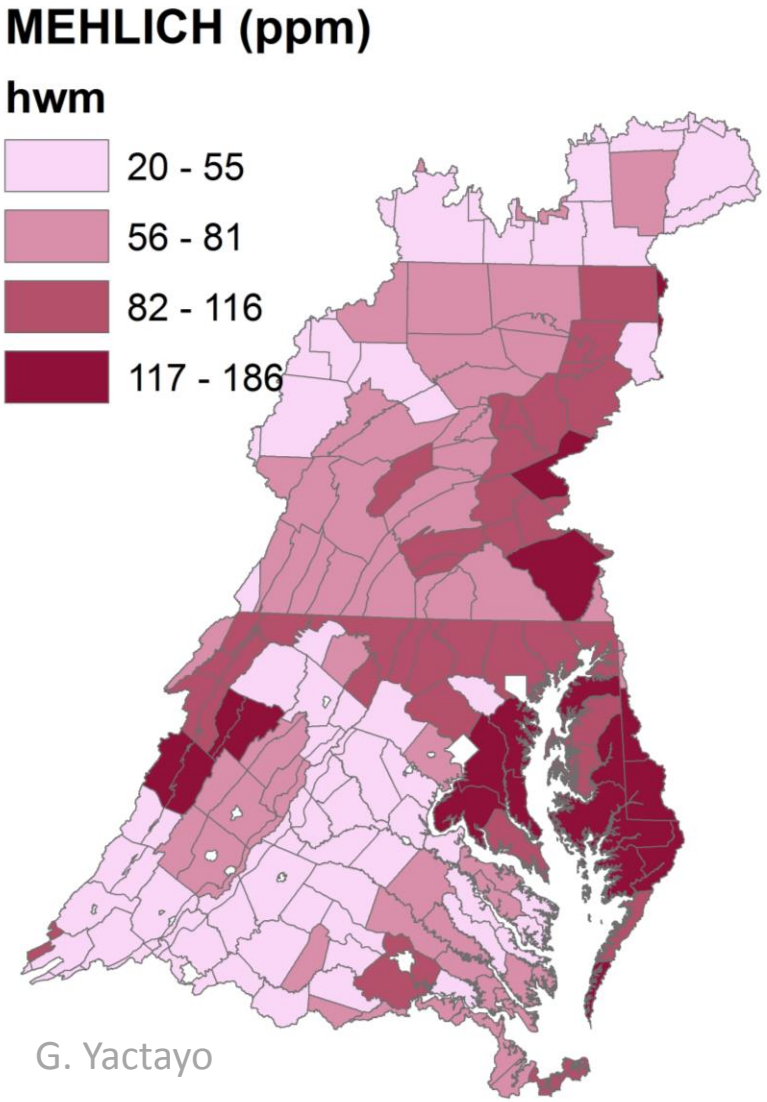
RIMP Stations vs. Below-RIMP Stations:

change in EOF, EOS, DEL

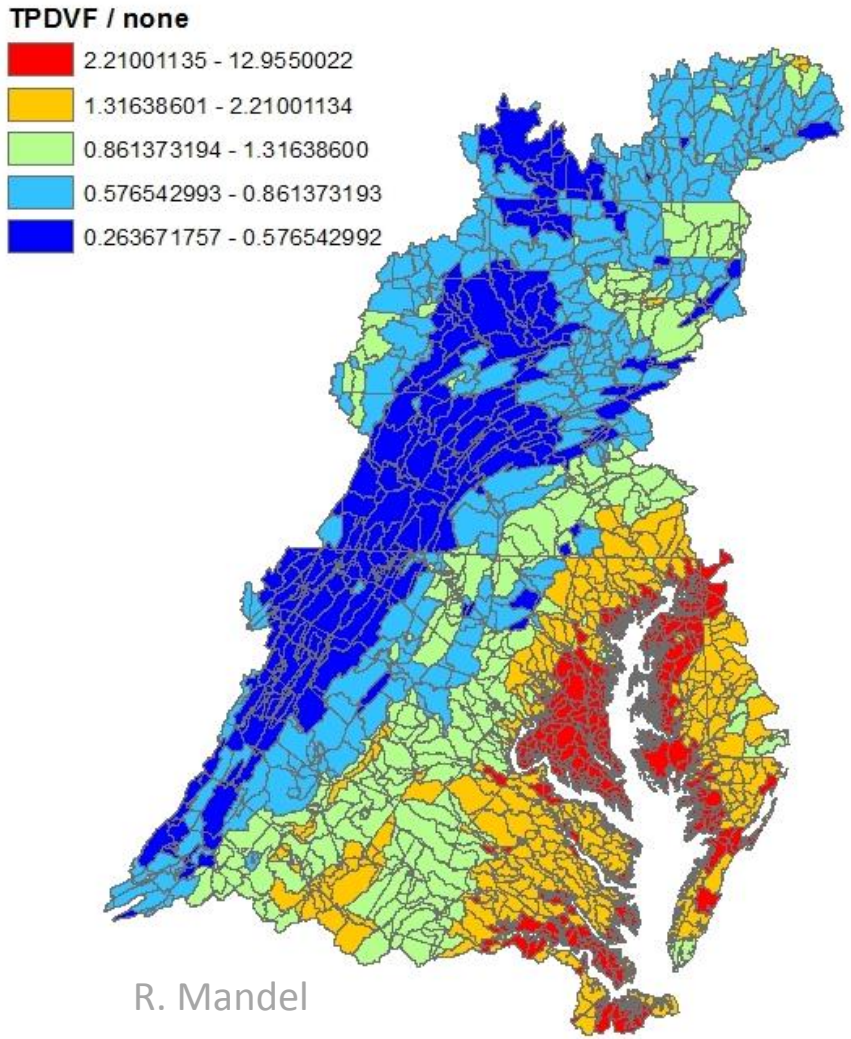
RIMP				Below-RIMP			
specifier	EOF	EOS	DEL	specifier	EOF	EOS	DEL
FLOW	-1	-1	-3	FLOW	-1	-1	1
HEAT	90	90	30	HEAT	22	22	2
NH3X	7	-7	0	NH3X	4	5	6
NO23	45	-38	-1	NO23	15	17	21
ORGN	-22	-72	-31	ORGN	-11	3	11
TOTN	30	-117	-31	TOTN	9	26	38
PO4X	**1**	**0**	**-1**	**PO4X**	**0**	**9**	**9**
ORGP	-4	-4	-2	ORGP	-2	0	0
TOTP	**-3**	**-3**	**-3**	**TOTP**	**-2**	**9**	**9**
TSSX	-7016	-1803	-965	TSSX	588	-104	783
ORGC	-20	-708	59	ORGC	-59	347	378
TSED	-4	-1	0	TSED	0	0	0
acre	0	0	0	acre	0	0	0

