Chesapeake Bay Program
Science. Restoration. Partnership.

Review of Phase III WIP Planning Targets Method

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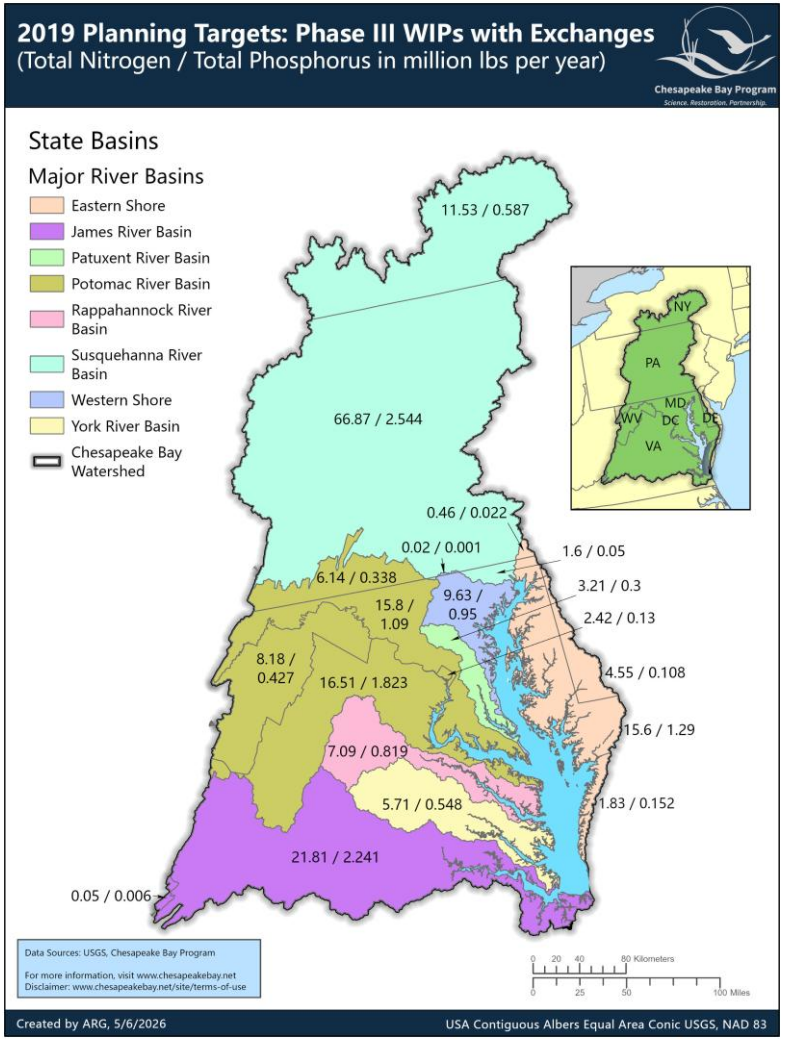
Clean Water Goal Team
05/18/2026



Agenda

1. **Objective**
   Goals of Planning Targets
2. **Key Principles**
   Foundational Partnership Decisions
3. **Assimilative Capacity**
   Determine Needed Load Reductions
4. **Distribution Method**
   Distribute Load Across the Partnership
5. **Complications**
   Additional Distribution Considerations

1

Objective

Goals of Planning Targets

Planning Targets Determine the Size and Distribution of Needed Load Reductions

1. Determine what reductions in TN, TP, and TSS are needed to meet Water Quality Standards

2. Inform the distribution of these reductions based on suite of watershed and estuarine models

2

Key Principles

Foundational Partnership Decisions

Broad Partnership Principles Guided Planning Target Development

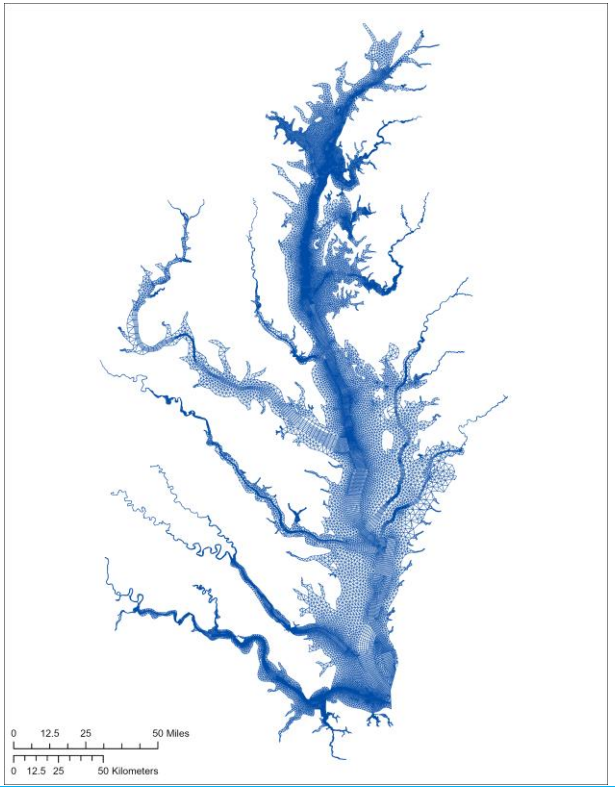
1. Distributed loads must result in achievement of the jurisdictions' Bay water quality standards.

2. State-river basins that contribute the most to Bay water quality problems must do the most to resolve those problems.
   a) More effective basins do more.

3. All tracked and reported reductions in loads are credited toward achieving assigned targets.

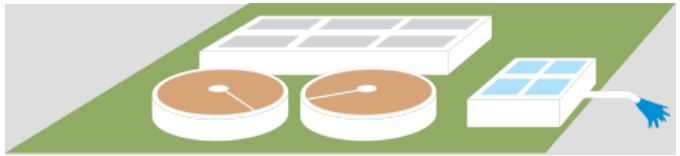
Critical Period Greatly Influences the Overall Effort to Meet WQS

- Critical period chosen as 1993-1995
  - Representative of an approximate 10-year return period for flow
    - Partnership conducted an extensive analysis of historical flow data



Hydrologic Averaging Period Sets Balance Between Point Source & Non-Point Source Loads

- Hydrologic averaging period chosen to be 1991-2000 in Phase 6 & Phase 5.3.2.
  - Slightly more representative of average hydrology compared to other periods (at the time)



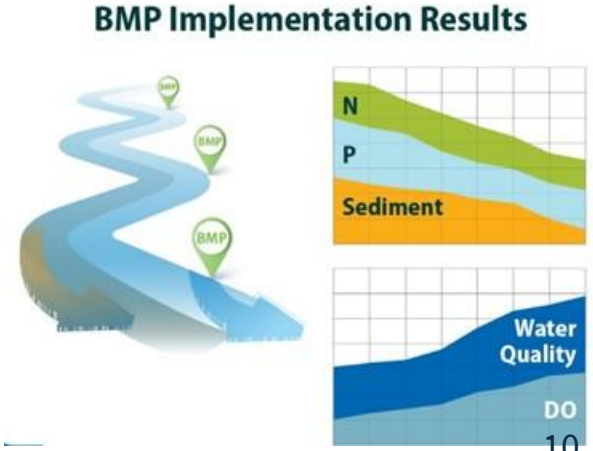
Credit: Integration and Application Network (ian.umces.edu/media-library)

Growth Prior to Scenario Base Year for No Action and E3 was Shared Equally

- Scenario Base year for Phase 5.3.2 and Phase 6 for land use, animals, septics, etc. set to 2010 for No Action and E3 scenarios

Previous Planning Targets Answer This Question

- What loads, given the hydrology of 1991-2000, would have been sufficient to meet Water Quality Standards in 1993-1995?



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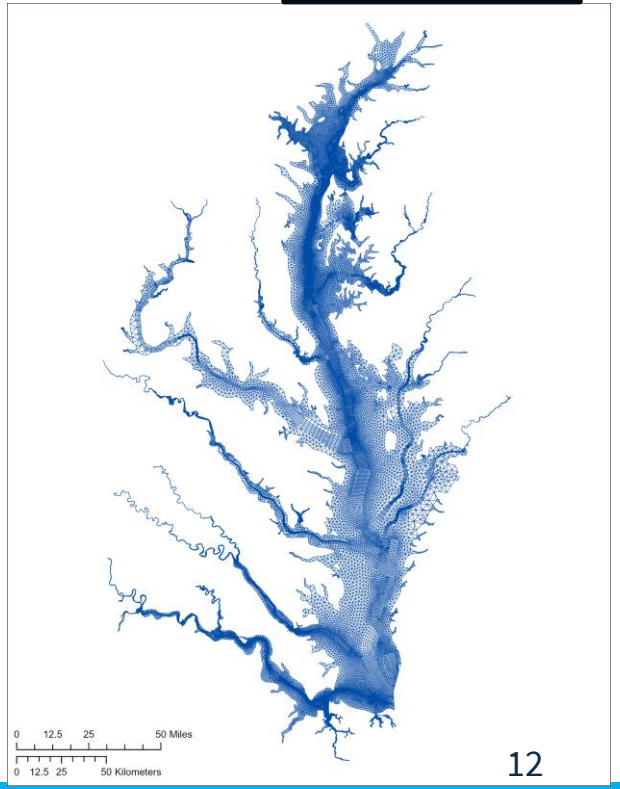
Assimilative Capacity

