An Early Look at Draft Phase 6 Key Scenarios

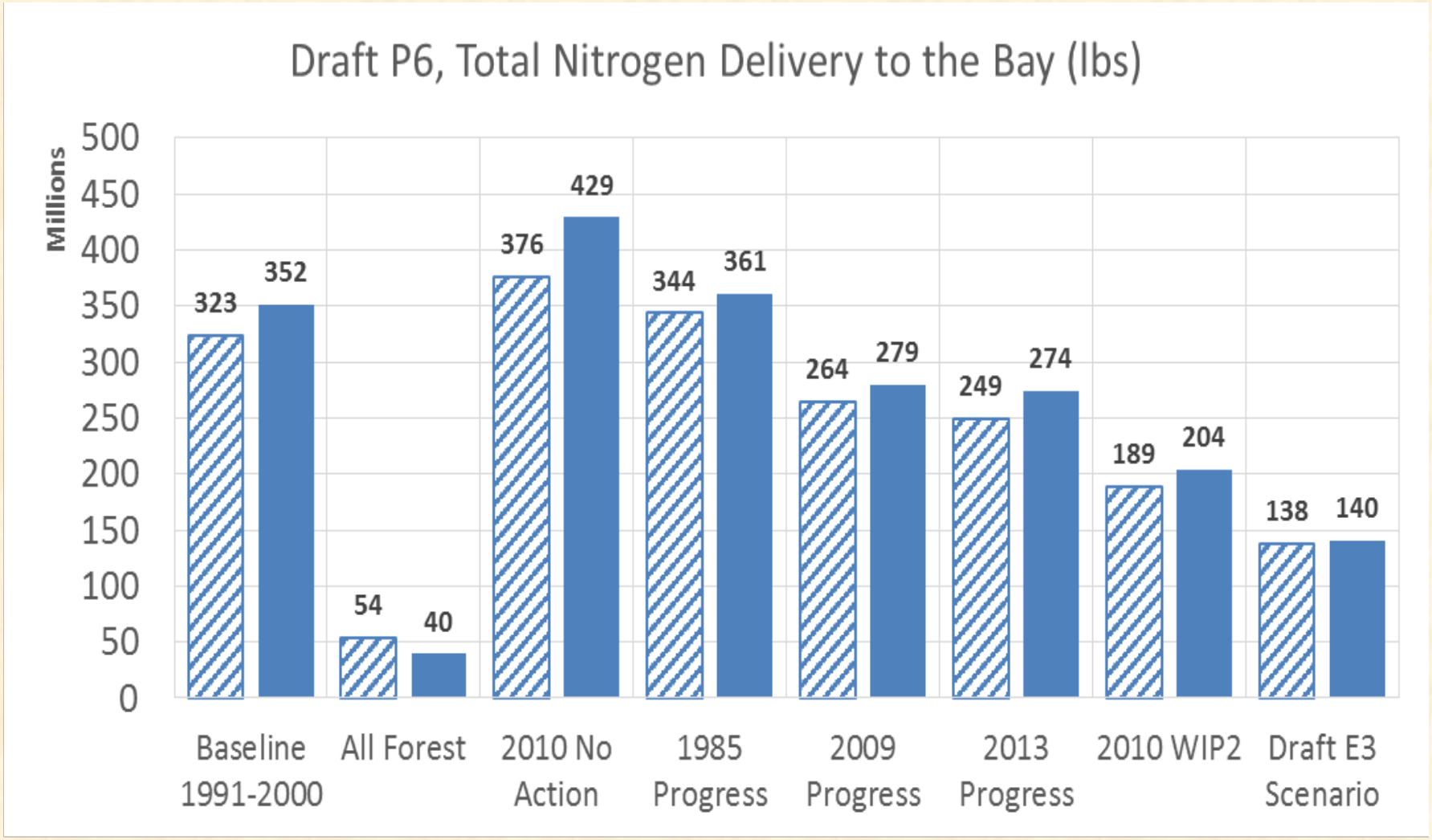
Modeling Workgroup Quarterly Review
August 9, 2017

Lew Linker, Ping Wang, Richard Tian, and the CBPO Modeling Team (with outstanding assistance from Carl Cerco & Mark Noel, CoE ERDC)