in millions

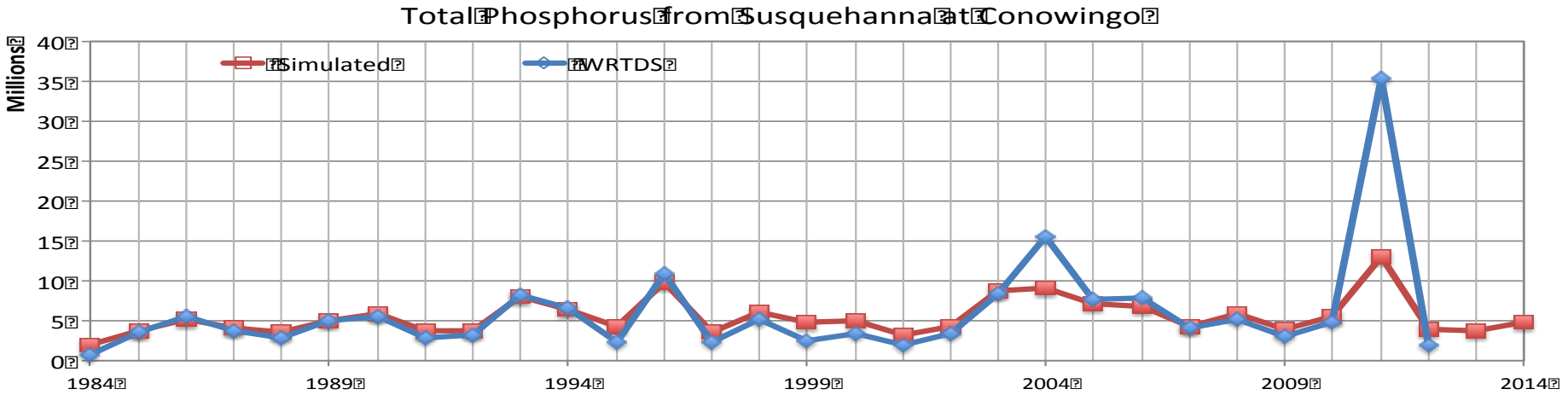
Major change is introduced at EOS of Non-RIMP region, that includes (1) L2W DVs, (2) S2R Factors, and (3) BMPs

