Chesapeake Bay Water Quality Standards Attainment Indicator (1985-2024)

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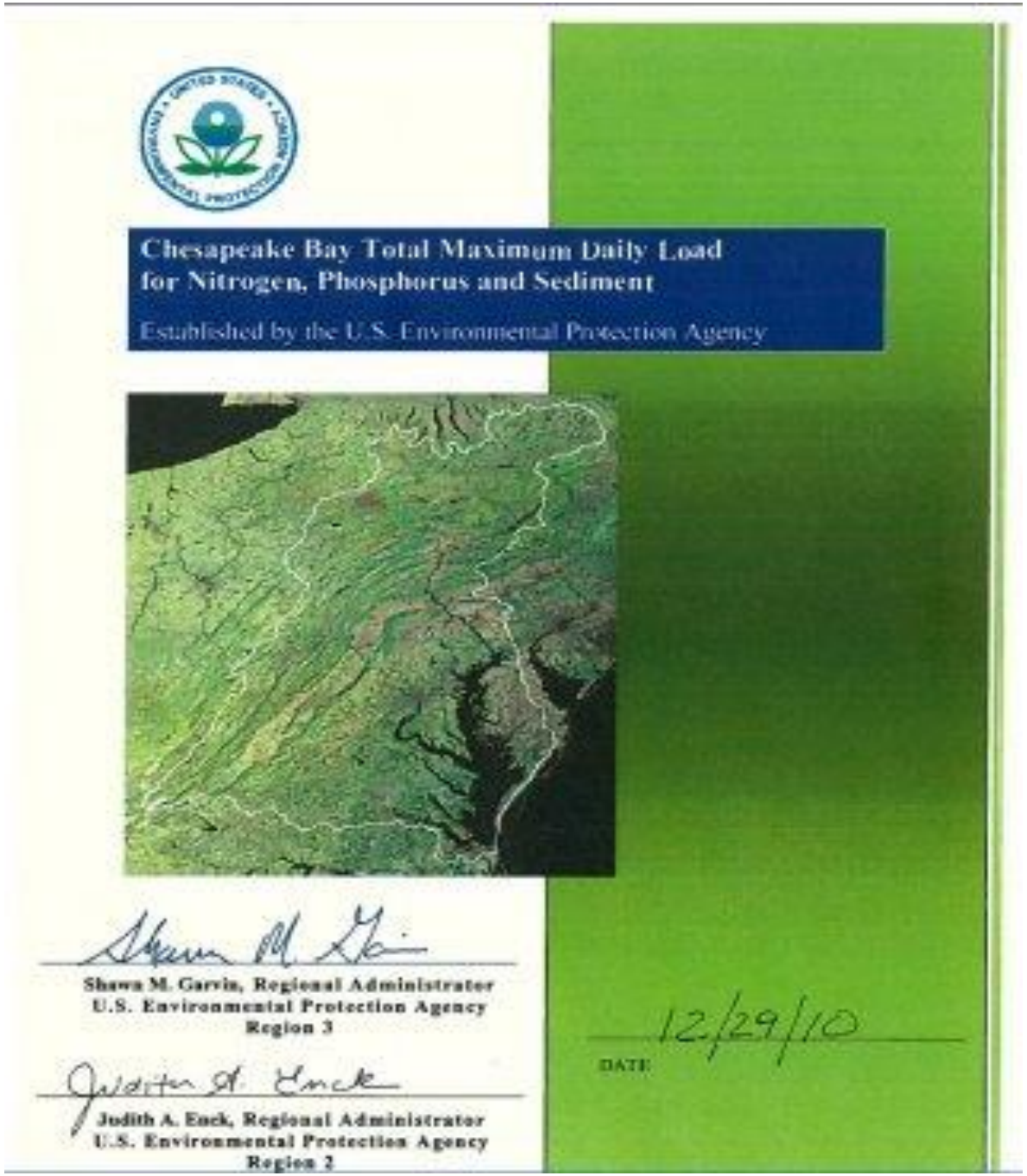
STAR Meeting

May 28, 2026

TMDL (2010)

- "Allocated loads [of nitrogen and phosphorus] should **protect living resources of the Bay and its tidal tributaries** and should result in all segments of the Bay mainstem, tidal tributaries and embayments meeting **water quality standards** for dissolved oxygen, chlorophyll a, water clarity and underwater Bay grasses."



Watershed Agreement 2025

Water Quality, Standards Attainment & Monitoring

Measure changing water quality conditions by maintaining monitoring networks and tracking our collective progress toward achieving clean water throughout the Chesapeake Bay and its watershed.

- Maintain full core monitoring network operations (i.e., nontidal water quality, SAV, tidal water quality, benthic and community science) annually to support analysis and communication of water quality loads, trends and criteria attainment.
- Develop and expand partnership-approved approaches for assessing whether water quality criteria are being met for all designated uses. For dissolved oxygen criteria, establish an approved method by 2028 and apply the method for data analysis and reporting by the end of 2030.
- Maintain or exceed the rate of improvement in the water quality standards attainment indicator relative to the 1985-2022 baseline.
- Analyze and report status/loads, trends and factors affecting those trends for nontidal and tidal water quality.

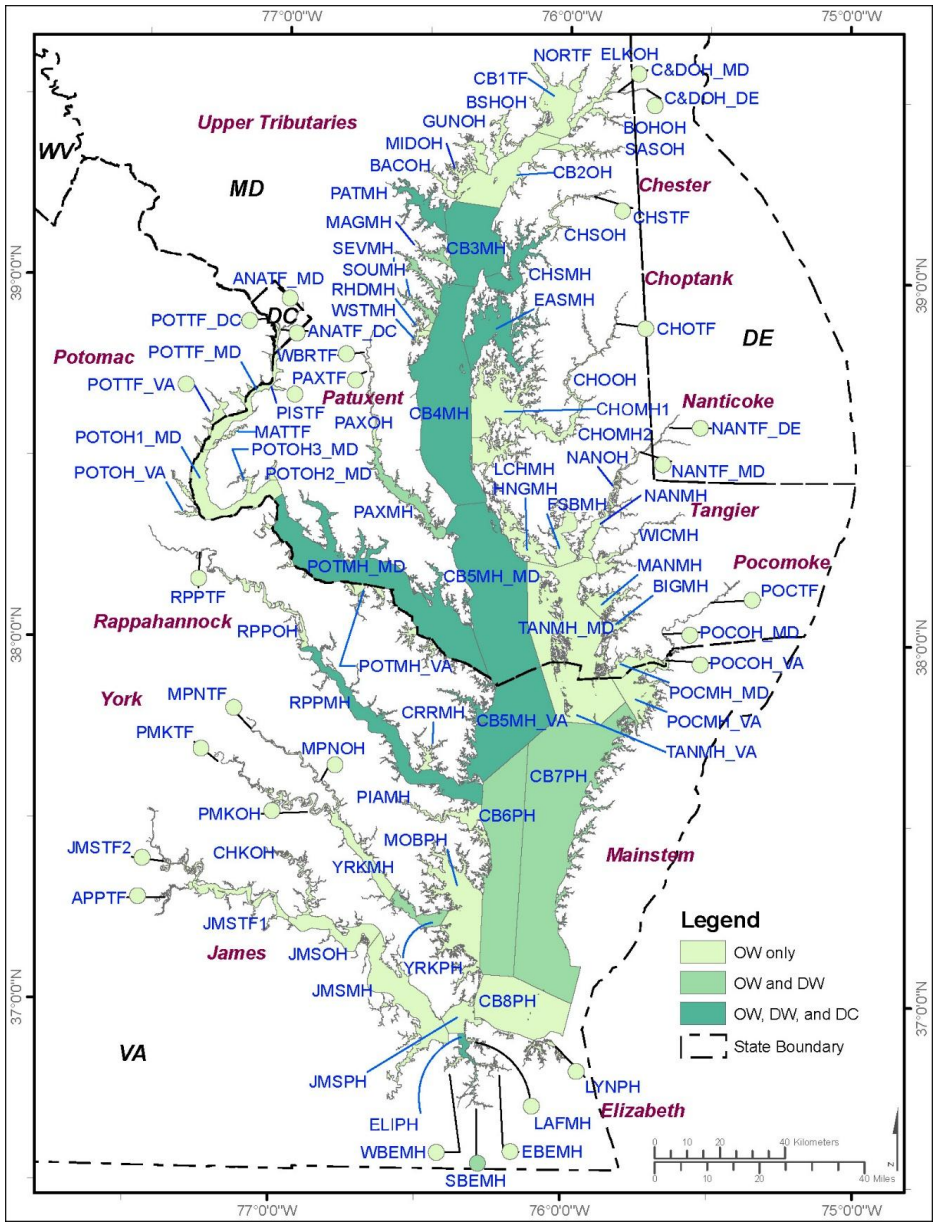
https://www.chesapeakebay.net/files/documents/CBWA-2025-IV-Final-Facing.pdf