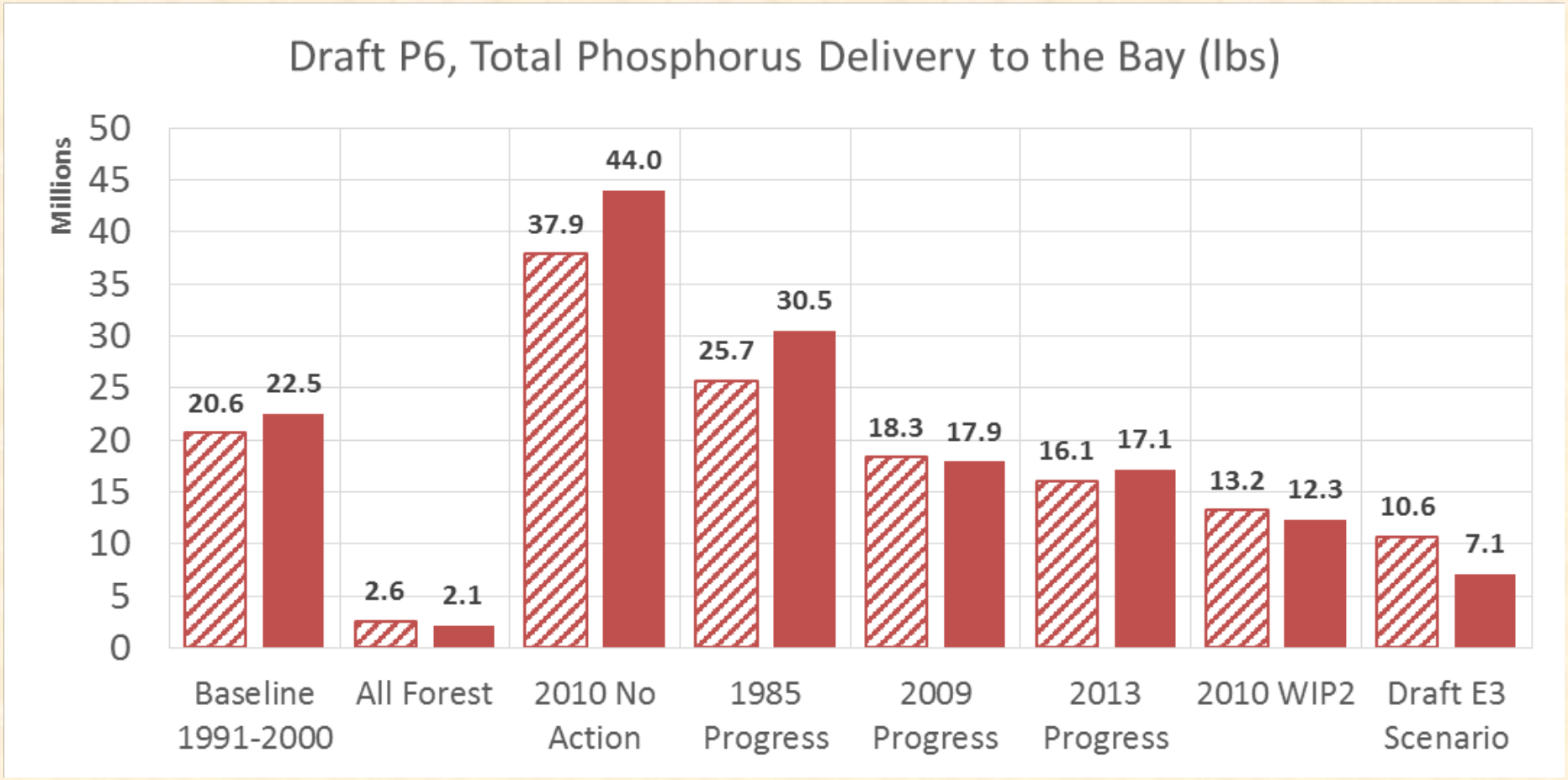
Chesapeake Bay Program
Science, Restoration, Partnership

Overview:

- Early review of key Phase 6 draft scenarios of No Action, 1985 Progress, 2009 Progress, 2013 Progress, WIP2 Level of Effort, E3, and All Forest.
- Errata:
  - The 2025 atmo. dep. used for tidal water for 1985 Progress, 2009 Progress, 2013 Progress, E3, and No Action. The Base, WIP2, and All Forest atmo. dep. to tidal water are correct.
  - Correction of atmo dep to coastal water exchange needed for all scenarios other than Base.
  - E3 Scenario needs to be finalized.
  - Historical BMPs need to be added to Progress Scenarios.
  - All scenarios to be run on final Phase 6 WSM and WQSTM.