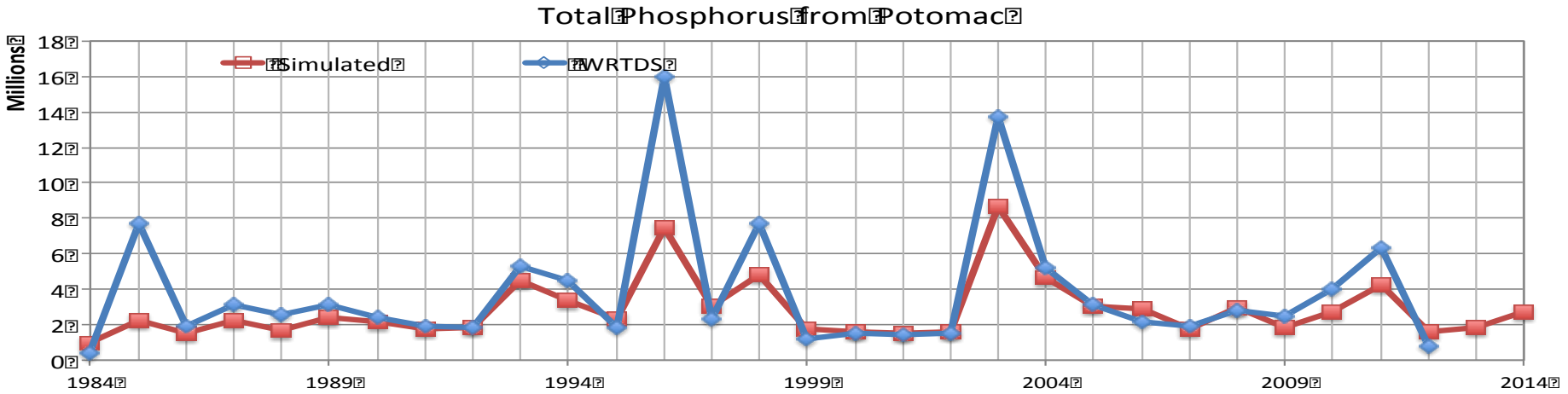


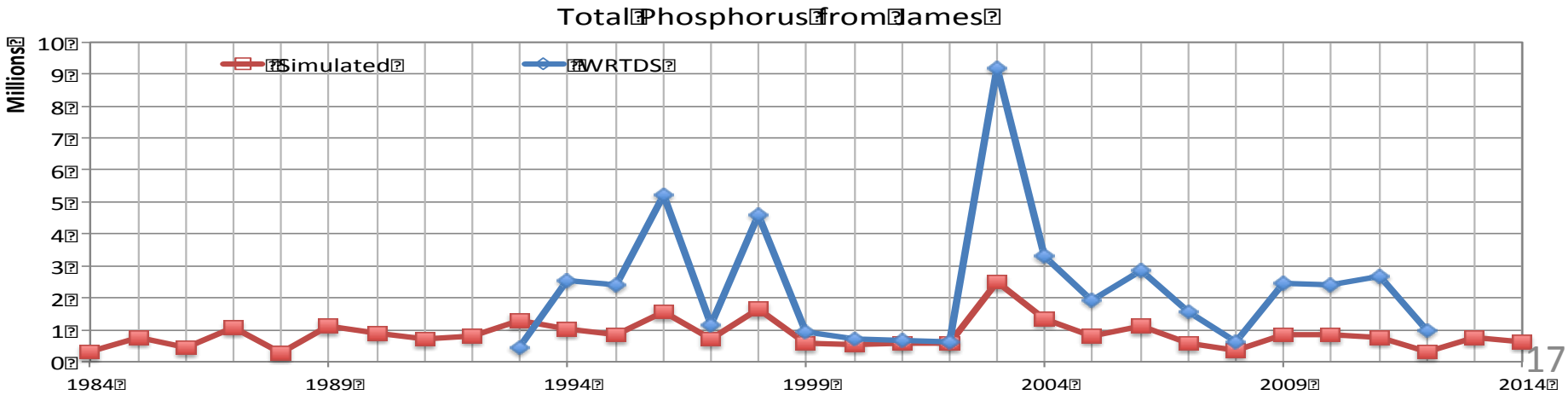
G. Yactayo



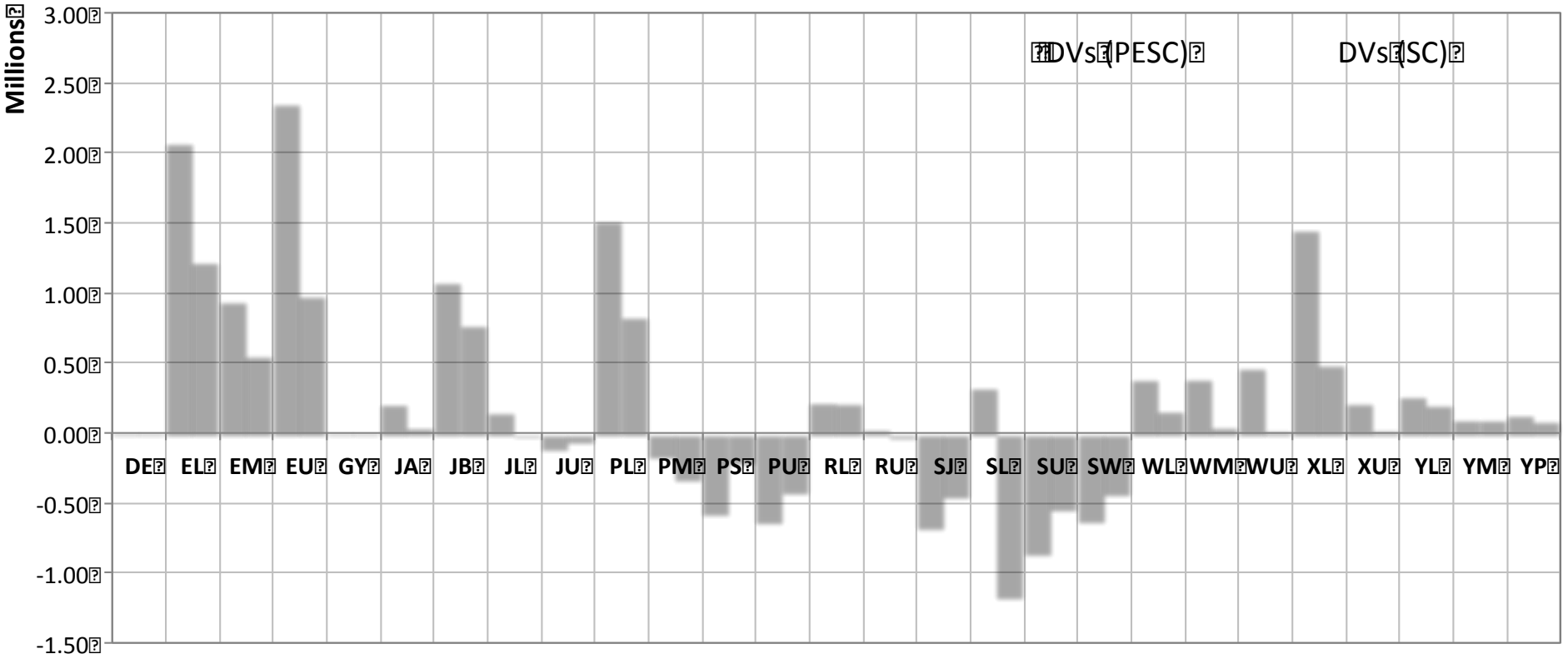
R. Mandel


Total Phosphorus from Susquehanna at Conowingo
Millions
Simulated
WRTDS
40
35
30
25
20
15
10
5
0
1984
1989
1994
1999
2004
2009
2014


Total Phosphorus from Potomac
Millions
Simulated
WRTDS
18
16
14
12
10
8
6
4
2
0
1984
1989
1994
1999
2004
2009
2014


Total Phosphorus from James
Millions
Simulated
WRTDS
10
9
8
7
6
5
4
3
2
1
0
1984
1989
1994
1999
2004
2009
2014