Determine Needed Load Reductions

1. Determine Load Reductions to Meet WQS

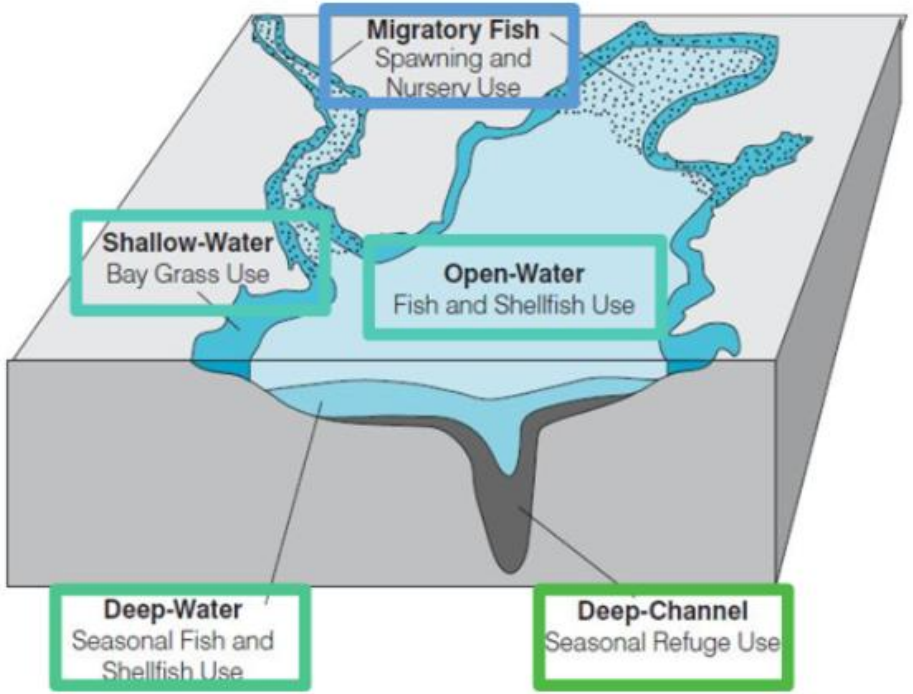
Assimilative Capacity is the Limit to What the Bay can Handle

- What is assimilative capacity?
  - The limit at which the Bay can absorb pollutants and still meet water quality standards as determined by the estuarine model.

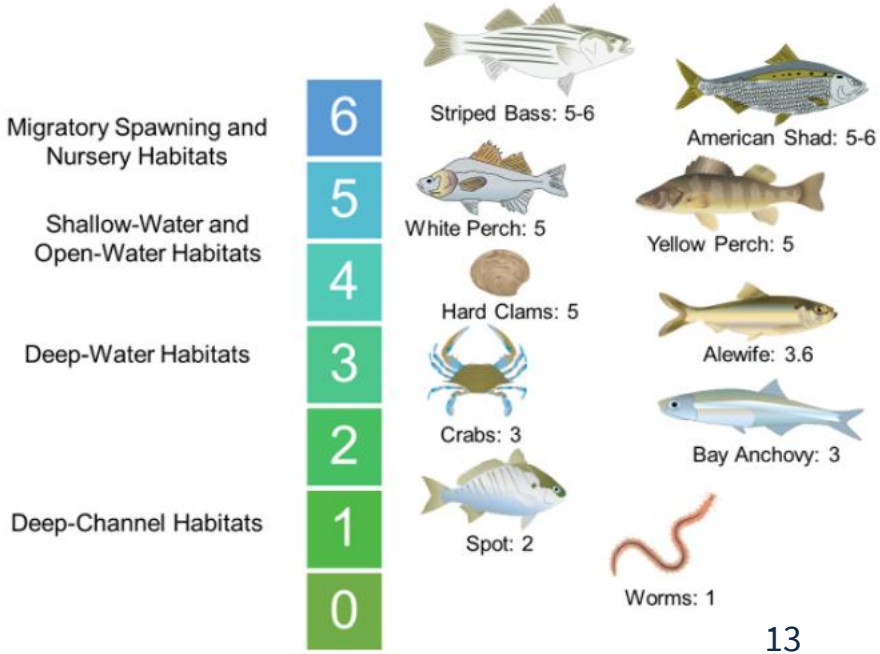


Designated Uses for Living Resources Drive Water Quality Criteria

1. Determine Load Reductions to Meet WQS



Oxygen (mg/l) requirements



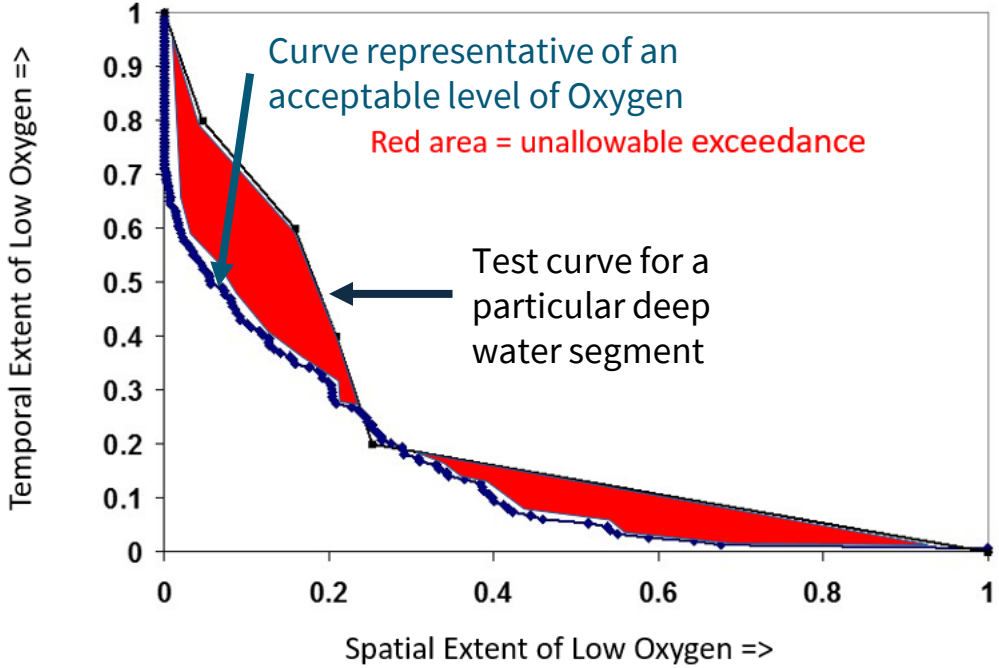
1. Determine Load Reductions to Meet WQS

WQ Criteria are Multifacted

- Critical values for Dissolved Oxygen (DO), Chlorophyll-a, and Water Clarity vary by
  - Designated Use
  - Season
  - Duration (e.g., 30-day mean)

Attainment is Binary but Attainment Defecit is Informative

1. Determine Load Reductions to Meet WQS

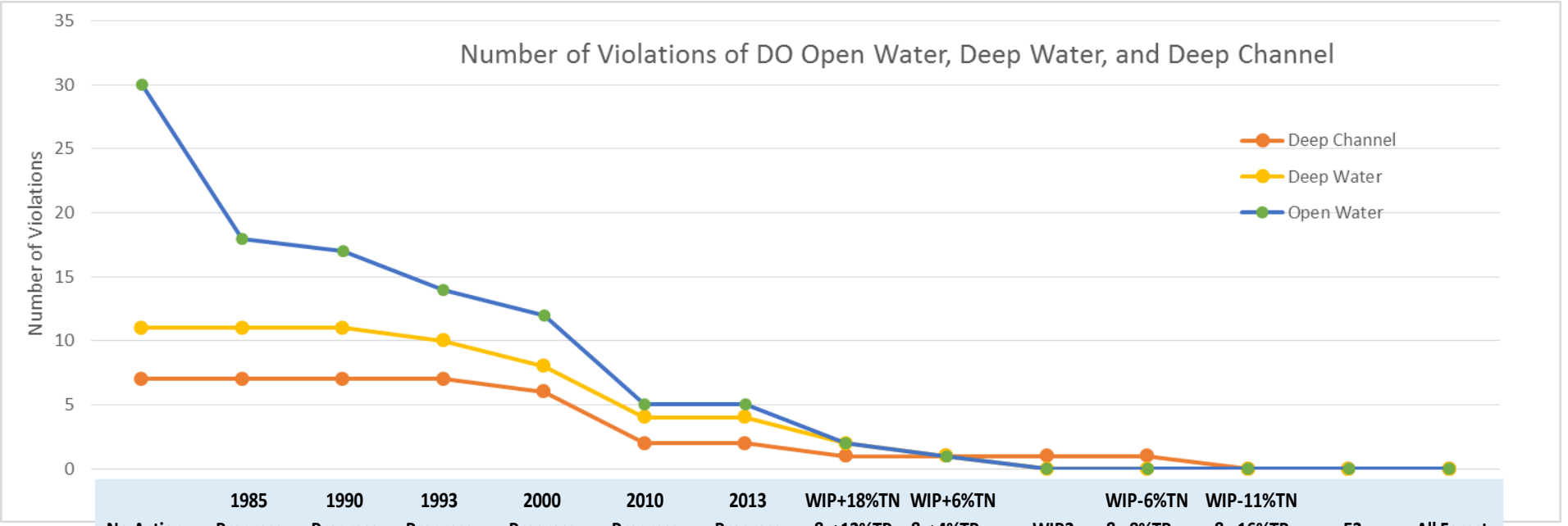


Stoplight Table

Deep Water Attainment			
Cbseg	Base	Draft Allocation	E3
CB3MH	2.5%	0.1%	0.0%
CB4MH	23.3%	3.8%	1.5%
CB5MH	5.3%	0.0%	0.0%
CB6PH	0.6%	0.0%	0.0%
CB7PH	0.4%	0.0%	0.0%
CHSMH	5.5%	0.0%	0.0%
EASMH	3.3%	0.0%	0.0%
Calculated January 2009			