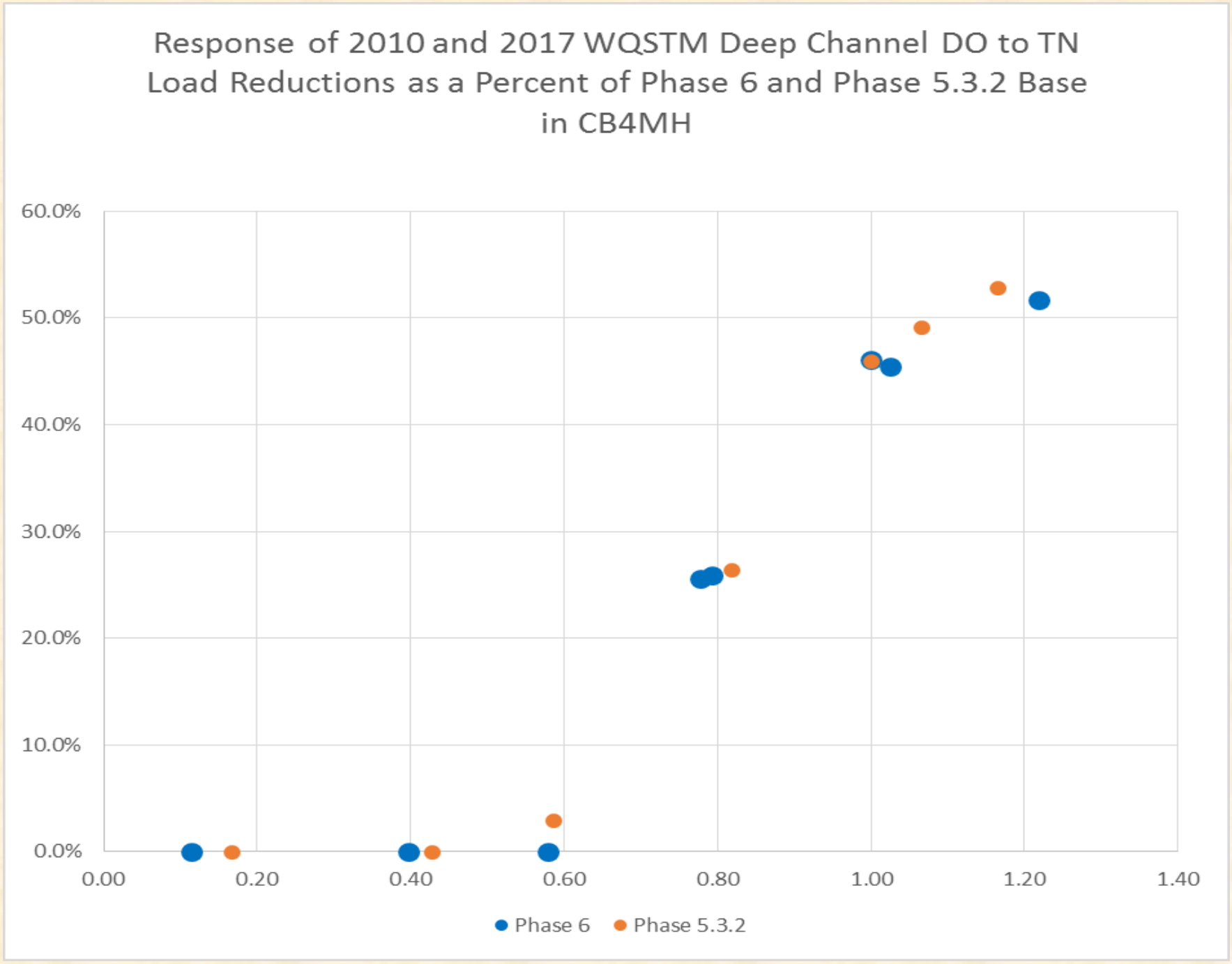
2017 Draft Phase 6 in solid blue bars. Phase 5.3.2 in stippled bars. Units in millions of pounds.