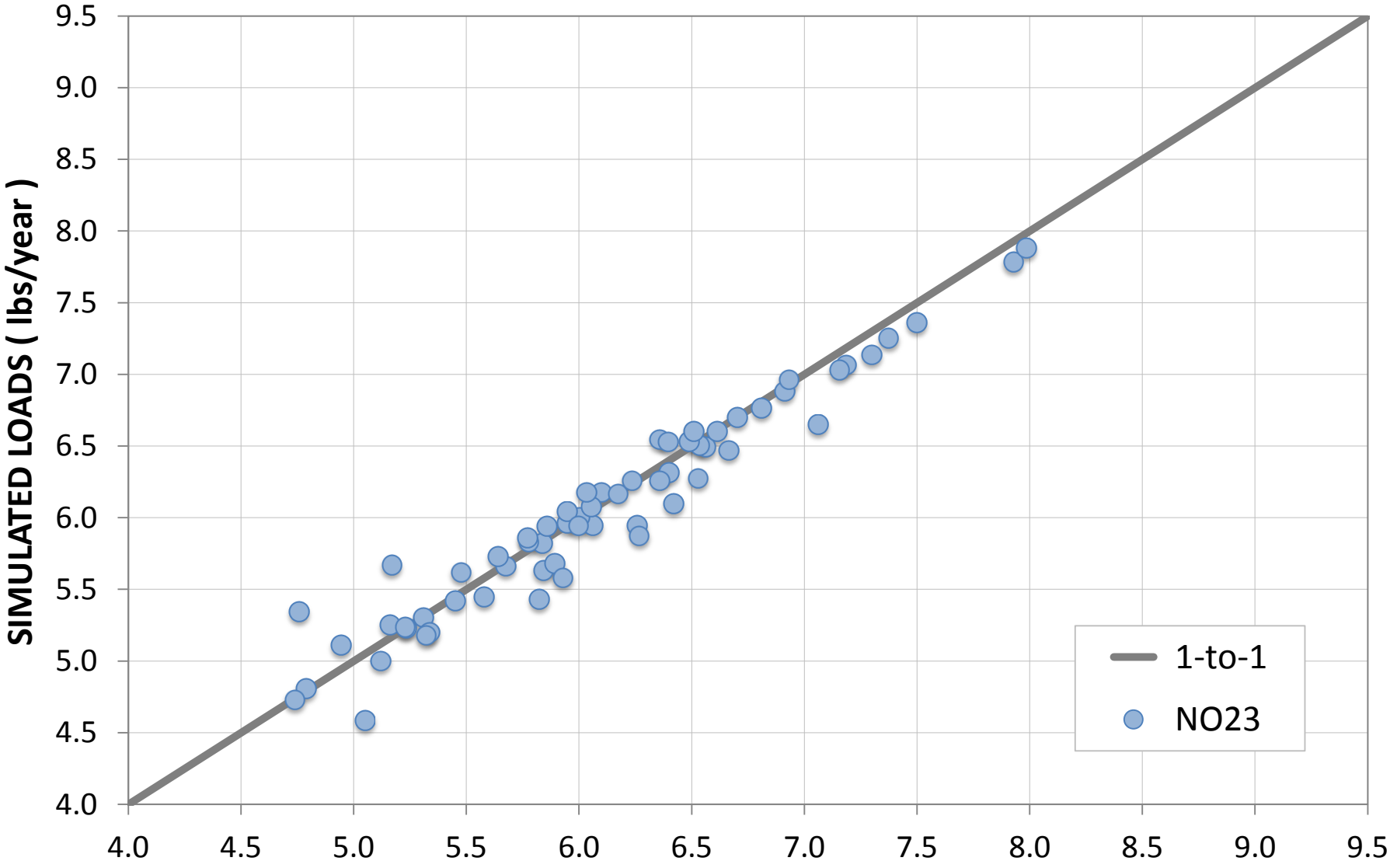
Affect of L2W delivery variances on the phosphorus export



total phosphorus load (target)	= 27.54 M lb.
total phosphorus load after PESC DVs	= 36.34 M lb.
total phosphorus load after SC DVs	= 29.77 M lb.