Assimilative Capacity was Explored by Comparing Scenarios

1. Determine Load Reductions to Meet WQS

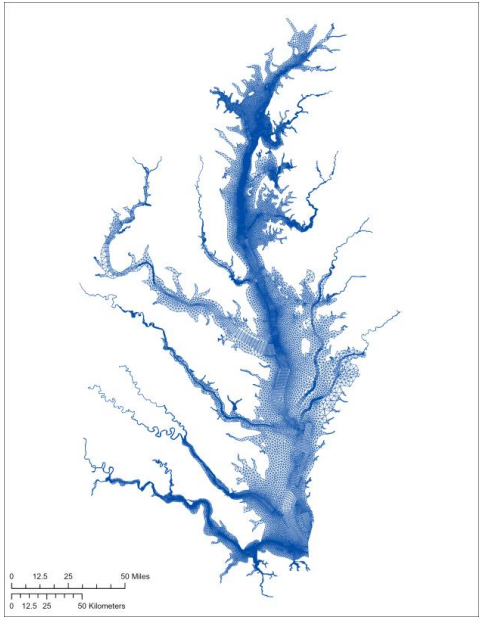


No Action	1985 Progress	1990 Progress	1993 Progress	2000 Progress	2010 Progress	2013 Progress	WIP+18%TN & +12%TP	WIP+6%TN & +4%TP	WIP2	WIP-6%TN & -8%TP	WIP-11%TN & -16%TP	E3	All Forest
404TN	347TN	338TN	337TN	317TN	266TN	253TN	224TN	205TN	195TN	185TN	174TN	133TN	40TN
41.7TP	30.4TP	27.7TP	23.7	21.9TP	16.9TP	15.9TP	14.8TP	14.4	13.7TP	13.0TP	11.9TP	8.6TP	3.9TP

1. Determine Load Reductions to Meet WQS

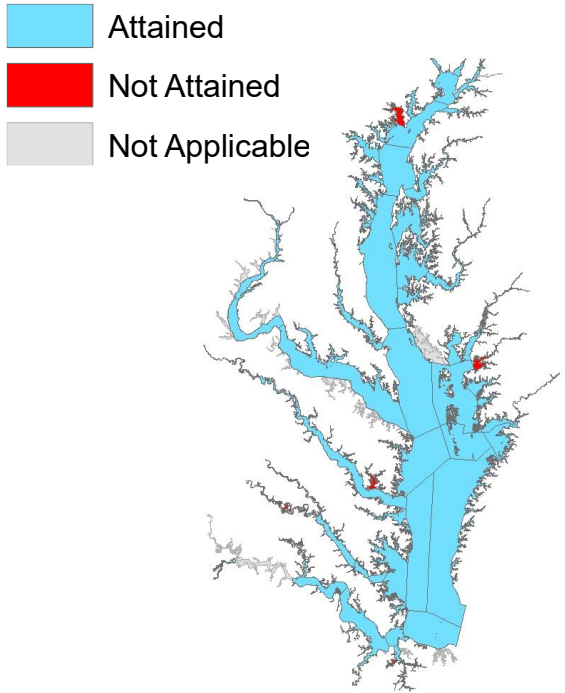
Determining Assimilative Capacity

1. Run many scenarios in the estuarine model
2. Review DO criteria violation rates for OW, DW, & DC at previous WIP ± x% of TN & TP
3. Repeat 1 & 2 with different scoping scenarios near the WIPs
4. Partnership considers monitoring evidence and point of diminishing returns to determine assimilative capacity



Edge Cases Were Excluded from Assimilative Capacity Given Extenuating Circumstances

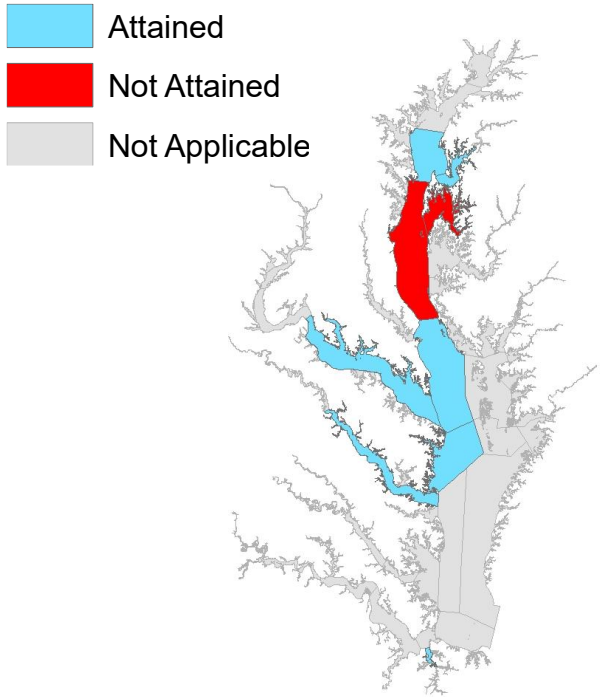
- Segments at the extreme were sometimes non-responsive to significant changes in TN & TP load reductions over a large range
  a. Ex: Small segments not well represented in the estuarine model



OW DO at WIP 2 Loads

Edge Cases Were Excluded from Assimilative Capacity Given Extenuating Circumstances

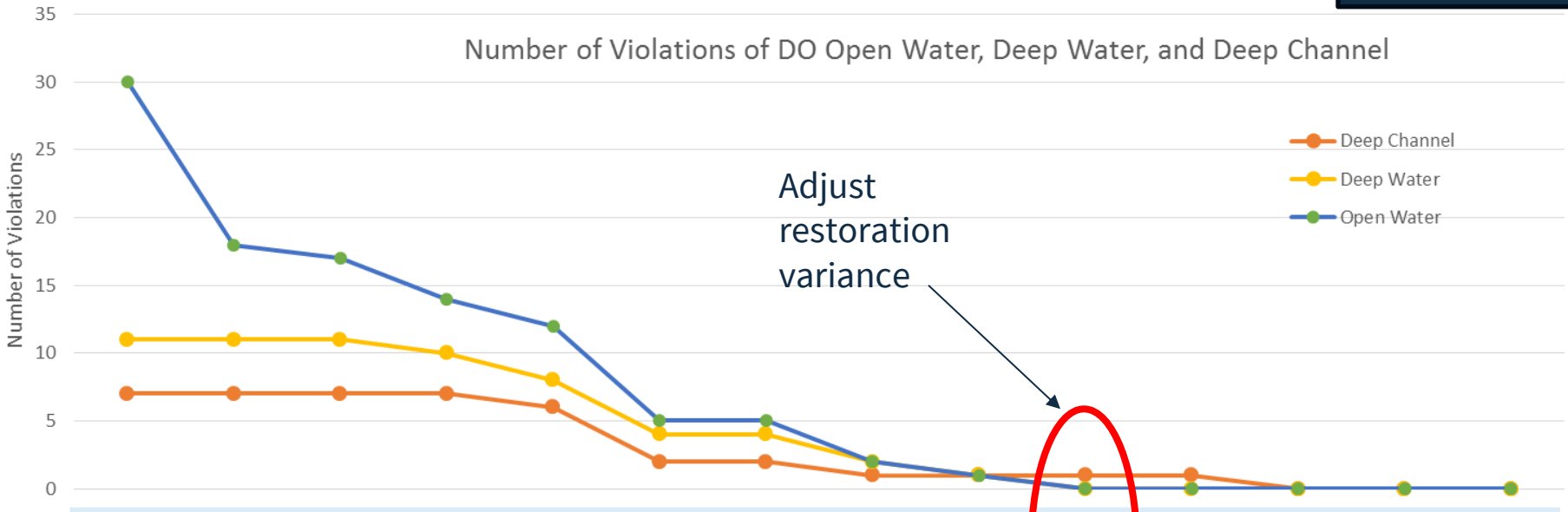
- Segments at the extreme were sometimes non-responsive to significant changes in TN & TP load reductions over a large range
  a. Ex: Large segments which are very difficult to reach full attainment



DC DO at WIP 2 Loads

Assimilative Capacity Set Where WQS are Met

1. Determine Load Reductions to Meet WQS



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Distribution Method

Distributing Load Based on Relative Effectiveness

More Effective Basins do More

2. Divide up the work

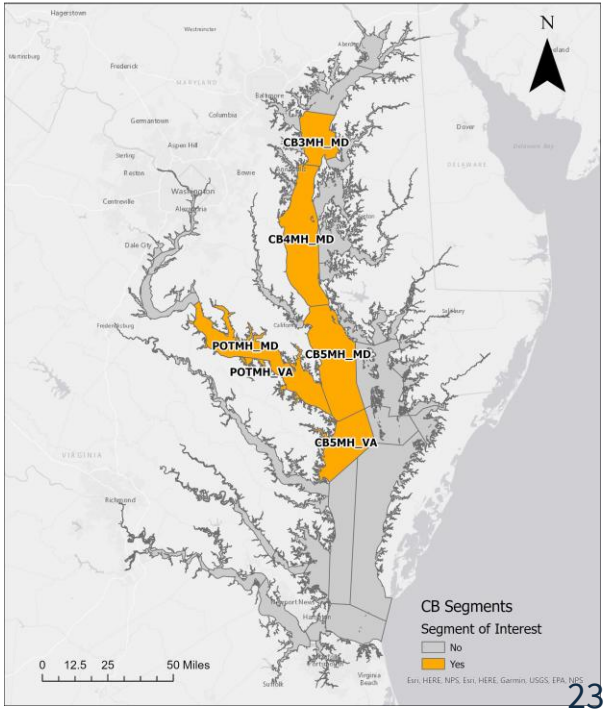
- Phase III WIPs relied on relative effectiveness of the state-basin for improving conditions during the summer for
  - Deep Water (CB3MH, CB4MH, CB5MH, POTMH)
  - Deep Channel (CB3MH, CB4MH, CB5MH)

Why use the DW and DC for Sensitivity?