2017 Draft Phase 6 in solid red bars. Phase 5.3.2 in stippled bars. Units in millions of pounds.

Phase 6		Base	No Action	1985 Progress	2009 Progress	2013 Progress	WIP2	E3	All Forest
8/9/17		352TN	429TN	361TN	279TN	274TN	204TN	140TN	40TN
		22.5TP	44.0TP	30.5TP	17.9TP	17.1TP	12.3TP	7.1TP	2.1TP
		1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1995
Cbseg	State	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel	Deep Channel
CB3MH	MD	16.0%	10.9%	7.7%	0.6%	0.6%	0.0%	0.0%	0.0%
CB4MH	MD	46.0%	51.6%	45.4%	25.9%	25.6%	0.0%	0.0%	0.0%
CB5MH	MD/VA	14.2%	18.5%	13.5%	0.9%	0.8%	0.0%	0.0%	0.0%
CHSMH	MD	37.4%	25.4%	17.7%	5.6%	5.1%	0.0%	0.0%	0.0%
POTMH	MD/VA	20.2%	20.4%	14.2%	0.0%	0.0%	0.0%	0.0%	0.0%
POMMH	MD	20.4%	20.6%	14.3%	0.0%	0.0%	0.0%	0.0%	0.0%
RPPMH	VA	19.0%	23.9%	13.2%	0.0%	0.0%	0.0%	0.0%	0.0%
EASMH	MD	25.4%	26.0%	18.8%	12.3%	12.2%	0.6%	0.0%	0.0%
MD5MH	MD	21.7%	25.3%	20.6%	4.3%	4.2%	0.0%	0.0%	0.0%
VA5MH	VA	4.5%	9.6%	3.7%	0.0%	0.0%	0.0%	0.0%	0.0%
PATMH	MD	24.8%	28.5%	26.6%	1.6%	1.0%	0.0%	0.0%	0.0%

Phase 5.3.2		Base	All Forest	No Action	1985 Progress	2009 Progress	WIP2	E3
		323TN	53.6TN	376TN	344TN	264TN	189TN	138TN
		20.6TP	2.6TP	37.9TP	25.7P	18.3TP	13.2TP	10.6TP
		1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	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%


Response of 2010 and 2017 WQSTM Deep Channel DO to TN Load Reductions as a Percent of Phase 6 and Phase 5.3.2 Base in CB4MH
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Phase 6
Phase 5.3.2