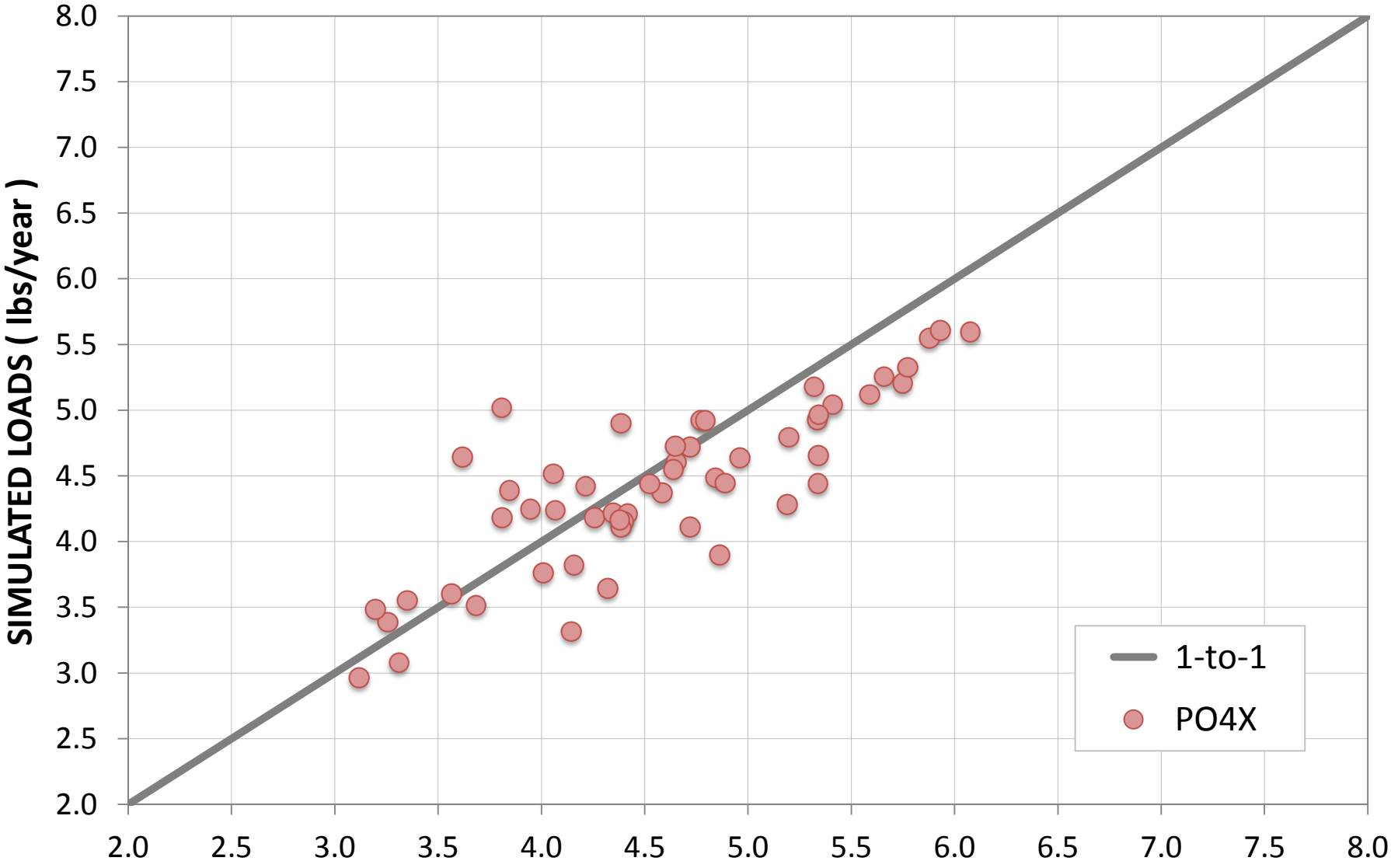
Average Annual Load

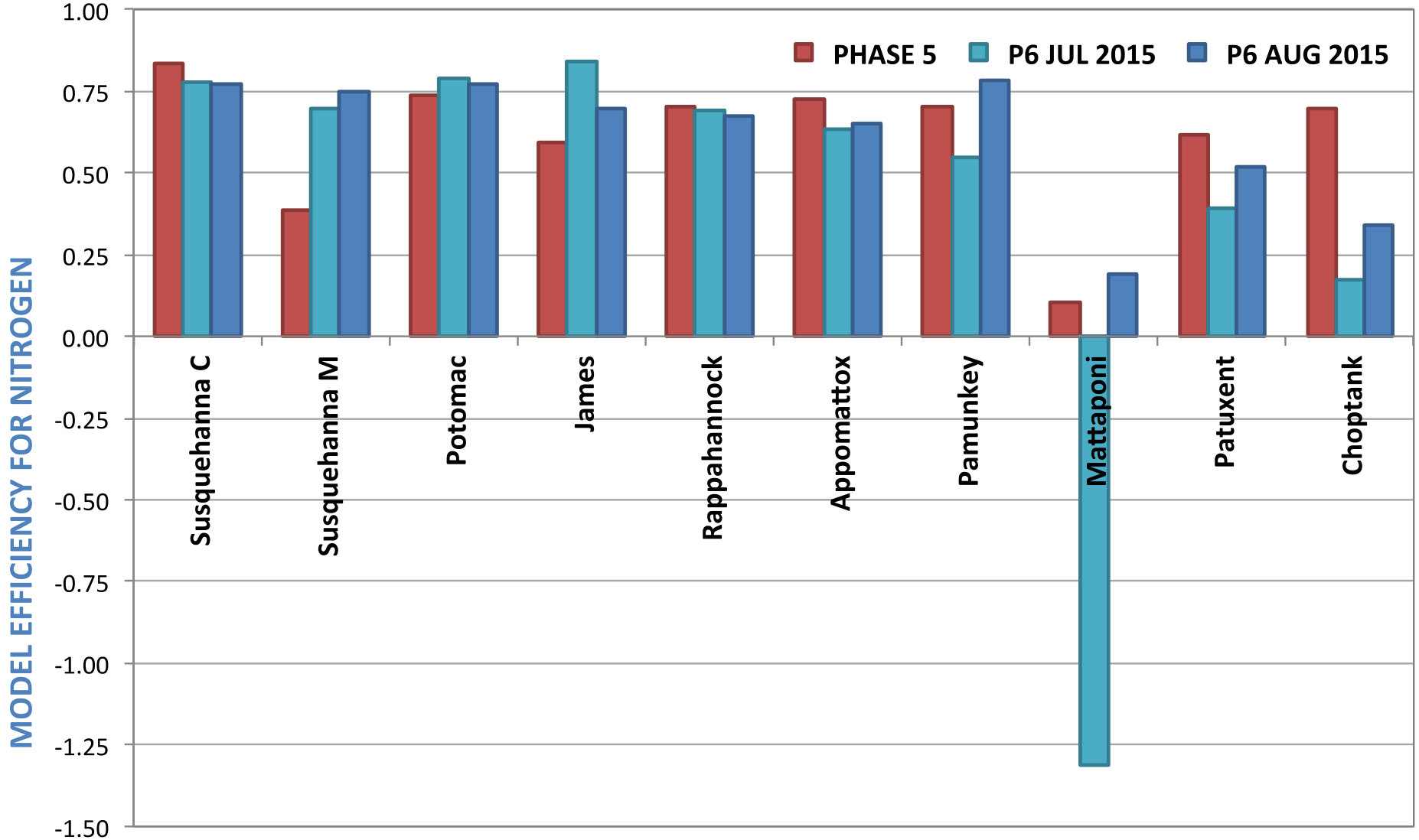
NITRATE

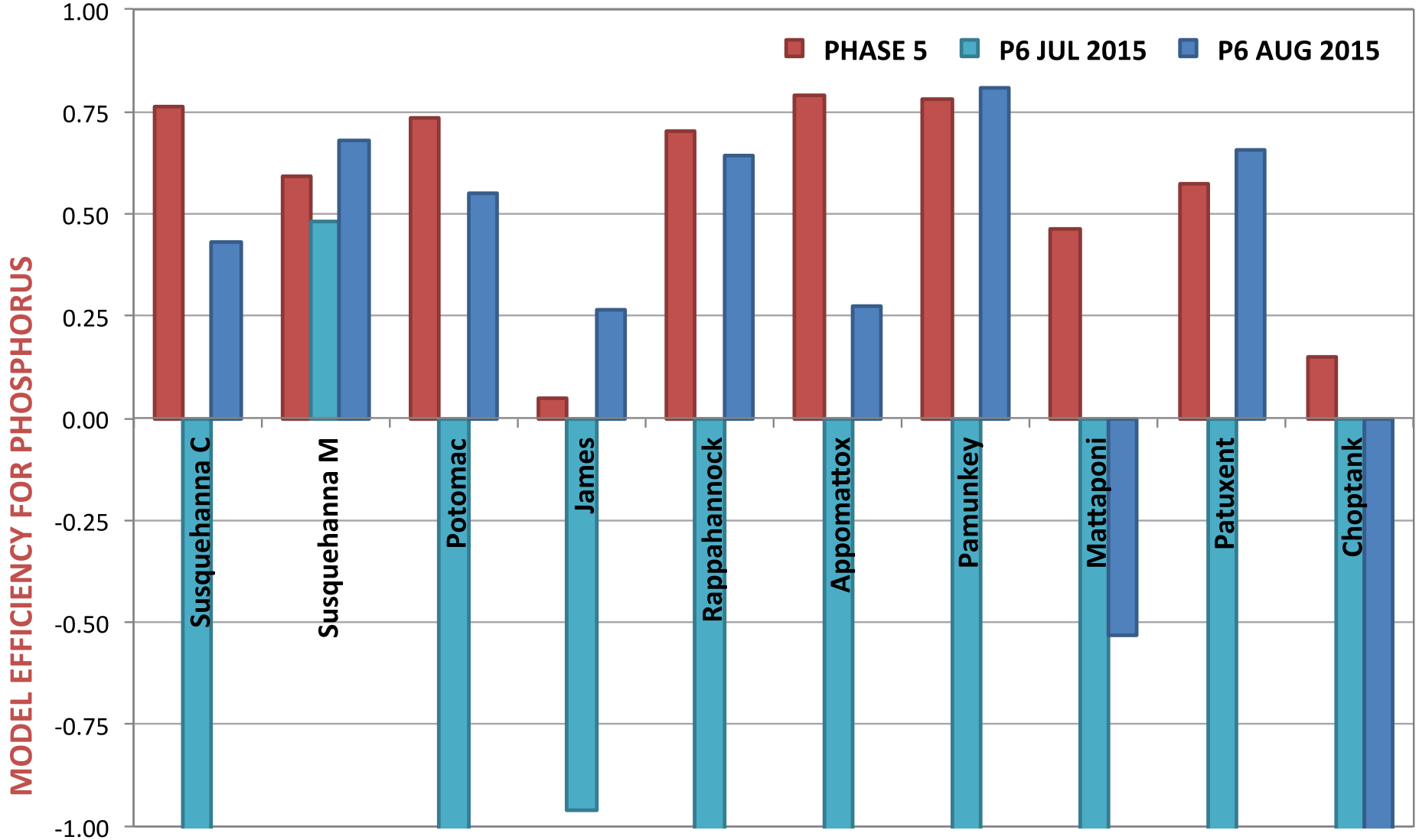


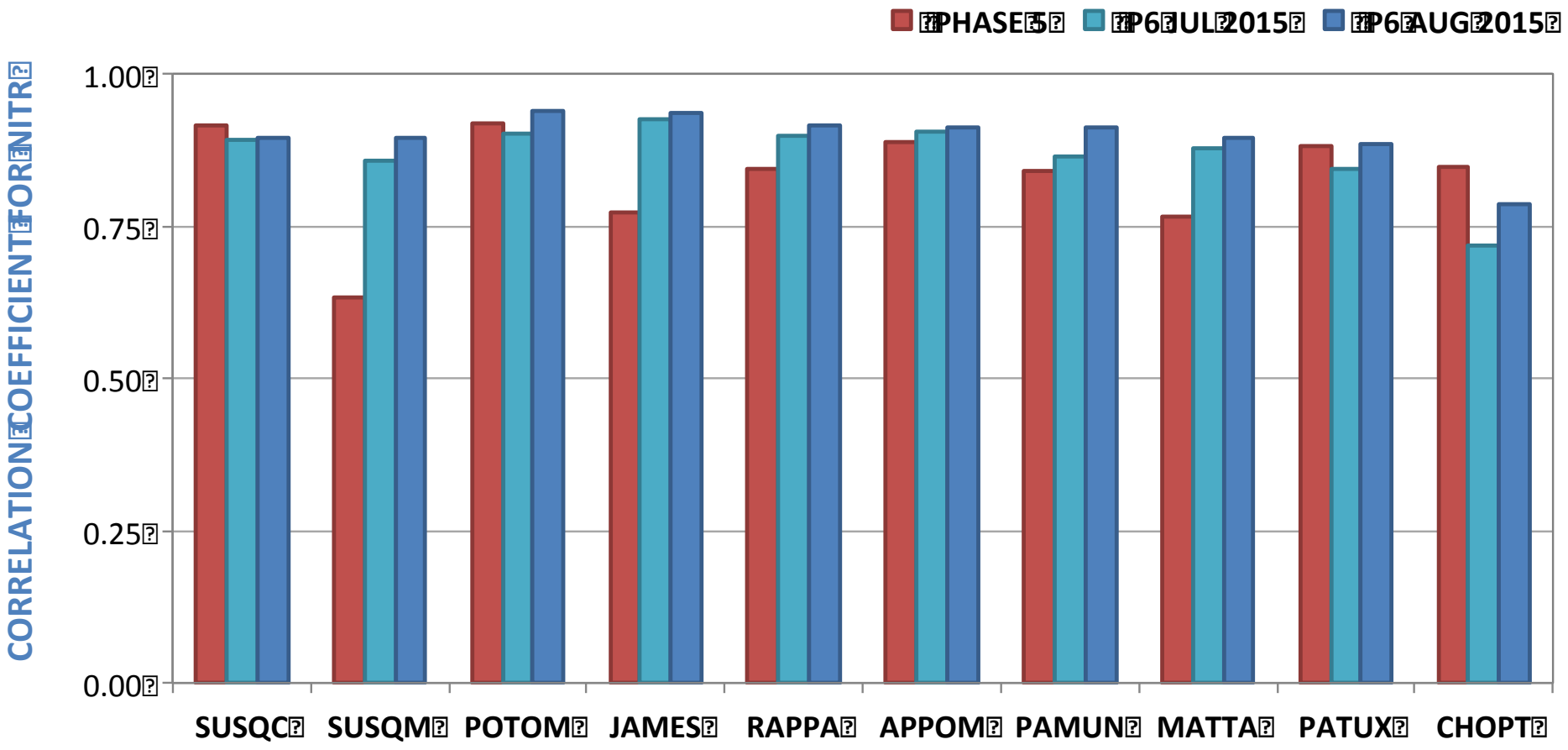
Average Annual Load

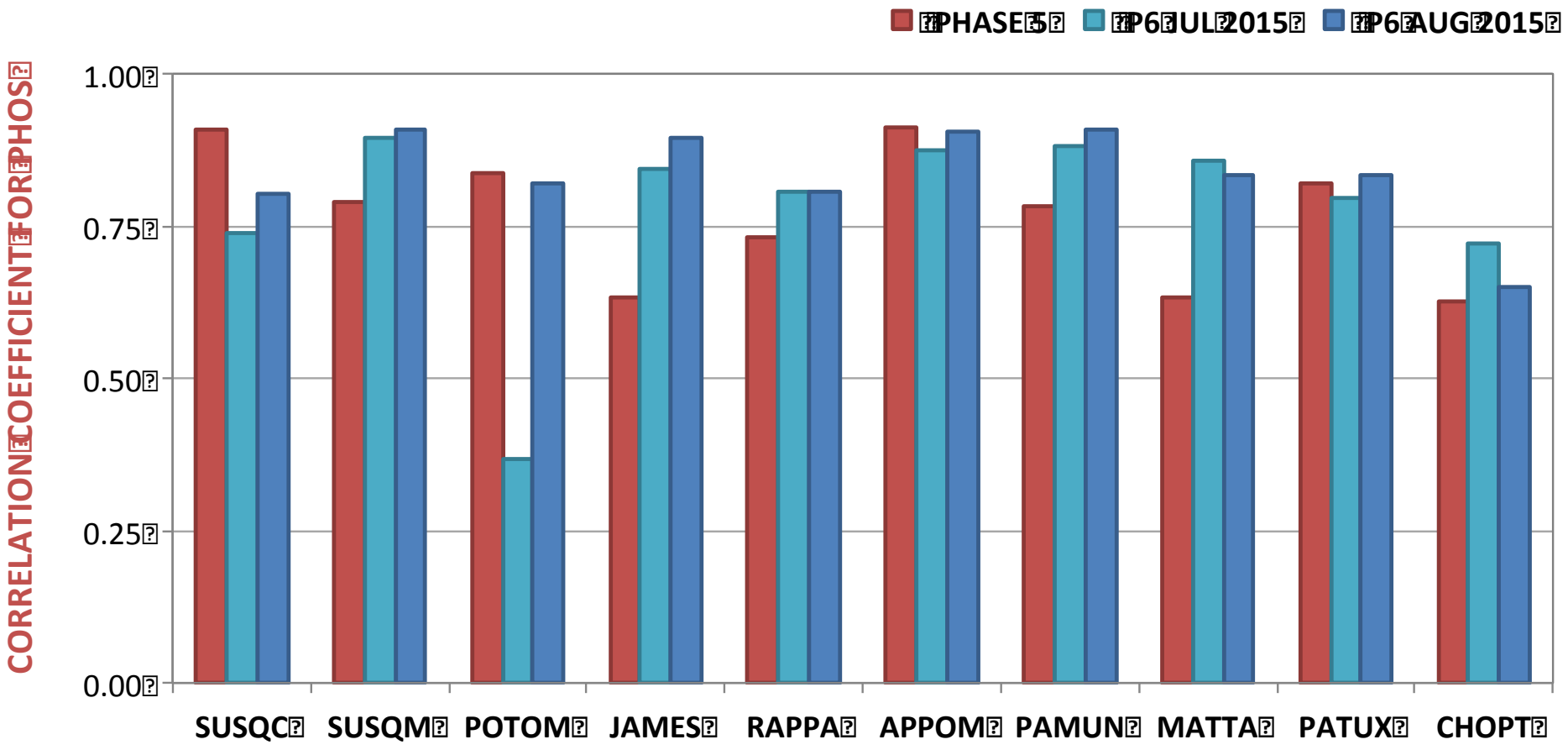