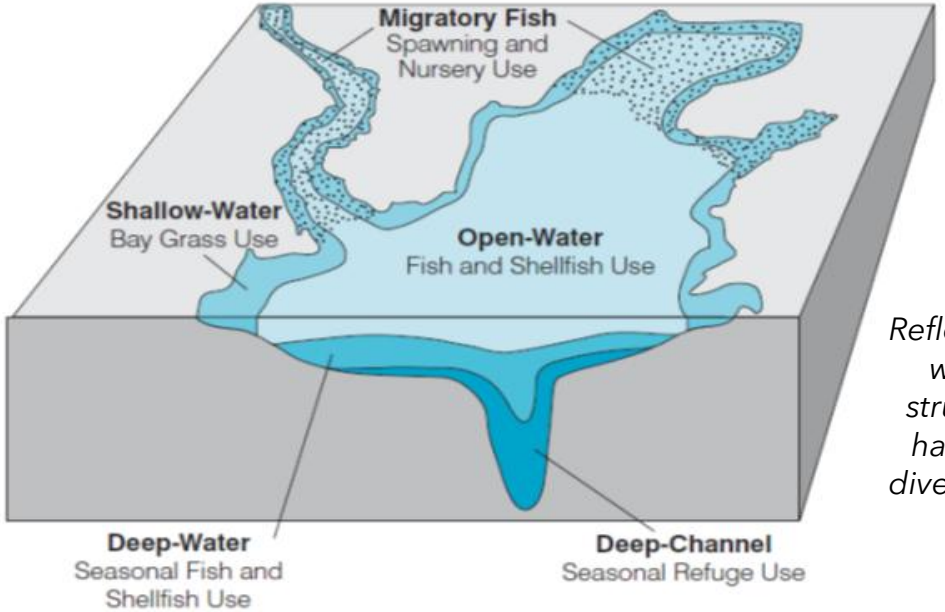
WQSAM Indicators

Four indicators to assess change over time for measuring the effectiveness of our management actions to improve WQ:

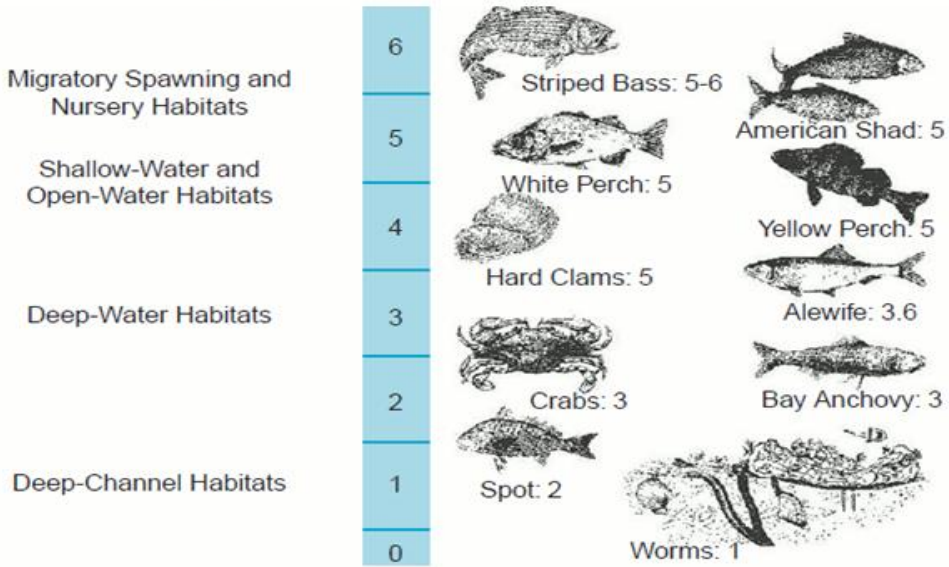
1. water quality standards attainment for dissolved oxygen, water clarity/submerged aquatic vegetation and chlorophyll a in tidal waters of the Bay.
2. annual total nutrient and sediment pollution loads delivered to the Bay.
3. monitored nutrient and sediment trends in the watershed.
4. Bay TMDL progress, combining monitored and modeled data to estimate the progress of nitrogen and phosphorus load reductions in response to implemented management practices.

Bay Segments and Designated Uses





Reflecting seasonal water-column structure and the habitat needs of diverse aquatic life.



WQS DUs and Criteria

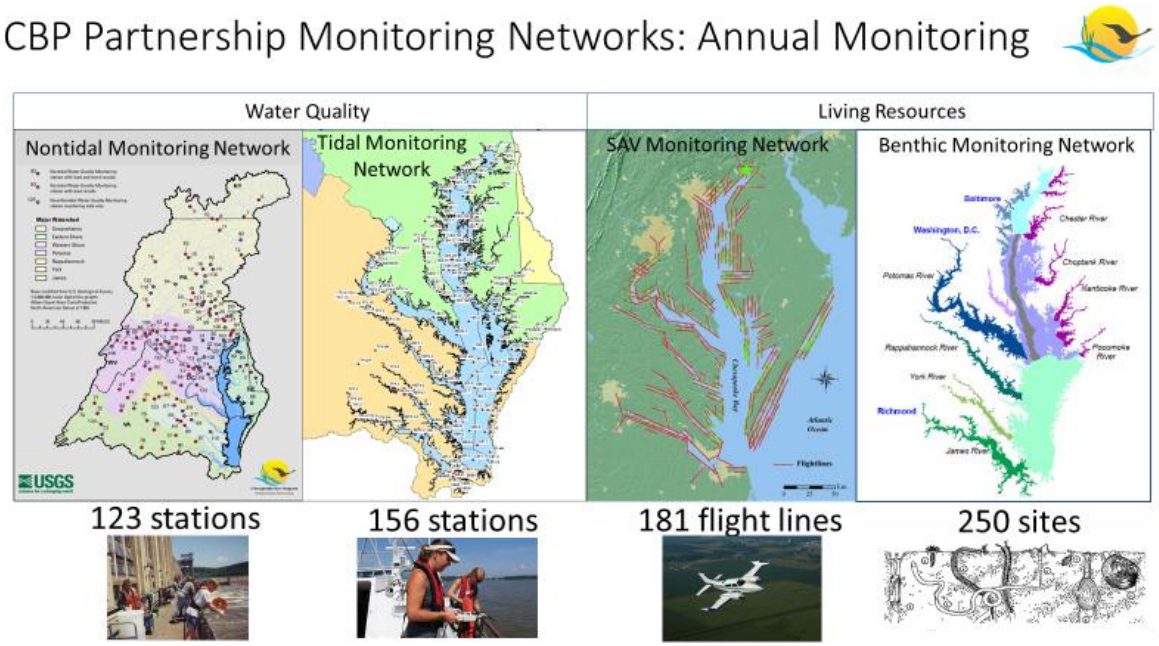
Criteria	Designated Use	Threshold	Applicable Segments
Dissolved Oxygen	Migratory Fish Spawning & Nursery (MSN)	30-day mean, February-May	73
	Open Water (OW)	30-day mean, June-September	92
	Deep Water (DW)	30-day mean, June-September	18
	Deep Channel (DC)	Instantaneous, June-September	10
Chlorophyll-a	Open Water (OW)	Chlorophyll-a concentrations	7
SAV and/or Water Clarity	Shallow Water (SW)	Segment-specific water clarity and bay grass acreage goals	79

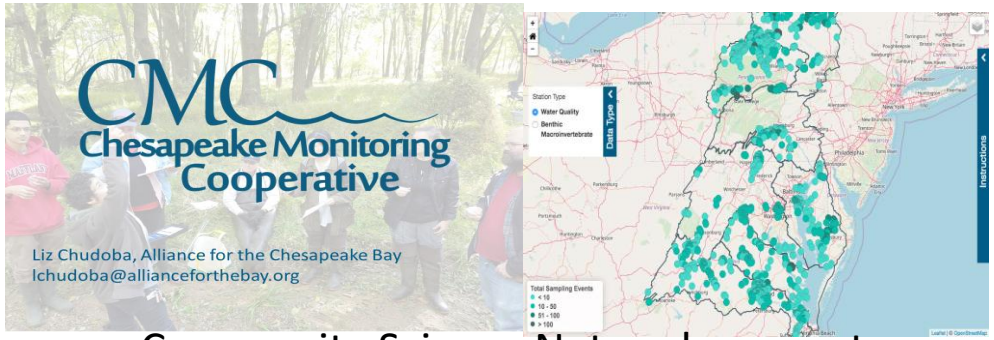
Note: The attainment indicator uses a subset of the complete accounting for the water quality criteria to ESTIMATE the attainment of water quality standards.

Monitoring Data

Data sources

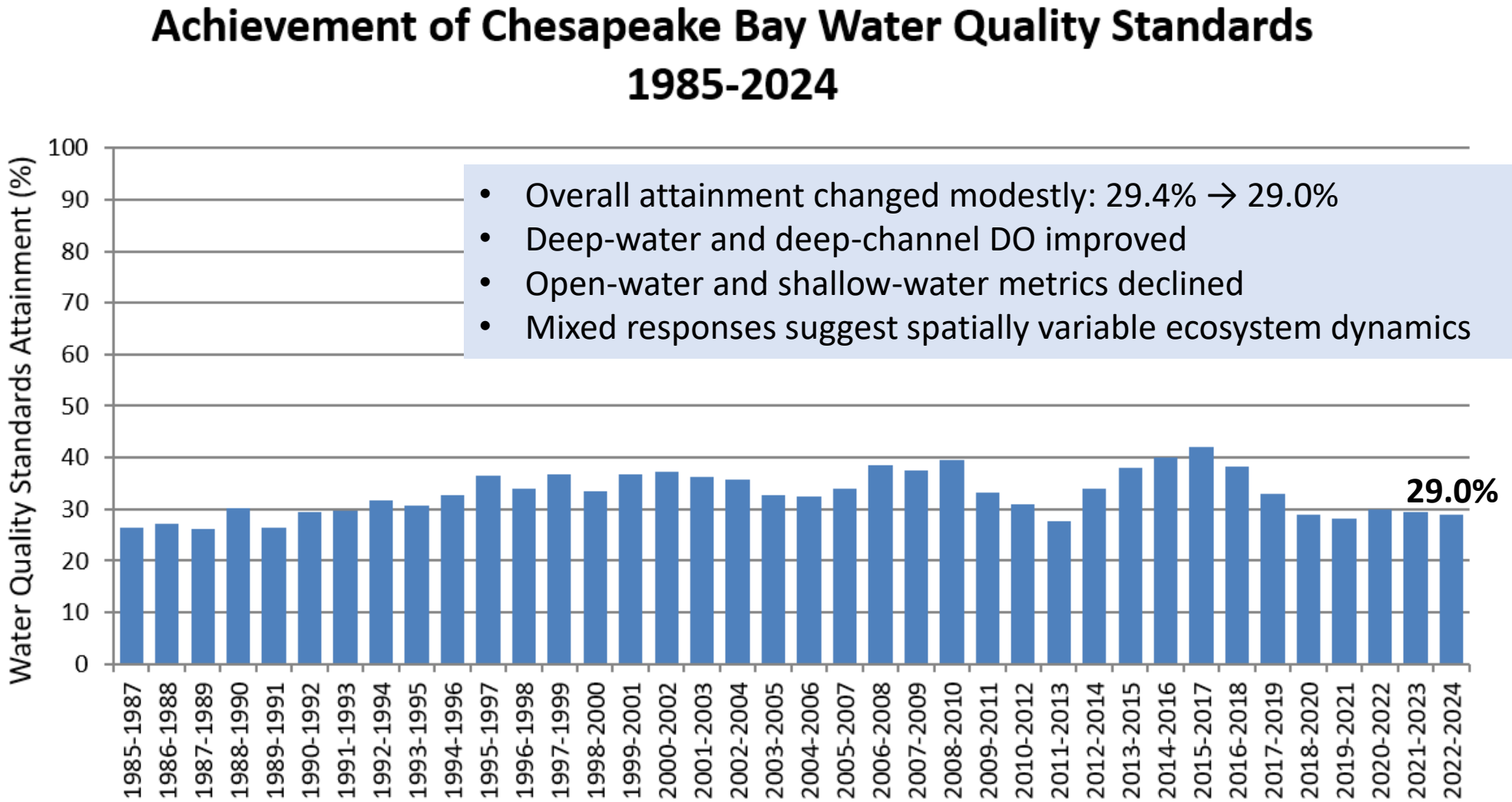
* Tidal water quality
* SAV acreage
* Community (Citizen) monitoring
* Tidal benthic organisms
* Nontidal nutrients and sediment