Phase 6 8/9/17		Base 352TN 22.5TP	No Action 429TN 44.0TP	1985 Progress 361TN 30.5TP	2009 Progress 279TN 17.9TP	2013 Progress 274TN 17.1TP	WIP2 204TN 12.3TP	E3 140TN 7.1TP	All Forest 40TN 2.1TP
		1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1995	1993-1995
Cbseg	State	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water	Deep Water
CB3MH	MD	2.1%	2.2%	1.3%	0.4%	0.4%	0.1%	0.0%	0.0%
CB4MH	MD	21.0%	23.3%	19.2%	10.7%	10.7%	5.0%	0.7%	0.0%
CB5MH	MD/VA	4.2%	4.4%	3.1%	1.4%	1.4%	0.1%	0.0%	0.0%
CB6PH	VA	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CB7PH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CHSMH	MD	25.7%	8.5%	3.2%	0.3%	0.3%	0.0%	0.0%	0.0%
EASMH	MD	5.9%	18.9%	2.2%	0.3%	0.2%	0.0%	0.0%	0.0%
PAXMH	MD	6.3%	15.4%	8.0%	0.1%	0.2%	0.0%	0.0%	0.0%
POTMH	MD/VA	4.1%	6.4%	4.0%	0.5%	0.4%	0.0%	0.0%	0.0%
POMMH	MD	4.1%	6.4%	4.1%	0.5%	0.5%	0.0%	0.0%	0.0%
RPPMH	VA	5.9%	9.4%	5.4%	1.6%	1.5%	0.0%	0.0%	0.0%
SBEMH	VA	0.0%	4.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YRKPH	VA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MD5MH	MD	8.5%	8.4%	6.6%	3.1%	3.1%	0.6%	0.0%	0.0%
VA5MH	VA	0.5%	0.6%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
PATMH	MD	12.4%	5.8%	6.4%	0.5%	0.5%	0.0%	0.0%	0.0%
MAGMH	MD	51.0%	51.0%	51.0%	27.3%	23.2%	0.4%	0.3%	0.0%
SOUMH	MD	18.6%	24.3%	18.6%	11.2%	13.8%	3.0%	0.0%	0.0%
SEVMH	MD	6.1%	19.2%	6.1%	0.0%	0.0%	0.0%	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
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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%
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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%
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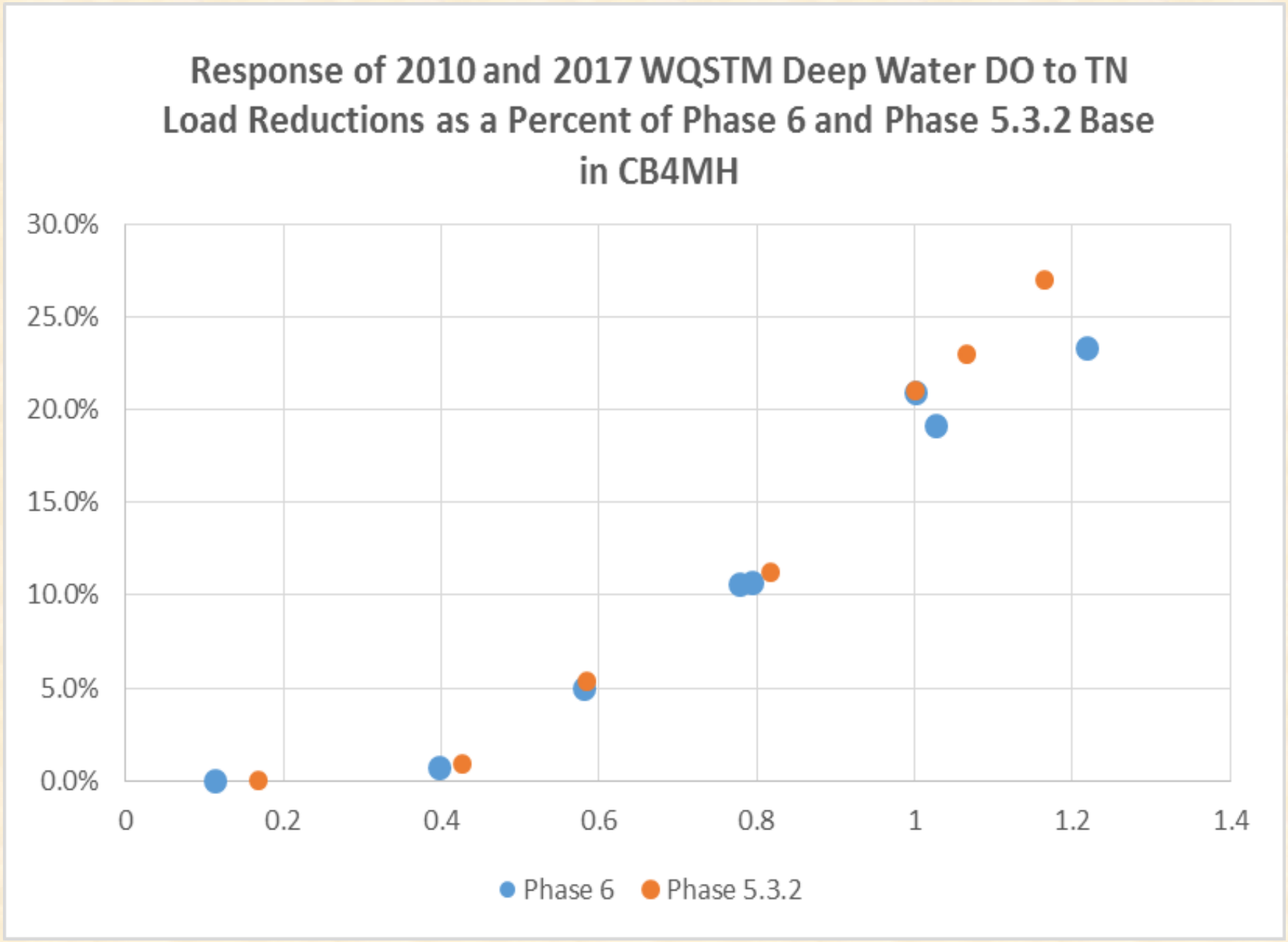
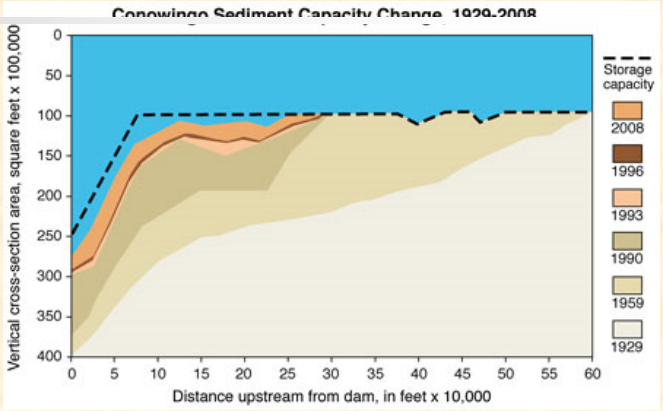
VA5MH	VA	0.5%	0.0%	0.8%	0.7%	0.0%	0.0%	0.0%
PATMH	MD	12.4%	0.0%	31.9%	19.0%	3.6%	0.0%	0.0%
MAGMH	MD	51.0%	0.0%	57.1%	51.0%	51.0%	9.5%	7.1%
SOUMH	MD	18.6%	0.0%	35.5%	22.8%	0.0%	0.0%	0.0%
SEVMH	MD	6.1%	0.0%	30.2%	6.1%	0.7%	0.0%	0.0%