PHOSPHATE




MODEL EFFICIENCY FOR NITROGEN
1.00
0.75
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
-1.25
-1.50
PHASE 5
P6 JUL 2015
P6 AUG 2015
Susquehanna C
Susquehanna M
Potomac
James
Rappahannock
Appomattox
Pamunkey
Mattaponi
Patuxent
Choptank

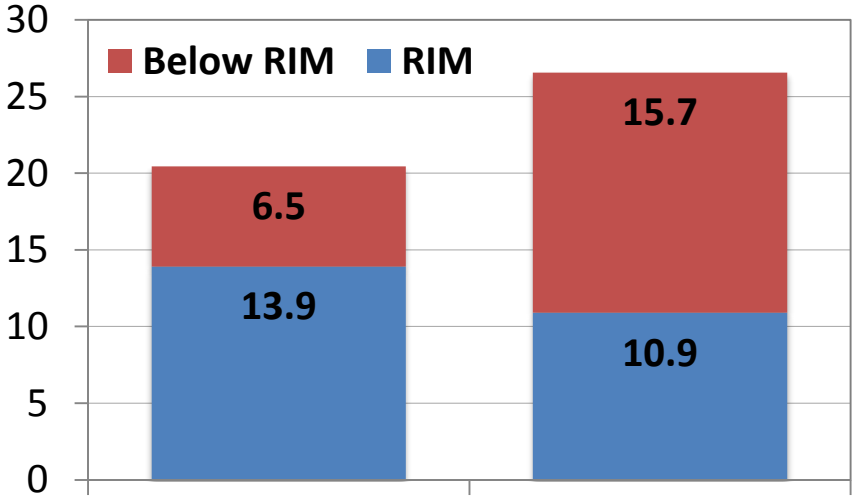

MODEL EFFICIENCY FOR PHOSPHORUS
1.00
0.75
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
PHASE 5
P6 JUL 2015
P6 AUG 2015
Susquehanna C
Susquehanna M
Potomac
James
Rappahannock
Appomattox
Pamunkey
Mattaponi
Patuxent
Choptank