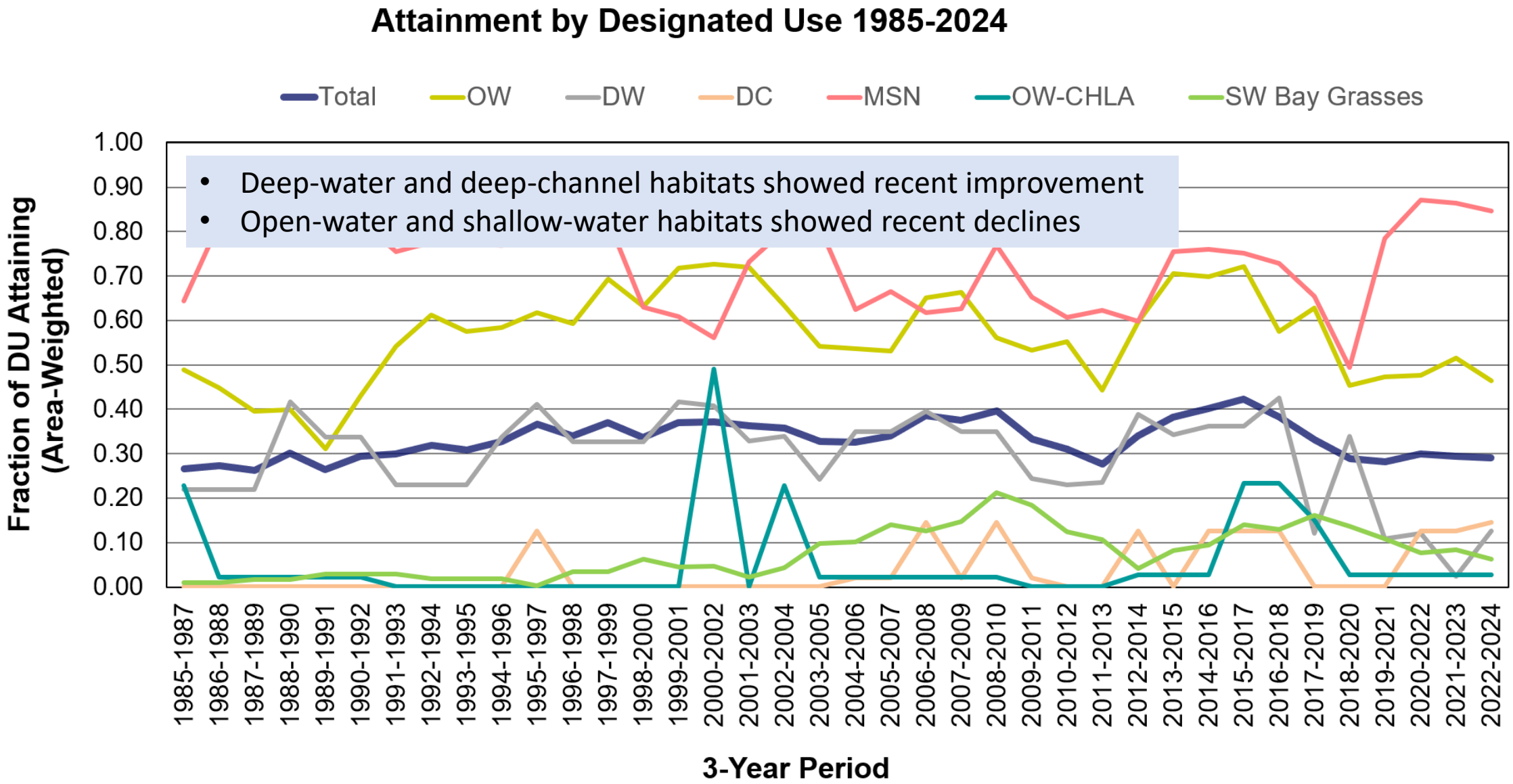


Community Science Network support

Recent assessment shows stable Bay-wide attainment despite mixed responses among DUs



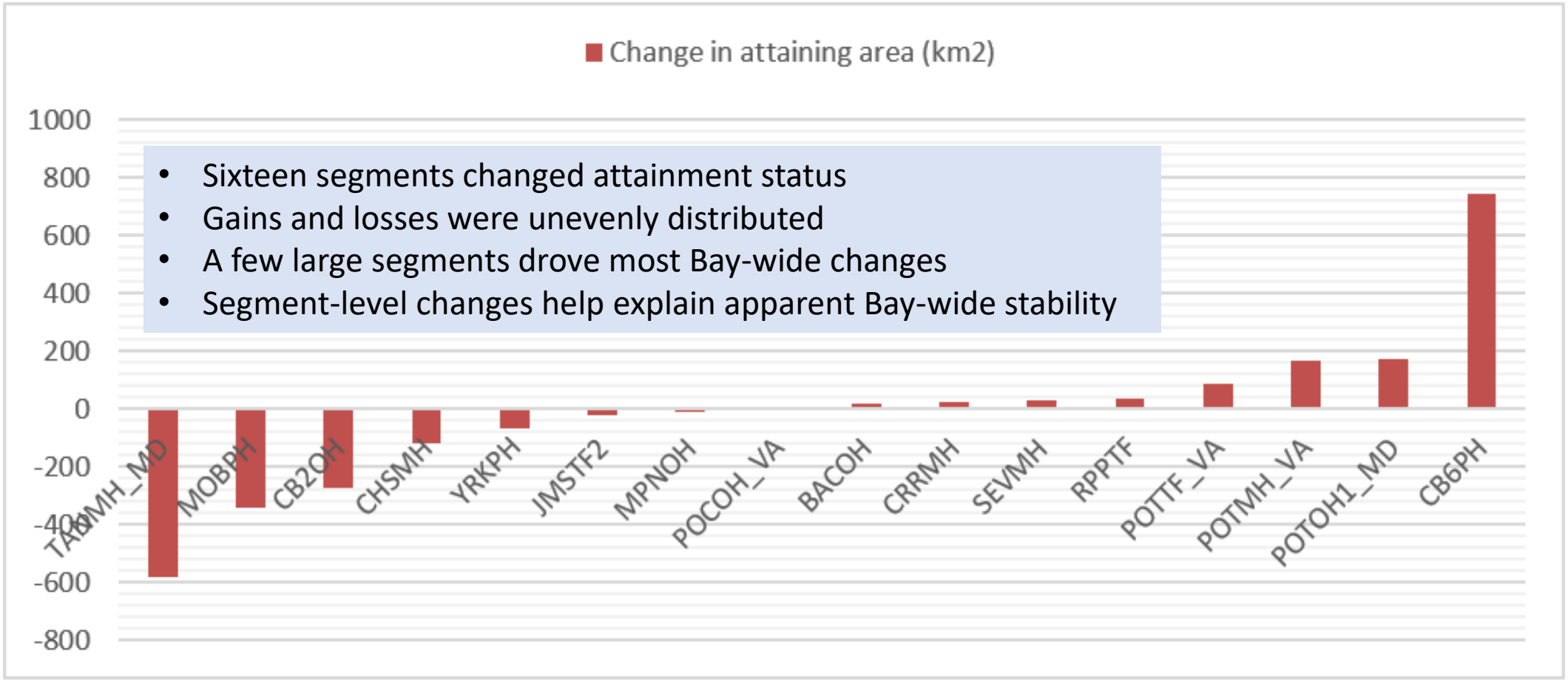
Designated uses show different trajectories