Response of 2010 and 2017 WQSTM Deep Water DO to TN Load Reductions as a Percent of Phase 6 and Phase 5.3.2 Base in CB4MH
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Phase 6
Phase 5.3.2

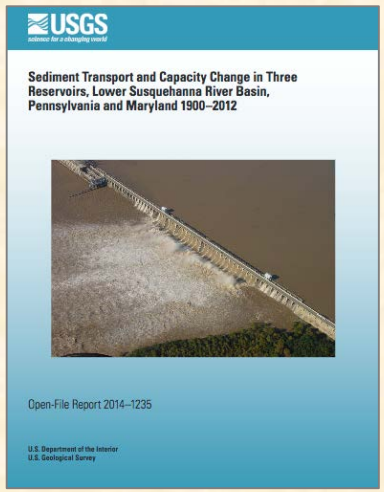
Brief Review of Conowingo Infill

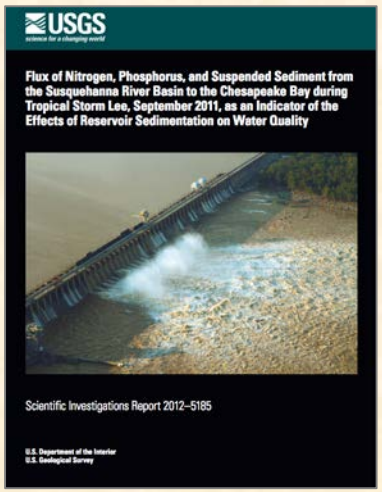
- Conowingo is nearing dynamic equilibrium, which has reduced its ability to trap sediment and nutrients.