2. Divide up the work

- CB3MH, CB4MH, CB5MH, POTMH were chosen because:
  - These segments were most sensitive to loads from all parts of the watershed
  - Considered “most restrictive” or most difficult to achieve

Chesapeake Bay Segments 3, 4, 5, and Potomac Mesohaline



Overall Effectiveness Guides Distribution of Planning Targets

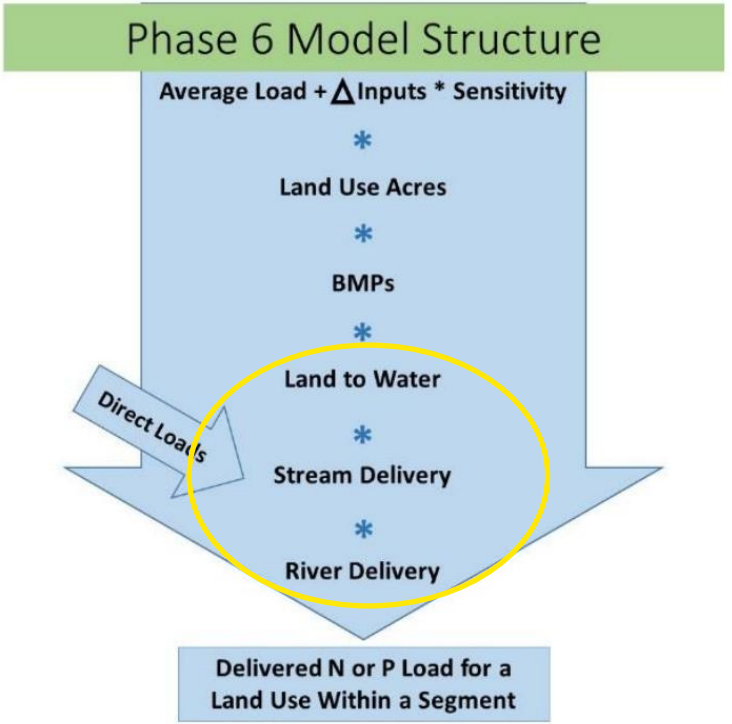
2. Divide up the work

- **Overall effectiveness** = Oxygen reduced per pound produced
  - Multiply watershed delivery and estuarine delivery
    - **Watershed Delivery** = Pound delivered per pound produced
    - **Estuarine Delivery** = Oxygen reduced per pound delivered

Watershed Delivery Informs How Loads Reach Tidal Waters

2. Divide up the work

- Remove anthropogenic effects and focus on natural factors
- Includes watershed transport characteristics, travel time, and impoundments



Estuarine Delivery Informs Influence of Equal Loads from Each Basin on DO in DW/DC

2. Divide up the work

- Oxygen decrease (µg/l) per million lbs delivered = Δ 25th percentile of DO per Designated Use when increasing TN, TP, and TSS for each basin in isolation

- A pound of N from the Susquehanna has:
  - ~Half the oxygen effect as P from the Susquehanna
  - ~Twice the oxygen effect as N from the Rappahannock (Above RIM)
  - ~6x the oxygen effect as N from the James (Above RIM)

Oxygen decrease per million pounds

GeoBasin	N	P
Susquehanna	16.325	38.503
Western Shore	14.109	35.264
Patuxent AFL	10.931	27.505
Patuxent BFL	13.514	35.667
Potomac AFL	14.045	22.210
Potomac BFL	13.201	22.165
Rappahannock AFL	8.065	11.765
Rappahannock BFL	9.278	15.453
York AFL	4.630	9.111
York BFL	5.165	8.681
James AFL	2.647	7.673
James BFL	2.351	7.434
Upper Eastern Shore	10.709	31.840
Middle Eastern Shore	11.244	43.196
Lower Eastern Shore	9.782	25.243
Virginia Eastern Shore	15.214	20.404

Eutrophication Units (EUs) are our Common Currency

2. Divide up the work

- EUs = TN * TN Exchange Ratio + TP * TP Exchange Ratio
  - Oxygen damage to Bay in µg/l

- EUs allow for comparison and exchange of N and P within and between basins

Exchange Ratios

GeoBasin	N	P
Susquehanna	16.325	38.503
Western Shore	14.109	35.264
Patuxent AFL	10.931	27.505
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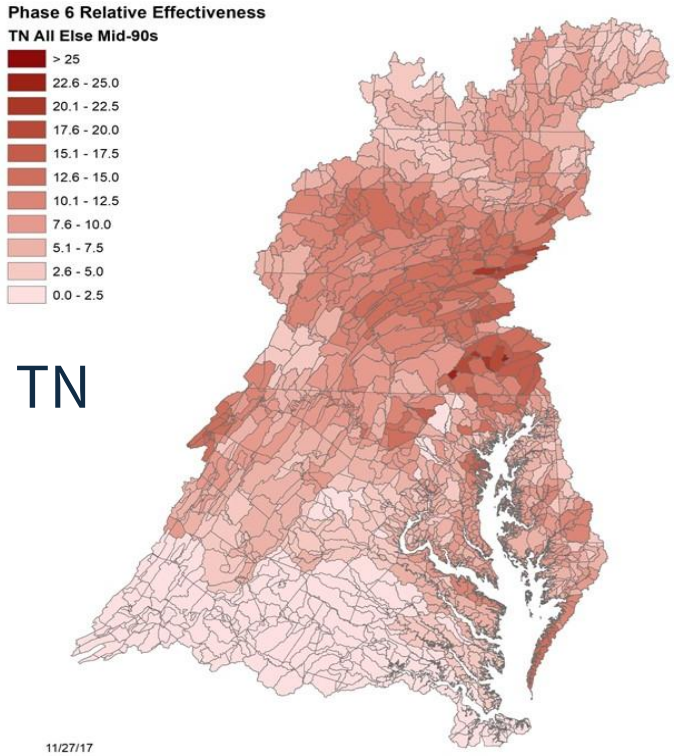
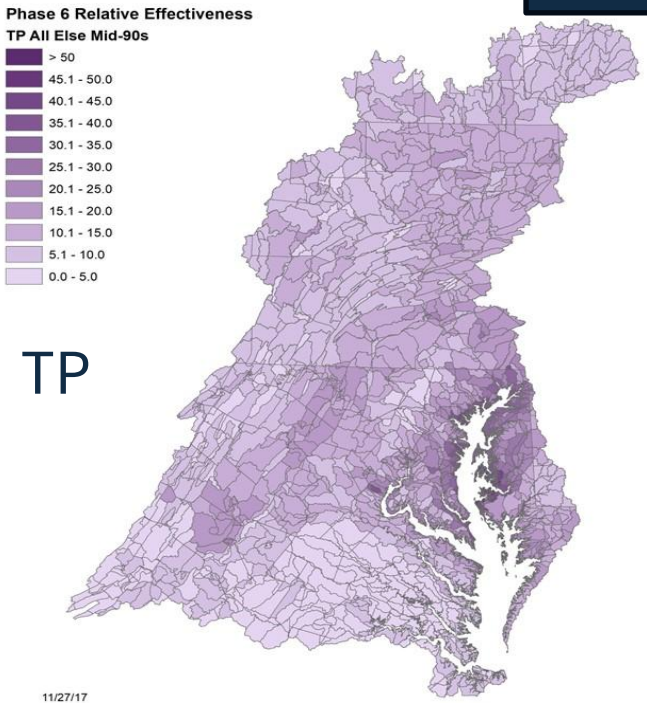
Overall Effectiveness is MEBs