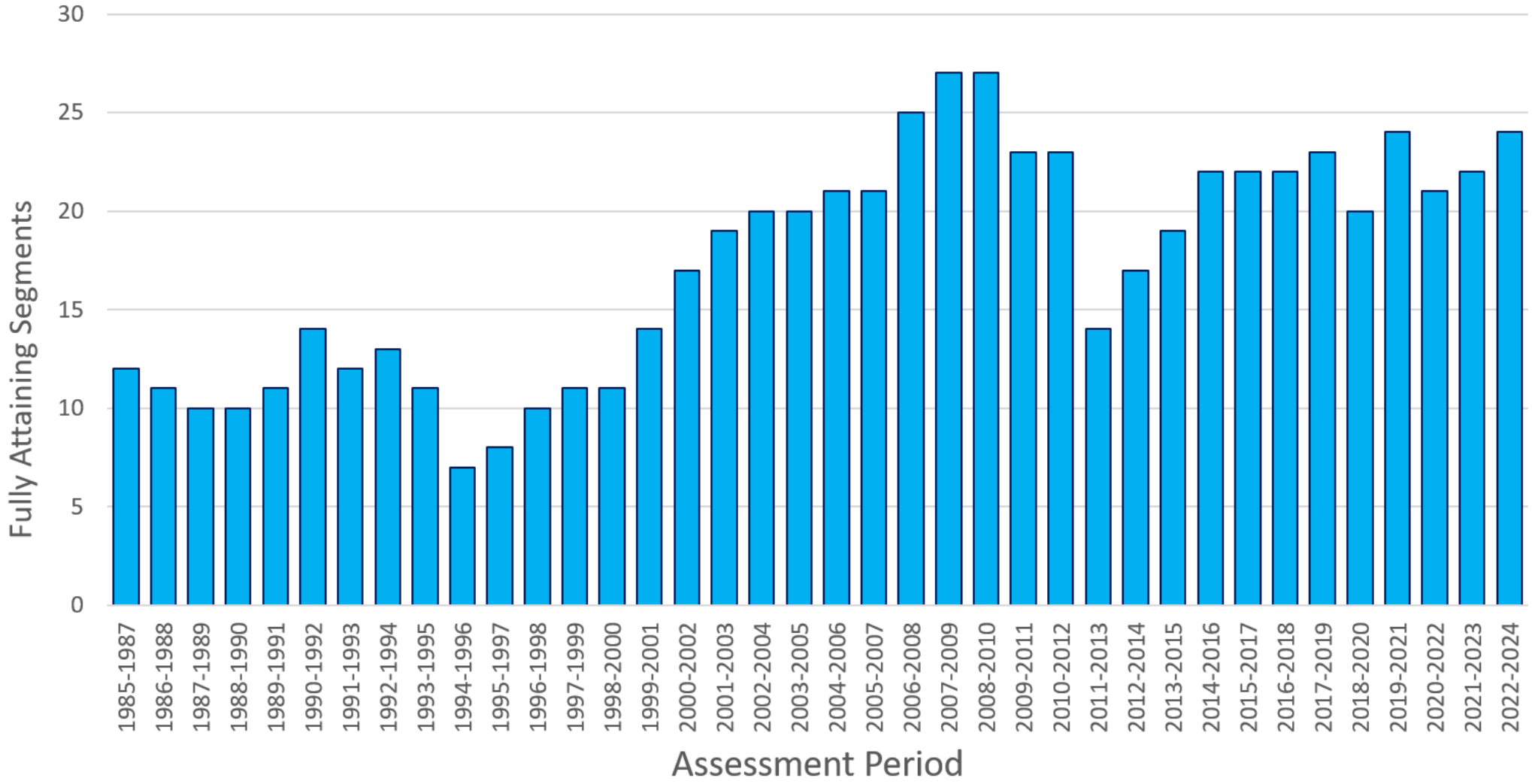
Recent changes were driven by a relatively small number of segments

CBSEG_92	MSN	OW	DW	DC	SWBG	CHLA	Total	Area, km2	Area, %total	Change in attainment area, km2
BACOH					1		1	16.2	0.14%	16.2
CB2OH					-1		-1	275.2	2.36%	-275.2
CB6PH			1				1	743.3	6.38%	743.3
CHSMH	-1						-1	119.3	1.02%	-119.3
CRRMH					1		1	23.5	0.20%	23.5
JMSTF2		-1					-1	21.3	0.18%	-21.3
MOBPH		-1					-1	342.7	2.94%	-342.7
MPNOH	-1						-1	8.0	0.07%	-8.0
POCOH_VA		1					1	7.4	0.06%	7.4
POTMH_VA		1		1			2	83.7	0.72%	167.3
POTOH1_MD		1					1	175.1	1.50%	175.1
POTTF_VA	1	1					2	44.2	0.38%	88.3
RPPTF		1					1	36.5	0.31%	36.5
SEVMH			1				1	29.4	0.25%	29.4
TANMH_MD		-1					-1	581.1	4.98%	-581.1
YRKPH			-1				-1	68.4	0.59%	-68.4

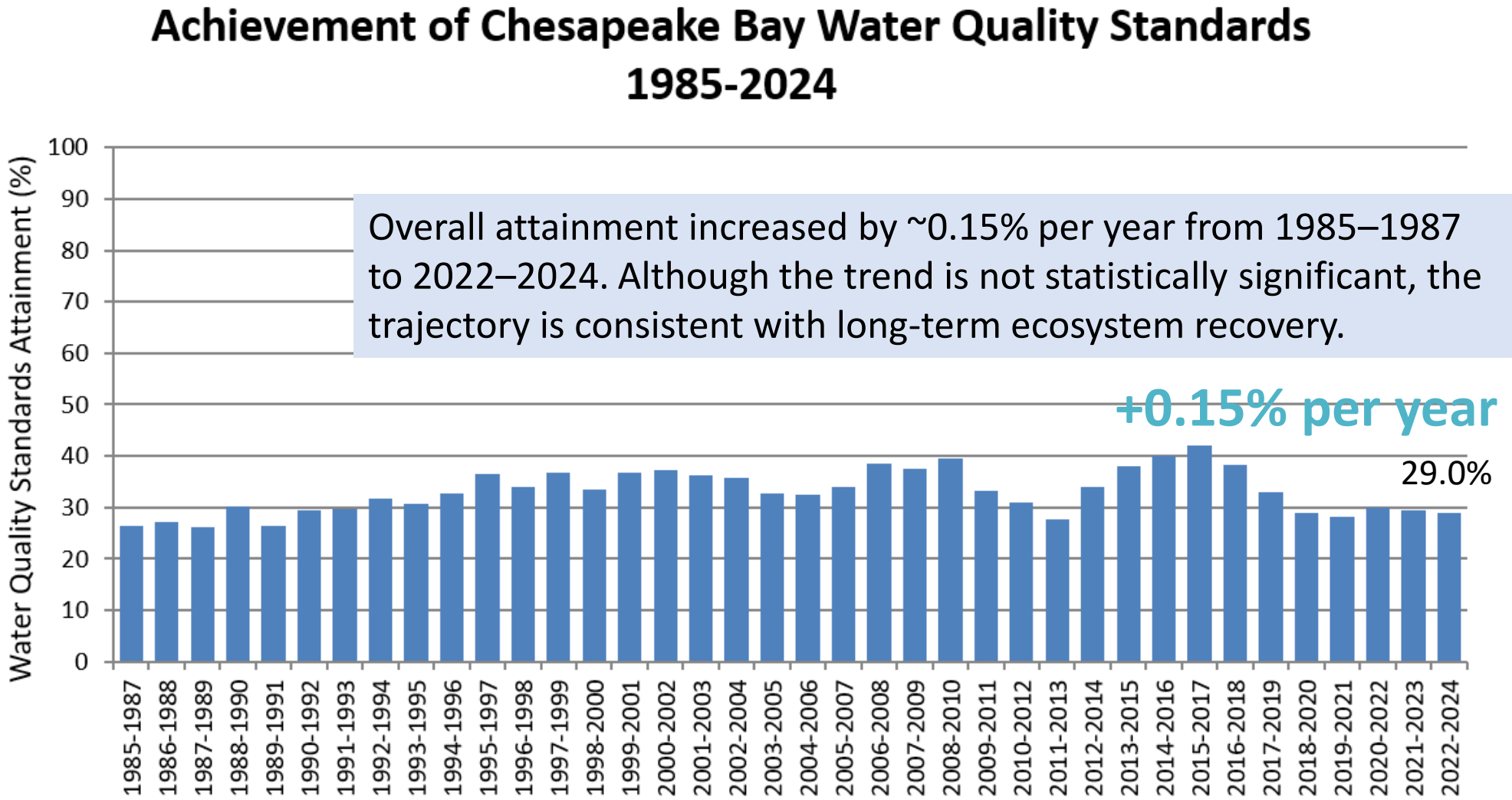
16 segments showed switch in attainment status between 2021-2023 and 2022-2024