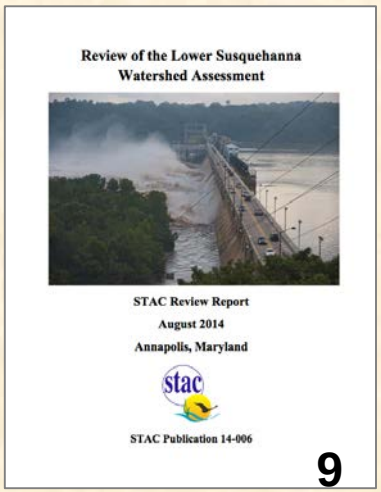


Source: Graph, Michael Langland, U.S. Geological Survey

- Several research articles have documented it, and they provide an analysis of changes in transport, which are incorporated in this analysis.







JEQ Estimated Deep Channel Nonattainment under Conowingo Infill Conditions

Table 1. Model-estimated level of time and space nonattainment of deep-channel dissolved oxygen (DO) in all Chesapeake Bay segments that have a deep-channel designated use. The first four scenarios (columns 2–5) are key milestone scenarios and are ordered from the highest to the lowest nutrient and sediment loads for the entire Chesapeake watershed. The nutrient and sediment scenario loads are under the scenario title and have units of millions of kilograms for total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS). The last four columns (columns 6–9) are different Conowingo infill scenarios. Deep-channel variances of 2% are applied in the central mainstem (CB4MH) and Eastern Bay (EASMH) and 16% in the lower Chester River (CHSMH). (A variance is an allowable exceedance of an established water quality standard based on the best available data on achievable water quality conditions.) The estimated degree of nonattainment of the deep-channel DO water quality standard is shown in bold type for each deep-water segment of the Chesapeake. Once attainment is estimated to be achieved, the value is shown in italic type.

Scenario	1985 Scenario 160 TN 11.2 TP 5480 TSS	2010 Scenario 119 TN 8.8 TP 3790 TSS	TMDL WIP† Scenario 87 TN 6.8 TP 3030 TSS	All Forest Scenario 24 TN 1.2 TP 610 TSS	Increase of nonattainment under Conowingo scour conditions in January storm	Increase of nonattainment under January storm conditions compared with No Storm Scenario	Increase of nonattainment under June storm conditions compared with No Storm Scenario	Increase of nonattainment under Moderate High Flow conditions
CB segment	%							
CB3MH	**17**	**5**	*0*	*0*	*0*	**1**	**1**	*0*
CB4MH	**49**	**23**	*1*	*0*	**1**	**1**	**4**	**2**
CB5MH	**17**	*0*	*0*	*0*	*0*	*0*	*0*	*0*
CHSMH	**39**	**28**	*15*	*0*	**1**	**2**	**8**	**1**
EASMH	**29**	**14**	*1*	*0*	**1**	**2**	**3**	**3**
PATMH	**42**	**18**	*0*	*0*	*0*	*0*	*0*	*0*
POTMH	**20**	*0*	*0*	*0*	*0*	*0*	*0*	*0*
RPPMH	**23**	*0*	*0*	*0*	*0*	*0*	*0*	*0*

† Total maximum daily load Watershed Implementation Plan.

Initial, Preliminary Conclusions:

- The 2017 CBP Models have findings consistent with the 2010 CBP Models.

- The current best estimates of the increase in net transport of phosphorus loads to the Chesapeake due to Conowingo infill is about 1.7 million pounds which results in an estimated 1-3% increase in nonattainment of the Deep Channel DO water quality standard under WIP levels of nutrient loads.

- The current best estimate of the increase in nitrogen and phosphorus loads to the Chesapeake due to estimated 2025 climate induced changes to hydrology is 1% or less watershed wide for both nutrients. The detrimental influence of increased nutrient loads will be offset in 2025 by sea level rise (0.17m) and a Bay more open to the ocean.

Next Steps:

- Finalize both Phase 6 WSM & WQSTM. Assess if recalibration is needed after all input changes are applied in August.
- Begin geo runs now with current WQSTM calibration using a combination of NESC, ERDC, and cloud supercomputers to do about 200 geo runs.
- Finalize E3 and No Action Scenarios. Redo all key scenarios.
- Complete initial 2010 targets, 2010 targets + Conowingo infill, and 2010 targets + Conowingo infill + climate change for WQGIT 9/25-26 F2F.
- In addition, complete initial 2025 targets (and targets based on 2013, 2017, and 2025 land use variants to the extent possible).