2. Divide up the work



TN

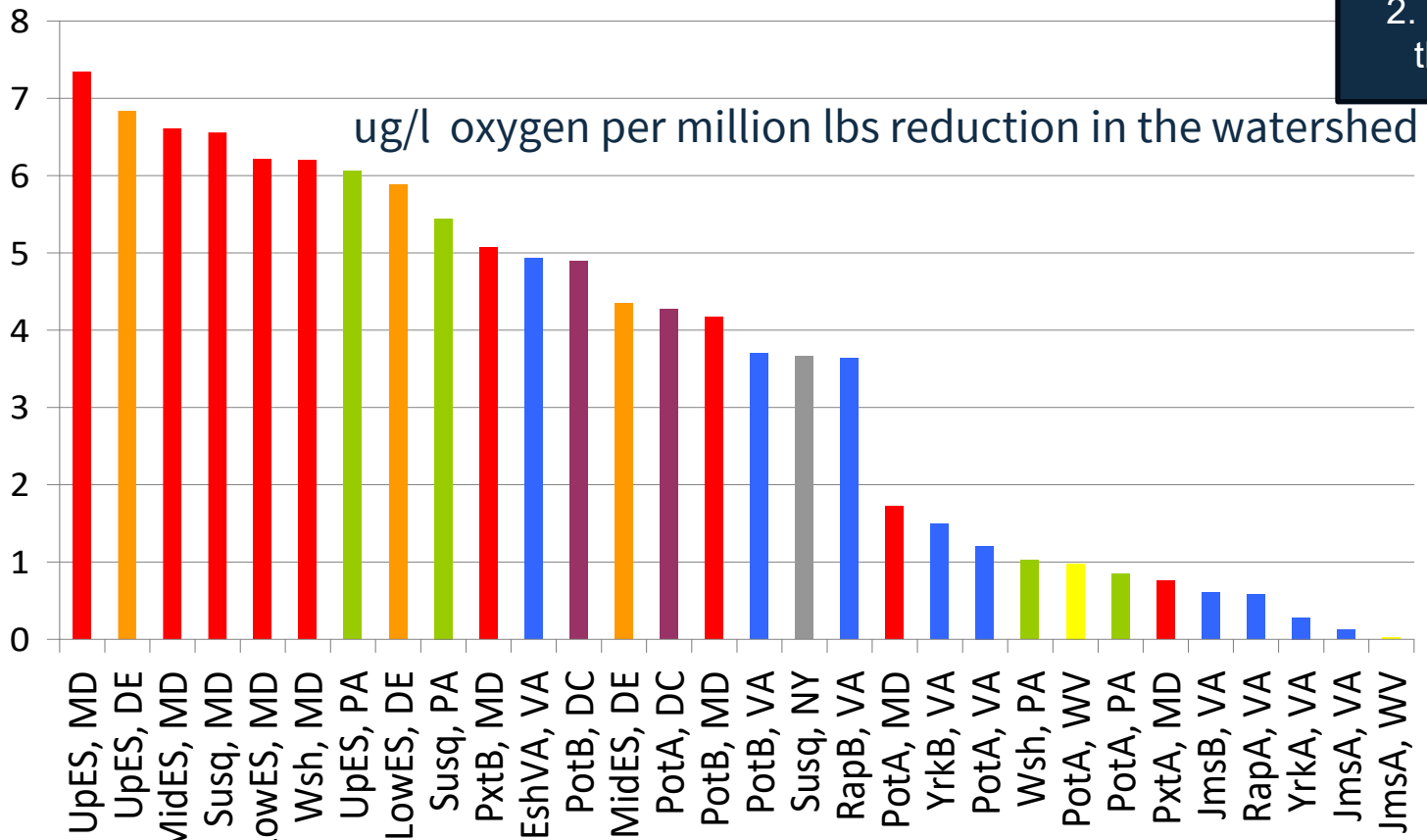


TP

ug/l oxygen per million lbs reduction in the watershed

Major River Basin by Jurisdiction: Relative Impact on DW/DC DO

2. Divide up the work



Guidelines for Planning Targets

2. Divide up the work

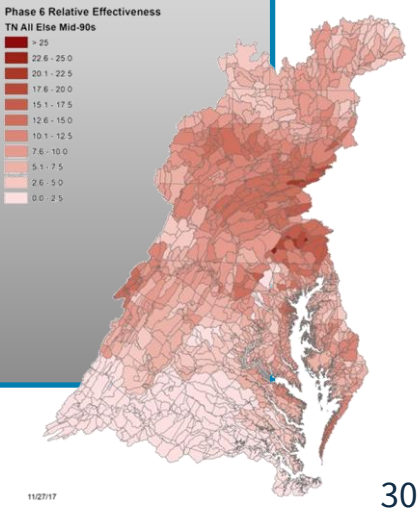
E3

Effort

No Action

Effectiveness

Increasing relationship between Relative Effectiveness and Effort



Planning Targets Require These Components

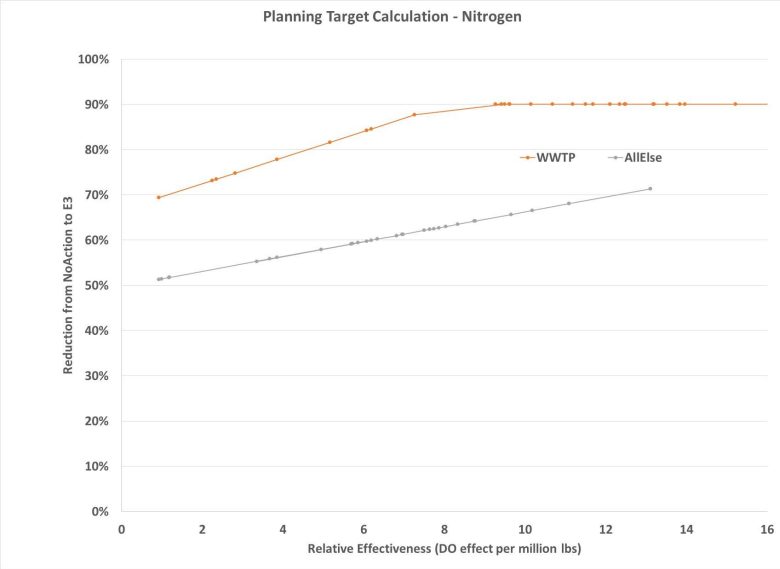
2. Divide up the work

1. Agreed-to methodology
2. No Action and E3 scenario, including scenario base year
3. Watershed and estuarine relative effectiveness
4. Bay's assimilative capacity
5. Accounting for projected atmospheric deposition load reductions

Enter the “Hockey Stick”

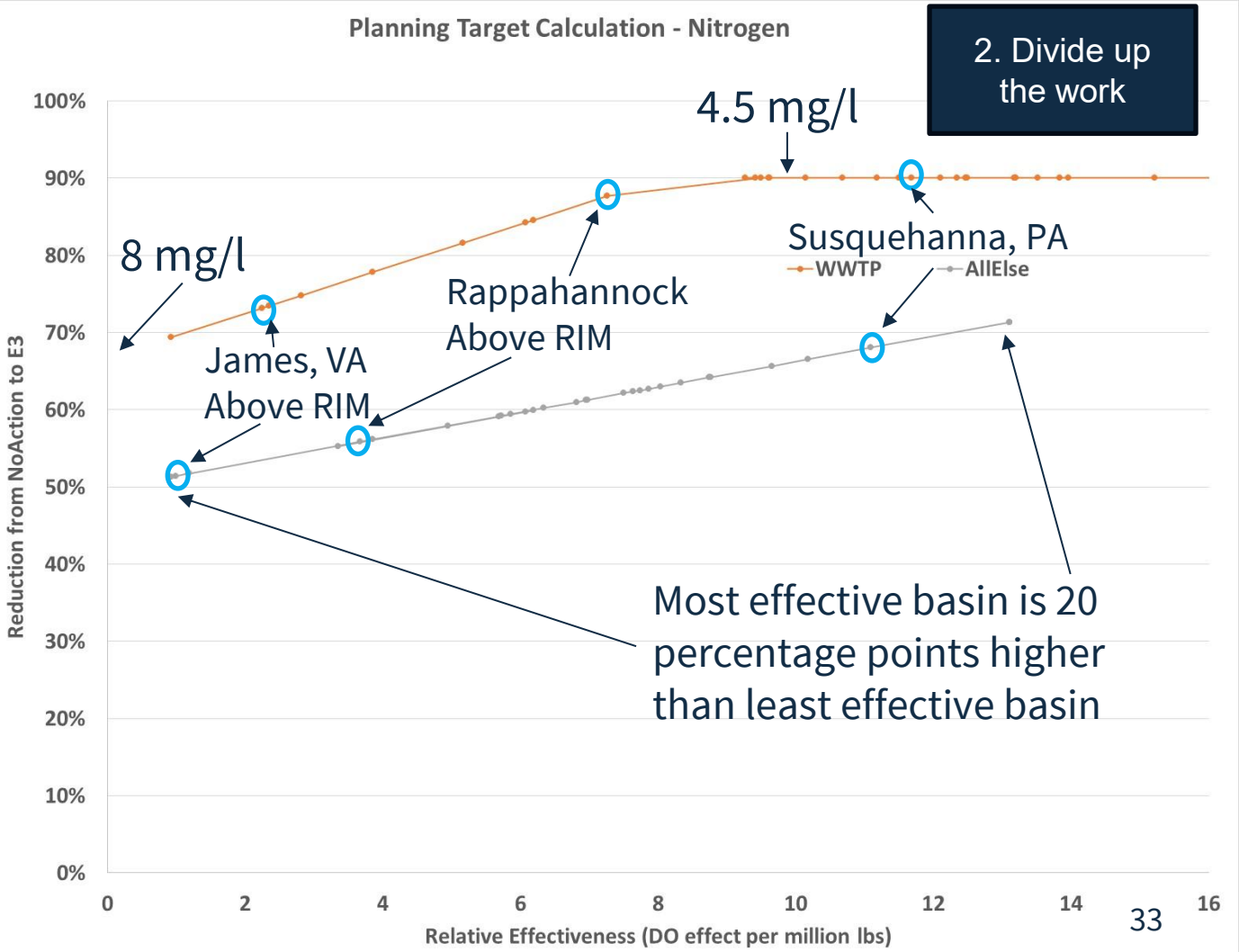
2. Divide up the work

- Distribution method approved by PSC
- Expression of policy decisions representing the overarching partnership principles