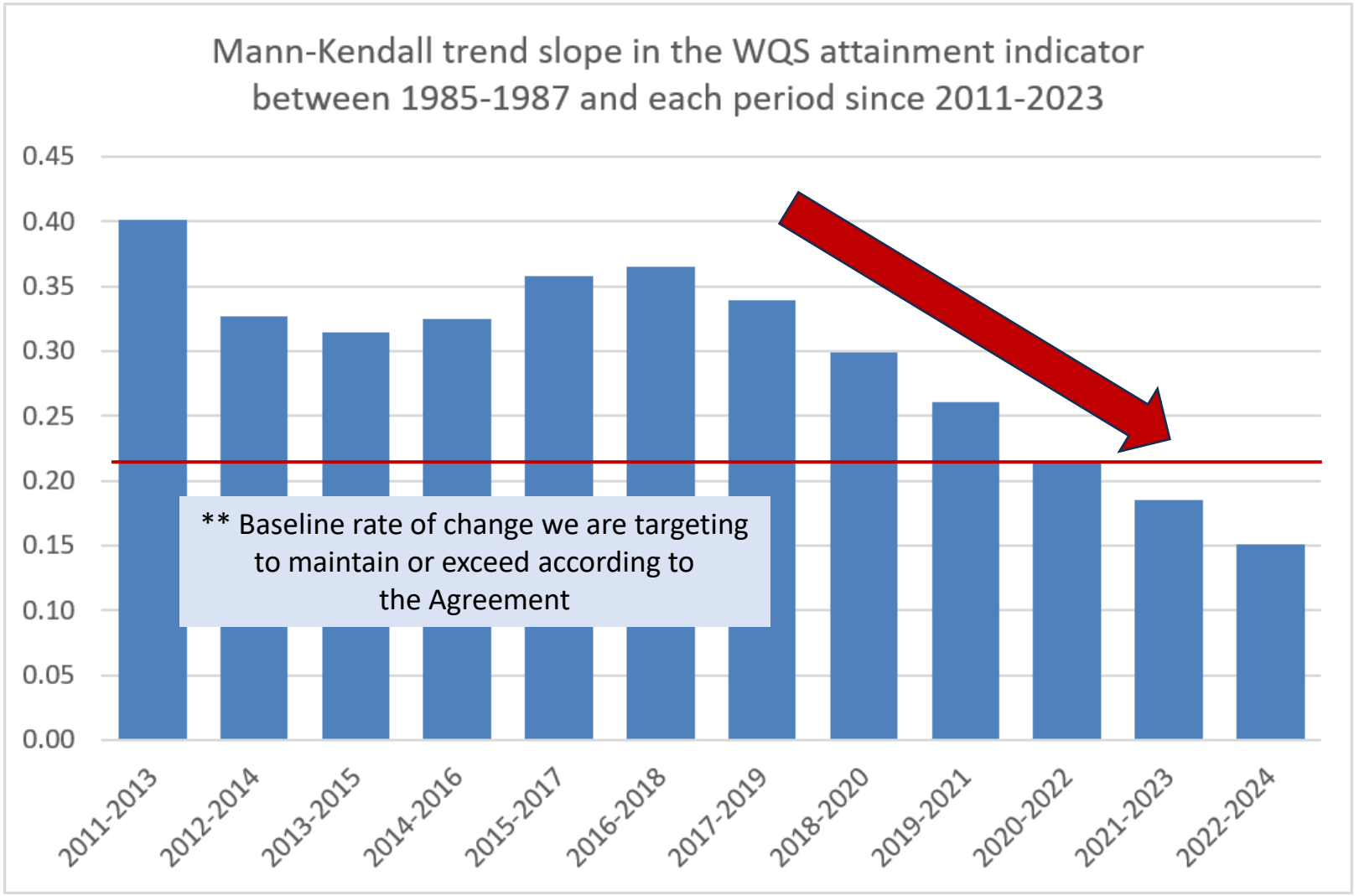
Segments attaining all applicable DU-criterion categories increased from 22 to 24, 4th highest



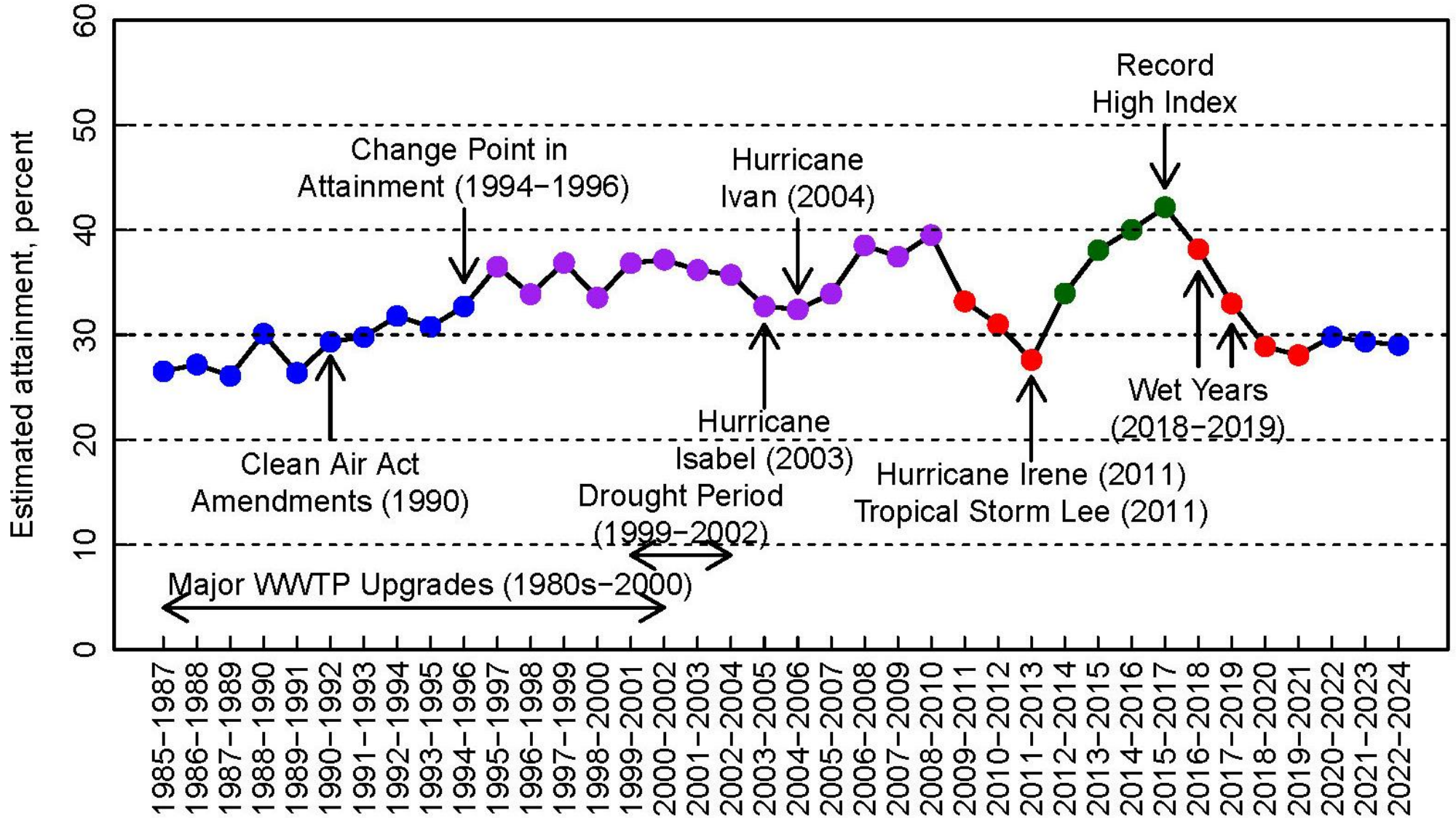
Long-term improvements suggest a gradual recovery trajectory



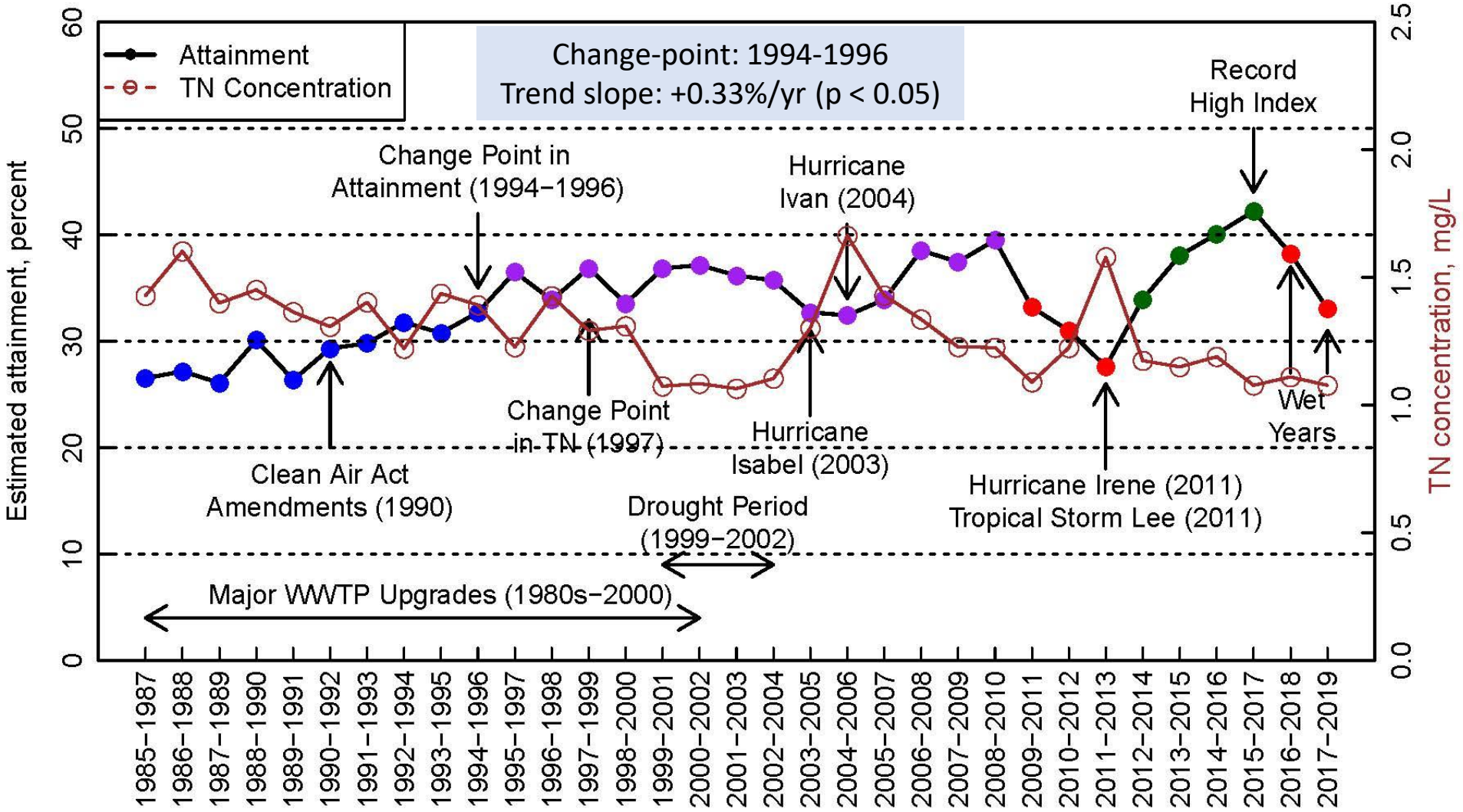
Pace of improvement has slowed down based on the binary indicator