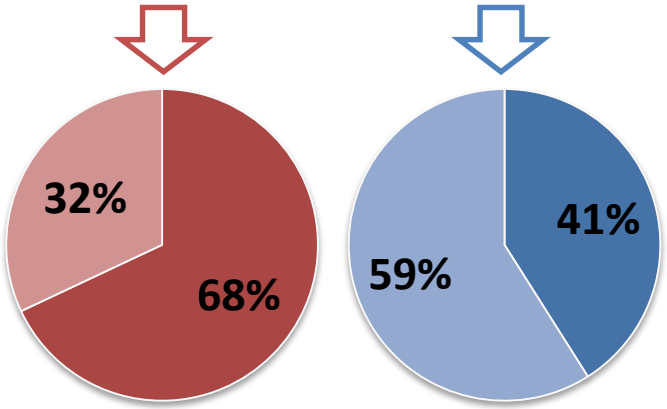

PHASE5
P6JUL2015
P6AUG2015
CORRELATIONCOEFFICIENTFORNITR
1.00
0.75
0.50
0.25
0.00
SUSQC
SUSQM
POTOM
JAMES
RAPPA
APPOM
PAMUN
MATTA
PATUX
CHOPT


PHASE5
P6 JUL 2015
P6 AUG 2015
CORRELATION COEFFICIENT FOR PHOS
1.00
0.75
0.50
0.25
0.00
SUSQC
SUSQM
POTOM
JAMES
RAPPA
APPOM
PAMUN
MATTA
PATUX
CHOPT

Total Phosphorus Delivery to the Bay

1985 – 2005

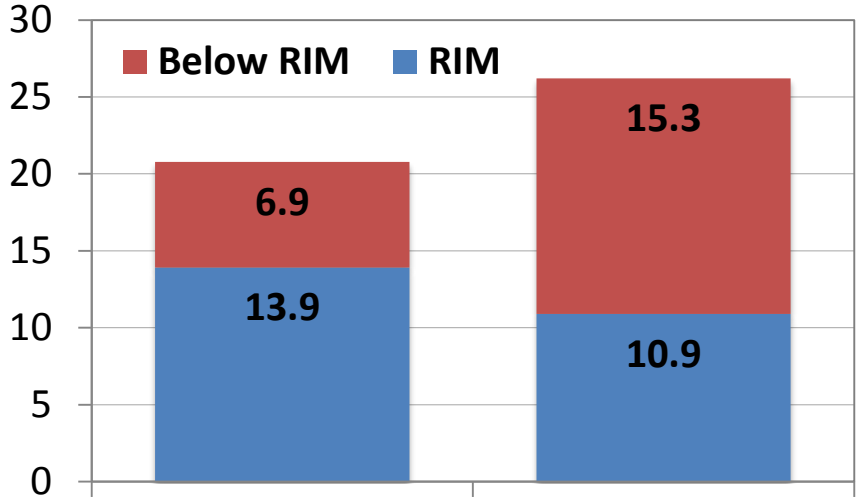


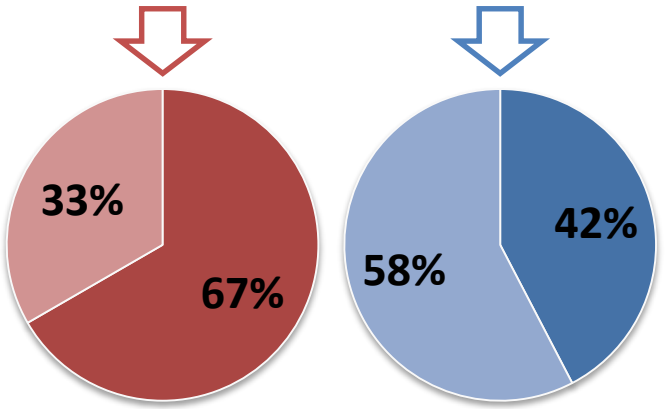


P5 RIM P6 RIM

P5 Below RIM P6 Below RIM

1991 – 2000





P5 RIM P6 RIM

P5 Below RIM P6 Below RIM

Watershed Phosphorus Loads

in millions

specifier	EOF		EOS		DEL	
	P532	P6	P532	P6	P532	P6
FLOW	63	61	62	61	61	59
HEAT	634	746	631	743	724	755
NH3X	72	83	81	79	53	59
NO23	218	278	273	253	148	168
ORGN	187	155	209	140	112	92
TOTN	478	517	563	472	313	320
PO4X	**39**	**40**	**29**	**38**	**16**	**24**
ORGP	11	5	9	5	5	3
TOTP	**49**	**45**	**38**	**43**	**20**	**27**
TSSX	104486	98059	14359	12452	8497	8315
ORGC	2491	2412	2709	2349	1180	1617
TSED	52	49	7	6	4	4
ACRE	41	40	41	40	41	40

RIMP Stations vs. Non-RIMP Stations – Delivered

OLD

Difference at RIMP Stations

specifier	*DEL* (P6 – P5)
FLOW	-3
HEAT	30
NH3X	0
NO23	-1
ORGN	-31
TOTN	-31
PO4X	**-1**
ORGP	-2
TOTP	**-3**
TSSX	-965
ORGC	59
TSED	0
ACRE	0

in millions

Difference at non-RIMP Stations

specifier	*DEL* (P6 – P5)
FLOW	1
HEAT	2
NH3X	6
NO23	21
ORGN	11
TOTN	38
PO4X	**9**
ORGP	0
TOTP	**9**
TSSX	783
ORGC	378
TSED	0
ACRE	0

in millions