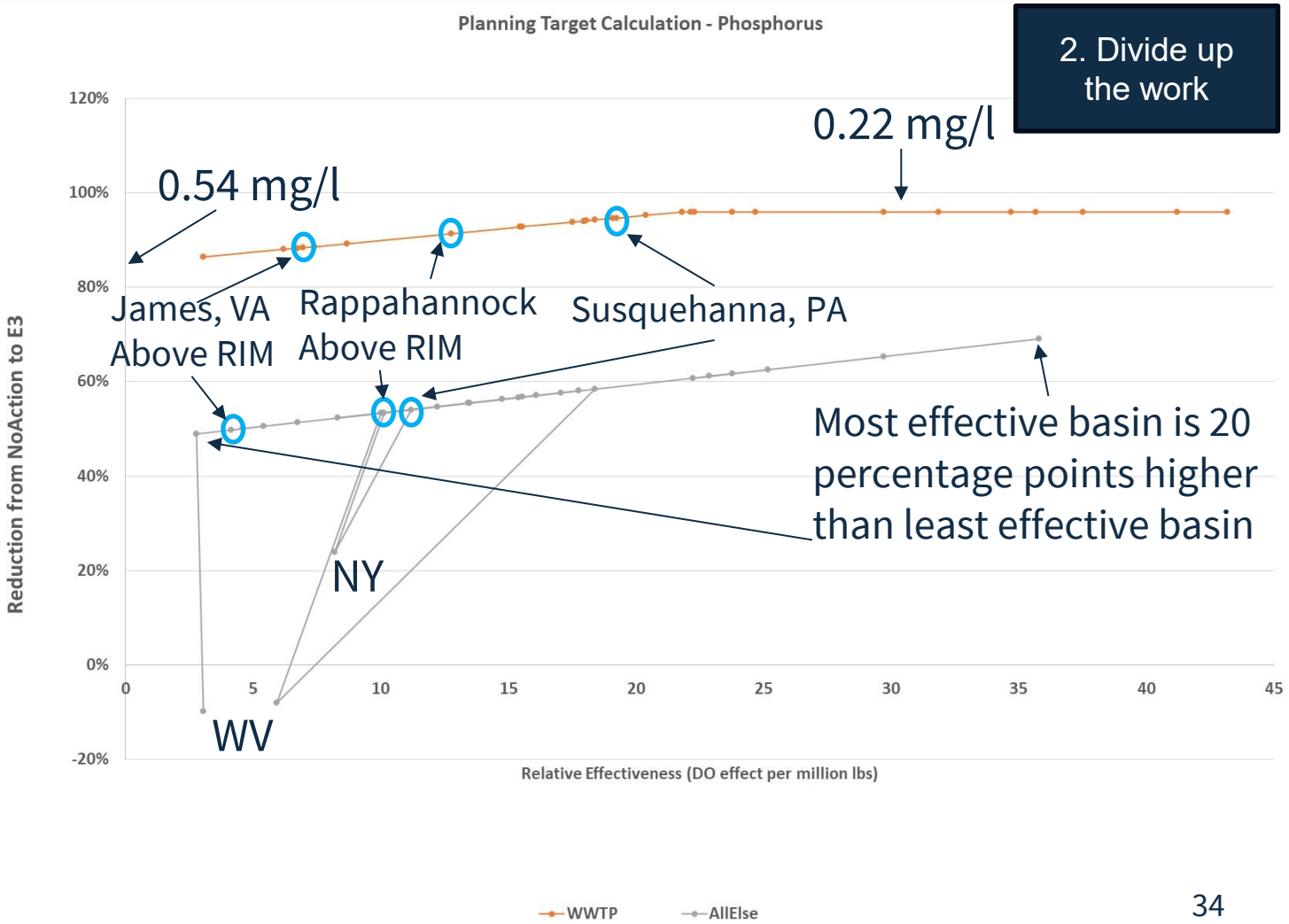
Phase III WIP Target for TN

2010 Scenario Base Year



Phase III WIP Target for TP

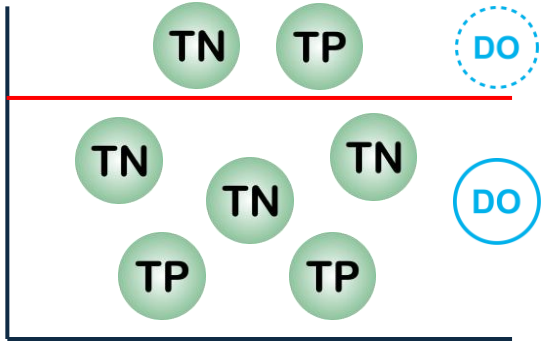
2010 Scenario Base Year



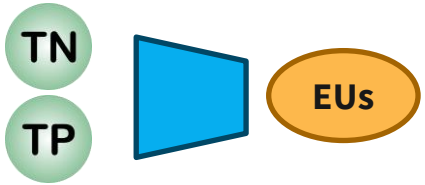
Planning Targets Were Calculated in This Order

2. Divide up the work

- Decided on Bay's assimilative capacity



- Converted to Eutrophication Units



- Divided up Using Hockey Stick

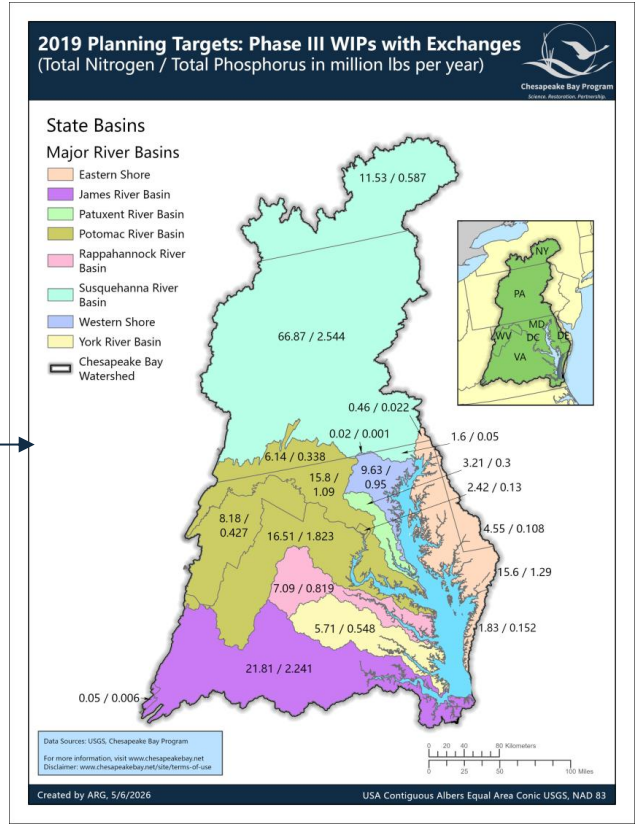
First Exchange: Total Assimilative Capacity Must Remain the Same After Using the Hockey Stick

2. Divide up the work

Major State	State		2018 Planning Targets approved by PSC	
Major	State	StateBasin	Nitrogen	Phosphorus
Potomac	DC	DC Potomac	2.42	0.130
Eastern Shore	DE	DE Eastern Shore	4.55	0.108
Eastern Shore	MD	MD Eastern Shore	15.21	1.286
Patuxent	MD	MD Patuxent	3.21	0.301
Potomac	MD	MD Potomac	15.30	1.092
Susquehanna	MD	MD Susquehanna	1.18	0.053
Western Shore	MD	MD Western Shore	10.89	0.948
Susquehanna	NY	NY Susquehanna	11.53	0.587
Eastern Shore	PA	PA Eastern Shore	0.45	0.025
Potomac	PA	PA Potomac	6.11	0.357
Susquehanna	PA	PA Susquehanna	66.59	2.661
Western Shore	PA	PA Western Shore	0.02	0.001
Eastern Shore	VA	VA Eastern Shore	1.43	0.164
James	VA	VA James	25.92	2.731
Potomac	VA	VA Potomac	16.00	1.892
Rappahannock	VA	VA Rappahannock	6.85	0.849
York	VA	VA York	5.52	0.556
James	WV	WV James	0.04	0.005
Potomac	WV	WV Potomac	8.18	0.427

Second Exchange: Total Assimilative Capacity For Each State Must Remain the Same

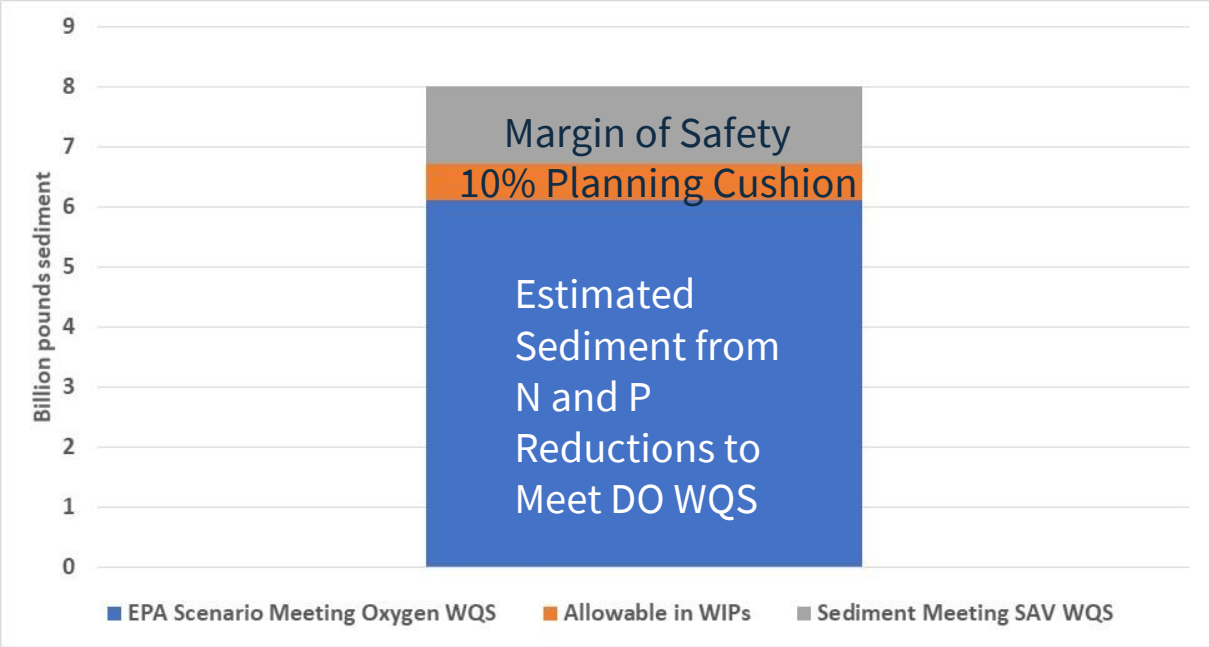
Major	State		2018 Planning Targets approved by PSC		2019 Planning Targets with Exchanges and Sediment		
Major	State	StateBasin	Nitrogen	Phosphorus	Nitrogen	Phosphorus	Sediment
Potomac	DC	DC Potomac	2.42	0.130	2.42	0.130	41.9
Eastern Shore	DE	DE Eastern Shore	4.55	0.108	4.55	0.108	26.7
Eastern Shore	MD	MD Eastern Shore	15.21	1.286	15.60	1.290	2903.4
Patuxent	MD	MD Patuxent	3.21	0.301	3.21	0.300	437.7
Potomac	MD	MD Potomac	15.30	1.092	15.80	1.090	1928.0
Susquehanna	MD	MD Susquehanna	1.18	0.053	1.60	0.050	113.8
Western Shore	MD	MD Western Shore	10.89	0.948	9.63	0.950	2959.9
Susquehanna	NY	NY Susquehanna	11.53	0.587	11.53	0.587	532.7
Eastern Shore	PA	PA Eastern Shore	0.45	0.025	0.46	0.022	27.4
Potomac	PA	PA Potomac	6.11	0.357	6.14	0.338	295.5
Susquehanna	PA	PA Susquehanna	66.59	2.661	66.87	2.544	1838.2
Western Shore	PA	PA Western Shore	0.02	0.001	0.02	0.001	0.3
Eastern Shore	VA	VA Eastern Shore	1.43	0.164	1.83	0.152	473.3
James	VA	VA James	25.92	2.731	21.81	2.241	2015.2
Potomac	VA	VA Potomac	16.00	1.892	16.51	1.823	1929.7
Rappahannock	VA	VA Rappahannock	6.85	0.849	7.09	0.819	1505.1
York	VA	VA York	5.52	0.556	5.71	0.548	949.1
James	WV	WV James	0.04	0.005	0.05	0.006	13.0
Potomac	WV	WV Potomac	8.18	0.427	8.18	0.427	595.9