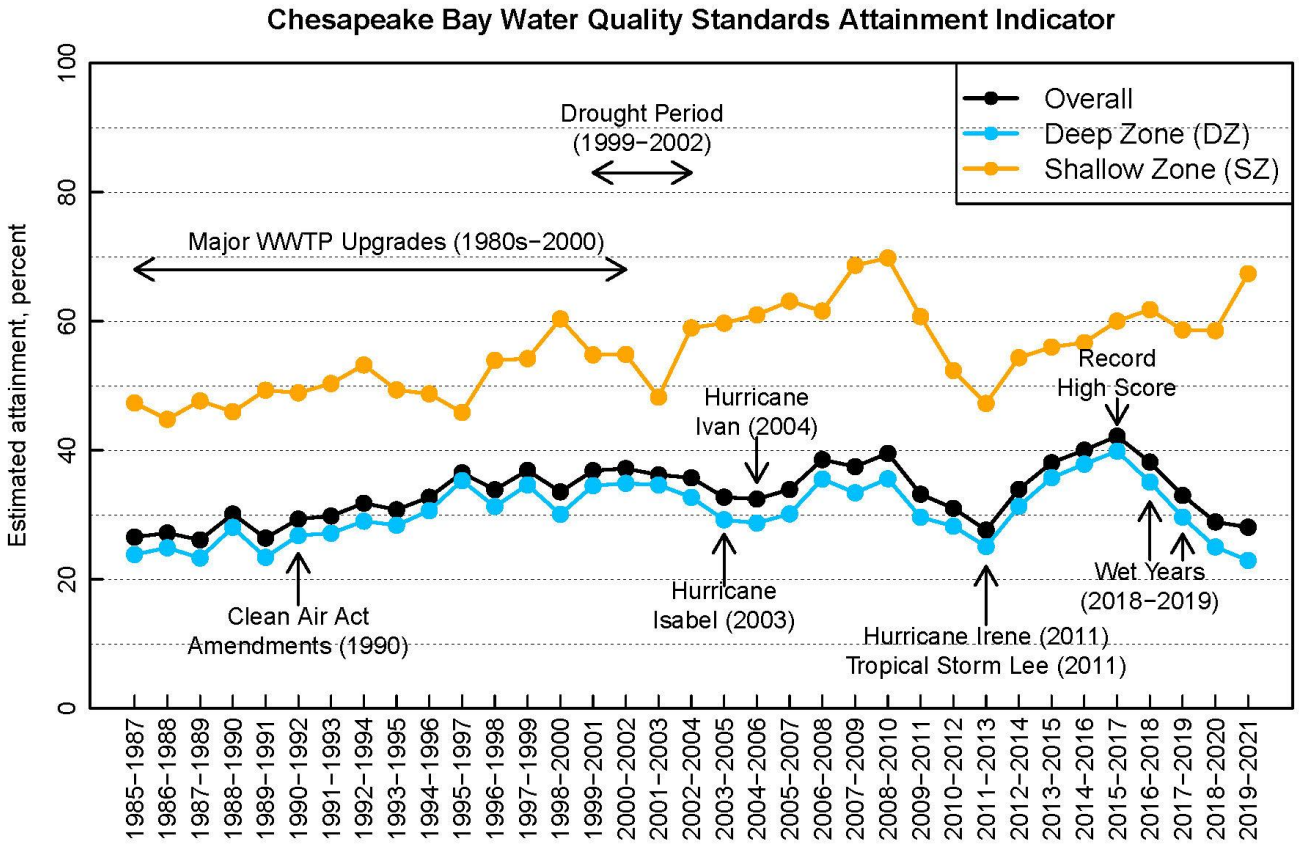
Indicator score impacted by short-term weather variability and recent declines tied to wet years



Indicator score has been negatively related to the level of nutrient inputs to the Bay



Recovery trajectories differ between shallow and deeper parts of the Bay

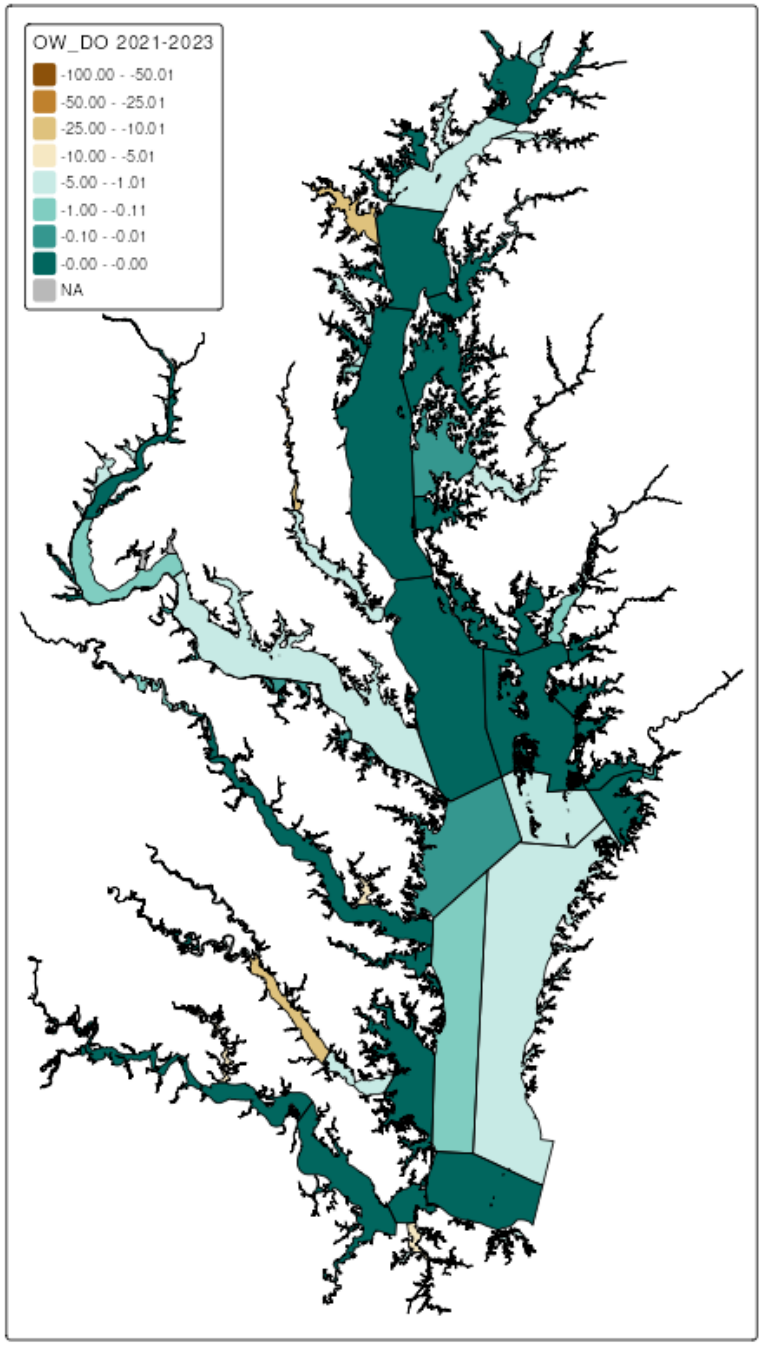


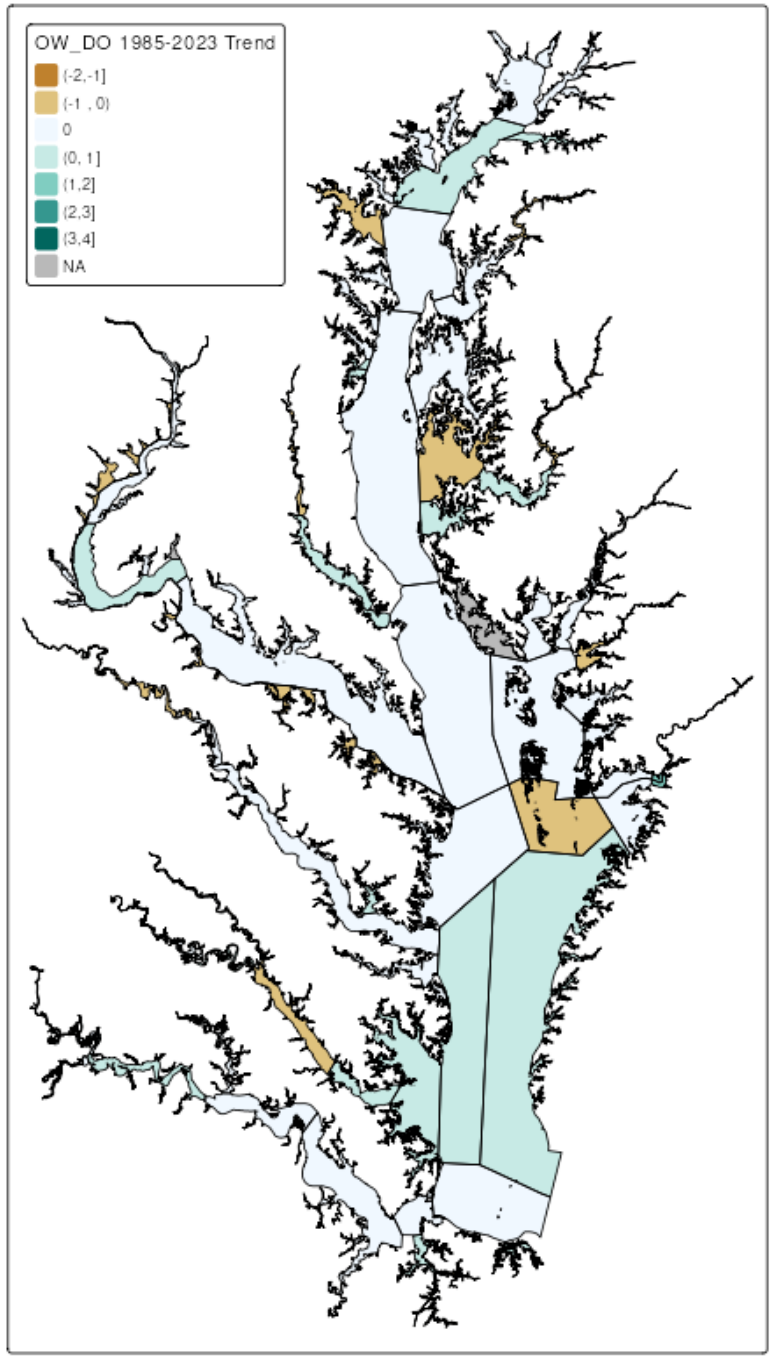
(Note: SZ = TF + OH; DZ = MH + PH)