Sediment Targets will be Met if TN and TP Targets for DO WQS are Met

2. Divide up the work

- Sediment target set at 10% more than WIP adjusted to meet the N and P target



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Complications

Additional Distribution Considerations

Complications Mean Planning Targets Required Revisions

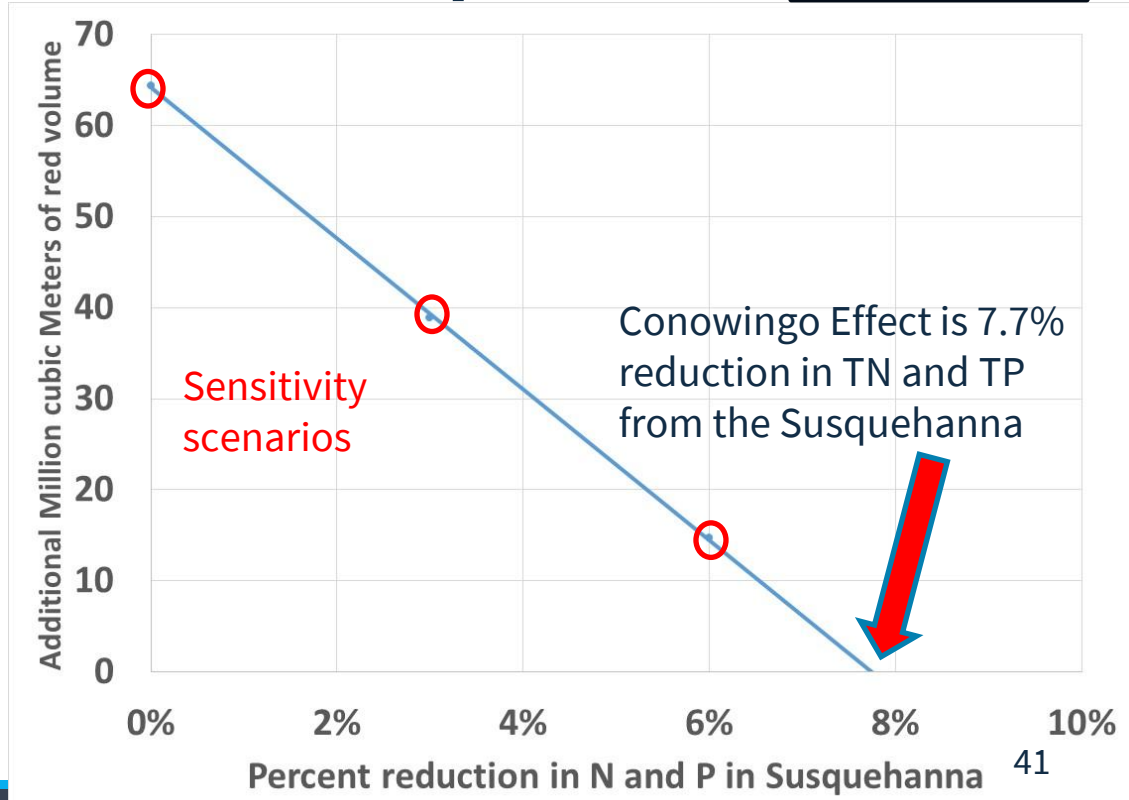
2. Divide up the work

- Conowingo Infill
- Changing Environmental Conditions
- Unaccounted Loads

Sensitivity Scenarios for Conowingo Determined Overall Effect from Susquehanna

2. Divide up the work

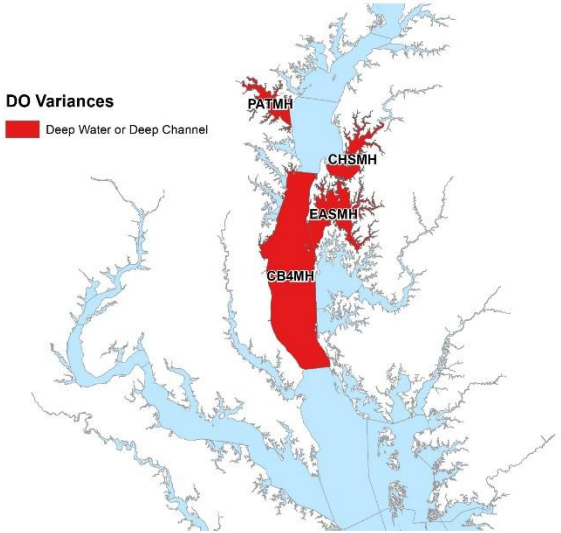
Ran Scenarios with 3% and 6% reduction in Susquehanna N and P



Loads to the Bay Increased due to Conowingo, but Bioavailability Reduced the Effect

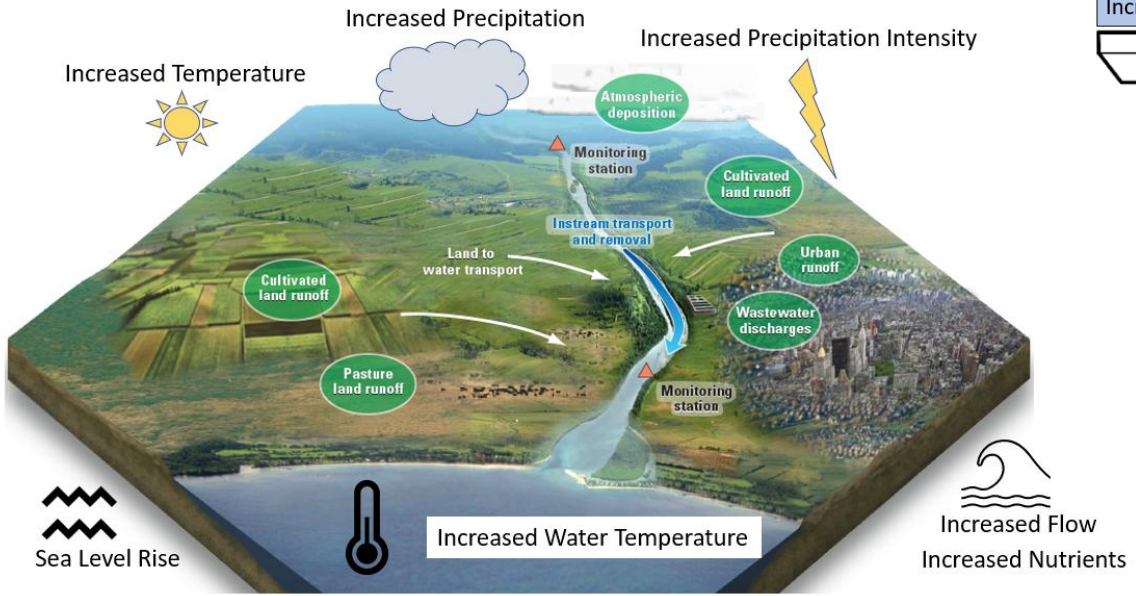
2. Divide up the work

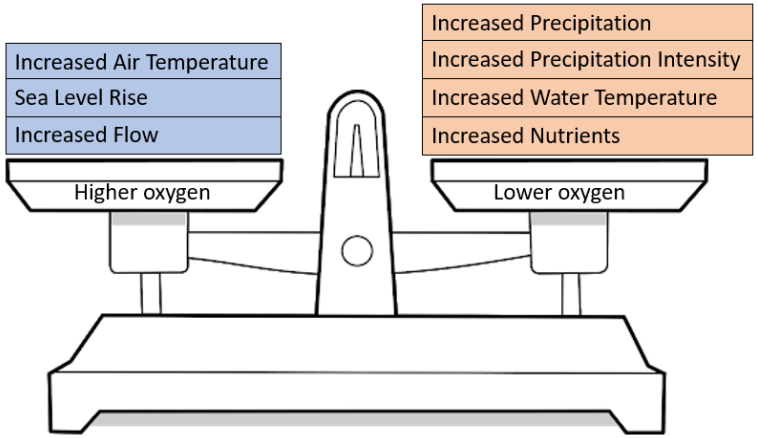
- Although additional load was 13 millions lbs for N and 1.8 million lbs for P, only a subset is bioavailable
  - 6 million lbs N and 0.26 million lbs P