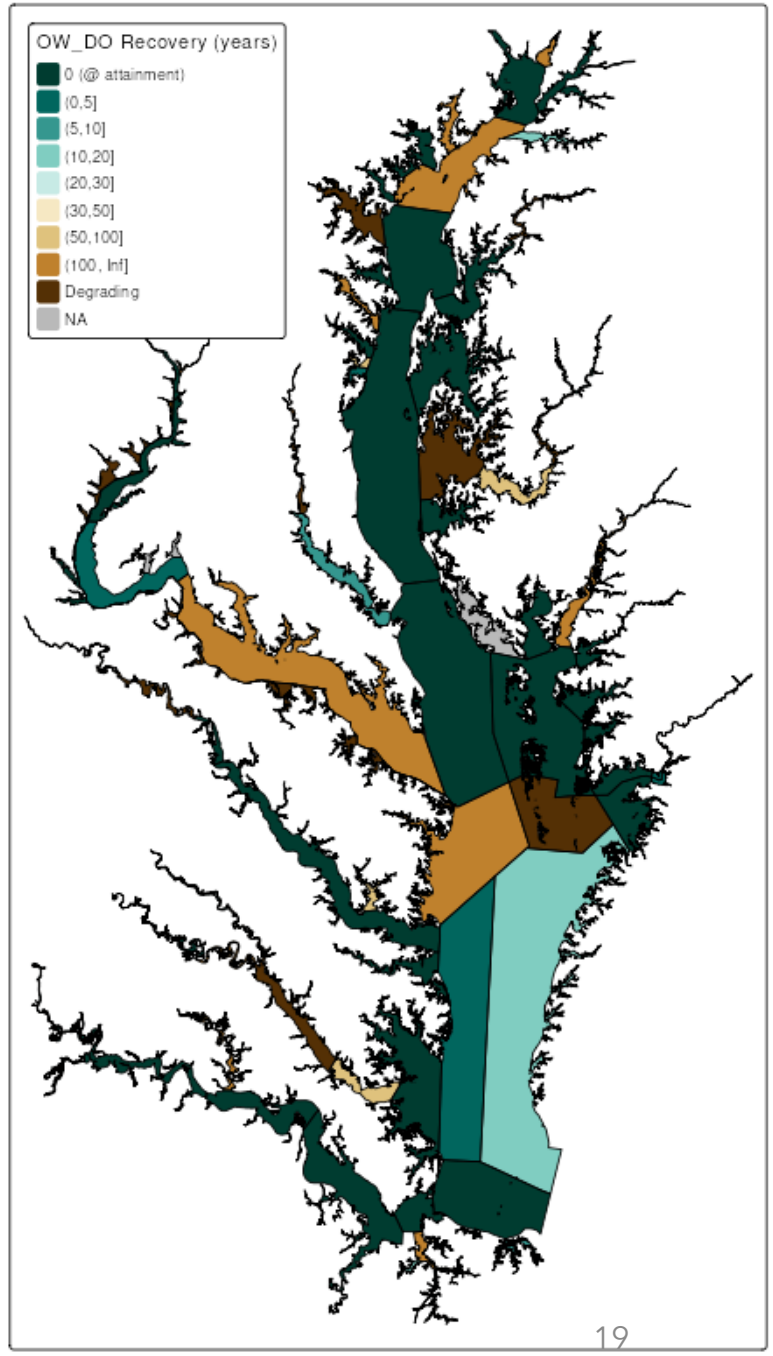
- **DZ attainment**: The long-term trend slope is 0.21%/year (p = 0.06), with less variability in its trajectory.
- **SZ attainment**: The long-term trend slope is 0.49%/year (p = 0.001). SZ rebounded in the most recent assessment period - more rapid than DZ.
- **Nutrient load reductions improved water quality, while internal processes such as warming and stratification may slow recovery.**

Beyond Binary Attainment: Why Additional Metrics Are Needed

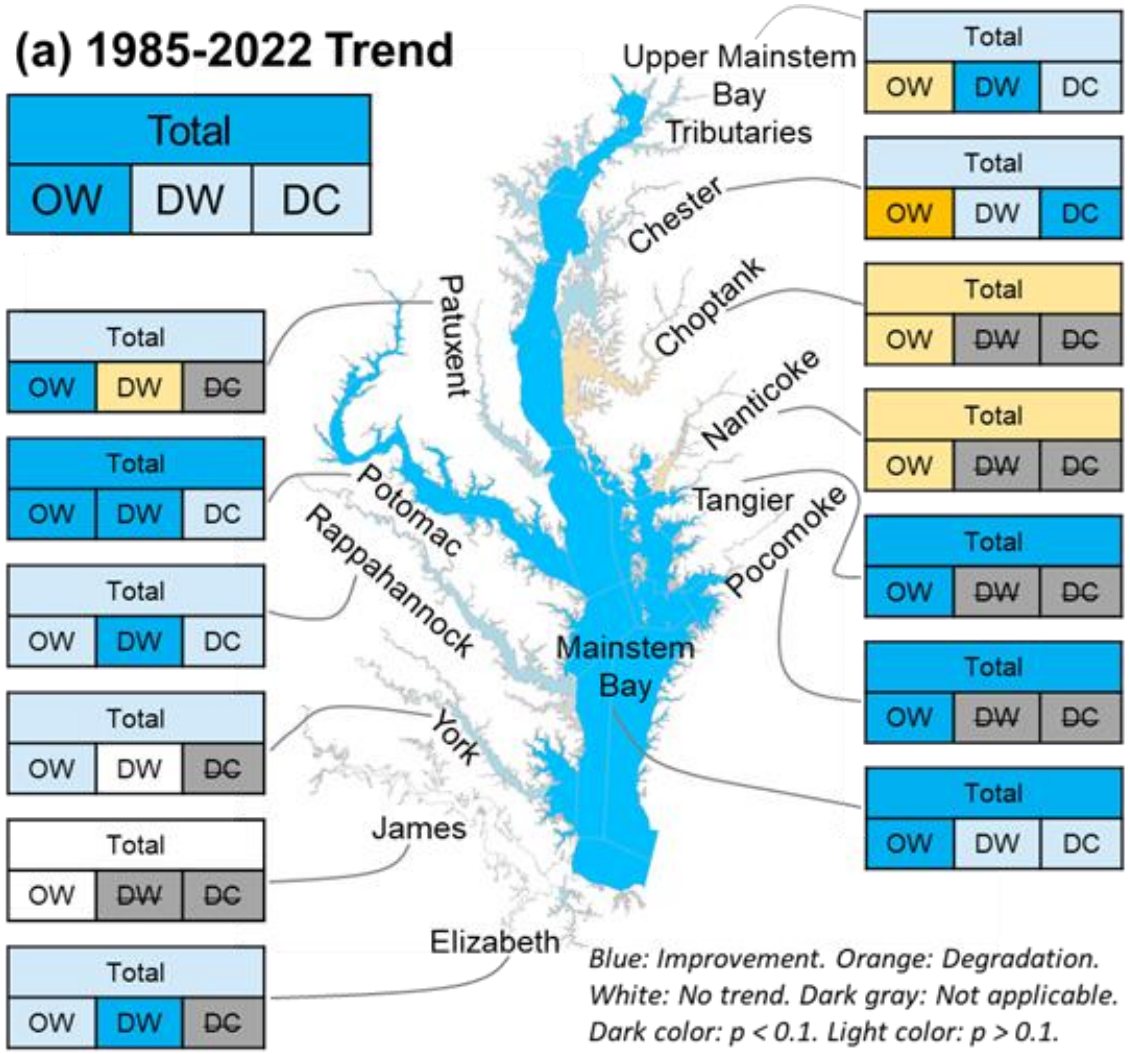
- Attainment uses pass/fail classification.
- Binary indicators communicate status clearly.
- But binary metrics may miss gradual improvements.
- Additional metrics can reveal earlier ecosystem responses.
- **Binary Attainment: Are standards met?**
- **Attainment deficit: How far are we from meeting them?**
  - Continuous metric
  - More sensitive to incremental change
  - Supports temporal and spatial comparisons


OW_DO 2021-2023
-100.00 - -50.01
-50.00 - -25.01
-25.00 - -10.01
-10.00 - -5.01
-5.00 - -1.01
-1.00 - -0.11
-0.10 - -0.01
-0.00 - -0.00
NA


OW_DO 1985-2023 Trend
(-2,-1]
(-1 , 0)
0
(0, 1]
(1,2]
(2,3]
(3,4]
NA


OW_DO Recovery (years)
0 (@ attainment)
(0,5]
(5,10]
(10,20]
(20,30]
(30,50]
(50,100]
(100, Inf]
Degrading
NA

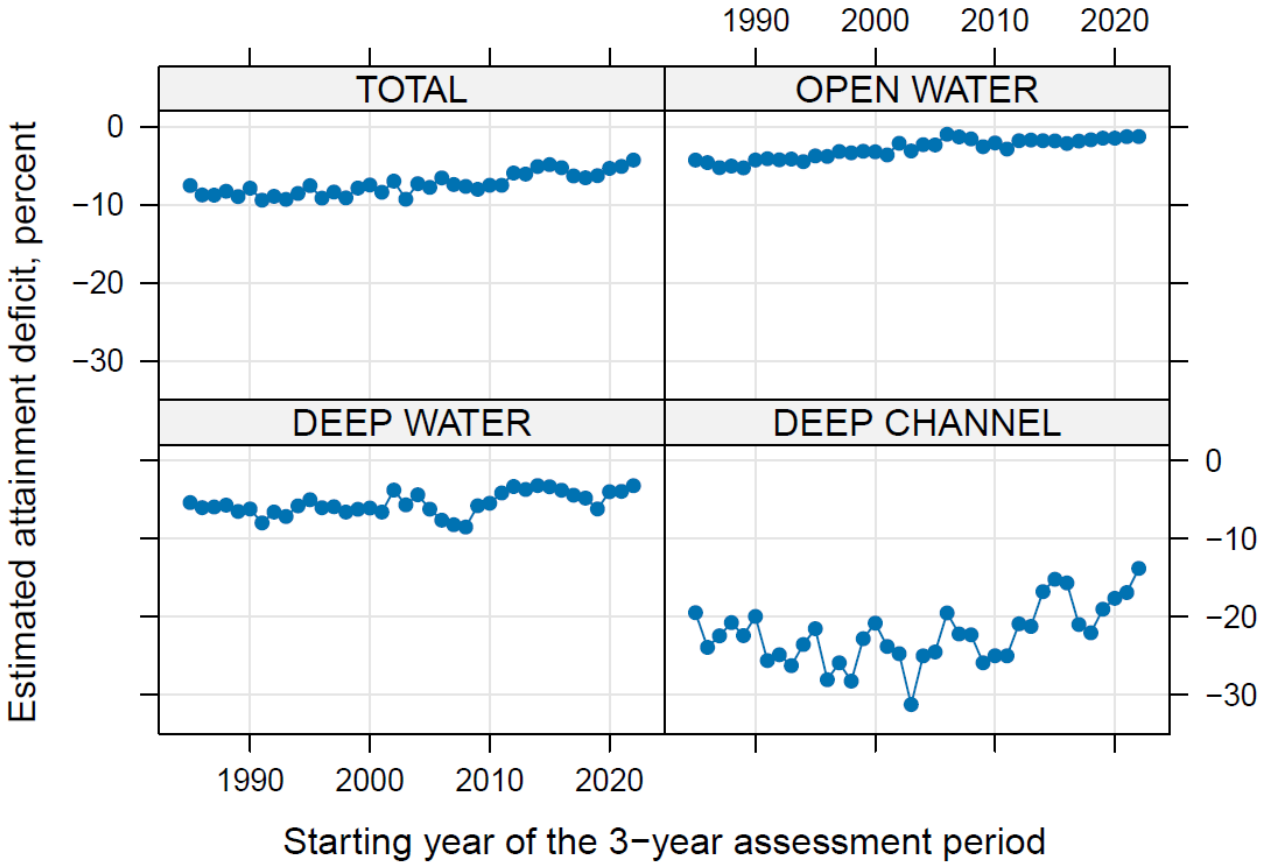
Spatial patterns reveal heterogeneous recovery across tidal systems



- A report card summary was produced to provide a concise depiction of the various trends for each system.

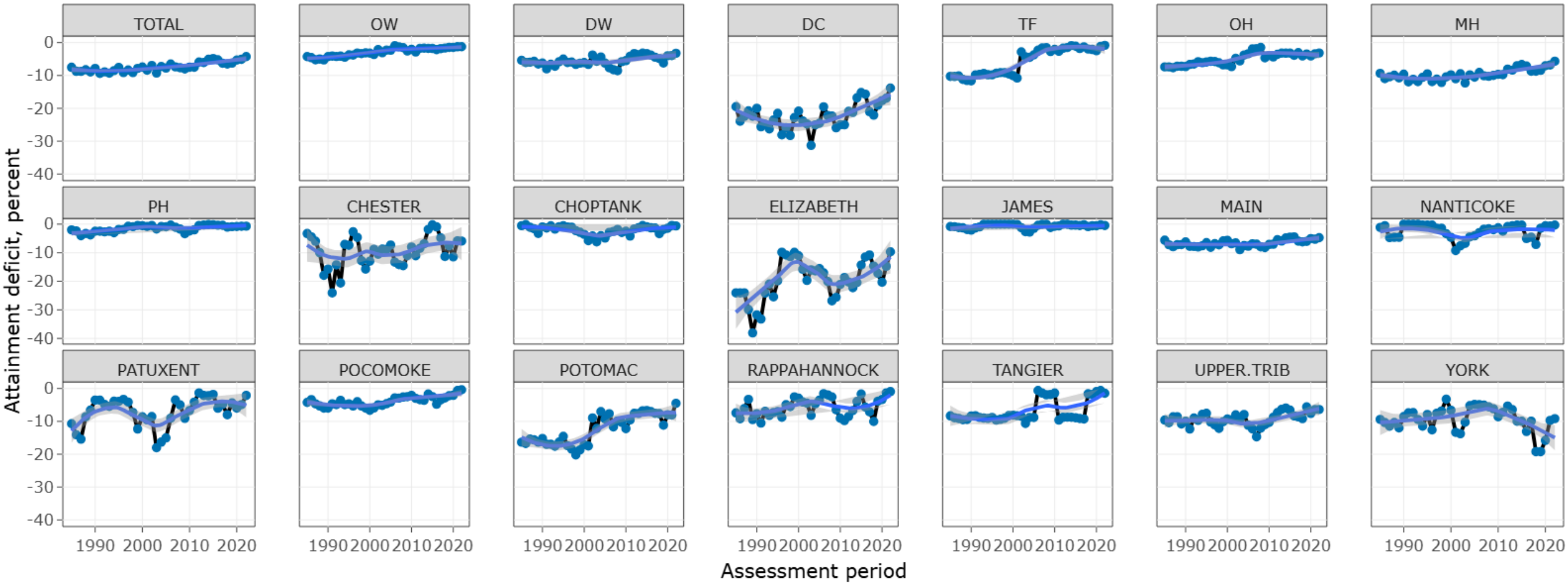
- Recovery patterns vary substantially among tidal systems.
- Some systems show widespread improvement across designated uses.
- Others exhibit persistent degradation or mixed responses.
- Spatial patterns provide opportunities for targeted management actions.

Attainment Deficit Reveals Widespread Improvements in DO Conditions



- Improvement observed from 1985 to 2024.
- **Long-term (LT) trend**: 0.10%/year improvement ($p < 0.05$).
- **Short-term (ST) trend**: 0.20%/year improvement ($p < 0.05$).

Attainment Deficit Reveals Widespread Improvements in DO Conditions



https://wqs.chesapeakebay.net/wqs_attainment_deficit/

Attainment Deficit Reveals Widespread Improvements in DO Conditions

Table 1. Estimated attainment deficit (initial and current status) and associated statistical results [a] for Chesapeake Bay dissolved oxygen criterion for the three designated uses, four salinity zones, and thirteen tidal systems.

Subgroup	LT MK trend slope		ST MK trend slope	
	percent/yr	p-value	percent/yr	p-value
Designated Use				
All segments & DUs (TOTAL)	0.10	***	0.20	***
Open water (OW)	0.10	***	0.07	***
Deep water (DW)	0.07	***	0.06	
Deep channel (DC)	0.16	*	0.69	***
Salinity Zone				
Tidal fresh (TF)	0.32	***	0.05	
Oligohaline (OH)	0.13	***	0.04	
Mesohaline (MH)	0.12	***	0.24	***
Polyhaline (PH)	0.06	***	0.08	
Tidal System				
Chester (CHES)	0.16	***	0.32	
Choptank (CHOP)	-0.01		0.11	***
Elizabeth (ELIZ) [b]	0.27	*	0.84	***
James (JAME)	0.00		0.00	
Mainstem Bay (MAIN)	0.06	***	0.18	***
Nanticoke (NANT)	0.00		0.05	
Patuxent (PATU)	0.09		0.01	
Pocomoke (POCO)	0.10	***	0.10	
Potomac (POTO)	0.31	***	0.16	
Rappahannock (RAPP)	0.10	***	0.48	***
Tangier (TANG)	0.04	***	0.08	
Upper mainstem Bay tributaries (UPPE)	0.08	*	0.29	***
York (YORK)	-0.02		-0.72	***

[a] Significance levels are provided next to each estimate: $p < 0.05$ (***), $0.05 < p < 0.1$ (*),

[b] Elizabeth does not have data in 1985-1987 or 1986-1988, so the earliest period with data

Key Takeaways

- Chesapeake Bay attainment shows gradual long-term recovery despite substantial year-to-year variability.
- Weather strongly affects short-term outcomes, while nutrient reductions drive long-term improvement.
- Binary attainment provides a useful tracking tool, but attainment deficit reveals additional ecosystem responses.
- Ecosystem recovery is emerging but remains uneven across space and habitat types.
- Long-term monitoring data and scientific assessment rules provide the foundation for tracking water quality changes in the Bay.

Thank you!

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