Changing Environmental Conditions Have an Overall Negative Effect on DO

2. Divide up the work

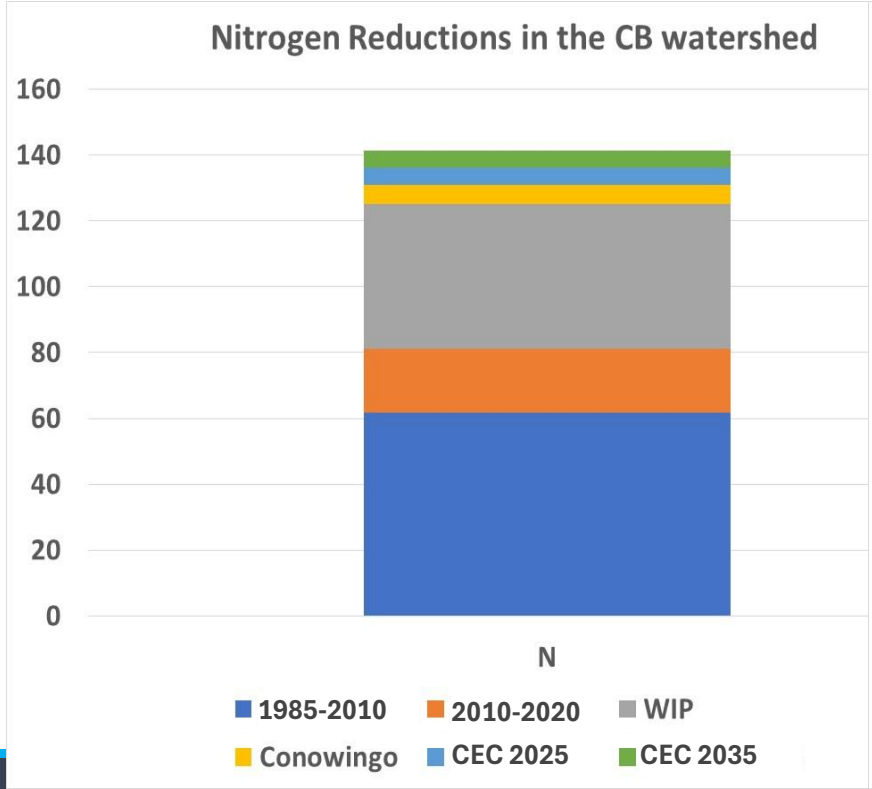


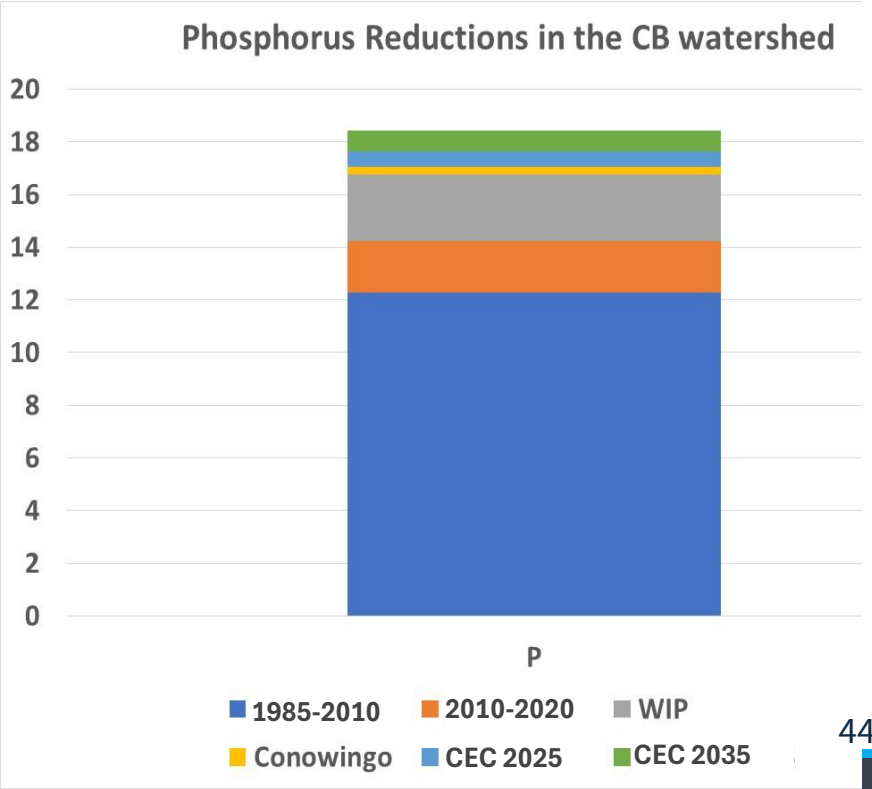


CBP studied 21 different effects producing an overall lower level of oxygen, requiring an additional 5 million lbs N and 0.6 million lbs P reduction

Conowingo and Changing Environmental Conditions are Small Influences in Perspective

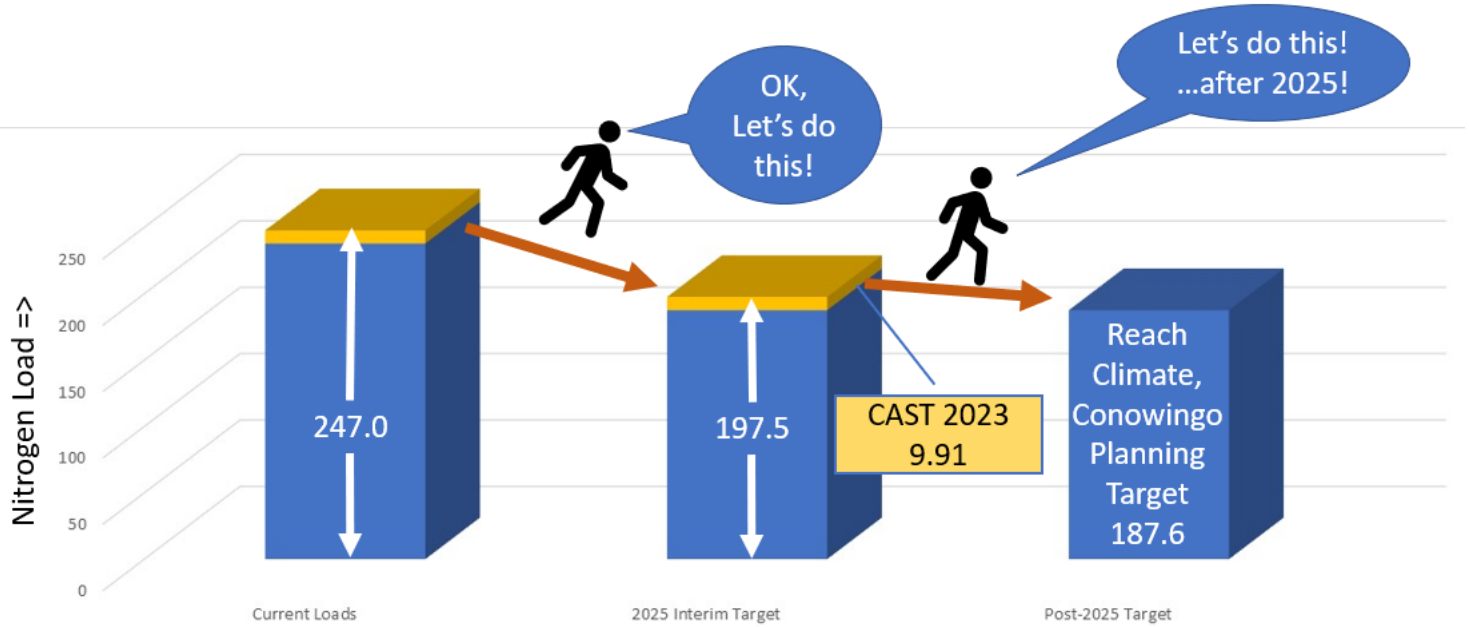
2. Divide up the work





Unaccounted Loads Were Not Included, But They Are Back In Consideration

2. Divide up the work



Take Home Points

- Phase III WIPs target method adhered to the three major partnership principles

- Estuarine model estimated attainment for all OW, DW, DC criteria in Bay, guiding assimilative capacity

- Relative effectiveness of basins' nutrient loading on DW and DC Dissolve Oxygen informed distribution, as well as level of effort

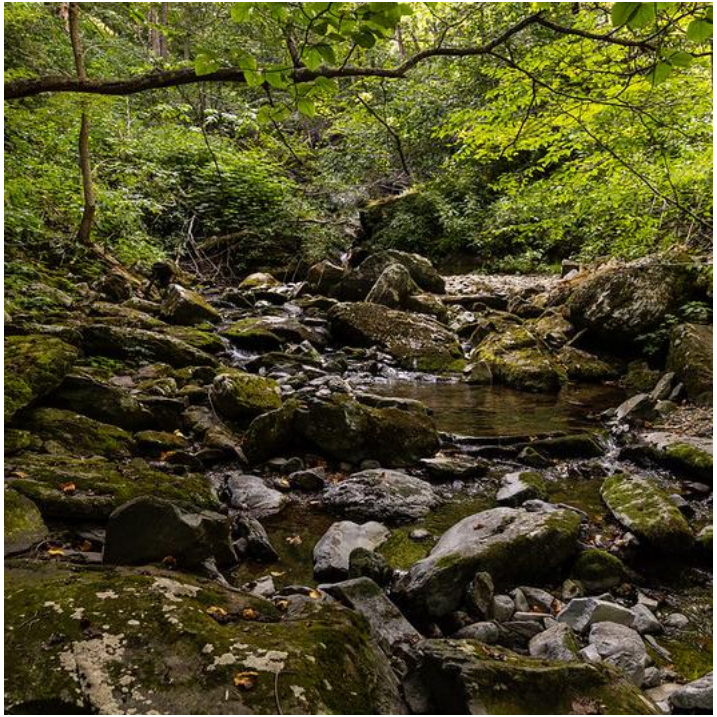


Photo: Charlie Nick/Chesapeake Bay Program

Thank you!

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